STRUCTURE OF THE CURRICULUM

for

BACHELOR OF TECHNOLOGY

in

OILS OLEOCHEMICALS AND SURFACTANT TECHNOLOGY

Department of Oils Oleochemicals and Surfactants Technology
Institute of Chemical Technology
Mumbai – 400019

ABOUT THE DEPARTMENT OF OILS, OELOCHECIALS AND SURFACTANTS TECHNOLOGY

Vision

Harnessing innovative skills of its faculty and students to achieve a global leadership position in Oils, Oleochemicals and Surfactants Technology, while nurturing a culture of trust and healthy competition in order to serve the critical professional needs of industry and society.

Mission

To pursue world class programs of excellence in education and research in specialized areas of Oils, Oleochemicals and Surfactants Technology relevant to the sustainable development of process industries that require problem solving competences in these core areas of knowledge.

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 Organizations 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.)

This Department was started in 1943 as Division of Oils, Fats and Waxes offering a 2-year course B.Sc. (Tech.) after completing B.Sc. (Chemistry). The duration of this course was increased to 3-years from 1965. In 1998, this Division was renamed as Division of Oils, Oleochemicals and Surfactants and the undergraduate course was changed to 4-years as B.Tech. [Technology of Oils, Oleochemicals and Surfactants]. Students are admitted on the basis of MH-CET and AIEEE after 12th Grade The course is a combination of theory, practicals, seminars, inplant trainings, industrial visits and project work. The course syllabus has been designed keeping in mind the requirement of the industry and international institutions, which, is updated from time to time. We have revamped the syllabi of the B. Tech. Oils programmes now in 2021. The 205 credit programmes each have around 6% humanities, 23% basic sciences, 8% engineering sciences, 12% chemical engineering plus 51% special subjects.

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

Around 30-50% of our undergraduate students choose to pursue further education in top most Universities abroad. Some of them opt for jobs in the edible oils, surfactants, cosmetics, perfumery, paints, and related industries. A few students emerge as first generation entrepreneurs. Students are generally well placed before the completion of their graduate course. The Department also offers a Post Graduate and Doctoral Program. The Department has done pioneering work in the field of Oil Technology. From the

time of its inception, faculty members have maintained a close interaction with industry and have been associated with the development of the oil industry. Several short and long term projects instituted by sponsoring bodies for process/product development at this Department have been supervised by faculty as part of their routine research activity. Alumni of this Department have reached very senior and responsible positions in the Indian oil and surfactant industry.

Syllabus Structure B.Tech.(Oils) FirstYear									
Semester I									
Course Code	Subjects	Credits	Hrs/Week			Marks for various Exams			
			L	T	P	C.A.	M.S.	E. S.	Total
CHT1132	Organic Chemistry I	3	2	1	0	10	15	25	50
CHT1341	Physical Chemistry-I	3	2	1	0	10	15	25	50
CHT1401	Analytical Chemistry	3	2	1	0	10	15	25	50
MAT1101	Applied Mathematics-I	4	3	1	0	20	30	50	100
PYT1101	Applied Physics-I	4	3	1	0	20	30	25	100
GEP1101	Engineering Graphics & Elementary AUTOCAD	4	2	0	4	50		50	100
CHP1132	Organic Chemistry Laboratory	2	0	0	4	25		25	50
	TOTAL:	23	14	5	8				500
Semester II									
Subject Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C.A.	M.S.	E. S.	Total
CHT1124	Industrial Inorganic Chemistry	3	2	1	0	10	15	25	50
CHT1342	Physical Chemistry-II	3	2	1	0	10	15	25	50
CHT1232	Organic Chemistry II	3	2	1	0	10	15	25	50
PYT1103	Applied Physics-II	3	2	1	0	10	15	25	50
MAT1102	Applied Mathematics-II	4	3	1	0	20	30	50	100
CET1507	Process Calculations	4	3	1	0	20	30	50	100
PYP1101	Physics Laboratory	2	0	0	4	25		25	50
CHP1343	Physical and Analytical Chemistry Laboratory	2	0	0	4	25		25	50
HUP1101	Communication Skills	2	0	0	4	50			50
	TOTAL:	26	14	6	12				550

Syllabus Structure B. Tech. (Oils) Second Year									
Semester III									
Subject Code	**Subjects**	**Credits**	**Hrs /week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Total**
BST1110	Basics of Biology and Applications to Technology	3	2	1	0	10	15	25	50
GET1110	Basic Mechanical Engineering	3	2	1	0	10	15	25	50
OLT 1101	**SPL1: Chemistry of Oils and Fatty Acids**	**4**	**3**	**1**	**0**	**10**	**15**	**50**	**100**
PCB1302	Material Technology	3	2	1	0	10	15	25	50
BST1102	Biochemistry	4	3	1	0	20	30	50	100
BST1109	Microbiology	3	2	1	0	10	15	25	50
OLP 1201	**Pr 1: Analysis of Oilseeds, Oils and Raw Materials of Oils and Soap Industry**	**2**	**0**	**0**	**4**	**25**		**25**	**50**
OLP 1215	**Pr 2: Preparation and Purification of Organic Derivatives**	**2**	**0**	**0**	**4**	**25**		**25**	**50**
	TOTAL:	24	14	6	8				500
Semester IV									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C. A.**	**M.S.**	**E. S.**	**Total**
GET1116	Engineering Mechanics and Strength of Materials	3	2	1	0	10	15	25	50
CET1105	Transport Phenomena	4	3	1	0	20	30	50	100
GET1105	Electrical Engg. and Electronics	3	2	1	0	10	15	25	50
OLT 1103	**SPL2: Nutrition**	**4**	**3**	**1**	**0**	**20**	**30**	**50**	**100**
OLT 1102	**SPL3: Chemistry of Oleochemicals and Surfactants**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
OLT 1110	**SPL4: Technology of Drying Oils and Resins**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
GEP1106	Electrical Engineering and Electronics Laboratory	2	0	0	4			25	50
MAP1201	Computer Applications Laboratory	2	0	0	4			25	50
	TOTAL:	24	14	6	8				500

Regional Case Study Course or Social Entrepreneurship Course

1. The Course, which is being floated in optional mode and add-on-credit format, will be offered as 02 Credit course curriculum with total duration of 30 hours. At least 50% of the course is to be done compulsorily in the field for all students.
2. This course will be conducted during summer vacation after fourth semester of B Tech Programme. The second year B Tech students, desirous of pursuing said course, will submit request for registration to said course, to concerned Department Head at the beginning of fourth Semester.
3. Upon successful completion of Course, the Certificate reflecting assessment of performance will be awarded to student.
4. Since the course being optional, these credits will not be counted in calculations of SGPA and CGPA and hence the results of this course will not be reflected in Mark list. The course credits are thus primarily the add on Credits.

Course Objectives

i. To prepare B Tech students for real-life project work through development of case-studies on important regional problems.
ii. To develop skills of the student in problem identification, analysis and reporting, all in a social context.
iii. To catalyse acquisition of values of public service and active citizenship amongst students

Course Outcomes

After completing this course, student will be able to

i. gain an understanding of rural life, culture and social realities
ii. develop a sense of empathy and bonds of mutuality with local community
iii. Appreciate significant contributions of local communities to Indian society and economy
iv. Learn to value the local knowledge and wisdom of the community
v. Identify opportunities for contributing to community's socio-economic improvements

Mode of Evaluation of a Regional Case Study Course or Social Entrepreneurship Course

Module Unit Marks

Module	Unit	Marks
1	Basic structure of society, key definitions of problem area, analysis of preliminary data	15
2	Classroom-work - correspondence, formats, interactions, liaisoning	05
3	Field-work and data gathering	15
4	Analysis and Reporting	10
5	Feedback to Community	05
	Total	50

Syllabus Structure B. Tech. (Oils) Third Year									
Semester V									
Subject Code	**Subjects**	**Credits**	**Hrs /week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A**	**M.S**	**E.S.**	**Total**
CET1401	Chemical Engineering Operations	3	2	1	0	10	15	25	50
CET1212	Chemical Reaction Engineering	3	2	1	0	10	15	25	50
OLT 1105	**SPL5: Oil & Fat Production and Edible Oil Processing**	**4**	**3**	**1**	**0**	**20**	**30**	**50**	**100**
OLT 1121	**SPL6: Perfumery Chemicals**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
OLT 1104	**SPL7: Chemistry of Oils, Lipids, Essential Oils and their Applications**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
MAT1106	Design and Analysis of Experiments	4	2	2	0	20	30	50	100
OLP 1202	**Pr 3: Processing of Oleochemicals& Waxes and Cosmetics Formulations**	**4**	**0**	**0**	**8**			**50**	**100**
OLP 1206	**Pr 4: Paint Technology Laboratory**	**2**	**0**	**0**	**4**			**25**	**50**
	TOTAL:	**26**	**13**	**7**	**12**				**550**
Semester VI									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E. S.**	**Total**
OLT 1106	**SPL8: Production and Applications of Soaps, Surfactants and Detergents**	**4**	**3**	**1**	**0**	**20**	**30**	**50**	**100**
OLT 1107	**SPL9: Cosmetics Science**	**4**	**3**	**1**	**0**	**20**	**30**	**50**	**100**
OLT 1109	**SPL10: Supramolecular Chemistry of Nanomaterials**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
HUT1103	Industrial Psychology & Human Resource Management	3	2	1	0	10	15	25	50
HUT1106	Environment Science and Technology	3	2	1	0	10	15	25	50
OLT 1119	**Institute Elective – I : Product Management**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
OLP 1207	**Seminar**	**3**	**0**	**0**	**6**				**50**
OLP 1204	**Pr 5: Evaluation and Testing of Soaps and Detergents**	**2**	**0**	**0**	**4**	**25**		**25**	**50**
OLP 1203	**Pr 6: Analysis of Surfactants**	**2**	**0**	**0**	**4**	**25**		**25**	**50**
	TOTAL:	**27**	**14**	**6**	**14**				**550**

In-plant Training of 8 to 10 weeks after end of semester

Internship

• After the end of the sixth semester examination and before the start of the seventh semester, Every student will have to undergo an internship. The Internship would be of 6 credits.

• The internship (preferably Industrial Internship) would be assigned to the student by the Departmental Internship Coordinator, with the approval of the Head of the Department.

• The total duration of the internship would be for a period equivalent to 12 Calendar weeks. This period typically start from 1st May and end before 30th July every year. This means the end semester examination of T. Y. Tech (Semester VI) should be completed by 25th April every year. The Semester VII (4th Year B.Tech.) should commence w.e.f. 1st Aug every year. The internship may be completed in one or more organizations as described below.

• The internship could be of the following forms:
(i) 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.
(ii) Research internship in reputed Institutes (within India or Abroad) like, ICT, IITs, NITs, IISC,NCL, IICT 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 Department.

• Students will be assigned a grade based on the written report and a presentation; evaluated by a committee of faculty members.

Syllabus Structure B. Tech. (Oils) Final Year									
Semester VII									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Tot al**
CET1703	Chemical Process Control	3	2	1	0	10	15	25	50
OLT1114	**SPL11: By-products Utilization and Waste Management**	**3**	**3**	**1**	**0**	**10**	**15**	**25**	**50**
OLT1123	**SPL12: Technology of Oleochemicals**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
OLT 1124	**Institute Elective- II: New Product Development**	3	2	1	0	10	15	25	50
OLP 1216	**In-Plant Training**	**6**	**0**	**0**	**0**	**10**	**15**	**25**	**50**
HUT1203	Industrial Management	4	3	1	0	20	30	50	100
CEP1714	Chem. Eng. Laboratory	2	0	0	4	25		25	50
OLP1212	**Pr 7: Essential Oil Laboratory**	**2**	**0**	**0**	**4**	**25**		**25**	**50**
OLP1216	Project I	2	0	0	4				50
	TOTAL:	29	**12**	**6**	**12**				**550**
Semester VIII									
Subject Code	**Subjects**	**Credits**	**Hrs /week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E. S.**	**Total**
CET1504	Chemical Project Engineering and Economics	3	2	1	0	10	15	25	50
OLT 1115	**SPL13: Petroleum Technology**	**4**	**3**	**1**	**0**	**20**	**30**	**50**	**100**
OLT 1111	**SPL14 : Nutraceuticals**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
OLT 1113	**SPL15: Functional Fluids and Performance Chemicals**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
OLT 1117	**Department Elective – I Spectroscopy of Organic Molecules**	**3**	**2**	**1**	**0**	**10**	**15**	**25**	**50**
	Pre-approved Open Electives from MOOOCs/NPTEL	3	2	1	0	10	15	25	50
OLP1209	**Project II**	**4**	**0**	**0**	**8**				**100**
OLP 1210	**Pr 8: Processing of Soaps, Detergents & Surfactants and Tribo-applications Laboratory**	**4**	**0**	**0**	**8**	**50**		**50**	**100**
	Total	**27**	**13**	**6**	**16**				**550**

Semester I

Course Code: CHT1132		Course Title: Organic Chemistry – I	Credits = 3		
			L	**T**	**P**
Semester: I		Total Contact Hours: 45	**2**	**1**	**0**

List of Prerequisite Courses

This is a Basic Organic Chemistry Course. The Organic Chemistry studied at HSC is the basis for building up Advanced Organic Chemistry knowledge.

List of Courses where this course will be Prerequisite

Organic Chemistry – II, Biochemistry and several Special Subjects of individual departments

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

To acquaint the students with IUPAC and other types of Nomenclature of organic compounds, fundamentals of Organic Chemistry including reaction mechanisms, organic transformations, types of reactions, selectivity of chemical transformations, etc., stereochemical implications of organic reactions, functional group identification and reactions

Sr. No.	Course Contents (Topics and Subtopics)		Required Hours
1	**a.IUPAC Nomenclature of Organic Compounds**		3
	b. Reactive intermediates Carbocations, Carbanions, Carbon radicals and Carbenes – Generation, Structure, Stability and Reactions		5
2	**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
3	**Haloalkanes** Aliphatic Nucleophilic Substitution Reactions: S_N1, S_N2 Elimination Reactions: E1, E2		7
4	**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
5	**Chemistry of Aromatic Compounds** Hückel rules, Aromatic, Non-aromatic and Anti-aromatic compounds, Benzenoid and non-benzenoid aromatic compounds		3
6	**Electrophilic Aromatic 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		10
		Total	**45**

List of Text Books/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	appreciate the stereochemical implications of organic compounds and visualize and appreciate chirality concept (K2)
CO3	understand organic chemistry reactions related to aliphatic as well as aromatic compounds as well as decipher the outcome of a given organic transformation (K3)
CO4	interpret and analyse reactions having different functionalities, deduce and solve problems related to the reactions as well as apply them, if need be (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: CHT1341	Course Title: Physical Chemistry - I	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 , Physical Chemistry - II

Description of relevance of this course in the B. Tech (Oils) 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	**Introduction -** Thermodynamic systems, Work, Heat and Energy, State and Path functions, Intensive and Extensive variables	3
2	**First Law of Thermodynamics -** Enthalpy and heat capacities, Application of First Law to gases, Standard states, Enthalpy changes of chemical and physical conversions, Thermochemistry – Hess's Law	6
3	**Second and Third Laws of Thermodynamics -** 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 Third Law of Thermodynamics, Absolute entropies, Verification of Third Law	6
4	**Spontaneous Process and Equilibrium -** Combined statement of First and Second Laws of thermodynamics, Helmholtz and Gibbs free energy, Spontaneity and Free energy, Maxwell's relations, Effect of T and P on free energy, Van't Hoff equation, Free energy and equilibrium constant, Ellingham diagrams	7
5	**Multicomponent Systems -** Free energy and entropy of mixing, Partial molar quantities and chemical potential, Gibbs Duhem equation	5
6	**Phase Equilibria -** Gibbs Phase rule, Clausius- Clapeyron equation, Stability of phases, First and second order phase transitions, Phase diagrams of one and two two-component systems, l-L systems - TC, PC phase diagrams, distillation and azeotropes, L/S systems, S/S – eutectics and deep eutectics, Phase diagram of three-component systems	3
7	**Equilibrium in Solutions –** Ideal and non-ideal solutions,Henry's law and Raoult's law, Colligative properties Solubility Equilibria – Solubility constant, Common ion effect, Effect of added salts on solubility, pH, Weak and strong acids and bases, Buffer solutions, Ionic solutions, Activity and activity coefficients, Thermodynamic properties of electrolytes in solutions	6
8	Chemical Equilibria - Equilibrium constants, Le Chaterlier's principle, Effect of temperature, pressure and composition on equilibrium	6
9	Electrochemistry – Thermodynamics of electrochemical systems - Types of electrochemical cells, Determination of electrode potentials, Activity and activity coefficients, Dissociation of electrolytes, Ionic equilibria	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	Atkins, Peter W.; Paula, Julio de. Elements of Physical Chemistry; 7th Ed.; Oxford University Press (2017)
3	Levine, Ira.Physical Chemistry; 6th Ed.; McGraw-Hill Education (2009)

