

Semester III

Sr. No.	Course Code	Subjects	Hours/week (L+T)	Marks	Credits
1	OLT 1101	Spl 1: Chemistry of Oils and Fatty Acids	3+1	100	4
2	OLT 1102	Spl 2: Chemistry of Oleochemicals and Surfactants	2+1	50	3
3	BST 1101	Microbiology	3+1	100	4
4	BST 1103	Biochemistry	2+1	50	3
5	DYT 1201	Chemistry and application of Colorants	3+1	100	4
TOTAL			18	400	18
6	OLP 1201	Pr 1: Analysis of oilseeds, oils and raw materials of oils and soap Industry	4	50	2
7	MAP 1201	Pr 2: Computer Applications Lab	4	50	2
Total Practicals			08	100	6
			26	500	22

Detailed Syllabus for Second Year B. Tech. Semester III

	Course Code: SPL1	Course Title: Chemistry of Oils and Fatty Acids (Marks 100)	Credits = 4		
			L	T	P
	Semester: III	Total contact hours: 60	3	1	0

List of Prerequisite Courses

HSC (Science)

List of Courses where this course will be prerequisite

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 fatty acids, various derivatisation pathways and related analytical tools.

Sr. No.	Course Contents (Topics and subtopics)	CO Mapping	Delivery method	Teaching Hours
1.	General introduction to oils, fats, waxes and essential oils: principal sources and composition, 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. Classification of oils and fats by Source Type and Fatty Acid Composition.	CO1	Chalk and board/ LCD, Tutorial	5
2.	Physical characteristics of natural oils & fats: oiliness and	CO2	Chalk and board/	5

	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.		LCD, Tutorial	
3.	Fatty acids: Nomenclature and classification. Physical properties of fatty acids and their esters. Polymorphism and crystal structure, solubility, refractivity, optical activity, spectroscopic properties.	CO2	Chalk and board/ LCD	4
4.	Theories of glycerides structure, effect of fatty acid distribution on physical properties.	CO1, CO2	Chalk and board/ LCD	4
5.	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, Metals and Metalloproteins etc.	CO3	Chalk and board/ LCD, Tutorial	6
6.	Separation and isolation of fatty acids; Distillation, crystallization and counter current distribution. Methods of structure determination: physical (spectroscopic) and chemical methods.	CO2	Chalk and board/ LCD, Tutorial	6
7.	Fat Splitting/ hydrolysis, Neutralization, saponification, formation of metallic soaps, acylation, Esterification, Interesterification/ Transesterification, halogenation, Reduction and hydrogenation, Pyrolysis and alkali fusion, Metathesis	CO1, CO2, CO4	Chalk and board/ LCD, Tutorial	10
8	Epoxidation, Hydroxylation, Ozonolysis. Thermal and Oxidative Polymerization, Estolide synthesis, Diels-Alder reaction, Stereomutation, double bond migration and cyclization, Autoxidation and rancidity: Mechanism of rancidification, general characteristics of fat oxidation, antioxidants, prooxidants and synergists, flavour reversion	CO1, CO2, CO4	Chalk and board/ LCD, Tutorial	10
9.	Chemical analysis of oils: Acid value, saponification value, Acetyl and hydroxyl value, peroxide and anisidine value, iodine value, Colour tests for identification of adulteration of edible oils, Bellier Turbidity Temperature Test, dilatometry, micro penetration tests.	CO2, CO3, CO4, CO5	Chalk and board/ LCD, Tutorial	10

List of Recommended Text Books/ Reference Books:

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

COURSE OUTCOMES (students will develop/demonstrate the.....)

CO1: Ability to understand and explain the constitution of Oils and Fats and their importance as feedstock for Food and Chemical Industries.

CO2: Ability to analyse and illustrate the physical, chemical and stability characteristics of oils and Fats/ fatty acids.

CO3: Ability to understand the technical importance of the Minor Constituents of natural oils and fats.

CO4: Ability to conceptualize and develop the different modes of derivatizations from oils/ fatty acids.

CO5: Ability to identify and interpret the tools for Chemical analysis of oils and fats.

Assessment method:

1. Unit Test
2. Assignment
3. Seminar

Literature survey including review of US/European/ Japanese/ Indian Patents patents and research papers published in PEER Reviewed Journals.

Course Code: SPL2	Course Title: Chemistry of Oleochemicals and Surfactants (Marks 100)	Credits = 4		
Semester: III	Total contact hours: 60	L	T	P
		3	1	0

List of Prerequisite Courses

HSC (Science)

List of Courses where this course will be prerequisite

All the Oils, Oleochemicals & Surfactants Special Courses

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

Students will be able to understand the industrial chemistry of Surfactants and Oleochemicals. They will be trained with respect to techniques of synthesis of oleochemicals and surfactants, colloidal behavior, interfacial phenomenon, and related analytical tools.