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

CO1   comprehend the laws of thermodynamics and related concepts and to explain the molecular basis for the same (K2)

CO2   apply the concepts of partial molar quantities to explain the behaviour of pure substances and

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solutions (K3)
CO3   apply principles of phase equilibria in two- and three-component systems (K3)
CO4   elucidate the effect of thermodynamic quantities on chemical equilibria and relate it to properties
        of chemical systems (K2)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **CHT1401**		Course Title: **Analytical Chemistry**									Credits = 3		
											L	**T**	**P**
Semester: **I**		Total Contact Hours: **45**									**2**	**1**	**0**

<table>
<tr><td colspan="4" align="center">List of Prerequisite Courses</td></tr>
<tr><td colspan="4">Standard XII Chemistry</td></tr>
<tr><td colspan="4" align="center">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="4">Physical and Analytical Chemistry Laboratory , other Chemistry Courses</td></tr>
<tr><td colspan="4" align="center">Description of relevance of this course in the B. Tech.(Oils) Programme</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to Chemical Analysis, Terminology (technique/method/procedure/protocol), Broad classification of analytical techniques, Good Laboratory Practices (GLP)	5
2	Sampling: Basics and procedures, preparation of laboratory samples 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 - Fluorescence spectroscopy	8
5	Electrochemical Methods:General principles, instrumentation and applications of – Conductometry, Potentiometry, Coulometry, Voltammetry	8
6	Chromatographic Methods: General principle, instrumentation and applications of - Gas chromatography (GC), High-performance liquid chromatography (HPLC), Ion-exchange chromatography, Size-exclusion chromatography	10
	Total	**45**

<table>
<tr><td colspan="2" align="center">List of Textbooks/Reference Books</td></tr>
<tr><td>1</td><td>Modern Analytical Chemistry by David Harvey, McGraw-Hill, 1999.</td></tr>
<tr><td>2</td><td>Quantitative Analysis by R. A. Day and A. L. Underwood, Prentice Hall of India, 2001.</td></tr>
<tr><td>3</td><td>Instrumental Methods of Analysis by H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Wadsworth Publishing, USA</td></tr>
<tr><td>4</td><td>Fundamentals of Analytical Chemistry by D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch, Cengage Learning, 2014</td></tr>
<tr><td>5</td><td>Principles of Instrumental Analysis by D. A. Skoog, F. James Holler and S. R. Crouch, Cengage Learning, 2007</td></tr>
</table>

	Course Outcomes (Students will be able to…..)
CO1	Apply the knowledge of sampling, data analysis and select proper analytical method (K3)
CO2	Explain the principles of UV Visible and Fluorescence spectroscopic methods (K2)
CO3	Explain the principles of electrochemical methods(K2)
CO4	Explain the principles of chromatographic methods (K2)

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

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

Course	K														
	3	3	3	2	2	2	3	3	3	0	0	0	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **MAT1101**	Course Title: **Applied Mathematics – I**	Credits = 4		
		L	**T**	**P**
Semester: **I**	Total Contact Hours: **60**	3	1	0

List of Prerequisite Courses
HSC Standard Mathematics
List of Courses where this course will be prerequisite
This is a basic Mathematics course. This knowledge will be required in almost all subjects later.
Description of relevance of this course in the B. Tech.(Oils) Programme
Applied Mathematics is beyond crunching numbers. It is useful for solving real-life problems and make an impact in the world, technology being one of those fields. The knowledge gained is required for solving various mathematical equations in several Chemical Engineering courses such as MEBC, Momentum Transfer, Reaction Engineering, Separation Processes, Thermodynamics, and several others.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Linear Algebra:** Vectors in IR^n, Notion of linear independence and dependence. Vector subspaces of IR^n, Basis of a vector subspace, Row space, Null space, and Column space, Rank of a matrix, Determinants and rank of matrices. Abstract vector spaces, Linear transformations in IR^n, Matrix of a linear transformation, Change of basis and similarity, Rank-nullity theorem, and its applications. Inner product spaces, Orthonormal bases, Gram-Schmidt orthogonalization process, Eigenvalues and eigenvectors, Characteristic polynomials, Eigenvalues of special orthogonal projection and its application to least methods. Diagonalization of matrices and its applications stochastic matrices, Solving initial value system of linear ordinary differential equations	15
2	**Differential Calculus:** Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, Convexity of functions, Radius of Curvature. Functions of two or more variables, Limit and continuity, Partial differentiation, Total derivatives, Taylor's theorem for multivariable functions and its application to error calculations, Maxima/Minima	15
3	**Integral Calculus:** Beta and Gamma functions, Differentiation under the integral sign, Multiple integrals, Line and surface integrals, Applications of Green's, Gauss-Divergence and Stokes theorems	15
4	**Probability & Statistics:** Random variables and cumulative distribution function, Probability mass function and probability density function, Some common univariate distributions: Binomial, Poisson, Uniform, exponential, Normal, Expectation and Moments, Moment generating function, Multiple random variables and Joint distribution, Marginal distributions, Covariance and Correlation. Concept of parameter estimation: Maximum likelihood estimation, Method of least squares and Simple linear regression, Nonlinear regression	15
	Total	**60**

List of Textbooks/Reference Books	
1	Stang, G. Linear Algebra and its Applications; 4th Ed.; Thomson (2006)
2	Anton, Howard; Kaul, Anton. Elementary Linear Algebra; 12th Ed.; Wiley (2019)
3	Friedberg, Stephen H.; Insel, Arnold J.; Spence, Lawrence E. Linear Algebra; 5th Ed.; Pearson Education (2019).
4	Hughes-Hallett, Deborah; Gleason, Andrew M.; McCallum, William G. Calculus: Single and Multivariable; 6th Ed.; John Wiley & Sons, Inc. (2012)
5	Kreyszig, E.; Advanced Engineering Mathematics; 10th Ed.; Wiley Global Education (2010) (Officially Prescribed)

6	Iyengar, S. R. K.; Jain, R. K. Advanced Engineering Mathematics; 4th Ed.; Alpha Science (2014)
7	Ross, Sheldon M. A First Course in Probability; 10th Ed.; Pearson Education (2018)
8	Hines, William W.; Montgomery, Douglas C.; Goldsman, David M.; Borror, Connie M. Probability and Statistics in Engineering; 4th Ed.; John Wiley & Sons, Inc. (2003)
9	Boes, Duane C.; Graybill, Franklin A.; Mood, Alexander McFarlane. Introduction To the Theory of Statistics; 3rd Ed.; McGraw Hill Education (India) (2013)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **PYT1101**	Course Title: **Applied Physics – I**	Credits = 4		
		L	**T**	**P**
Semester: I	Total Contact Hours: **60**	3	1	0

List of Prerequisite Courses

Standard XII Physics

List of Courses where this course will be prerequisite

Applied Physics – II, Physics Laboratory, Chemical Engineering Thermodynamics, Momentum and Mass Transfer, Heat Transfer, Material Science and Engineering, Structural Mechanics, etc.

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

This is a basic physics course. This knowledge will be required in almost all subjects later on.
This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Solid State Physics** Crystal Structure of Solids: unit cell, space lattices and Bravais lattice, Miller indices, directions and crystallographic planes, Cubic crystals: SSC, BCC, FCC, Hexagonal crystals: HCP, atomic radius, packing fraction, Bragg's law of x-ray diffraction, determination of crystal structure using Bragg spectrometer Semiconductor Physics: Formation of energy bands in solids, concept of Fermi level, classification of solids: conductor, semiconductor and insulator, intrinsic and extrinsic semiconductors, effect of doping, mobility of charge carriers, conductivity, Hall effect	15
2	**Fluid Mechanics** Basic concepts of density and pressure in a fluid, ideal and real fluids, Pascal's law, absolute pressure and pressure gauges, basic concepts of surface tension and buoyancy, fluid flow, equation of continuity, Bernoulli's equation, streamlined and turbulent flow, concept of viscosity, Newton's law of viscosity, brief introduction to non-Newtonian behaviour	15
3	**Optics and Fibre Optics** Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres	10
4	**Lasers** Introduction to interaction of radiation with matter, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, types of laser: solid state, semiconductor, gas; application of lasers least squares and Simple linear regression, Nonlinear regression	10
5	**Ultrasound** Generation of ultrasound: mechanical, electromechanical transducers; propagation of ultrasound, attenuation, velocity of ultrasound and parameters affecting it, measurement of velocity, cavitation, applications of ultrasound	10
	Total	**60**

	List of Textbooks/Reference Books
1	Physics:Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.
4	Introduction to Modern Optics – G. R. Fowles ,Dover Publications
5	A Course of Experiments with LASERs – R. S. Sirohi, Wiley Eastern.
6	Optical Fibre Communication – G. Keiser, McGraw-Hill

7	Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, Prentice-Hall India
8	Ultrasonic: Methods and Applications – J. Blitz, Butterworth
9	Applied Sonochemistry – T. J. Mason and J. P. Lorimer, Wiley VCH.
	Course Outcomes (Students will be able to…..)
CO1	apply acoustic cavitation of Chemical Engineering Processes (K3)
CO2	apply Bernoulli equation in simple pipe flows(K3)
CO3	explain the principles of lasers, types of lasers and applications (K2)
CO4	calculate resolving power of instruments (K3)
CO5	describe principles of optical fibre communication (K2)

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

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

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

Course Code: **GEP1101**	Course Title: **Engineering Graphics and Elementary AUTOCAD**	**Credits = 4**		
		L	**T**	**P**
Semester: I	**Total Contact Hours: 90**	**2**	**0**	**4**

List of Prerequisite Courses

Basic Geometry

List of Courses where this course will be prerequisite

Engineering Graphics – II, Equipment Design and Drawing-I, Equipment Design and Drawing-II, Home Paper – II, Structural Mechanics

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

A Chemical Engineering student is required to know various processes and equipments used in the processes. Some of the elementary processes such as filtration, size reduction, evaporation, condensation, crystallization etc., are very common to all the branches of Technology. These and several other processes require machines and equipments. One should be familiar with the design, manufacturing, working, and maintenance of such machines and equipments. The subject of 'Drawing' is a medium through which, one can learn all such matters, because the drawings are used to represent the objects and the processes on paper. With the help of the drawings, a lot of accurate information is conveyed, which otherwise will not be practicable through spoken words or written text. Drawing is a language used by Engineers and Technologists. This course is required in many subjects as well as later on in the professional career.

	Course Contents (Topics and Subtopics)	**Required Hours**
1	**Orthographic Projections:** Conversion of 3D object or pictorial view into front view, top view and side views using first angle method of projection Sectional views draw sectional front view, top view, and side view Problems with section plane cutting object exactly at center or off center Orthographic views of at least 15 machine parts using mini drafter and drawing board	20
2	**Isometric Projections and Isometric Views:** Isometric scale, draw pictorial view or 3D view using front and top view or front view and any one side view Machine parts with circle, semicircle in the orthographic views and slots on inclined planes At least 10 isometric drawings using mini drafter and drawing board	12
3	**Missing Views:** Draw top view when front and any one side view is given Draw any one side view or both the side views when front view and top view is given. Problems involving sectional views. At least 6 machine parts using mini drafter and drawing board.	12
4	**Assembly Drawing**: Draw front view and top view or side view of assembly after assembling all the details of machine parts Convert assembly into details Assembly drawing of Nut and bolt, footstep bearings, Plummer block, etc.	20
5	**Introduction to Computer-Aided Drawing:** Role of CAD in design and development of new products, Advantages of CAD. Creating two-dimensional drawing with dimensions using suitable software (Minimum 2 exercises mandatory) Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software (Minimum 2 exercises mandatory)	26
	Total	**90**

List of Textbooks/Reference Books

1	Bright, Steven. AutoCAD Fundamentals: A Comprehensive Guide on Engineering Drawing and Modeling (2020)
2	Rathnam, K. A First Course in Engineering Drawing; Springer (2017)
3	Agrawal, Basant. Engineering Drawing; McGraw-Hill Education (2015)
4	Bhatt, N. D. Engineering Drawing by N. D. Bhatt.; 11th Ed.; C. Publishing House Pvt. Ltd. (2011)
5	Shah, M. B.; Rana, B. C. Engineering Drawing; 2nd Ed.; Pearson Education (2014)
6	Giesecke, Frederick E.; Lockhart, Shawna; Goodman, Marla; Johnson, Cindy M. Technical Drawing with Engineering Graphics; 15th Ed.; Pearson Prentice Hall (2016)
7	Dubey, N. H. Engineering Drawing; 15th Ed.; Nandu (2015)

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

CO1	Prepare multi view orthographic projections of objects by visualizing them in different positions. (K3)
CO2	Draw sectional views and develop surfaces of a given object. (K3)
CO3	Prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions. (K3)
CO4	Prepare assembly drawing. (K3)
CO5	Obtain Multi view projections and solid models of objects using CAD tools (K3)

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

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

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

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

List of Prerequisite Courses
Standard XII Organic Chemistry Laboratory

List of Courses where this course will be prerequisite
All the Applied Chemistry Practicals

Description of relevance of this course in the B. Tech. (Oils) Program
The course is relevant for training the students for working with binary mixtures. The students are exposed to basics of organic separations and identification of organic compounds based on their physicochemical properties. The laboratory training is crucial for the students to carry out work-up of organic reactions leading to separation of crude products followed by purification using recrystallization and/or distillation or related methods.

	Course Contents (Topics and Subtopics)	Required Hours
1	a) Principles of qualitative separation of organic mixtures using physical properties, chemical properties and their combination	4
	b) Principles of quantitative separation of organic mixtures using physical properties, chemical properties and their combination	4
2	a) Separation of solid-solid water insoluble binary organic mixtures	5X4
	b) Separation of solid-solid partly water soluble binary organic mixtures	2X4
	c) Separation of solid-solid mixtures by fractional crystallization	2X4
	d) Separation of liquid-liquid mixtures by distillation	2X4
	e) Separation of liquid-liquid mixtures by solvent extraction	2X4
	Total	**60**

List of Textbooks/Reference Books	
1	Arthur, Vogel. Textbook of practical organic chemistry, 5th edition, publishers Longman group Ltd, 1989
2	F.G. Mann and B.C. Saunders, Practical Organic Chemistry, 4thedition published by Orient Longman
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	work safely in the organic chemistry laboratory (K3)
CO2	separate binary organic mixtures by multiple techniques (K4)
CO3	understand basic principles for separation of binary organic mixtures qualitatively and quantitatively (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Semester II

	Course Code: CHT1124		Course Title: Inorganic Chemical Technology					Credits = 3		
								L	T	P
	Semester: I		Total Contact Hours: 45					2	1	0

List of Prerequisite Courses

Standard XII Inorganic Chemistry

List of Courses where this course will be Prerequisite

Material Technology, Strength of Materials, Environment Science and Technology

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

To acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Primary Inorganic Materials:** Water, Hydrogen, Hydrogen Peroxide and Inorganic Peroxo Compounds, Nitrogen, Ammonia, Nitric acid, and Nitrogen Compounds, Phosphorus, Phosphoric acid and its Compounds, Sulfur, Sulfuric acid andSulfur Compounds, Halogens, Chloralkali and Halogen Compounds	12
2	**Metals and Their Compounds:** Alkali and Alkaline Earth Metals and their Compounds, Aluminium and its Compounds, Chromium Compounds and Chromium, Silicon and its Inorganic Compounds, Manganese Compounds and Manganese, Metallurgy of Iron	10
3	**Organo-Silicon Compounds:** Industrially important Organo-silicon Compounds, Industrially Important Silanes, Silicones, Industrial Silicone Products	7
4	**Inorganic Solids:** Silicate Products, Inorganic Fibers, Construction Materials, Enamel, Ceramics, Metallic Hard Materials, Carbon Modifications, Fillers, Inorganic Pigments, Cement, Glass	8
5	**Nuclear Cycle:** Economic Importance of Nuclear Energy, General Information about the Nuclear Fuel Cycle, Availability of Uranium, Nuclear Reactor Types, Nuclear Fuel Production Disposal of Waste from Nuclear Power Stations	8
	Total	**45**

List of Text Books/ Reference Books

1	Büchel, Karl Heinz; Moretto, Hans-Heinrich; Woditsch, Peter. Industrial Inorganic Chemistry, Second, Completely Revised Edition; Wiley-VCH (2008)
2	Benvenuto, Mark Anthony. Industrial Inorganic Chemistry; de Gruyter (2015)
3	Swaddle, T. W. Inorganic Chemistry – An Industrial and Environmental Perspective; 1st Ed.; Academic Press (1997)
4	House, James E. Inorganic Chemistry; 3rd Ed.; Academic Press, Inc. (2019)

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

CO1	Explain various industrial chemicals of nitrogen, sulfur, hydrogen, phosphorus and halogens (K2)
CO2	Explain and apply the concept the alkali and alkaline-earth metal based industrial chemicals, iron metallurgy (K3)
CO3	Explain inorganic solid materials like glass, silicone, cement, ceramics, etc. (K2)
CO4	Explain the concept of nuclear fuel and power industry (K2)

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

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

Cours e	2														
	K 3	3	3	2	2	2	3	3	3	0	0	0	2	3	3

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

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

Course Code: CHT1342	Course Title: Physical Chemistry - II	Credits = 3		
		L	T	P
Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Chemistry, Physical Chemistry - I

List of Courses where this course will be prerequisite

Other Chemistry and Applied Chemistry courses

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

Students should learn to appreciate the relevance of kinetic studies and parameters affecting the same. The understanding of kinetic principles should be applied towards understanding complex reaction pathways and their mechanistic studies. The concept of interfaces and surfaces are instrumental in conveying the applications and importance of disperse systems.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	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
2	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
3	Homogenous catalysis – homogeneous acid / base catalysis (specific and general acid catalysis), enzyme catalysis (Michalis-Menten kinetics)	4
4	Reactions at interface – Adsorption isotherms, kinetics of surface reactions- Hishelwood and Rideal models of surface reactions	4
5	Theories of reaction rates - Theory of unimolecular reactions, collision theory and transition state theory, Effect of temperature, Solvent effects on reaction rates	6
6	Surface and interfacial Chemistry – introduction, surface tension and surface free energy, methods of determining surface and interfacial tensions	10
7	Thermodynamics of surfaces – surface excess, Gibbs adsorption equation, curved surfaces- bubbles, droplets and foams, Kelvin, Young Laplace and Thomson equations, homogeneous nucleation	4
8	Liquid-liquid and solid-liquid interfaces – contact angle, wetting and spreading, adhesion and cohesion, contact angle measurements and hysteresis	4
9	Surfactants: Types, adsorption at surfaces and interfaces, surfactant aggregates, factors affecting aggregation phenomena, applications of surfactants and mixed surfactant systems	4
10	Colloids: preparation, stability, characterization, surface charges and electrical double layer Emulsions: Thermodynamics and stability of emulsions, micro emulsions and foams, HLB values	5
	Total	**45**

List of Textbooks/Reference Books

1	Physical Chemistry (11th edition) by P. W. Atkins, J. de Paula and J. Keeler, Oxford University Press, 2017.
2	Chemical Kinetics (3rd edition) by Keith J. Laidler, New York : Harper & Row, 1987.
3	Introduction to Colloid and Surface Chemistry (4th edition) by Duncan Shaw, Butterworth-Heinemann 2013.
4	Surfaces, Interfaces, and Colloids: Principles and Applications (2nd edition) by Drew Myers, John Wiley & Sons, Inc., 1999
5	Surfactants and Interfacial Phenomena (4th edition) by M. J. Rosen, John Wiley & Sons, Inc., 2012

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

CO1	comprehend fundamental knowledge in chemical kinetics with basics of order, molecularity and

		temperature effect (K2)
CO2		examine kinetics for complex, fast as well as surface reactions and comprehend different theories in kinetics (K4)
CO3		comprehend fundamental knowledge and thermodynamics in surface and interfacial chemistry (K3)
CO4		evaluate the behavior of surface-active agents and disperse systems based on the knowledge of interfacial phenomena (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

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Course Code: CHT1232	Course Title: Organic Chemistry - II	Credits = 3		
		L	**T**	**P**
Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Organic Chemistry - I

List of Courses where this course will be prerequisite

Other Chemistry and Applied Chemistry courses

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

To acquaint the students with concepts related to aromatic, hetero aromatic and pericyclic reactions so that they are perfectly aligned to apply the same for the future courses and in their professional career

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Nitro and amino arenes Reactions, basicity of aminoarenes, diazotisation reactions	5
2	Aromatic nucleophilic substitution reactions Addition, elimination mechanism; elimination – addition mechanism (benzyne), Sandmeyer reaction	5
3	Pericyclic Reactions Symmetry of molecular orbitals, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system, classification of pericyclic reactions; Woodward-Hoffmann correlation diagrams, FMO and PMO approaches; electrocyclic reaction -conrotatory and disrotatory motions of 4n, 4n+2 and allyl systems; cycloaddition -antara facial and suprafacial addition, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions; sigmatropic rearrangements - suprafacial and antarafacial shifts of hydrohen, sigmatropic shifts involving carbon moieties, 3,3- and 5,5-sigmatropic rearrangements, Claisen, Cope and Aza-Cope rearrangements, ene reaction.	13
4	Heteroaromatic compounds IUPAC nomenclature, structures and common names, comparison with benzenoid compounds, reactivity and synthesis – pyrroles, furans, thiophenes and pyridines	10
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	12
	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	Explain the aromatic chemistry and interpret the outcome of general transformations (K3)
CO2	appreciate and visualize the reactions involving radicals such as cyclizations, pericyclic reactions in synthesis (K3)
CO3	understand the importance of heterocycles, learn the properties and synthetic routes, interpret IUPAC of compounds and decipher outcomes of various transformations involving heterocycles (K3)
CO4	apply the knowledge obtained through the course to predict the outcome of reactions and devise solutions to unknown problems (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **Pyt1103**	Course Title: **Applied Physics - II**	Credits = 3		
		L	**T**	**P**
Semester: II	Total Contact Hours: **45**	2	1	0

List of Prerequisite Courses
Standard XII Physics, Applied Physics – I, Physics Laboratory

List of Courses where this course will be prerequisite
This is a basic physics course. This knowledge will be required in almost all subjects later on.

Description of relevance of this course in the B. Tech. (Oils) Program
The knowledge gained from this course is required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Quantum Mechanics** Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom (no detailed derivation)	25
2	**Dielectric and Magnetic Properties of Materials** Introduction to the 'del' operator and vector calculus, revision of the laws of electrostatics, electric current and the continuity equation, revision of the laws of magnetism. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics. Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.	20
	Total	**45**

List of Textbooks/Reference Books	
1	Physics:Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.
4	Solid State Physics – A. J. Dekker, 1957, MacMillan India.
5	Perspectives of Modern Physics – A. Beiser, 1969, McGraw-Hill.

Course Outcomes (Students will be able to…..)	
CO1	do simple quantum mechanics calculations (K3)
CO2	define various terms related to properties of materialssuch as, permeability, polarization, etc (K2)
CO3	state some of the basic laws related to quantum mechanics as well as magnetic and dielectric properties of materials (K2)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code:		Course Title: Applied Mathematics – ii	Credits = 4		
MAT1102			**L**	**T**	**P**
Semester: II		Total contact hours: 60	3	1	0

<table>
<tr><td colspan="3" align="center">List of Prerequisite Courses</td></tr>
<tr><td colspan="3">HSC Standard Mathematics, Applied Mathematics – I</td></tr>
<tr><td colspan="3" align="center">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="3" align="center">This is a basic Mathematics course. This knowledge will be required in almost all subjects later.</td></tr>
<tr><td colspan="3" align="center">Description of relevance of this course in the B. Tech. Program</td></tr>
<tr><td colspan="3">This is a basic Mathematics course. This knowledge will be required in almost all subjects later on. This knowledge is also required for solving various mathematical equations that need to be solved in several chemical engineering courses such as MEBC, momentum transfer, reaction engineering, separation processes, thermodynamics, etc.</td></tr>
</table>

	Course Contents (Topics and subtopics)	Hours
1	**Numerical Methods - I:** Solutions of system of linear equations (Gauss-elimination, LU-decomposition etc.) Numerical methods for solving non-linear algebraic / transcendental etc. Newton's method, Secant, Regula Falsi methods. Numerical solution set of linear algebraic equations: Jacobi, Gauss Siedel, and under / over relaxation methods	15
2	**Numerical Methods - II:** Interpolation and extrapolation for equal and non-equal spaced data (Newtons Forward, Newtons backward and Lagrange) Numerical integration (trapezoidal rule, Simpson's Rule) Numerical methods for solution of initial values problems using RK method, Euler's method and Taylor series method.	15
3	**Differential Equations - I:** Differential Equations: Solution of Higher order ODE with constant and variable coefficients and its applications to boundary and initial value problems, Series solution of differential equations, Bessel functions, Legendre Polynomials, Error function.	15
4	**Differential Equations – II:** Fourier series, Laplace Transforms and their application in differential equation (both ODEs PDEs). Partial Differential Equations, Classification of higher order PDEs, Solution of parabolic equation using separation of variables	15
	Total	**60**

	List of Textbooks/ Reference books
1	E. Kreyszig, Advanced Engineering Mathematics (8th Edition), John Wiley (1999). (Officially prescribed)
2	S. R. K. Iyengar, R. K. Jain, Advanced Engineering Mathematics Narosa.
3	M. K. Jain, S R K Iyengar and R K Jain, Numerical Methods: For Scientific and Engineering Computation, New Age International Publication
4	W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005).
5	R. V. Churchill and J. W. Brown, Fourier series and boundary value problems (7th Edition), McGraw-Hill (2006).

	Course Outcomes (students will be able to…..)
CO 1	Solve system of linear algebraic equations. K3
CO 2	Do numerical integrations of functions. K3
CO 3	Solve higher order ODE by analytical methods. K4
CO 4	Solve initial value problems using numerical methods. K3
CO 5	Apply Fourier series and Laplace transform techniques to solve ODE and PDE.K4

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **CET1507**	Course Title: **Process Calculations**	Credits = 4		
		L	**T**	**P**
Semester: II	Total Contact Hours: 60	2	2	0

List of Prerequisite Courses
Standard XII 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. (Oils) Program
The course introduces various concepts used in Chemical Engineering to the students. The knowledge of this course is required for in ALL B. Tech. courses in the subsequent semesters including the project work. It can be applied in various situations such as process selection, economics, sustainability, environmental impacts and others.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to chemical process calculations, Overview of single- 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	
1	Elementary Principles of Chemical Processes, Felder, R.M. and Rousseau
2	Chemical Process Principles, Hougen O.A., Watson K. M.
3	Basic Principles and Calculations in Chemical Engineering, Himmelblau,
4	Stoichiometry, Bhatt B.I. and Vora S.M.

Course Outcomes (students will be able to…..)	
CO1	convert units of simple quantities from one set of units to another set of units (K2)
CO2	calculate quantities and /or compositions, energy usages, etc. in various processes and process equipment such as reactors, filters, dryers, etc. (K3)
CO3	apply material balances in multiphase systems (K3)
CO4	apply energy balance to various systems (K3)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain: S, Psychomotor domain

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

List of Prerequisite Courses
Applied Physics - I

List of Courses where this course will be prerequisite
This is a basic physics Laboratory course. This knowledge will be required inalmost all subjects later on.

Description of relevance of this course in the B. Tech.(Oils) Program
Students will be able to learn various concepts by doingexperiments on different topics. This knowledge will be required in almost all subjects later on. This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Viscosity	5
2	Thermistor	6
3	Thermal conductivity	5
4	Ultrasonic interferometer	6
5	Photoelectric effect	5
6	Hall effect	6
7	Newton's rings	5
8	Dispersive power of prism	8
9	Laser diffraction	8
10	Resolving power of grating	6
	Total	**60**

List of Text Books/ Reference Books	
1	Physics:Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.
4	Introduction to Modern Optics – G. R. Fowles ,Dover Publications.
5	Optical Fibre Communication – G. Keiser, McGraw-Hill.
6	A Course of Experiments with LASERs – R. S. Sirohi, Wiley Eastern
7	Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, Prentice-Hall India.
8	Ultrasonics: Methods and Applications – J. Blitz, Butterworth
9	Applied Sonochemistry – T. J. Mason and J. P. Lorimer, Wiley VCH.

Course Outcomes (students will be able to…..)	
CO1	Apply various laws which they have studied throughexperiments (K3)
CO2	Measure transport properties like viscosity, conductivity, etc.(K4)
CO3	Explain the application of acoustic cavitation (K2)

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

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

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

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

List of Prerequisite Courses

Standard XII Chemistry Laboratory Course

List of Courses where this course will be prerequisite

This is a basic Course. This knowledge will be required in Applied Chemistry subjects later.

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

Students will become familiar with laboratory experimental skills, plan and interpretation of experimental tasks, understand the relevance of principles of physical chemistry in chemical processes

Sr.No.	Course Contents (Topics and Subtopics)	Required Hours
1	Experiments based on chemical reaction kinetics, phase equilibria and electrolyte systems, surface and interfacial phenomena such as surface tension and CMC measurements	4 hrs/session X 15 sessions
	Total	**60**

List of Text Books/ Reference Books

1	Practical physical Chemistry – B.Viswanthan and P.S. Raghavan
2	Practical physical Chemistry- Alexander Findlay

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

CO1	identify and determine physicochemical parameters using simple tools (K3)
CO2	interpretation of data and drawing scientific conclusions, dryers, etc (K4)

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

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

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

Course Code: **HUP1101**	Course Title: **Communication Skills**	**Credits = 2**		
		L	**T**	**P**
Semester: II	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses
Standard XII English

List of Courses where this course will be prerequisite
All

Description of relevance of this course in the B. Tech. (Oils) Program
This is an important course for the effective functioning of an Engineer and a Technologist. Communication skills are required in all courses and professional career.

Sr.No.	Course Contents (Topics and Subtopics)	Required Hours
1	Development of communication skills in oral as well as writing	10
2	The writing skills should emphasize technical report writing, scientific paper writing, letter drafting, etc.	14
3	The oral communication skills should emphasize presentation skills.	10
4	Use of audio-visual facilities like power point, LCD. for making effective oral presentation	14
5	Group Discussions	12
	Total	**60**

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

Course Outcomes (students will be able to…..)	
CO1	write grammar error free technical reports in MS Word or equivalent software (K3)
CO2	make power point slides in MS PowerPoint or equivalent software (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Semester III

	Course Code:**BST1110**	Course Title: **Basics of Biology and Applications to Technology**	**Credits = 3**		
			L	**T**	**P**
	Semester: III	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Biology

List of Courses where this course will be prerequisite

Safety studies pertaining to Chemicals, Pharmaceuticals, Polymers, cosmetics, Lubricants, Textiles, etc.

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

This interdisciplinary course will help a student understand basics of Human biology along with certain terminologies to enable them to read contemporary research pertaining to important technological developments. The course will help a student to understand the safety evaluation of materials as per regulatory guidelines

	Course Contents (Topics and Subtopics)	**Required Hours**
1	Overview of basics of Human Anatomy and Physiology, the terminologies used etc. Definitions of Anatomy, Physiology, Histology, Biochemistry, Homoeostasis, Health, Disease, Toxicity, Safety, Genotoxicity etc. Systems that make the human body, the rationale behind introducing the subject to the technology students of Pharma, foods, Polymers, Surface coatings, Oils, Textiles, Dyes	7
2	Overview of the cell functioning as a whole unit and its organelles with their functions and its applications to technology. An overview of normal cell division, cell death by apoptosis, necrosis , Cancerous growth, metabolites/ energy production , cellular secretions, different types of cells, cell repair, biomarkers, etc.	8
3	Overview of Biomaterials: Biodegradable, Biocompatible and their technological applications	5
4	Practical applications: design some simple experiments to evaluate toxicity using cellular experiments, organisms, animals etc. OECD guidelines. Concept of Safety studies and industrial relevance. (oral, dermal, inhalation)	5
5	Toxicity evaluation in terms of mortality, Genotoxicity, hypersensitivity (allergy), biocompatibility as per various international guidelines namely, ICH, OECD, ISO to name a few.	10
6	Toxicity evaluation in terms of mortality, Genotoxicity, hypersensitivity (allergy), biocompatibility as per various international guidelines namely, ICH, OECD, ISO to name a few.	5
7	Irritation potential evaluation of Lubricants, surfactants, excipients, etc.	5
	Total	**45**

List of Textbooks/Reference Books

1	Human Anatomy and Physiology R. K. Goyal, Ahmedabad, India.
2	Pharmacology H. P. Rang, M. M. Dale, J. M. Ritter
3	Ross and Wilson's Anatomy and Physiology in Health and Illness Anne Waugh and All
4	Online guidelines of OECD, ISO, ICH

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

CO1	understand and explain the basic concepts and terminologies of Biology (K2)
CO2	Appreciate interdisciplinary nature of biology and will be able to design and execute simple experiments (K3)
CO3	understand about the concept of toxicity/safety and its relevance to technology and its applications in everyday life (K2)

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

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

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3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **GET1110**	Course Title: **Basic Mechanical Engineering**	**Credits = 3**		
		L	**T**	**P**
Semester: III	**Total Contact Hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses
None

List of Courses where this course will be Prerequisite
Material Technology, Strength of Materials, Environment Science and Technology