Sr. No.	Course Contents (Topics and subtopics)	CO Mapping	Delivery method	Teaching Hours
1.	Oleochemical and Surfactant raw materials and their derivatives as feedstock for Chemical Industries, Worldwide Statistics of Oleochemical and Surfactant Industries	CO1	Chalk and board/ LCD, Tutorial	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	CO1, CO2	Chalk and board/ LCD	08
3.	Introduction to the nature of colloidal solutions, Surface Tension and Energy, Definition and classification of surfactants, Hydrophilic and hydrophobic groups and HLB balance, Theory of Surface Actions.	CO3, CO4	Chalk and board/ LCD	06
4.	Self-assembly and packing features of surfactants (bi and multilayers, direct & reverse micelles, vesicles, Microemulsions). Thermodynamics of Adsorption and Micellization, structure of micelles	CO3, CO4	Chalk and board/ LCD	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	CO3, CO4	Chalk and board/ LCD	08
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.	CO5, CO6	Chalk and board/ LCD	12
7.	Synthesis, analysis and applications of Nonionic	CO5, CO6	Chalk and board/	08

	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		LCD, Tutorial	
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	CO5, CO6	Chalk and board/ LCD, Tutorial	08

List of Recommended Text Books/ Reference Books:

- Synthetic Detergents, Davidson, A. S.; Milwidsky, B. 7th Ed. John Wiley and Sons, New York, (1987).
- 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).
- Bailey's Industrial Oil and Fat Products, D. Swern, ed., Vol. I (1979), Vol. 2 (1982), 4th ed., John Wiley & Sons, Inc., New York,.
- Bailey's Industrial Oil and Fat Products, Sixth Edition Vol. 6: Industrial and Nonedible Products from Oils and Fats, Ed. Fereidoon Shahidi, Wiley Interscience Publication (2005).
- Fatty Acids in Industry, R. W. Johnson, and E. Fritz, eds., Marcel Dekker, Inc., New York, (1989).
- Richard M.; Marilyn E. K.; Pashley. Applied Colloid and Surface Chemistry, *John Wiley and Sons Ltd*, Chichester, UK (2004).
- James, R.; Carlos, K. J.; Montilla, L.; Pandey, S.; Shah, D. O. Handbook of Applied Surface and Colloid Chemistry, *John Wiley and Sons Ltd*, Chichester, UK (2002).

COURSE OUTCOMES (students will develop/demonstrate the.....)

CO1: Ability to understand the technical significance of Oleochemical and Surfactant Industries.

CO2: Ability to conceptualize and develop the different modes of oleochemical derivatizations.

CO3: Ability to analyse and illustrate the HLB, diverse interfacial phenomenon, molecular aggregations and phase behaviour of surfactants.

CO4: Ability to understand the quantitative surface activity relationships.

CO5: Ability to conceptualize and develop the different modes of derivatizations anionic, nonionic, cationic and amphoteric surfactants

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

Assessment method:

4. Unit Test
5. Assignment
6. Seminar

Literature survey including review of US/European/ Japanese/ Indian Patents. and Research Papers published in PEER Reviewed Journals.

	Course Code: DYT 1201	Course Title: Chemistry and application of Colorants (Marks 100)	Credits = 4		
			L	T	P
	Semester: III	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Technology of Textile Dyeing, Additives for polymers, Additives for Coatings Compounding and polymer Processing Analysis of Paints Pigment synthesis Lab Experimental Dyeing, Theory of Textile Coloration				
Description of relevance of this course in the B. Tech. (dyes) Programme					
Students will understand the chemistry behind the colorants. They will be able to explain the its applications in various field according to the chemistry involved..					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction of Pigments, Colour Index Generic Names of Pigments, Colour Constitution Number, Polymorphism, Properties required in a pigment and extender, Pigment dispersion basics Definitions of pigment, extenders, dyes, pigment dyestuffs, toner and lakes				4
2	Theory of color formation in organic compounds, effect of auxiliary groups on the shade and hue of the pigment (Bathochromic and hyper chromic shift) Practices and requirement of Pigments				4
3	Azo dyes: Diazotisation and coupling reactions, azoic colours, acid dyes, mono azo dye; diasazo, nitro, diphenylamine and anthraquinone dyes; acid mordant dyes, azo metal complex dyes, direct dyes				12
4	Organic pigments - Antraquinone, Benzimidazolonedioxazines, Diazo lakes				8
5	Litholrubones, Monoazo lakes, Napthol AS lakes, Napthol AS, Perylenes, Phthalocyanines, Quinacridones effect pigments				8
6	Basic dyes: Diphenylmethane and triphenylmethane dyes and heterocyclic analogues thereof, triphenodioxazine dyes. Disperse dyes: azo, anthraquinone, dinitrophenylamine, methine dyes; properties in relation to constitution				12
7	Vat dyes: Indigoid, anthraquinonoid and polycyclic quinonoid dyes; solubilised vat dyes. Sulphur dyes and sulphurised vat dyes				4