Description of relevance of this course in the B. Tech. (Oils) Programme
To acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	**Introduction to Thermodynamics:** First Law of Thermodynamics, Steady-flow energy equation, Second Law of Thermodynamics	3
2	**Properties of Steam and Boilers:** Steam formation, Types of steam, Steam Properties – Enthalpy, Simple numerical for finding enthalpy and dryness fraction. Steam Boilers: Classification, Working principle of Cochran, Babcock & Wilcox, etc. boilers	6
3	**I. C. Engines:** Classification, Working of 2-stroke, 4-stroke C.I. and S.I. Engines with P-V diagrams, Definitions and simple numerical for determining indicated power, Brake power, Mechanical efficiency, Indicated thermal efficiency, and Brake thermal efficiency	6
4	**Prime Movers:** Classification of Prime movers, Working principle of steam, gas and water turbines, Concept of impulse and reaction steam turbines	4
5	**Compressors:** Classification of compressors, Reciprocating compressors, Single-stage and multistage compressors, P-V diagram, Rotary compressors, Fan, Blower & Compressors, Centrifugal and axial compressors, Application of compressors	4
6	**Pumps:** Classification of pumps, Reciprocating pumps, Centrifugal pumps, Axial pumps, Gear pumps, Maintenance of pumps	4
7	**Refrigeration:** COP of refrigerator and heat pumps, Classification of refrigerants, Nomenclature, Properties desired by refrigerants, Vapour compression refrigeration cycle, Methods of increasing COP of VCRS, Vapour absorption refrigeration systems	5
8	**Renewable Energy:** Role and importance of nonconventional and alternate energy sources such as solar, wind, ocean, bio-mass and geothermal	4
9	**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 numericals)	5
10	**Properties and Applications of Engineering Materials:** Metals –ferrous, cast-iron, tool steels and stainless steels and non-ferrous aluminium, brass, bronze. Polymers – Thermoplastic and thermosetting polymers. Ceramics – Glass, optical fibre, glass, cermets. Composites – fibre-reinforced composites, metal-matrix composites	4
	Total	**45**

List of Text Books/ Reference Books	
1	Nag, P. K. Engineering Thermodynamics; 5th Ed.; McGraw Hill Education (2013)
2	Morse, Frederick T. Power Plant Engineering; 3rd Ed.; Van Nostrand Reinhold Inc. (1953)
3	Ballaney, P. L. Thermal Engineering: Engineering Thermodynamics & Energy Conversion Techniques; 5th Ed.; Khanna Publishers (1966)
4	Lal, J. Hydraulic Machines Including Fluidics; 6th Ed.; Metropolitan Book Co. Pvt. Ltd. (2016)
5	Twidell, John; Weir, Tony. Renewable Energy Resources; 3rd Ed.; Routledge (2015)
6	Rai, G. D. Non-conventional Energy Sources; Khanna (1988)

7	Arora, C. P. Refrigeration and Air Conditioning; 4th Ed.; McGraw Hill (2021)
8	Rattan, S. S. Theory of Machines; 5th Ed.; McGraw Hill (2019)
Course Outcomes (Students will be able to…..)	
CO1	Discuss the steam formation process and its properties. (K2)
CO2	Understand basics of heat transfer, refrigeration and I. C. Engines. (K2)
CO3	Understand mechanism of power transfer through belt, rope and gear drives and understand the properties of common engineering materials and apply in engineering industry. (K3)
CO4	Explain the working principles of power-absorbing devices such as pumps and compressors and explain need and importance of various renewable energy sources. (K2)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code:	Course Title: SPL1: Chemistry of Oils and Fatty Acids	Credits = 4		
		L	T	P
OLT 1101				
Semester: III	Total contact hours: 60	3	1	0

List of Prerequisite Courses
HSC (Science), Organic Chemistry I, Organic Chemistry II

List of Courses where this course will be prerequisite
All the Oils, Oleochemicals& Surfactants Special Courses

Description of relevance of this course in the B. Tech. (Oils, Oleochemicals& Surfactants Technology) Programme
Students will be able to understand the industrial chemistry of oils and fatty acids. They will be trained with respect to basics of sources of oils, minor constituents, physical and chemical properties of oils and fatty acids, various derivatisation pathways and related analytical tools.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1.	**General introduction to oils, fats and waxes:** Chemical structure, sources and composition. Classification of oils and fats by source type, fatty acid composition and drying properties. Statistics of Indian as well as world production of commercial oil seeds/ oil bearing materials, oils and fats, importance as feedstock for food and chemical industries.	6
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.	6
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.	6
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.	6
5.	**Separation and isolation of fatty acids**: Distillation, crystallization and counter current distribution. Methods of structure determination.	4
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.	8
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	**60**

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)

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	0	0	0	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3
CO3	K2	3	2	1	2	1	3	3	3	0	0	0	1	3	2
CO4	K3	3	3	2	2	2	3	3	3	0	0	0	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	0	0	0	2	3	3
Course	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3

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

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

Course Code: PCB1302	Course Title: Material Technology		Credits = 3		
			L	T	P
Semester: III	Total Contact Hours: 45		2	1	0

	List of Prerequisite Courses		

Structural Mechanics, Applied Physics, Applied Chemistry

List of Courses where this course will be prerequisite

Equipment design, Final Year Project, Process Development and Engineering, Project Engineering and Economics

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

Selection of Material of Construction for a given application, Maintenance and corrective measures for various Engineering materials, Troubleshooting

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Engineering Materials: Classification, Fundamentals of Engineering properties of materials, Phase diagrams, Study of ferrous and nonferrous materials	12
2	Composite and smart materials	03
3	Structure-Property Relationship: Subatomic to macroscopic level, Modification and control of material properties	10
4	Theory of Failure of Materials: Fracture, creep and fatigue	08
5	Corrosion Engineering: Electrochemical principles, different types of corrosion, Polarization, Mechanisms of corrosion control and prevention, Preventive coatings. Corrosion behaviour of industrial materials	08
6.	Criteria for selection of materials in Chemical Process industry	04
	Total	**45**

	List of Textbooks
1	The Essence of Materials for Engineers, Robert W. Messler, Jr.
2	Materials Science and Engineering, Raghavan V.
3	Materials Science and Engineering, Van Vlack L.H.
4	Engineering Materials and Applications, Flin R.A., Trojan P.K.

	List of Additional Reading Material/Reference Books
1	Material Science and Engg, Callister
2	Mechanical Metallurgy, Dieter

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

CO1	resolve the issues related to mechanical failure (K3)
CO2	troubleshoot corrosion-related industrial problems (K3)
CO3	learn from incidences (LFI) (K2)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: BST1102		Course Title: Biochemistry	Credits = 4		
			L	T	P
Semester: III		Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

Standard XII Biology and Chemistry

List of Courses where this course will be prerequisite

Pharmaceutical and Biochemical Analysis Laboratory, Pharmaceutical Biotechnology, Process Technology and Biotechnology Laboratory or other relevant courses

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

To train the students with respect to the core chemistry principles involved in functioning of biological systems, structural and chemical biology of macromolecules, including proteins, carbohydrates, lipids, nucleic acid and vitamins , structure, function and kinetic properties of enzymes and their role in metabolism of living cells, major catabolic as well as anabolic pathways involved in cell metabolism and quantitative aspects of biochemical analysis of macromolecules

	Course Contents (Topics and Subtopics)	Required Hours
1	Carbohydrates: Fundamentals of chemistry of carbohydrates, concept of ring structures and straight chain structure of common carbohydrates glucose, fructose, galactose, lactose, maltose, sucrose, polysaccharides, starch, glycogen, cellulose	5
	Qualitative tests / colour reaction: phenyl hydrazine, alkali – oxidation reduction with practical significance	2
	Metabolic pathways and energy yield for breakdown of carbohydrates: glycolysis, gluconeogenesis, citric acid cycle, pentose phosphate pathway, electron transport chain and coupled oxidative phosphorylation	5
2	Lipids: Fatly aids, waxes, phospholipids, sphingolipids, terpenoids. With are representative structure and significance	4
	Functions & comparative distribution of lipids, lipoproteins	4
	B-oxidation of fatly acids, functions of cholesterol & significance	
	Rancidity, sap value, iodine value & hydrogenating	4
3	Proteins & Amino acids: Amino acids: Structures, pK – isoelectric point, essential & non-essential amino acids, Colour reaction of amino acids	5
	Structure of protein: globular, fibrous	4
	Structural organization of protein: primary, secondary, tertiary, quaternary	5
	Elementary idea about chromatography & electrophoresis	2
4	Nucleic acids and their components: DNA& RNA bases, nucleosides, nucleotides, chemistry of nucleic acids, Structure and functions of RNA & DNA	5
	Types of RNA: mRNA, tRNA & rRNA	5
	Salient factures of protein biosynthesis & idea of genetic code	
5	Enzymes- definition, function, nomenclature, classification, mechanism of enzyme action, specificity of enzymes,enzyme kinetics, enzyme inhibition and regulation	5
6	Vitamins & Co-enzymes: Structures& function of Nicotinamide, nicotinic acid, riboflavin, lipoic acid, biotin, thiamine, B6, folic acid, B12,pantothenic acid, ascorbic acid, vitamins A, D, K, and E	5
	Total	60

List of Textbooks/Reference Books

1	Principles of Biochemistry, Lehninger AL, Nelson DL and Cox MM, 5th Edition, 2008, MacMillan
2	Biochemistry, Stryer L, Berg JM and Tymoczko JL, 5th Edition, 2002,Freeman & Co.
3	Fundamentals of Biochemistry – Voet DJ and Voet JG, Upgrade edition,2002, John Wiley & Sons

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

CO1	apply of fundamental knowledge of chemistry to biological systems and understand and elucidate structural as well as metabolic role of differentmacromolecules in the cell (K3)
CO2	apply analytical tests involved in detection of macromolecules in/derivedfrom biological samples (K3)
CO3	understand the role of enzymes in cellular environment and their use inindustrial applications for their practical applications and evaluate and elucidate impact of different catalytic reactions involved inmetabolic pathway (K4)

CO4	evaluate and explain influence and interactions of different metabolic pathway on each other (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code:BST1109		Course Title: Microbiology	Credits = 3		
			L	**T**	**P**
Semester: III		Total Contact Hours: 45	2	1	0

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

To familiarize students with diverse microorganisms in different industries like food, dairy, bio-based fermentation, oil, pharmaceutical industry and bioenergy, with diversity of microorganisms, microbial cell structure and function, microbial growth and metabolism, environmental factors affecting their growth and cultivate/control growth of microbes using physical and chemical technologies; with basics of microbial replication, transcription, translation and mutagenesis and involvement of microorganisms in diseases and role of immune system in defending invading pathogens

	Course Contents (Topics and Subtopics)	**Required Hours**
1	Introduction to microbiology and its significance (beneficial and harmful) in Foods (Dairy including pre and probiotics, cheese, vitamins, beverages etc.), Pharmaceuticals (Antibiotics, vaccine production, pathogenic organisms etc), Oils (bioremediation, bio-diesel from microorganism etc.), and environ-ment (waste water, nitrification, methanation, green chemicals and biofuels, etc.)	5
2	Prokaryotes and Eukaryotes- morphology, structure and function of microbial cells and their components	5
3	Major groups of microorganisms - Bacteria, Virus, Yeasts and Molds, Rickettsia, Chlamydia and Algae	5
4	Gram character and staining techniques, Isolation, preservation and maintenance of pure cultures	5
5	Nutrient requirements of microorganism, Composition, preparation and sterilization of microbiological media; Classification of media, Methods of sterilization, disinfection, sanitation, asepsis	5
6	Growth studies (lag phase, log phase, stationary phase, death phase); concept of generation time; Physical and chemical factors affecting growth of microbes	5
7	Extremophiles and their applications-Acidophiles, Basophiles,Thermophiles, Hyperthermophiles, Psychrophiles, Osmophiles	5
8	Microscopy (dark, Fluorscence, atomic force, scanning tunnel, confocal etc.); Enumeration of microorganisms (TPC, Yeast and molds count, MPN, turbidometry, rapid methods like flow cytometry, etc.)	5
9	Principles of immunology	5
	Total	**45**

List of Textbooks/Reference Books

1	Microbiology by Prescott, Harley & Klein's 7th Edition, 2008, Mcgraw-Hill
2	Microbiology by Pelczar, 5th edition, 1993, Mcgraw-Hill

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

CO1	Explain the application of diverse microorganisms in different industries likefood, dairy, oil, pharmaceutical, bio-based fermentation and bio-energy (K2)
CO2	Describe the cultivation/control methods for diversity of microorganisms, theirphysiology and metabolism (K2)
CO3	Explain the flow of genetic information from DNA to protein and themechanisms involved therein (K2)
CO4	Understand and apply the significance of microorganisms in diseases and basicimmune system against invading pathogens (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

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 $Na_2S_2O_3$, NaOH and HCl, Determination, Analysis of NaOH, Analysis of acetic acid	3
2	Determine Volatile content by air, oven method, Determine specific gravity of oil and glycerine, the viscosity of given sample by using viscometer	3
3	amine content in given sample by indicator method	5
4	Determination of titer value of given fatty acid	5
5	Determination of aldehyde content in the given oil sample	5
6	determine the hardness of water in PPM by 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 by Bockisch Michael

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

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

Course Code: OLP 1215	Course Title: Pr. 2: Preparation and Purification of Organic Derivatives	Credits = 2		
		L	**T**	**P**
Semester: III	Total contact hours: 60	0	0	4

<div align="center">List of Prerequisite Courses</div>

HSC (Science), Organic Chemistry Laboratory (Semester I/II)

<div align="center">List of Courses where this course will be prerequisite</div>

Chemistry of Oleochemicals and Surfactants, Production and Applications of Soaps, Surfactants and Detergents

<div align="center">Description of relevance of this course in the B. Tech. (Oils, Oleochemicals& Surfactants Technology) Programme</div>

Students will be able to learn and execute various derivatization techniques of organic functional groups. They will be trained to isolate solid crude products and purify those via crystallization. They will also learn to calculate yield of reaction. Finally, the students will learn thin layer chromatography (TLC) techniques and calculate R_f values.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1.	**Thin layer chromatography (TLC):** **I.** Techniques to perform thin layer chromatography (TLC) (essential for monitoring progress of a reaction). Calculation of R_f values in different solvent systems. **II.** Separation of mixture of organic compounds by TLC - Mixtures of two different unknown organic compounds will be provided. The R_f values for each of the compounds in the mixture is to be reported.	20
2.	**Preparation of important organic compounds and their purification:** Different types of organic reactions will be performed. The crude product will be isolated and purified via recrystallization process. Isolated yield of the product is to be reported. Melting point of the purified product is to be noted. The following organic preparations are to be carried out **(any five)**: **I.** Preparation of acetanilide from aniline (acetylation of primary aromatic amines) **II.** Preparation of *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

<div align="center">List of Text Books/ Reference Books</div>

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.

<div align="center">Course Outcomes (Students will be able to…..)</div>

CO1	Execute various derivatization techniques to synthesize important organic compounds. (K3)
CO2	Analyze purity of solid organic compounds via melting point determination. (K4)
CO3	Learn and apply thin layer chromatography (TLC) techniques to calculate R_f values of unknown compounds. (K3)

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

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

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

Semester IV

Course Code: GET1116	Course Title: Engineering Mechanics and Strength of Materials	Credits = 3		
		L	T	P
Semester: IV	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Physics and Mathematics, Applied Mathematics - I and - II, Applied Physics - I

List of Courses where this course will be Prerequisite

Material Technology, Strength of Materials, Environment Science and Technology

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

This subject will help students to understand use of basics of Applied Mechanics and Strength of Materials. As a practicing Engineer and Technologist, the students will relate different types of forces to be considered along with their quantification during design of equipments. It will also help in understanding the conditions of equilibrium and their application for analysing the problems, importance of centre of gravity and moment of inertia in Engineering Design, study of different types of stresses and strains occurring in various components of the structure including in thin cylindrical shells., advantages and disadvantages of various geometric sections available for Engineering design. In addition, the students will be acquainted with different advance fibre polymer composite materials used in industry for various applications and several performance- enhancing construction chemicals. In summary, this is a foundation course for a proficient Design Engineer and Technologist.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Concepts of forces, their types, Resolution of forces, Composition of forces, Steps in Engineering Design, Different types supports and free body diagram	4
2	Equilibrium of rigid bodies - Conditions of equilibrium Determinant and indeterminate structures Equilibrium of beams, trusses and frames Problems on analysis of beams and truss.	6
3	Concept of Cetroid and moment of Inertia (Second moment of area) its use Parallel axis theorem Problems of finding centroid and moment of Inertia of single figures, composite figures Perpendicular axis theorem, Polar M.I., Radius of gyration.	5
4	Shear Force and Bending Moment - Basic concept, S.F. and B.M. diagram for cantilever, simply supported beams (with or without overhang) Problems with concentrated and U.D. loads.	4
5	Stresses and Strains - Tensile and compressive stresses, Strains, Modulus of elasticity, Modulus of rigidity, Bulk modulus Thermal stresses and strains Problems based on stresses and strains Basics of Engineering Design - Steps in the engineering design, Importance of analysis, 1-D, 2-D and 3-D analysis and interpretation of results. Design philosophies	6
6	Theory of Bending - Assumptions in derivation of basic equation, Basic equation, Section modulus, Bending stress distribution	3
7	Problems on shear stress - Concept, Derivation of basic formula Shear stress distribution for standard shapes Problems of Shear stress distribution	3
8	Slope and Deflection of beams - Basic concept, Slope and Deflection of cantilever and simply supported beams under standard loading Macaulay's method	4
9	Thick and Thin cylinders - Concept of radial, longitudinal stresses, behaviour of thin cylinders Problems on thin cylindrical and spherical shells Behaviour of thick cylinders (Theory only)	4
10	Natural Materials, Manmade Materials Composite Materials – Types of composite materials and their uses in various industrial applications Different types of performance enhancing and special purpose construction	6

	chemicals Plasticizers and super-plasticizers Recycling of waste – value addition Testing of Materials and its relevance		
		Total	**45**

<table>
<tr><td colspan="2" align="center">List of Text Books/ Reference Books</td></tr>
<tr><td>1</td><td></td></tr>
<tr><td>2</td><td>Popov, Egor P. Introduction to Mechanics of Solids; Macdonald (1968)</td></tr>
<tr><td>3</td><td>Beer. Mechanics of Materials; 7th Ed.; McGraw Hill India (2016)</td></tr>
<tr><td>4</td><td>Dadhe, V. G.; Jamdar, M. G.; Walavlkar, Y. N. Fundamentals of Applied Mechanics; SaritaPrakashan (1989)</td></tr>
<tr><td>5</td><td>Timoshenko, S.; Young, D. H.; Rao, J. V.; Pati, Sukumar. Engineering Mechanics; 5th Ed.; McGraw Hill Education (2017)</td></tr>
<tr><td>6</td><td>Singer, Ferdinand L.; Pytel, Andrew. Strength of Materials; 4th Ed.; Harper Colins Publishers (2012)</td></tr>
<tr><td>7</td><td>Kaw, Autar K. Mechanics of Composite Materials; 2nd Ed.; CRC Press (2006)</td></tr>
<tr><td>8</td><td>Shetty, M. S.; Concrete Technology: Theory and Practice; S. Chand & Co. Ltd. (2005)</td></tr>
</table>

	Course Outcomes (Students will be able to…..)
CO1	Quantify the actions and able to find reactions by applying conditions of equilibrium, find out the Centroid and Moment of Inertia for various cross sections used in engineering structures and for plane areas and be able to draw the Shear Force and Bending Moment diagram for different types of beams under simple and complex loading (K3)
CO2	Calculate the forces, reactions, stresses, strains in components of the bodies of a complex engineering structure (K3)
CO3	Find out the Bending Stresses at different positions and Shear Stress distribution across the cross section at various points and calculate the Slope and Deflection at different points under simple and complex loading (K3)
CO4	Explain various materials used in various applications in engineering. cement composite – Concrete, Chemicals used to alter the properties of concrete (K2)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **CET1105**	Course Title: **Transport Phenomena**		Credits=**4**		
			L	**T**	**P**
Semester:IV	TotalContactHours:60		**3**	**1**	**0**

<table>
<tr><td colspan="3" align="center">List of Prerequisite Courses</td></tr>
<tr><td colspan="3">XIIth Standard Physics and Mathematics</td></tr>
</table>

List of Prerequisite Courses

XIIth Standard Physics and Mathematics

List of Courses where this course will be prerequisite

Thisisabasiccourserequiredinspecialsubjectsthatdealwithflowoffluids 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 equipment's 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	ApplicationsofBernoulli'sEquation,Pressure-dropinpipesandFittings,Meters,Fluid moving machinery such as pumps	10
3	Particle Dynamics, Flow through fixed and fluidized Beds	4
4	EquationsofContinuityandMotioninlaminarflowsanditsapplicationsforsimple 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	Calculate friction factor, pressure drop, power (K3)
CO2	Calculate flow and power required for pumps(K3)
CO3	Calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers (K3)
CO4	Calculate mass transfer coefficients and estimate mass transfer rates in simple situations (K3)

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

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain: S, Psychomotor domain

	Course Code:GET1105	Course Title: Electrical Engineering and Electronics	Credits = 3		
			L	T	P
	Semester: IV	Total Contact Hours: 45	2	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.(Oils) Program

In this course, students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand basics of electricity alongside basic knowledge about Transformer and selection of different types of drives for a given application process. They will get basic knowledge of electronic devices and their applications in Power supplies, amplifiers and other circuits.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Basic Laws: Kirchoff's current and voltage law, Simple series and parallel connections, star and delta transformation. Mesh and nodal analysis, Basic elements R, L and C. Concept of self and mutual inductance	6
2	Network theorems: super position, Thevenin's theorems	3
3	A.C. Fundamentals: Equations of alternating voltages and currents, cycle, frequency. Time period, amplitude, peak value average value, R.M.S. value, A.C. through resistance, inductance and capacitance, simple RL, RC and RLC circuits. Resonance in series RLC circuits, Power, power factor, series and parallel circuits	5
4	Three Phase systems: Star and delta connections, relationship between line and phase voltages and currents, Power in three phase circuits	5
5	Transformer: Introduction, principle of operation, e.m.f. equation, phasor diagrams. Ideal transformer, transformer on no load, Transformer under load, Transformer losses, efficiency, regulation	5
6	Introduction to dc and ac drives	5
7	Diodes and rectifiers: P-N junction diode characteristics, Zener diode, Half wave and full wave rectifiers, their waveforms, brief introduction to filters	4
8	Bi-polar junction transistor: Current components. Modes of operation, Input and output characteristics. Regions of operation, Transistor as an amplifier, classification of amplifiers	6
9	Introduction to Uni junction transistor, Characteristics, UJT relaxation oscillator	3
10	Silicon controlled rectifier, controlled rectification, characteristics, methods of turning-on. Applications	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 Machines by P.S. Bhimbra
5	Electrical Technology by B.L.Theraja, A.K.Therajavol I,II,IV
6	Thyristors and their applications by M.Ramamurthy
7	Power Electronics by P.S. Bhimbra

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

CO1	Explain the basic concepts of D.C circuits. Solve basic electrical circuit problems (K3)
CO2	Explain the basic concepts of single phase and three phase AC supply and circuits (K2)
CO3	Explain the basic concepts of transformers & motors used as various industrial drives (K2)
CO4	Explain the basic concepts of electronic devices and their applications (K2)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code:	Course Title: SPL2:NUTRITION				
	Semester: IV	Total contact hours: 60		3	1	0

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 derivatization pathways and related analytical techniques.

Sr No	Topics	No. of lectures
1	**Introduction** to Nutrition, Importance of study of Nutrition in health and disease, Branches of Nutrition, Nutrigenomics ,Neutraceutics	**4**
2	Food as a source of nutrients, Sources and functions of Food, Concept of RDA of nutrients	2
3	**Study of major food constituents** viz Carbohydrates and Proteins with ref. to Chemical nature, classification, digestion, nutritional role and food sources	8
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	**10**
5	**Proximate analysis of foods**, Fuel value and Physiological fuel value of foods	**2**
6	**Computation of daily calorie requirements** with ref to BEE, AT and TEF, ICMR Calorie Requirements for Indians	**4**
7	**Non digestible carbohydrates, Dietary Fibre,** Resistant starch, FOS, Pro and Prebiotics	**6**
8	**Glycemic properties** of carbohydrates ,fructose as a Health risk factor	**2**
9	**Protein quality evaluation**: Chemical score, PER, BV, NPU, PDCAA, Protein requirements at different life stages, Mutual supplementation, Available Lysine	4

10	**Anti-nutritional factors** in foods and their significance, Bioavailability of nutrients		**3**
11	**Vitamins**: Chemical nature, nutritional function, stability to processing conditions, deficiency symptoms, hypervitaminosis for fat soluble vitamins, RDAs and food sources		**6**
12	**Minerals**: nutritional role, RDAs, sources of macro and microelements		**5**
13	**Role of nutrients in** metabolic syndrome, CVD, Atherosclerosis, Diabetes, Hypertension, obesity		**2**
14	ABCDs of nutritional assessment		**2**
		Total	**60**

<div align="center">

List of Text Books/ Reference Books

</div>

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

<div align="center">

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

</div>

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

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

| CO5 | K3 | 3 | 3 | 2 | 2 | 2 | 3 | 0 | 3 | 0 | 0 | 0 | 2 | 3 | 3 |
| Course | K4 | 3 | 3 | 2 | 3 | 2 | 3 | 0 | 3 | 0 | 0 | 0 | 2 | 3 | 3 |

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

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

Course Code: **OLT 1102**	Course Title: **SPL3:Chemistry of Oleochemicals and Surfactants**	Credits = 3		
		L	**T**	**P**
Semester: **IV**	Total contact hours: **45**	**3**	**1**	**0**

<table>
<tr><th colspan="3">List of Prerequisite Courses</th></tr>
<tr><td colspan="3">HSC (Science)</td></tr>
<tr><th colspan="3">List of Courses where this course will be prerequisite</th></tr>
<tr><td colspan="3">All the Oils, Oleochemicals& Surfactants Special Courses</td></tr>
<tr><th colspan="3">Description of relevance of this course in the B. Tech. (Oils, Oleochemicals& Surfactants Technology) Programme</th></tr>
<tr><td colspan="3">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.</td></tr>
</table>

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	04
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	05
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.	04
4.	Self-assembly and packing features of surfactants (bi and multilayers, direct & reverse micelles, vesicles, Micro-emulsions). 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	05
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.	9
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	06
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	06
	Total	**45**

	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)
CO6	Ability to identify and interpret the role of surfactants as specialty and high performance chemicals. (K5)

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

Course Code: OLT 1110	Course Title: SPL4: Chemistry and Technology of Drying Oils and Resins		Credits = 3	
			L	T	P
Semester: IV	Total contact hours: 45		3	1	0

List of Prerequisite Courses
HSC (Science)

List of Courses where this course will be prerequisite
Technology of Oleochemicals, 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.

		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,	10
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	7
3	Chemical and physical modification of alkyd resins, uralkyd, epoxy esters, alkyl polyamide, silicon modified alkyd	8
4	Natural resins Natural resins classification, composition, physical and chemical properties of Resin, shellac, Copl, manila	10
5	Synthetic Resins - Amino resins, urea formaldehyde, epoxy resins, and their application, polyamide resin, chlorinated rubbervinyl resins. Polyurethanes, classification, properties and application	10
	Total	45

Organic Coating Technology by H. F. Payne.
Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D.VanNostrand Company Inc, 1959.
Organic Coating: Science and Technology by Z. Wicks.]
Handbook of Thermoplastics, O. Olabisi, Marcel Dekker, 1997
Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley – Interscience Publication, 1977
Introduction to paint chemistry – Principles of paint technology, Turner G.P.A.,, Chapman and Hall , London

Course Outcomes (students will be able to …..)
Understand fundamental knowledge on basics of chemistry involved in the drying Oils (K2)
Discus the types of drying Oils, resins and their applications (K4)
Summarise about synthetic methods used for manufacture of alkyd resins (K3)

		Classify different types of resins and drying Oils on the basis of application and its properties .
CO4		(K4)

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

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

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

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

	Course Code:GEP1106	Course Title: Electrical Engineering and Electronics Laboratory	Credits = 2		
			L	T	P
	Semester: IV	Total Contact Hours: 60	0	0	4

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. (Oils) Program
In this course, students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand basics of electricity alongside basic knowledge about Transformer and selection of different types of drives for a given application process. They will get basic knowledge of electronic devices and their applications inPower supplies, amplifiers and other circuits.

	Course Contents (Topics and Subtopics)	Required Hours
	Suitable no of experiments out of the following will be conducted -	
1	Superposition Theorem	5
2	Thevenin's Theorem	5
3	Series RL circuit	4
4	Resonance in Series RLC circuit	5
5	H.W. and F.W. Rectifiers	4
6	Cathode Ray Oscilloscope	5
7	Input and output characteristic of npn transistor in CE mode	4
8	Load Test on Transformer	4
9	Three phase star connection	4
10	Three phase delta connection	4
11	Study of UJT relaxation oscillator	4
12	Design of UJT relaxation oscillator	4
13	Load Test on 3 phase induction motor	4
14	Study of Thermocouple	4
	Total	**60**

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 Machines by P.S. Bhimbra
5	Electrical Technology by B.L.Theraja, A.K.Therajavol I,II,IV
6	Thyristors and their applications by M.Ramamurthy
7	Power Electronics by P.S. Bhimbra

Course Outcomes (Students will be able to…..)	
CO1	Explain concepts of basic working of D.C circuits (K2)
CO2	Explain the basic applications of single phase and three phase AC supply and circuits (K2)
CO3	Explain the working and utility of transformers and motors used as various industrial drives (K2)
CO4	Apply the basic principles in electronic devices and circuits (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code:	Course Title:	Credits = 2		
MAP1201	Computer Applications Laboratory	L	T	P
Semester: IV	Total Contact Hours: 64	0	0	4

List of Prerequisite Courses
HSC Standard Mathematics, Applied Mathematics – I
List of Courses where this course will be prerequisite
This is a basic Mathematics course. This practical knowledge will be required in several subjects later.
Description of relevance of this course in the B. Tech. Program
Students will understand the basics of Python programming and get exposure to the use of spreadsheet programme and Excel for numerical computations and statistical analysis for engineering applications. The students will also explore R-programming for Regression Analysis, Testing of Hypothesis using of standard statistical inference. B. Tech programme requires students to analyze data and develop computer programmes to solve various problems in Engineering and Technology fields.

	Course Contents (Topics and subtopics)	Hours
1	Introduction to Spreadsheet Programmes, Use of formulae and Plotting Graphs of Function and Data Plotting in Excel	4
2	Exploring Basic Statistics and Hypothesis Testing with Spreadsheet	4
3	Numerical Solution of Linear and Non-Linear Equations in Excel	4
4	Basic Introduction to R and R Studio, Data Management in R	4
5	Plotting Graphs in R, Exploring Probability Distribution Function in R	3
6	Hypothesis Testing in R	4
7	Basic Regression Analysis in R	4
8	Introduction to Python, Installation of Python and jupyter notebook through Anaconda. Variables in Python, Exploring math and cmath modules	3
9	List, Tuples and Dictionaries in Python, if else and elif statements, Creating functions (using def and lambda functions)	4
10	For loops and while loops in Python, Use of break and continue statements with loops, Developing Python programmes using loops	4
11	Writing Python Programme to solve problems in basic numerical analysis such root finding, Numerical solutions of linear equations, Numerical integration, etc.	4
12	Use of Numpy and Scipy to deal with vectors, matrices and their operations	4
13	Use of Numpy and SciPy continued	3
14	Plotting graphs using matplotlib	4
15	Use of Pandas for data processing and analysis	4
16	Linear and multilinear regression using Python	3
	Total	**60**

	List of Textbooks/ Reference Books
1	Carlberg, Conrad George. Statistical analysis: Microsoft Excel 2016; Que (2018).
2	Langtangen, Hans Petter. A Primer on Scientific Programming with Python; 5th Ed.; Springer-Verlag Berlin Heidelberg (2016)
3	Thareja, Reema; Python Programming - Using Problem Solving Approach; Oxford University Press (2017)
4	Beazley, David; Jones, Brian K. Python Cookbook: Recipes for Mastering Python 3; O'Reilly Media (2013)
5	VanderPlas, Jack; Python Data Science Handbook: Essential Tools for Working with Data; 1st Ed.; O'Reilly Media (2016)
6	Dalgaard, Peter; Introductory Statistics with R; 2nd Ed.; Springer (2008)

7	Navarro, Daniel; Learning Statistics with R (2013)
8	Dennis, Brian; The R Student Companion; CRC Press (2012)
9	Verzani, John; Using R for Introductory Statistics; 2nd Ed.; CRC Press (2014)
	Course Outcomes (Students will be able to…..)
CO1	perform descriptive statistical analysis using Excel (K3)
CO2	perform basic statistical tests using R (K3)
CO3	perform linear regression using R (K3)
CO4	write Python programs to implement basic numerical methods (K4)
CO5	perform data processing and regression analysis using Python (K4)

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

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

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

Semester V

Course Code: **CET1401**	Course Title: **Chemical Engineering Operations**	**Credits = 3**		
		L	**T**	**P**
Semester: V	**Total Contact Hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses
Process Calculations, Transport Phenomena

List of Courses where this course will be prerequisite
This is a basic course. It is required in many other courses that involve physical processes

Description of relevance of this course in the B. Tech. (Oils) Programme
This is a basic Chemical Engineering course. The principles learnt in this course are required in almost all the forthcoming courses and throughout the professional career of students.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Distillation: Fundamentals of flash-, batch- and continuous distillation, Distillation columns internals, Steam and azeotropic distillation	12 – 15
2	Liquid-Liquid Extraction: Solvent selection, Construction of ternary diagrams, Staged calculations, Types of extraction equipment	6
3	Crystallization: Phase diagram (temp/solubility relationship), Evapo-rative 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, ypes of dryers	5
6	Introduction to Other Aspects of Unit Operations: Content will be aimed towards understanding practical and safety aspects of unit operations and/or introducing other separation processes like: adsorption/ion exchange, membrane processes and gas absorption, etc.	9 – 6
7	Industrial Case Studies: Interactive discussion with experienced professionals from industry or equipment vendors with emphasis on applicability, importance and challenges of different unit operations	3
	Total	**45**

List of Text Books/ Reference Books	
1	Richardson, J.F., Coulson, J.M., Harker, J.H., Backhurst, J.R., 2002. Chemical engineering: Particle technology and separation processes. Butterworth-Heinemann, Woburn, MA.
2	Seader, J.D., Henley, E.J., 2005. Separation Process Principles, 2 ed. Wiley, Hoboken, N.J.
3	Svarovsky, L., 2000. Solid-Liquid Separation. Butterworth-Heinemann, Woburn, MA.
4	McCabe, W., Smith, J., Harriott, P., 2004. Unit Operations of Chemical Engineering, 7 ed. McGraw-Hill Science/Engineering/Math, Boston.
5	Green, D., Perry, R., 2007. Perry's Chemical Engineers' Handbook, Eighth Edition, 8 ed. McGraw-Hill Professional, Edinburgh.
6	Dutta, B.K., 2007. Principles of Mass Transfer and Separation Process. Prentice-Hall of India Pvt. Ltd, New Delhi.