8	Reactive dyes: Chlorotriazine and other halo heterocyclic compounds, vinyl sulphone based dyes, high fixation, highly substantive, neutral fixing bifunctional reactive dyes.	8
List of Text Books/ Reference Books		
1	Color Chemistry, 3rd Edition, Heinrich Zollinger, Wiley – VCH 2003	
2	Colorants and Auxiliaries: Colorants v. 1: Organic Chemistry and Application Properties, John Shore, Society of Dyers & Colourists; 2nd edition edition (Jan. 2002)	
3	The Chemistry of Synthetic dyes, K. Venkataraman, Academic Press (1 January 1971)	
4	Industrial Inorganic Pigments, Gunter Buxbaum, Wiley-VCH; 1 edition (March 11, 2005)	
5	Industrial Organic Pigments: Production, Properties, Applications, 3 rd , Completely Revised Edition by Herbst, Klaus Hunger Willy March 2006	
6	Application Properties of Pigments By A.Karnik, First Edition Thane 1999	
Course Outcomes (students will be		
1	Able to understand fundamental knowledge on basics of chemistry involved in the colorants. (K2, A2)	
2	Able to describe the types of pigments and their applications (K2, A2)	
3	Able to understand and explain the physical properties of Pigments and dyes (K2, A2, S1)	
4	Able to explain the synthetic methods used for azo dyes and their properties. (K2, A2, S1)	
5	Able to explain the types of dyes on the basis of application, properties. (K2, A3, S1)	

	Course code: BST 1102	Course Title: Biochemistry	Credits = 4		
	Semester: III	Total contact hours: 60	L	T	P
			3	1	0
List of Prerequisite Courses					
	10 th std. Biology; 12 th std. Chemistry				
List of Courses where this course will be prerequisite					
	Pharmaceutical and Biochemical Analysis Laboratory, Pharmaceutical Biotechnology, Process Technology and Biotechnology Laboratory				
Description of relevance of this course in the B.Tech./B.Pharm. 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.					
Sr. No.	Course contents (Topics and subtopics)				Reqd. 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: Fatty acids, waxes, phospholipids, sphingolipids, terpenoids. With are representative structure and significance	4
	Functions & comparative distribution of lipids, lipoproteins.	4
	B oxidation of fatty 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 Structural organization of protein: primary, secondary, tertiary, quaternary	4
	Elementary idea about chromatography & electrophoresis	5
	Metabolism of proteins (digestion and absorption), catabolic reactions of amino acids, urea cycle	2
4	Nucleic acids and their components: DNA & RNA bases, nucleosides, nucleotides, chemistry of nucleic acids, Structure and functions of RNA & DNA Types of RNA: mRNA, tRNA & rRNA	5
	Salient features of protein biosynthesis & idea of genetic code.	5
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
List of Text Books/ Reference Books		
1	Principles of Biochemistry, Lehninger AL, Nelson DL and Cox MM, 5 th Edition, 2008, MacMillan.	
2	Biochemistry, Stryer L, Berg JM and Tymoczko JL, 5 th 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)		
1	Apply of fundamental knowledge of chemistry to biological systems	
2	Understand and elucidate structural as well as metabolic role of different macromolecules in the cell	
3	Apply analytical tests involved in detection of macromolecules in/ derived from biological samples	
4	Understand role of enzymes in cellular environment and their use in industrial applications for their practical applications	
5	Evaluate and elucidate impact of different catalytic reactions involved in metabolic pathway	
6	Evaluate and explain influence and interactions of different metabolic pathway on each other	