Course Outcomes (students will be able to…..)	
1	perform basic sizing of continuous and batch distillation columns (K3)
2	analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage (K4)
3	describe few industrial crystallization, filtration and drying equipment (K2)
4	describe the need and importance of other separation processes like adsorption, ion exchange and membrane (K2)
5	Apply the concept of unit operation in chemical industries (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: CET1212	Course Title: Chemical Reaction Engineering	Credits = 3		
		L	**T**	**P**
Semester: V	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Physical Chemistry – I and – II, Transport Phenomena

List of Courses where this course will be prerequisite

Environmental Engineering and Process Safety, Chemical Project Economics

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

The course 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, oleo chemicals, and surfactants, Minerals, clean sing agents, Polymers and textiles, Biochemicals and biotechnology, Pharmaceuticals and drugs, Microelectronics, energy from conventional and non-conventional resources, Metals

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Kinetics of homogeneous reactions, Interpretation of batch reactor data, Single ideal reactors including design aspects	10
2	Multiple reactions, Temperature and pressure effects	5
3	Introduction to Non-ideal flow, RTD measurements, Models to predict conversions	5
4	Homogeneous and Heterogeneous Catalysis, Kinetics of Solid Catalyzed Reactions. Design of gas – solid catalytic reactors	15
5	Introduction to multiphase reactors	5
6	Mass Transfer with Chemical Reactions: Regimes of operation and Model contactors	5
	Total	**45**

List of Textbooks

1	Elements of Chemical Reaction Engineering – H. Scott Fogler

List of Additional Reading Material / Reference Books

1	Heterogeneous Reactions, Vol.I and II –L.K. Doraiswamy, M.M.Sharma

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

CO1	describe and apply the principles of various types of reactors (K3)
CO2	calculate rates of reactions based on given reaction scheme (K3)
CO3	design various components of reactors used in industrial practice (K3)
CO4	compare various reactors and select an appropriate reactor for a given situation (K4)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: OLT 1105	Course Title: SPL5:Technology of Oil and Fat Production and Edible Oil Processing (Marks 100)			

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.

	Course Contents (Topics and subtopics)	**Reqd hours**
	Natural sources of oils and fats, domestic and world production, trade and marketing of oilseeds and oils. Newer sources of oils and fats	4
	Storage, sampling, grading, cleaning, crushing, and heat treatment of oilseeds	5
	Mechanical expression, solvent extraction, rendering and other methods of recovering oils and fats. Economic aspects of these processes.	7
	Specific methods for the production of palm oil, palm kernel oil and rice bran oil.	2
	technical refining of oils for industrial uses, detoxification and technical products from oil cakes, edible products from oil meals, synthetic fatty material.	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	6
	Processes and plants employed for refining, bleaching, deodorization,	7
	hydrogenation and winterization of oils or edible purposes,	5
	manufacture and evaluation of auxiliary materials such as activated earth and carbon, Ni catalysis and hydrogen	4
	newer techniques of refining of oils and fats	4
	manufacture of butter, margarine an ghee, Vanaspati, bakery and confectionery fats and fatty foods	5
	composition and properties of these spoilage during storage of fats, and fat products, protection against auto oxidation	5
	Total	**60**

	Bailey's Industrial Oil and Fat Products Volume I to V by Daniel Swern, A Wiley Interscience Publication (1979)
	Palm oil by F. D. Gunstone, John Wiley and Sons (1987)
	Oils and Fats Manual (Vol. I & II) by A. Karleskind and J. P. Wolff, Lavoisier Publishing (1996)
	Oils, Fats and fatty foods by K. A. Williams, J. A. Churchill Ltd. (1966)
	Journal of American Oil Chemists' Society, International News on Fats, Oils and Related Materials, Lipids.
	Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)
	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
	Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)
	Natural fatty acids and their sources by E. H. Pryde

	Hydrogenation of fats and oils by H. Patterson, Applied Science publishers (1983)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge evel from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: OLT 1121	Course Title: SPL6: Perfumery Chemicals	Credits = 3		
		L	T	P
Semester: V	Total contact hours: 30 + 15 = 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.	5
2	Chemistry of terpenes and terpenoids. Preparation of terpeneless and sesquiterpenless oils. Technology of preparation for alcohols, esters, aldehydes, ketones.	7
3	Biosynthesis of monoterpenoids. Synthetic geraniol, geraniol esters, synthesis of terpene alcohols and their esters. Citronellol and their esters. Alpha terpineol: chemical synthesis.	8
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	15
	Total	**45**

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

		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	0	0	0	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	0	0	0	2	3	3
CO4	K3	3	3	2	3	2	3	3	3	0	0	0	2	3	3
Course	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3

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

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

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

Course Code: OLT 1104	Course Title: SPL7:Chemistry of Oils, Lipids, Essential Oils and their Applications	Credits = 3		
		L	T	P
Semester: V	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	Glyceride Synthesis, acylation procedures, introduction and removal of protecting groups, 1-monoglycerides, 2-monoglycerides, 1,2-diglycerides, 1,3-diglycerides, Trans fatty acids	8
2	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	9
3	Gas Liquid Chromatography. High performance liquid chromatography, Mass spectrometry of triglycerides and related compounds. Nuclear Magnetic Resonance Spectroscopy.	9
4	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.	9
5	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	45

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

9	Essential oils (Vol. I to VI) by Guenther E.
10	Perfume and flavour materials of natural origin by Arctander S.
11	Perfume, Cosmetics and Soap by Poucher W., Chapman and Hall ltd., (1959)
12	Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)

Course Outcomes (Students will be able to…..)	
CO1	Able to understand the basic process of glyceride synthesis, optically active glycerides and allied products. (K2)
CO2	Selects the process for the manufacture of monoglyceride, diglycerides, and isomers. (K4)
CO3	Select or identify advance method of analysis of oils and lipids like GC, MS, HPLC, NMR (K4)
CO4	Discuss novel process of extraction of essential oils from various natural sources and different types of Essential Oils. (K5)

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

Course Code: **MAT1106**	Course Title: **Design and Analysis of Experiments**	Credits = 4		
		L	**T**	**P**
Semester: V	Total Contact Hours: 60	3	1	0

<table>
<tr><td colspan="3">List of Prerequisite Courses</td></tr>
<tr><td colspan="3">HSC Standard Mathematics, Applied Mathematics – I, Engineering Application of Computers (MAP1201)</td></tr>
<tr><td colspan="3">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">Description of relevance of this course in the B. Tech. (Oils) Program</td></tr>
<tr><td colspan="3">This course is required for graduating technocrats to function effectively and efficiently in Industry, Academia and other Professional Spheres.</td></tr>
</table>

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
	Module I (Statistical Theory of Design of Experiments)	
1	**Fundamental Principles of Classical Design of Experiments:** Strategy of Experimentation, Typical applications of experimental design, Basic principles, Guidelines for designing experiments	2
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	4
3	**Experiments with a Single Factor: 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	8
4	**Factorial Designs:** Definition, Estimating model parameters, Fitting response curves and surfaces	4
	Module II (Data Analysis using Software (R/Python))	
5	The 2^k Factorial design, Blocking and confounding in the 2^k Factorial design, Focus of 2^2 and 2^3 designs, Blocking and confounding in the 2k Factorial Design	8
6	Plackett Burman methods, Central Composite Design (CCD)	4
7	Descriptive Statistics, Probability Distribution and Testing of Hypothesis using R	6
8	Regression techniques, Diagnostic checks, ANOVA using R and implementation of contrasts	6
9	Construction of Balanced Incomplete Block Designs and data analysis using R	6
10	Analysis of factorial designs using R, Understanding output and interpretation	6
11	Factorial designs, Data analysis and interpretation.	6
	Total	**60**

	List of Textbooks/ Reference Books
1	Montgomery, Douglas C. Design and Analysis of Experiments; 9th Ed.; John Wiley & Sons, Inc. (2017)
2	Box, G. E.; Hunter, J. S.; Hunter, W. G. Statistics for Experimenters: Design, Innovation, and Discovery; 2nd Ed.; Wiley (2005)
3	Lawson, John. Design and Analysis of Experiments with R; 1st Ed.; CRC Press (2015)
4	Rasch, D.; Pilz, J.; Verdooren, R.; Gebhardt, A. Optimal Experimental Design with R; 1st Ed.; CRC Press (2011)
5	Unpingco, J. Python for Probability, Statistics, and Machine Learning; 2nd Ed.; Springer (2019)
6	Anderson-Cook, Christine M.; Montgomery, Douglas C.; Myers, Raymond H. Response Surface Methodology: Process and Product Optimization using Designed Experiments; 4th

	Ed.; Wiley (2016)
7	Montgomery, Douglas C. Introduction to Statistical Quality Control; 7th Ed.; Wiley (2009)
8	Lazić, Živorad R. Design of Experiments in Chemical Engineering: A Practical Guide; 1st Ed.; Wiley-VCH (2005)

Course Outcomes (Students will be able to…..)	
CO1	Explain the basic principles of design of experiments (K2)
CO2	perform statistical analysis of single experiments and do post hoc analysis (K3)
CO3	conduct experiment and analyse the data using statistical methods (K4)
CO4	choose an appropriate design given the research problem (K5)
CO5	perform statistical analysis of different designs using R and interpret the results (K5)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code: OLP 1202	Course Title: Pr 3: Processing of Oleochemicals & Waxes and Cosmetics Formulations			

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.

			Reqd. hours
		Methyl esters from oil, fatty acids, acid oil, frying oil etc. preparation and properties	20
			15
		Fatty acids by saponification and acidulation, high pressure fat splitting	15
		metallic soap by double decomposition and fusion method	10
		Rice bran wax processing (separation of fatty acid and fatty alcohol)	15
		Study in esterification reaction of butyl esters, reaction kinetics	15
		Alkyd resins and Wax esters	10
8			20
		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,	
			120
		Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)	
		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)	
		Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)	
		Poucher's Perfumes, Cosmetics and Soaps by Hilda Butler	

Course Outcomes (students will be …..)

	Apply synthesis knowledge for developing a oleochemical molecule (K3)	
	Explain the reaction chemistry, for synthesis of various oleochemicals (K2)	
	Evaluate properties and quality parameters of oleochemicals (K5)	
	Create various cosmetics formulations (K6)	
5	Analyze the properties/ physical quality parameters and efficacy of cosmetics formulations (K4)	

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge evel from cognitive domain; A, Affective domain; S, Psychomotor domain

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 Oleochemicals, 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
	Analysis of paint properties like hiding power, drying, DPUR etc	5
	Preparation of varnishes and preliminary analysis of products.	6
	Analysis of General purpose air-drying paint as per the specification.	5
	Formulation of wall finishes and its analysis.	6
	Preparation and Analysis of Emulsion paint as per the IS specification.	5
	Preparation and Analysis of Aluminum paint as per the IS specification	5
	Total	60

List of Text Books/ Reference Books
	The Testing of Paints, Vol – V, Paint Technology Manual,.Dunkley F.G. and Collier, C.W., Chapman and Hall.London
2	Paint film defects and their remedies, Manfred, H., Chapman and Hall Ltd. London.
3	Introduction to paint chemistry – Principles of paint technology, Turner G.P.A.,, Chapman and Hall , London
4	OCCA Surface Coating Technology Vol, 1 & 11
5	Paint Technology Manuals., Oil and color chemists Association, Vol-I – Vol. VIII, Chapman and Hall , London

Course Outcomes (students will be able to …..)
1	Understand fundamental knowledge on basics of chemistry involved in the Paints (K2)
2	Classify different types of resins, Pigments and additives with respect to their properities and their applications (K4)

	3	Summarise methods used for manufacture for different paints. (K3)
	4	Discuss on different properties of paints on the basis of applications. . (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; Psy, Psychomotor domain

Semester VI

Course Code: OLT 1106	Course Title: SPL8: Production & Application of Soap, Surfactants and Detergents			

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.

	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.	20
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	20
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.	10
4	Application of soaps, surfactants and detergents in food, pharmaceuticals, textile, leather, surface coating, adhesives and other industries	10
	Total	**60**

	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)
	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 …..)
Understand basics of soaps, surfactants and detergents (K2)
Outline the plant and processes for soaps, surfactants and detergents (K4)

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

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

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

Course Code: OLT 1107	Course Title: SPL9: Cosmetics Science	Credits = 4		
		L	T	P
Semester: VI	Total Contact Hours: 60	3	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 Tribo applications 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.	10
2	Formulations of different cosmetic creams such as hair care products: Hair dressing cream, hair tonics, shampoos, antidandruff, depilatories, hair weaving preparations and straightners.	10
3	Formulations of skin creams, hand cream, moisturizers, nail polish, lipsticks. Stability tests and product specifications Nail polish, lipsticks, face powders, baby toiletries	10
4	Dentifrices, Sun protection and sunscreen products, Antiperspirants, Deodorants, Shaving products, after shave products, Aerosol cosmetics.	10
5	Evaluation and Efficacy of cosmetics products. Stability tests and product specifications	10
6	Concept of product design, labeling, claiming and claim support understanding of current needs, translation of current needs to products	10
	Total	60

List of Text Books/ Reference Books	
1	Modern Cosmetics by Thomssen, Universal Publishing Corporation (1951)
2	Formulations and functions of cosmetics by Jellinek, Wiley Interscience 970)
3	Chemistry and manufacture of cosmetics by Denavarre, Grosse farm
4	Hand book of Cosmetic Science and Technology, Third Edition, André O. Barel Marc Paye, Howard I. Maibach
5	Cosmetics, Science and Technology, Edward Sagarin 1957
6	Poucher's Perfumes, Cosmetics and Soaps, Hilda Butler 2000 Cosmetics and Soaps 10th Edition

Course Outcomes (Students will be able to…..)	
CO1	Understand the basic formulation of cosmetics (K2)
CO2	Selects the various ingredients and manufacturing processes for various cosmetics.(K4)
CO3	Develop formulations of different cosmetics products (K3)
CO4	Summarize stability analysis of cosmetic formulations . (K3)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge evel from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **OLT 1109**	Course Title: **SPL10: Supramolecular Chemistry of Nanomaterials**		**Credits = 3**		
			L	**T**	**P**
Semester: **VI**	Total contact hours: **45**		**2**	**1**	**0**

<div align="center">

List of Prerequisite Courses

</div>

Basic Organic, Inorganic and Physical Chemistry

<div align="center">

List of Courses where this course will be prerequisite

</div>

Production and applications of soaps, surfactants etc., Advanced materials and Nanotechnology

<div align="center">

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

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Students will understand the chemistry of supramolecules and the importance of supramolecular interactions in the formation of host–guest complexes, various kinds of molecular self-assemblies including supramolecular polymers and self-assembly of nanoparticles.

Sr. No.	Course Contents (Topics and subtopics)	Reqid Hours
1	**Introduction to supramolecular chemistry:** Binding interactions in supramolecular chemistry: ion–ion, ion–dipole, dipole–dipole, hydrogen bonding, cation–π, π-π, van der Waals, and hydrophobic interactions. Concepts of host–guest chemistry and self-assembly.	7
2	**Host–guest chemistry:** Acyclic (podands) and cyclic (macrocycles) hosts, host-guest complexes, binding constant and selectivity.	6
3	**Self-assembly in molecular systems:** Self-assembly processes in metal-containing compounds, self-assembled supramolecular cages. Mechanically interlocked molecules: catenanes, rotaxanes.	8
4	**Supramolecular polymers:** Synthesis and study of various supramolecular polymers based on hydrogen bonding, π-π stacking, metal coordination and host-guest interactions.	8
5	**Metal nanoparticles:** Self-assembled monolayers (SAMs) on flat and curved substrate. Synthesis, structure and important properties of metal nanoparticles, ligand exchange etc.	8
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.	8
	Total	**45**

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List of Text Books/ Reference Books

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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.

<div align="center">

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

</div>

CO1	Draw and understand the importance of intermolecular forces, calculate the energetics and observe topological view of structure. (K2)
CO2	Interpret the logic behind the design of molecular building blocks towards the synthesis of varied self-assemblies including supramolecular polymers. (K3)
CO3	Demonstrate various self-assembled architectures. (K3)
CO4	Relate the effect of ligand structure to stabilize nanoparticles and self-assembly of nanoparticles. (K4)
CO5	Utilize the acquired knowledge towards development of nano-technological devices. (K3)

<div align="center">

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

</div>

		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	0	3	0	0	0	1	3	2
CO2	K3	3	3	2	2	2	3	0	3	0	0	0	2	3	3
CO3	K3	3	3	2	2	2	3	0	3	0	0	0	2	3	3
CO4	K4	3	3	2	3	2	3	0	3	0	0	0	2	3	3
CO5	K3	3	3	2	2	2	3	0	3	0	0	0	2	3	3
Course	K4	3	3	2	3	2	3	0	3	0	0	0	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; −No Contribution
K, knowledge level from cognitive domain; A, Affective domain; Psy, Psychomotor domain

	Course Code:HUT1103	Course Title: Industrial Psychology and Human Resource Management	Credits = 3		
			L	T	P
	Semester: VI	Total Contact Hours: 45	2	1	0

<table>
<tr><td colspan="3" align="center">List of Prerequisite Courses</td></tr>
<tr><td colspan="3">None</td></tr>
<tr><td colspan="3" align="center">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="3">Technology Courses in the forthcoming semesters</td></tr>
<tr><td colspan="3" align="center">Description of relevance of this course in the B. Tech. Program</td></tr>
<tr><td colspan="3">This course equips students with human resource management skills to be able to function effectively in their professional careers.</td></tr>
</table>

	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction and Overview	2
2	Management Theories Taylor,Fayol,Weber, Hawthorne; Basic types of structures; Span of Control, Delegation, Authority, Responsibility	4
3	Recruitment Philosophies, Different methods of attracting candidates	3
4	Selection Application blanks, Interviews, Induction	2
5	Performance Management Goal setting process, Performance appraisal methods, Appraisal interviews, Rating errors	3
6	Training & Development Identifying training needs, Training methods (on the job and off the job techniques), Evaluation of training	3
7	Change Management Types of change, Theories of change management, Hurdles to change, Olmosk change strategies	3
8	Knowledge Management Innovation, Importance and benefits of Knowledge Management, Framework	3
9	Motivation Theories Classification of motives, Various theories(Maslow, Herzberg, ERG,Vroom,Equity and Nohria's 4 drive model)	4
10	Leadership Theories Blake Mouton model, Hersey Blanchard Model, Michigan Model	3
11	Organizational Culture Types of cultures, Understanding and influencing cultures	3
12	Conflict Management Stages of conflict, Types of conflict and sources of conflicts, Conflict resolution	3
13	Power &Politics Bases of power, Politicking strategies	3
14	Personality Theories of personality, Behaviour and personality styles	3
15	Perception Persception versus sensation, Perceptual process, Perceptual errors	3
	Total	45

	List of Textbooks/Reference Books
1	Innovation and Entrepreneurship, Peter Drucker
2	Essentials of organizational Behaviour, Srephen Robbins
3	Organizational Behaviour, Luthans
4	Select HBR cases and articles for review
5	Innovation and Entrepreneurship, Peter Drucker

	Course Outcomes (Students will be able to…..)
CO1	Explain the fundamental concepts of industrial psychology and human resource management (K2)
CO2	Analyze practical solutions (K4)

| CO3 | Provide applicable solutions (K3) |

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code:HUT1106		Course Title: Environmental Science and Technology	Credits = 3		
			L	T	P
Semester: VI		Total Contact Hours: 45	2	1	0

List of Prerequisite Courses
Various Technology Courses in previous semesters

List of Courses where this course will be prerequisite
Various Technology Courses in the forthcoming semesters

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	Multidisciplinary Nature of Environmental Studies: • Scope and Importance • Need for Public Awareness • Depleting Nature of Environmental resources such as Soil, Water, Minerals, and Forests • Global Environmental Crisis related to Population, Water, Sanitation and Land • Ecosystem: Concept, Classification, Structure of Ecosystem, overview of Food-chain, Food-web and Ecological Pyramid	4
2	Sustainable Development • Concept of sustainable development • Social, Economical and Environmental aspect of sustainable development • ControlMeasures:3R (Reuse, Recovery, Recycle), Appropriate Technology, Environmental education, Resource utilization	4
3	Environmental Pollution: • Air Pollution: Sources, Effects of air pollution with respect to Global Warming, Ozone layer Depletion, Acid Rain, Photo chemical smog, Two Control Measures-Bag house Filter, Venturi scrubber, Case Study • Water Pollution: Sources and Treatment, Concept of wastewaters-Domestic &Industrial and treatment, Case Study • Land Pollution: Solid waste, Solid waste Management by Land filling, Composting • Noise Pollution: Sources and Effects	7
4	Environmental Legislation: • Overview • Ministry of Environment and Forests (MoE& F), Organizational structure of MoE&F • Functions and powers of Central Control Pollution Board • Functions and powers of State Control Pollution Board • Environmental Clearance, Consent and Authorization Mechanism • Environmental Protection Act	5
5	Renewable sources of Energy: • Limitations of conventional sources of Energy. • Various renewable energy sources. • Solar Energy: Principle, Working of Flatplate collector&Photovoltaic cell	5
6	Environment and Technology • Role of Technology in Environment and health • Concept of Green Buildings, Indoor air pollution • Carbon Credit: Introduction, General concept. • Disaster Management: Two Events: Tsunami, Earthquakes, Techniques of Disaster Management, Case Study	5
	Total	45

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. AnanditaBasak, 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.
Course Outcomes (Students will be able to. ...)	
CO1	Explain the Multidisciplinary Nature of Environmental Studies (K2)
CO2	Apply the concept of sustainable development in Social, Economic & Environmental aspect (K3)
CO3	Describe the sources & effects of environmental pollution and renewable sources of energy (K2)
CO4	Analyze the environmental legislation in appropriate cases (K4)

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

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

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

	Course Code: **OLT 1119**	Course Title: **Institute Elective I: Product Management**	**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

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)
CO2	Identify market segment for a product (K3)
CO3	explain strategies for a product to be effectively marketed(K2)
CO4	Identify competitors for new product (K3)

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

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	2														
CO2	K3	3	3	2	2	2	3	3	3	0	0	3	2	3	3
CO3	K2	3	2	1	2	1	3	3	3	0	0	3	1	3	2
CO4	K3	3	3	2	2	2	3	3	3	0	0	3	2	3	3
Course	K3	3	3	2	2	2	3	3	3	0	0	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; - No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: OLP1207	Course Title: Seminar	Credits = 3		
		L	**T**	**P**
Semester: VI	Total contact hours: 90	0	1	4

List of Prerequisite Courses
None

List of Courses where this course will be Prerequisite
Project I,

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

Course objectives

1. Develop a systematic thinking about a topic related to oleochemical technology

2. Develop skills for presenting a topic in oleochemical technology

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Each Student will conduct literature survey, collect full papers, reviews, book chapters etc. and prepare presentation and written review report on the given seminar topic. Oral presentation & written report of the seminar will be evaluated.	90
	Total	**90**

Course Outcomes (Students will be able to…..)	
CO1	Develop a protocol for literature survey about a certain topic (K4)
CO2	Evaluate the literatures and interpret the scientific content (K5)
CO3	Apply the concept of oleochemical technology on a selected topic (K3)
CO4	Develop skills for presenting a scientific topic in Oleochemical technology (K6)
CO5	Develop skills for writing a scientific document (K6)

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

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

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

Course Code: OLP 1204	Course Title:Pr5: Evaluation and Testing of Soaps and Detergents			

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 and Triboapplications laboratory

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

		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 1)	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
	BIS methods for testing of soaps and detergents	

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

Interpret analysis of soaps and detergents(K3)
Evaluate performance properties of soaps and detergents(K5)
Able to explain the composition of soaps and detergents (K4)
explain the significance of various tests for soaps and detergents(K5)

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

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

	Course Code: **OLP 1203**					

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. (dyes) Programme

	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
		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
	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
	Detergency tests: standard soiling and tergotometer, instrumental methods of analysis. Analysis of Detergents – including PO_4s, silicate, actives, enzymes, bleaches, polymers	5
		60

Handbook of Surfactants,Porter, M. R., Springer Science and Business Media (1993).
Surfactants in Consumer Products: Theory, Technology and Applications, Ed. J. Falbe, Springer-Verlag, Berlin (1987).
Industrial Applications of Surfactants-II, D. R. Karsa, Royal society of Chemistry (1990).

Course Outcomes (students will be able to …..)
understand basic analytical techniques for surfactants (K2)
Perform wet analytical techniques and elemental analysis for surfactants K4
Evaluate physical properties of surfactants (K5)
Evaluate separation techniques for surfactants (K5)
Able to explain the analysis of detergents (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Semester VII

Course Code: CET1703	Course Title: Chemical Process Control	Credits = 3		
		L	**T**	**P**
Semester: VII	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses
Material and Energy Balance Calculations, Applied Mathematics, Chemical Engineering Operations, Chemical Reaction Engineering

List of Courses where this course will be prerequisite
Chemical Engineering Laboratory, Projects

Description of relevance of this course in the B. Tech. Program
Process control plays a very critical role in the context of actual operation of a process plant. Most of the core chemical engineering courses focus on the steady state operation. In the real life environment, process is continuously subjected to various disturbances which deviates the operation from the designed steady state. This course specifically prepares students to assess the impact of such disturbances and equip them with the tools available to tackle these situations.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Instrumentation: Principles of measurement; Pressure, Temperature, Level, Flow and composition measuring devices; Introduction to controllers (PLC, digital control, DCS), Introduction to control valves, Types of control valves, Control valve characteristics	9
2	Introduction to system dynamics, Concept of dynamic response, Linear systems, First, second and higher order system, Systems with dead-time, Definition of terms such as transfer function, Time constant, Gain of the process with practical examples Response of processes to standard inputs	9
3	Introduction to Process Control: Set point, disturbance, closed loop and open loop control, Feedback and feed-forward configurations, Poles and zeros of the transfer functions Basic control actions (ON/OFF, P, I and D), Effects of controller action on process response: Offset, closed-loop gain, controller gain effect of controller parameters	6
4	Stability analysis of feedback systems, Notion of stability, Criteria for stability	6
5	Control System Design: Introduction to controller design Identification of controlled, manipulated and disturbance variables, Pairing of inputs and outputs Controller selection for pressure, flow, temperature, level and composition	9
6	Multiple Loop and Traditional Advanced Control Systems: Cascade control, Ratio control, Feed-forward control, Selective control, Split-range control, Inferential control	6
	Total	**45**

List of Text Books/ Reference Books	
1	Chemical Process Control: An Introduction to Theory and Practice, Stephanopolous G.
2	Process Modeling, Simulation, and Control for Chemical Engineers, Luyben W.L.
3	Process Dynamics and Control, Seborg, D.E. and Mellichamp, D.A. and Edgar, T.F. and Doyle, F.J.
4	Process Control: Modeling, Design, and Simulation, Bequette, B.W.
5	Process Control Instrumentation Technology, Johnson, C.D.

Course Outcomes (Students will be able to ………..)	
1	Specify the required instrumentation and control elements for a particular process (K3)
2	Develop input-output transfer function models for dynamics of processes (K4)
3	Characterize the dynamics and stability of processes based on mathematical analysis (K5)
4	Design and tune process controllers (K6)
5	Specify the required instrumentation and control elements for a particular process (K3)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code: **OLT 1114**				

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

<div align="center">

List of Courses where this course will be prerequisite

</div>

Project II

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

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		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.	10
	Protein based surfactants, microbial surfactants	9
	Utilization of oilseed hulls (groundnut, sunflower), husk (rice bran), shell (coconut, cottonseed) and residues, production of surfactants from protein residues	8
	Utilization of Waste frying oils, glycerin from bio-diesel industry	10
	Primary, secondary and tertiary treatments for waste water. Aerobic and non aerobic treatment, Chemical, biological and total oxygen demand, Carbon adsorption	8
	Total	**45**

	Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)
	Treatise on fats, fatty acids and oleochemicals by O. P. Narula Vol. I & II, Industrial Consultants (India), (1994)
	Natural fatty acids and their sources by E. H. Pryde

<div align="center">

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

</div>

Understand basics of waste management (K2)
Evaluate possible utilization and value addition to the byproducts (K5)
Develop or synthesis of novel oleochemicals from waste streams/ byproducts (K3)
Evaluate and design various techniques for waste water treatments and pollution control (K5)
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	0	0	0	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	0	0	0	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3

Cours	K														
e	4	3	3	2	3	2	3	3	3	0	0	0	2	3	3

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

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

	Course Code: OLT 1123	Course Title: SPL12: Technology of Oleochemicals	Credits = 3		
			L	T	P
	Semester: VII	Total Contact Hours: 45	2	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	7
2	Separation of fats and fatty acids, fractional distillation	8
3	Miscellaneous applications of oleochemicals in food, pharmaceutical, textile, plastic, leather and other industries	8
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	7
6	Products obtained by interesterification, hydrogenation, oxidation and pyrolysis. Metallic soaps.	10
	Total	**45**
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	
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)
CO2	Select appropriate process for the manufacture of oleochemicals (K4)
CO3	Summarise about advance method of analysis of oleochemicals. (K3)
CO4	Select Specific method for the identification of particular oleochemical and understand its properties. (K4)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; −No Contribution
K, knowledge level from cognitive domain; A, Affective domain; Psy, Psychomotor domain

Course Code: **OLT 1120**		Course Title: **Institute Elective II: New Product Development**		**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
Product Management

Description of relevance of this course in the B. Tech. Program
The course introduces the students to key concepts of New Product Development – Ideation, Idea Screening, Concept Testing, and Commercial Viability of a Product, Product Development, Product Testing and Commercialization. He will be in a position to Design and Develop Product which will fulfill the Unmet need of the Consumer

	Course Contents (Topics and Subtopics)	**Required Hours**
1	Why One requires a New Product Development (NPD) Strategy, Types of NPD Strategies	7
2	What is Ideation, Steps in Ideation, How to Conduct an Ideation Session, Factors affecting the Ideation session outcome, What is Point of View (POV), Defining POV, Characteristics of POV, Case studies	8
3	Factors affecting screening Ideas, Product Concept Designing and Testing, Inputs for a Concept design and outputs of a Concept, Sample Concept statements, Case Studies	8
4	Concept Testing Methodologies, Monadic, Sequential Monadic, Paired Comparative	7
5	Assessing Commercial Viability of a Product and Metrics used for the same, Capital Asset Pricing Model (CAPM),	8
6	Detail analysis of the customer prior designing the product, Customer Segmentation, Case Studies	7
	Total	**45**

List of Textbooks/Reference Books	
1	Concept Testing, David Schwartz
2	Design Thinking: New Product Development Essentials from the 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 (K2)

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

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	2														
CO2	K4	3	3	2	3	2	3	3	3	0	0	3	2	3	3
CO3	K2	3	2	1	2	1	3	3	3	0	0	3	1	3	2
Course	K4	3	3	2	3	2	3	3	3	0	0	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **OLP1214**	Course Title: **In-Plant Training**	**Credits = 6**		
		L	**T**	**P**
Semester: VII	Total duration: 12 weeks	0	0	0

<table>
<tr><td colspan="2" align="center">List of Prerequisite Courses</td></tr>
<tr><td colspan="2">None</td></tr>
</table>

<table>
<tr><td align="center">List of Courses where this course will be Prerequisite</td></tr>
<tr><td>Project I, Project II</td></tr>
</table>

Description of relevance of this course in the B. Tech. (Food Engg. & Tech.) Programme

Course objectives

1. Develop a systematic thinking about an industrial problem

2. Develop skills for communication, networking, personal grooming & professional conduct within an industrial environment

3. Develop the attitude for individual and teamwork

Sr. No.	Course Contents (Topics and subtopics)	Required weeks
1	-Each Student will be involved in R & D/ manufacturing (QA / QC / Plant Engineering /Stores and Purchase)/ marketing / finance/ consultancy/ Technical services/ Engineering / Projects, etc. -Oral presentation & written report of the in-plant training will be evaluated along with industry feedback.	12
	Total	**12**

	Course Outcomes (Students will be able to…..)
CO1	Apply the concept of project & production management in further planning (K3)
CO2	Develop critical thinking regarding the various operations involved in oleochemical industry (K4)
CO3	Solve certain industrial challenges in Oleochemical processing (K6)
CO4	Present and communicate an industrial problem effectively (K6)
CO5	Write a scientific report on the training (K6)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **HUT1203**	Course Title: **Industrial Management**	**Credits = 4**		
		L	**T**	**P**
Semester: VII	**Total Contact Hours: 60**	**3**	**1**	**0**

List of Prerequisite Courses
None

List of Courses where this course will be prerequisite
None

Description of relevance of this course in the B. Tech. Program
This course is required for effective and holistic functioning of students in their professional career.