Course Code: BST 1011	Course Title: Microbiology	Credits = 3
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Semester III		Total contact hours: 45	L	T	P
			2	1	0
List of Prerequisite Courses					
Science (Any combination of Physics, Chemistry, Maths and Biology) in Std 12					
List of Courses where this course will be prerequisite					
None					
Description of relevance of this course in the B. Tech/B.Pharm Program					
To familiarize students will diverse microorganisms in different industries like food industry, diary industry , Bio-based fermentation industry, oil industry, pharmaceutical industry and bio-energy: 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					
Sr. No.	Course contents (Topics and subtopics)				Reqd. hours
1	Introduction to microbiology and its significance (beneficial and harmful) in Foods (Diary including pre and probiotics, cheese, vitamins, beverages etc), Pharmaceuticals (Antibiotics, vaccine production, pathogenic organisms etc), Oils (bioremediation, bio-diesel from microorganism etc), and environment (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, Chlamdiya and Algae				5
4	Gram character and staining techniaques, 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, Fluorescence, atomic force, scanning tunnel, cofocalete); Enumeration of microorganisms (TPC, Yeast and molds count, MPN, turbidometry, rapid methods like flow cytometry etc)				5
9	Principles of immunology				5
List of Text Books/ Reference Books					
1	Microbiology bt Prescott, Harley and Klein's 7 th Edition, 2008, Mcgraw-Hill				
2	Microbiology by Pelczar, 5 th edition, 1993, Mcgraw-Hill				
Course outcomes (students will be able to)					
1	Know the application of diverse microorganisms in different industries like food, diary, oil, pharmaceutical, bio-based fermentation and bio-energy				
2	Know the cultivation/control methods for diversity of microorganisms, their physiology and metabolism				
3	Understand the flow of genetic information from DNA to protein and the mechanisms involved therein				
4	Understand the significance of microorganisms in diseases and basic immune system against invading pathogens				

	Course Code: OLP 1201	Course Title: Pr 1: Analysis of oilseeds, oils and raw materials of oils and soap industry	Credits =		
			L	T	P
	Semester: III	Total contact hours: 45	0	0	4
List of Prerequisite					
	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./ B. Pharm. Program					
Student will understand basic analysis of the oilseeds, oils, fats, soaps etc.					
	Course contents(topics/subtopics)				Required hrs
1	Standardization of Na ₂ S ₂ O ₃ , NaOH and HCl, Determination, Analysis of NaOH, Analysis of acetic acid				3
2	Determine Volatile content by air, oven method, Determine specific gravity of oil and glycerine, the viscosity of given sample by using viscometer				3
3	amine content in given sample by indicator method				2
4	Determination of titer value of given fatty acid				2
5	Determination of aldehyde content in the given oil sample				2
6	determine the hardness of water in PPM by complexometric titration with EDTA				3
7	To determine the acid value of heptanal				1
8	To determine the crystallization and supercooling of a given sample				3
9	Determine oxirane oxygen value in given oil sample				2
10	To determine the refractive index and color by Lovibond Tintometer of the given oil sample				1
11	To detect castor oil and soyabean oil mixture in TLC				1
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
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	Understand the analysis of $\text{Na}_2\text{S}_2\text{O}_3$, NaOH, acetic acid and HCl	
2	Understand the physical characteristics of oils like specific gravity, refractive index, color, viscosity etc.	
3	Understand the wet analysis of oils, fatty acids and oleochemicals like acid value, sap value, iodine value, oxidation, crystallization, oxirane value, amine value etc.	
4	Know the Analysis of seeds, cakes and extractions, Detection of oils in mixtures, Vanaspati, margarine, ghee and waxes	
5	Know the hardness of water in PPM by complexometric titration with EDTA	
6	Know about the GLC analysis, separation of mixtures of oils by TLC	

Syllabus for Computer Applications, B. Tech. Semester III

Part I: Spreadsheet Programme (Microsoft Excel or LibreOffice Calc) (3 Lab Sessions)

- %2. Basic Introduction to Spreadsheet Programmes, Plotting Graphs of Functions and Data Plotting.
- %2. Exploring Basic Statistics, Hypothesis Testing with Spreadsheet.
- %2. Numerical Solution of Linear and Non-Linear Equations.

Part II: Statistics with R-Programming (4 Lab Sessions)

- %2. Basic Introduction to R and Rstudio.
- %2. Data Management in R.
- %2. Exploring Distribution Function in R.
- %2. Hypothesis Testing in R.
- %2. Basic Regression Analysis in R

Part III: C-Programming

Unit I: (2 Lab Sessions)

What is C-programming? Data Types, Variables, Constants, Arithmetic Operations, Input-Output Statements, Expressions and Expression Evaluations, Type Conversions.

Unit II: (2 Lab Sessions)

Making Decisions-if and switch statement, Repetition Statements-For Loop, While and Do-While Loops, Nested Loops, Use of Break, Continue and Goto in Loops, File Input-Output statements and its use.

Unit III: (3 Lab Sessions)

Functions- User Defined functions, Calling Function and passing arguments, Arrays- Definition, Accessing and Storing elements, Concept of Multi-dimensional Arrays, Array and Functions.

Unit IV: (2 Lab Sessions)

String Manipulation. Basic of Structures and unions. Dynamic Memory allocation.

References:

1. Programming In Ansi C, E Balagurusamy, Tata McGraw-Hill Publishing Company Limited, 2002
2. Let Us C, Yashavant P. Kanetkar, 2008, Infinity Science Press
3. Introductory Statistics with R, Peter Dalgaard, Springer, 2008
4. Basic Statistics: An Introduction with R, Tenko Raykov, George A. Marcoulides, 2013
5. Excel for Chemists: A Comprehensive guide, E. Joseph Billo, WILEY, 2011
6. Mathematical Modeling with Excel, Brian Albright, Jones & Bartlett India Private Limited, 2010
7. Statistics and Probability for Engineering Applications With Microsoft® Excel by W.J. DeCoursey, 2003

Semester IV

Sr. No.	Course Code	Subjects	Hours/week (L+T)	Marks	Credits
1	GET 1104	Engg. Mechanics & Strength of Materials	3+1	100	4
2	PYP 1203	Colour Physics and Colour Harmony	2+1	50	3
3	CET 1105	Transport Phenomena	3+1	100	4
4		Electrical Engg and Electronics	2+1	50	3
5	OLT 1103	Nutrition	3+1	100	4
		TOTAL	18	400	18
6	GET 1106	Electrical Engg and Electronics Lab	4	50	2
7	PYP 1203	Colour Physics Lab	4	50	2
		Total Practicals	08	100	4
			26	500	22

	Course Code: OLT 1103	Course Title: NUTRITION (Marks 100)	Credits = 4		
			L	T	P
	Semester: IV	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	HSC (Science), Biochemistry, Chemistry of oils				
List of Courses where this course will be prerequisite					
	All the Oils, Oleochemicals & Surfactants Special Courses				
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme					
Students will be able to understand the lipids, basics of industrial chemistry of oils and Fatty Acids. They will be trained with respect to basics of sources of oils, minor constituents, physical and chemical properties of fatty acids, various derivatisation pathways and related analytical tools.					

Topics	No. of lectures
Introduction to Nutrition, Importance of study of Nutrition in health and disease, Branches of Nutrition, Nutrigenomics, Nutraceuticals	4
Food as a source of nutrients, Sources and functions of Food, Concept of RDA of nutrients	2
Study of major food constituents viz Carbohydrates and Proteins with ref. to Chemical nature, classification, digestion, nutritional role and food sources	8

<u>Study of Lipids</u> 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, trans fats, CLAs, lipoproteins, cholesterol	10
<u>Proximate analysis of foods</u> , Fuel value and Physiological fuel value of foods	2
<u>Computation of daily calorie requirements</u> with ref to BEE, AT and TEF, ICMR Calorie Requirements for Indians	4
<u>Nondigestible carbohydrates, Dietary Fibre</u> , Resistant starch, FOS, Pro and Prebiotics	6
<u>Glycemic properties</u> of carbohydrates, fructose as a Health risk factor	2
<u>Protein quality evaluation</u> : Chemical score, PER, BV, NPU, PDCAA, Protein requirements at different life stages, Mutual supplementation, Available Lysine	4
<u>Antinutritional factors</u> in foods and their significance, Bioavailability of nutrients	3
<u>Vitamins</u> : Chemical nature, nutritional function, stability to processing conditions, deficiency symptoms, hypervitaminosis for fat soluble vitamins, RDAs and food sources	6
<u>Minerals</u> : nutritional role, RDAs, sources of macro and microelements	5
<u>Role of nutrients in</u> metabolic syndrome, CVD, Atherosclerosis, Diabetes, Hypertension, obesity	2
<u>ABCDs of nutritional assessment</u>	2

List of Recommended Text Books/ Reference Books:

Lipid Biochemistry by Gurr, Biochemistry by Lehninger,
Nutrition by Young and Shil, Food and Nutrition by Krauss

COURSE OUTCOMES (students will develop/demonstrate the.....)

CO1: Ability to understand and explain the constitution of food and oils nutrition, Sources and functions of Food, Concept of RDA of nutrients and its importance

CO2: Ability to understand major food constituents like Carbohydrates, lipids and Proteins.

CO3: Ability to understand the Proximate analysis of foods, Computation of daily calorie requirements, Nondigestible carbohydrates, Dietary Fibre, Glycemic properties etc.