	Course Contents (Topics and Subtopics)	**Required Hours**
1	Greiner's Model of Organization Life Cycle Organic and mechanistic structures	3
2	Marketing Management Introduction, Porter's value chain, Porter's five forces, Porter's generic strategies	7
3	Introduction to the 4Ps of Marketing Product, Price, Place, Promotion	11
4	Production and Operations Management Concept of productivity, World class manufacturing, Business process reengineering, Kanban, JIT, Poka Yoke system, Maintenance practices	10
5	Quality Management The concept of quality, Quality control ,acceptance sampling and SQC Deing's 14 points, TQM, Insights into ISO-9000, ISO -14000,ISO-50000	6
6	Financial Management Accounting system, Balance-sheet evaluation, Fund-flow analysis, Financial ratios an insight, Costing	15
7	Materials Management Value analysis, Purchasing and vendor development, Warehousing and inventory control methods	4
8	Maintenance Management Classifications, Equipment and plant reliability and availability, Management of shut downs and turnarounds	4
	Total	**60**

List of Textbooks/Reference Books	
1	Industrial Management–I, Jhamb L. C. and Jhamb S.
2	Industrial Management, Spriegel U.S.
3	Operations Management for Competitive Advantage, Richard B. Chase, F. Robert Jacobs, Nicholas Acquilano
4	World Class Manufacturing - A strategic Perspective, B.S. Sahay, K.B.C. Saxena, Ashish Kumar
5	Management Finance, Varanasay Murthy
6	Essentials of Management,Koontz
7	Principles of Marketing, Kotler
8	Quality Planning and Analysis, Juran
9	Financial Management, Prasanna Chandra
10	Financial Management, R. M. Srivastava
11	Select HBR cases and articles for review

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

CO1	explain the fundamental concepts of Marketing management and the various aspects therein (K2)
CO2	describe the fundamental concepts of Finance and analyze the balance sheet (K4)
CO3	explain various productivity techniques that when combined with engineering knowledge can be applied successfully in the industry (K2)
CO4	study real life practical problems, constraints and will be able to think in terms of various alternative solutions (K3)

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: **CEP1714**	Course Title: **Chemical Engineering Laboratory**	**Credits = 2**		
		L	**T**	**P**
Semester: VII	**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
Other B. Tech. courses in this and the last semester

Description of relevance of this course in the B. Tech. Program
This course provides students the first-hand 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.

Sr. No.	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 Text Books/ Reference Books	
1	McCabe W.L., Smith J.C., and Harriott P. Unit Operations in Chemical Engineering, 2014
2	Bird R.B., Stewart W.E., and Lightfoot, E.N. Transport Phenomena, 2007
3	Coulson J.M., Richardson J.F., and Sinnott, R.K. Coulson & Richardson's Chemical Engineering: Chemical engineering design, 1996.
4	Green D. and Perry R. Perry's Chemical Engineers' Handbook, Eighth Edition, 2007.

Course Outcomes (students will be able to…..)	
CO1	Learn how to experimentally verify various theoretical principles (K3)
CO2	Visualize practical implementation of chemical engineering equipment (K4)
CO3	Develop experimental skills (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code: **OLP 1212**	Course Title: **Pr 7: Essential Oils laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: VII	**Total Contact Hours: 60**	**0**	**0**	**4**

List of Prerequisite Courses
Chemistry of oils, lipids, essential oils and their applications (OLT 1104),

List of Courses where this course will be Prerequisite
Technology of Oleochemicals (OLT 1112)

Description of relevance of this course in the B. Tech. (Oils) Programme
This course will help students to understand practical aspects of production and applications of essential oils. Students will get hands on experience in preparation, extraction, and various physical properties of essential oils.

Sr. No.	**Course Contents (Topics and subtopics)**	**Required Hours**
1	Preparation of raw materials and extraction of various essential oils.	10
2	Determination of various physical parameters like refractive index, density, solubility etc	10
3	Determination of various indexes of essential oils like acid, Iodine, Peroxide, ester, carbonyl value etc.	10
4	Quality control analysis of essential oil by TLC method	10
5	Evaluation of essential oils by using Gas chromatography	10
6	Sensory analysis of essential oils and quality control check.	10
	Total	**60**

List of Text Books/ Reference Books	
1	Essential oils (Vol. I to VI) by Guenther E.
2	Perfume and flavour materials of natural origin by Arctander S.
3	Perfume, Cosmetics and Soap by Poucher W., Chapman and Hall ltd., (1959)
4	Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)

Course Outcomes (Students will be able to…..)	
CO1	Understand the basic processes of extraction of different essential oils (K2)
CO2	Select appropriate processes for the extraction of essential oil (K3)
CO3	Experiment on new techniques in production of essential oil.(K6)
CO4	Perform analysis of essential oils (K4)

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

	6													
CO4	K4	3	3	2	3	2	3	3	3	3	3	0	2	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	0	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

Course Code: OLP 1208	Course Title: Project – I	Credits = 2		
		L	T	P
Semester: VII	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses
Seminar

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.	60
	Total	60

List of Textbooks/Reference Books	
1	Relevant research articles, patents, review articles, conference proceeding, book chapters and books

Course Outcomes (Students will be able to…..)	
CO1	Develop critical thinking to identify the research gap for the project (K5)
CO2	Formulate a scientific question and approach to solve it (K6)
CO3	Plan the experimental methodology for the project (K5)
CO4	Develop skills to communicate the research plan effectively (K6)
CO5	Develop skills for writing a scientific document on the research work (K6)

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

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

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

Semester VIII

Course Code:		Course Title:		Credits = 3		
CET1504		**Chemical Project Engineering and Economics**		**L**	**T**	**P**
Semester: VIII		Total Contact Hours: 45		**2**	**1**	**0**

<table>
<tr><td colspan="4" align="center">**List of Prerequisite Courses**</td></tr>
<tr><td colspan="4">Material and Energy Balance Calculations, Equip Design and Drawing I, Energy Engineering, Industrial Engineering Chemistry</td></tr>
<tr><td colspan="4" align="center">**List of Courses where this course will be prerequisite**</td></tr>
<tr><td colspan="4">Home Papers I and II</td></tr>
<tr><td colspan="4" align="center">**Description of relevance of this course in the B Tech. Program**</td></tr>
<tr><td colspan="4">This course is required for the future professional career.</td></tr>
</table>

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to the green field projects and global nature of the projects. Impact of currency fluctuations on Project justification and cash flows Concepts of 'Quality by Design' including typical design deliverables Understanding constructability, operability and maintainability during all stages of project execution. Meaning of Project Engineering, various stages of project implementation	6
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 Introduction to concept of inflation, location index and their use in estimating plant and machinery cost. Various costindices	8
4	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	7
5	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	7
6	Process Selection, Site Selection, Feasibility Report	4
7	Project: Conception to Commissioning: milestones, Project execution as conglomeration of technical and nontechnical activities, contractual details. Contract: Meaning, contents, Types of contract. Lump- sum Turnkey (LSTK),Eng, Procurement and Construction(EPC),Eng, Procurement and Construction Management (EPCM).Mergers and Acquisitions	6
8	Reading of balance sheets and evaluation of techno-commercial project Reports	3
9	PERT, CPM, Bar-charts and network diagrams	4
	Total	**45**

<table>
<tr><td colspan="2" align="center">**List of Text Books/ Reference Books**</td></tr>
<tr><td>1</td><td>Chemical Project Economics, Mahajani V.V .and Mokashi SM.</td></tr>
<tr><td>2</td><td>Plant Design and Economics for Chemical Engineers, Peters M.S.,Timmerhaus K.D.</td></tr>
<tr><td>3</td><td>Process Plant and Equipment Cost Estimation, Kharbanda O.P.</td></tr>
<tr><td colspan="2" align="center">**Course Outcomes (students will be able to…..)**</td></tr>
<tr><td>CO1</td><td>calculate working capital requirement for a given project (K3)</td></tr>
<tr><td>CO2</td><td>calculate cost of equipment used in a plant total project cost (K3)</td></tr>
<tr><td>CO3</td><td>calculate cash-flow from a given project (K3)</td></tr>
<tr><td>CO4</td><td>select a site for the project from given alternatives (K4)</td></tr>
<tr><td>CO5</td><td>list out various milestones related to project concept to commissioning (K2)</td></tr>
</table>

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: OLT 1115	Course Title:SPL13:Petroleum Technology			

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. (dyes) Programme

		Reqd. ho
	Introduction to crude oil, Sour crude and sweet crude, physicochemical properties, composition. National and global petroleum scenario	10
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.	4
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
	Processing of Light and Heavy Distillates, Thermal cracking, Catalytic cracking, Visbreaking, Coking, Hydroprocessing	6
	Processing heavy residue fraction using solvents. Source of such solvents. Process diagram for Atmospheric distillation unit (ADU) and vacuum distillation unit (VDU).	8
	Catalytic cracking: FCC Feed Pretreating, Process Variables.	4
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	10
	Total	60

	Crude Oil Chemistry by Vastly Simanzhenkov and Raphael Idem
	Petroleum Refining *Technology and Economics* (Fourth Edition) by James H. Gary and Glenn E. Handwerk
	Refining processes Handbook by Surinder parkash

Course Outcomes (students will be …..)

Understand basics of crude oil, national and international scenario K2
Summarise the processes for petroleum refining K3
Summarise the plant and processes for petrochemicals K3
Able to explain the key processes and products from petroleum K3
Able to explain the various applications of petrochemicals K4

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

	3													
CO4	K3	3	3	2	2	2	3	3	3	0	0	0	2	3	3
CO5	K4	3	3	2	3	2	3	3	3	0	0	0	2	3	3
Course	K4	3	3	2	3	2	3	3	3	0	0	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: OLT 1111		Course Title:SPL14: Nutraceuticals			

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. (dyes) Programme

Students will understand the micronutrients in oils and fats and will be able to explain methods of

			Reqd. hours
1	Introdcution to nutraceuticals: definitions, synonymous terms, claims for a compound as neutraceutical, 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 understand basics of nutraceuticals and regulatory issues (K2)
	Discuss about properties and functions of nutraceuticals (K4)
	Summaries on available technologies for manufacturing of nutraceuticals (K3)
	Evaluate the nutritional genomics and market information (K5)
CO5	Discus on the applications, Consumers'views on nutraceuticals as well as Labeling and claims for Nutraceuticals products of perfumery chemicals (K4)

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

	3													
CO4	K5	3	3	3	3	3	3	0	3	0	0	0	3	3	3
CO5	K4	3	3	2	3	2	3	0	3	0	0	0	2	3	3
Course	K5	3	3	3	3	3	3	0	3	0	0	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

Course Code: OLT 1113	Course Title: **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. (dyes) 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 Lubricants	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 …..)	
1	Understand basics of lubricants and functional fluids (K2)
2	Evaluate properties and functions of various types of base oils (petroleum and biobased) (K5)
3	Summaries about methods of synthesis and analyse properties of performance chemicals (K3)
4	Explain and evaluate the various properties and applications of functional fluids and performance chemicals (K5)
5	Apply technology for regeneration of waste lube oil, engine coolants and greases (K3)

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

Course Code: OLT 1117	Course Title: Department Elective I: Spectroscopy of Organic Molecules	Credits = 3		
		L	T	P
Semester: VIII	Total contact hours: 30 + 15 = 45	2	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.	10
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.	8
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.	10
5	**Tutorials**	15
	Total	**45**

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)
CO2	Explain the origin of UV-visible absorptions and predict classify which organic compounds

			should exhibit visible color and which are transparent in the UV-visible range. (K2)
CO3	Apply the knowledge to Interpret ^{1}H-NMR spectra of organic compounds and predict direction of chemical shifts caused by various structural shielding or de-shielding effects. (K3)
CO4	Analyze structure of organic compounds via these advanced spectroscopic techniques. (K4)

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; −No Contribution
K, knowledge level from cognitive domain; A, Affective domain; Psy, Psychomotor domain

Course Code:	Course Title: Pre-approved Open Electives from MOOCs / NPTEL	Credits = 3		
		L	T	P
Semester: VIII	Total Contact Hours: 45	2	1	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	45

List of Textbooks/Reference Books	
1	As prescribed by the Course Instructor(s)

Course Outcomes (Students will be able to…..)	
CO1	As prescribed by the Course Instructor(s)
CO2	As prescribed by the Course Instructor(s)
CO3	As prescribed by the Course Instructor(s)
CO4	As prescribed by the Course Instructor(s)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Code: **OLP1209**	Course Title: **Project -II**		**Credits = 4**		
			L	**T**	**P**
Semester: VII	Total contact hours: 120		0	0	8

List of Prerequisite Courses
Project I

List of Courses where this course will be Prerequisite
None

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

1. Develop a skill to execute & solve a research problem in food technology

2. Develop skills for presenting a research outcome effectively

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	The topic of the research with defined objectives and hypothesis should be explored by scientifically planned rational experiments. Students should have actual experimental data collected on the chosen research topic.	80
2	-Oral presentation of proposed research work with data generated during actual trial targeted towards the objectives -Submission of report of research proposal	40
	Total	**120**

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

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

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code: **OLT 1210**	**Course Title: Pr8 :Processing of soaps and detergents and surfactants and Triboapplications Laboratory**			

Production and Applications of Soaps, Surfactants and Detergents. Functional Fluids and Performance Chemicals

List of Courses where this course will be prerequisite

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

	Course Contents (Topics and subtopics)	**Reqd. ho**
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	24
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.	24
	Application of surfactants**:** Formulation using surfactants like floor cleaner, detergent, cosmetics, etc.	24
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.)	24
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.	24
	Total	**120**

	Soaps by Prof. J. G. Kane
	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)
	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)
	Fats, Oleochemicals and surfactants challenges in 21st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBI Pvt. Ltd. (1997)
	ASTM standards for testing of petrochemicals

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

	Classify raw materials for soap formulation and its analysis (K4)
	outline the synthesis of various types of surfactants (K4)
	Develop detergent formulation and its analysis (K6)
	summaries on application of surfactants for various home and personal care products (K3)
	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	0	2	3	3
CO2	K3	3	3	2	2	2	3	3	3	3	3	0	2	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	0	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	0	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	0	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	0	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; - No Contribution
K, knowledge level from cognitive domain; A, Affective domain; Psy, Psychomotor domain

ANNEXURE

ANNEXURE A

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)
for
B. Tech. (Oils, Oleochemicals & Surfactants Technology)

PEO1	The graduates of the department are expected to think critically, creatively and apply the fundamentals of Oils-Oleochemicals and Surfactant technology to industries for the benefit of country in general, economy, society and environment in particular
PEO2	Our graduates are expected to adopt and implement latest technologies for the benefit of mankind in general, economy, society, etc.
PEO3	To provide a strong base of knowledge to transform graduate students into good professionals and To motivate and enable students to opt for higher levels of learning viz. doctoral programs by research in this field with the view of developing highly skilled professionals to work in Industry and academia
PEO4	Our graduates are expected to be innovative and have good entrepreneurship and project management skills

Programme Outcomes (POs) for B. Tech. (Oils, Oleochemicals & Surfactants Technology)

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 team work:** 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 life-long learning in the broadest context of technological change.
PSO1	**Peruse Higher Studies:** Instil 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.**
PSO2	**Entrepreneurs :** Develop a **confident graduate** who can plan for **innovative start- up** career options or can offer **solutions to the complex problems** in **Oils, oleo chemicals and surfactants** field.