CO4: Ability to conceptualize Protein quality evaluation, Antinutritional factors, vitamins and minerals etc.

CO5: Ability to identify role of nutrients and ABCDs of nutritional assessment.

Assessment method:

1. Unit Test
2. Assignment
3. Seminar

Literature survey including review of text/ reference books, Patents, and research papers published in PEER Reviewed Journals

	Course Code: Spl 6 (B/C/P)	Course Title: Colour Physics & Colour Harmony (By Physics)	Credits = 3		
			L	T	P
	Semester: IV	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Applied Physics –I & II				
List of Courses where this course will be prerequisite					
	Colour Physics Lab, Additives for Polymers, Additives for Coatings, Pigment Synthesis Lab, Technology of Textile Dyeing, Technology of Textile Printing, Technology of Garment Manufacturing. & Processing.				
Description of relevance of this course in the B. Tech./B. Pharm. Program					
Students will be trained to understand the mechanism behind visibility of different colours. The students will be made aware of different technics and terms of colour physics that can be applied into various fields.					
	Course contents(topics/subtopics)				Required hrs
1	Introduction: Colour as a concept, its definition, geometric and chromatic attributes				3
2	Radiation and illumination: SPD, CT and CCT; Sources and illuminants; Need for artificial sources – various ways of producing light and different artificial sources; efficacy and colour rendering properties of sources.				6
3	Interaction of radiation with matter : gloss and diffused reflectance, travel, flip and flop colour, polar diagrams; absorption of light in sample-various transitions in dye molecule, Beer – Lambert law and its verification, deviation from Beer – Lambert law, Additivity of absorbances, mixture analysis, various instruments used for the purpose; absorbance and scattering in the sample – Kubelka Munk theory.				8
4	Perception of colour in eye \ brain: various colour coding processes at retina and beyond it, colour constancy, colour theories, anomalous colour visions, metamerism				6
5	Colour specification: Additive-subtractive mixing, Grassmann’s law, 1931 and 1964 CIE system-XYZ and L*a*b* colour spaces, colour difference formulae, Munsell colour order system				8
6	Recipe match prediction: Single constant Kubelka – Munk theory of colourant formulation and recipe prediction; Modern computerised methods of colour matching				6
7	Colour Harmony: Definition, colour associations, colour harmony theories; colour contrasts-successive and simultaneous contrast, contrast of proportion, intensity, value, hue etc. (Itten’s contrasts); colour wheel and various colour schemes, dominant, subdominant and accent colours; visual weight and balance in colour schemes				8
List of Text Books/ Reference Books					
1	Colour Physics for Industry, R. McDonald, West Yorkshire, 1997.				

2	Color: A Multidisciplinary Approach; Zollinger Heinrich Zurich, Verlag Helvetica Chemica Acta, 1999
3	The Colour Science of Dyes and Pigments, R. McLaren Bristol, Adam Hilger Ltd., 1983
4	Industrial Colour Technology, Johnson R. M., Sartzman M, American Chemical Society, Washington D.C., 1971.
5	Coloring of Plastics: Fundamentals by Robert A. Charvat John Wiley & Sons, 11-Mar-2005
6	Coloring of plastics: theory and practice by M.Ahmad Van Nostrand Reinhold, 1979
Course Outcomes (students will be able to.....)	
1	Understand the colour perception and the effect of various parameters on it. (K1,K2)
2	Understand various visual and colour processes in human beings. (K1,K2)
3	Understand various systems to specify uniquely a colour stimulus and use them to do so.(K1,K2,K3)
4	Use knowledge of such colour systems to predict recipe (K2, K3)
5	Understand colour harmony to study various colour contrasts. (K1, K2)
6	Understand various colour harmony theories and the use of colour wheel. (K1, K2, K3)

Course Code: Pr 2	Course Title: Colour Physics Lab (By Physics)	Credits = 2		
		L	T	P
Semester: IV	Total contact hours: 45	0	0	4
List of Prerequisite Courses				
Physics				
List of Courses where this course will be prerequisite				
Medicinal chemistry, Pharmaceutical Technology, drug regulatory affairs				
Description of relevance of this course in the B. Tech./B. Pharm. Program				
Student will understand human anatomy and Physiology, the common disorders and their pathophysiology, the drug categories, principles of pharmacology and its applications to medicinal chemistry and pharmaceutical technology				
	Course contents(topics/subtopics)	Required hrs		
1	Introduction to human body, Organization of human body, Different system of human body	1		

2	Composition and functions of blood, lymph, immunity	2
3	General pharmacology (ADME, routes of administration, MOA)	2
4	Haematinics, thrombolytic, coagulants / anticoagulants	2
5	Digestive system antacids, purgatives	3
6	Structure and function of kidney, diuretics	3
7	Respiratory system	1
8	CNS	3
9	Drugs acting on CNS	7
10	ANS	1
11	Drugs acting on ANS	5
12	Anti-diabetics	2
13	Drugs used in hypertensive, vasodilator	2
14	Analgesic, anti-inflammatory agents	2
15	Local anaesthetics, histaminic, anti-histaminic,	2
16	Principles of bioassay	1
17	Chemotherapy	6

List of Text Books/ Reference Books

1	Elements of Pharmacology R. K. Goyal, Ahmedabad, India.
2	Pharmacology H. P. Rang, M. M. Dale, J. M. Ritter 5
3	Ross and Wilson's Anatomy and Physiology in Health and Illness Anne Waugh and Allison Grant 10th edition, 2006 Churchill Livingstone, London

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

1	Understand the organization, placement, structures and functioning of human body as whole. (K1,K2,K4)
2	Understand the body fluids; namely, blood and lymph; their formation, presence and functions as well as disorders (K1,K2,K3,K4)
3	Understand the anatomy and physiology of systems namely respiratory, urinary, digestive, with the disorders affecting the systems.(K1,K2,K3,K4)
4	Know the different drug categories with special emphasis on antacids, diuretics, haematinic, coagulants and anti-coagulants, diuretics, anti-histaminics and local anaesthetics and concept of bioassay with example of histamine and anti-histaminics. (K1, K2, K3,K5)
5	Understand general principles of Pharmacology including pharmacokinetics and Pharmacodynamics. (K1, K2, K3, K4, K5)
6	Understand the Anatomy and Physiology of the Nervous system namely, CNS and ANS. (K1, K2, K3, K4, K5)
7	Know the drugs that act on the various disorders of CNS and ANS. (K1, K2, K3, K4, K5)
8	Know about the Pharmacology of chemotherapeutic agents and immunomodulators used for infectious diseases and cancer. (K1, K2, K3, K4, K5)

9	Know about drugs and their pharmacology used in Diabetes mellitus and cardiovascular disorders. (K1, K2, K3, K4, K5)
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	Course Code: GET 1116	Course Title: Engineering Mechanics and Strength of Materials	Credits = 4		
	Semester: IV	Total contact hours: 60, Marks : 100	L	T	P
			3	1	0

List of Prerequisite Courses

	XIIth Standard Physics and Mathematics, Applied Mathematics-I and II Applied Physics - I
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Description of relevance of this course in the B.Tech (All Branches)

This subject will help students to understand use of basics of Applied mechanics and Strength of Materials. As a practicing engineer and technologist, what are different types of forces to be considered and how to quantify them during design of equipments? To know the conditions of equilibrium and how to apply them to analyse 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. Advantages and disadvantages of various geometric sections available for engineering design. What are the different advance fibre polymer composite materials used in industry for various applications. Different performances enhancing construction chemicals. This is the foundation course for a good Design engineer and Technologist.

	Course Contents (Topics and subtopics)	Reqd. hours
1	Concepts of forces, their types, Resolution of forces, Composition of forces, Steps in engineering Design, Different types supports and freebody diagram	4
2	Equilibrium of rigid bodies – Conditions of equilibrium. Determinant and indeterminent structures.equilibrium of beams, trusses and frames problems on analysis of beams and truss	5
3	Concept of moment of inertia (Second moment of area) its use. Parallel axis theorem. Problems of finding centroid and moment of inertia of single figures, Perpendicular axis theorem, Polar M.I., Radius of gravitation.	5
4	Shear Force and Beaming 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	5
5	Stresses and Strains – Tensile and compressive stresses, strains, modulus of elasticity, modulus of rigidity, bulk modulud. 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 pjilosophies.	5
6	Theory of Bending – Assumptions in derivation of basic equation, Basic equation, section modulus, bending stress distribution	4
7	Problems on shear stress – Concept, Derivation of basic formula. Shear stress distribution for standard shapes. Problems of shear stress distributions	4

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	Short and Long Columns (Struts) – Basic Concept, Crippling load, End conditions, Euler’s and Rankine’s Approach (Without Derivations)	4
10	Torsion of a circular shaft – Concept, basic derivation, shear stress distribution, power transmitted by shafts, Simple problems	4
11	Thin and Thick Cylinders- Concept of circumferential, longitudinal stresses, Behavior of thin cylinders, problems on thin cylindrical and spherical shells, Behavior of thick cylinders (theory only)	4
12	Natural Materials, Manmade Materials, Materials used for coatings, anticorrosive coatings, special purpose floorings, water proofing compounds, Various polymers and epoxies used for industrial applications. Composite Materials – various types of fibres, fabrics used in polymer composites, Glass and carbon fibre polymer composites, methods of manufacturing, Uses in various industrial applications	6
13	Concrete – Basics, Ingredients of concrete, properties of concrete, testing of fresh and hardened concrete, uses of concrete. Different types of performance enhancing and special purpose construction chemicals. Plasticizers and super-plasticizers, air entraining agents, accelerators and retarders, viscosity modifying agents, corrosion inhibitors, Cement, Basic process of hardening, types of cements, blended cements, Recycling of waste-value addition	6
List of text Books/Reference Books		
	Engineering Mechanics Vol I Statics by B.N. Thadani, Publisher Wenall Book Corporation	
	Introduction to Mechanics of Solids by Egor Popov, Prentice Hall of India Pvt, Ltd	
	Mechanics of Materials by Ferdinand Beer and E. Russel Johnston, Tata McGraw Hill	
	Fundamentals of applied Mechanics by Dadhe, Jamdar and Walavalkar, Sarita Prakashan Pune	
	Engineering Mechanics by S. Timoshenko and D. H. Young, McGraw Hill Publications	
	Strength of Materials by Ferdinand Singer and Andrew Pytel, Harper Colins Publishers	
	Mechanics of composite Materials by Autar K. Kaw, Publisher CRC Press	
	Fundamental of Fibre reinforced composite materials by A. R. Bussel and J. Renard, Taylor & Francis	
	Concrete Technology by A, M, Neville, Pearson Education ltd	
	Concrete Technology – Theory and Practices by M. S. Shetty, S. Chand & co	
	Corrosion and Corrosion Protection Handbook by Philip A. Schweitzer, CRC press	

Course Objectives

- 1) To know the various types of forces acting on the various structures in engineering. To know the conditions of equilibrium and how to apply them to analyse the structures.
- 2) To understand the concept and importance of centroid and moment of Inertia for different sections used in engineering and plane areas.
- 3) To analyse the different types of structures to know axial force, shear force and bending moment in the different parts of the body/structure.
- 4) To know the basics of different stresses and strains, types of materials and their properties.
- 5) To able to determine the axial stress, bending stress and shear stress in the structure and draw its variation across the section.
- 6) To understand the deformations in axial, lateral and rotational direction. Calculation of slope and deflections in different beams under simple and complex loading.
- 7) To understand torsional loads, Use in power transmission. Behaviour of short and long columns with various end conditions.
- 8) To know the Thin and Thick cylinders, stresses and strains in thin cylinders.
- 9) To know various polymers, epoxies, fibre polymer composite materials used for various applications in engineering.
- 10) To make awareness about the cement and its composites, performance enhancing construction chemicals used to alter properties.

Course Outcome:

At the end of the course the student will be able to

CO 1	Quantify the actions and able to find reactions by applying conditions of equilibrium
CO 2	Find out the Centroid and Moment of Inertia for various cross sections used in engineering structures and for plane areas.
CO 3	Able to draw the Shear Force and Bending Moment diagram for different types of beams under simple and complex loading.
CO 4	Calculate the forces, reactions, stresses, strains in components of the bodies of a complex engineering structure.
CO 5	To find out the Bending Stresses at different positions and Shear Stress distribution across the cross section at various points.
CO 6	To calculate the Slope and Deflection at different points under simple and complex loading.
CO 7	To know effect of Torsion in shafts, power transmission, Euler's and Rankine's approach for columns.

	Course Code: CET1105	Course Title: Transport Phenomena (Marks 100)	Credits = 4		
	Semester: IV	Total contact hours:60	L	T	P
			3	1	0
List of Prerequisite					
	Applied Physics - I & II				
List of Courses where this course will be a prerequisite					
	Technologu of thermoplastics, Technology of Thermosers, Fibricarion and design of moulds, Project, Processing of Polymers				
Description of relevance of this course in the B. Tech. Programme					
Students will be trained to understand fundamentals of mass transfer, lamilar turbulent flow Bernoullies equation and its application. The students will be made aware of design aspect of heat exchangers, condensers evaporators and heat transfer basics					
	Course contents				Required hrs
1	Fluid Statics and applications to engineering importance.				2
2	Equations of Continuity and motion for Laminar and Turbulent Flows with applications to simple problems				8
3	Bernoulli's Equation and engineering applications, Pressure drop in pipes and Fittings, Piping design and fluid moving machinery such as pumps, blowers, compressors, vacuum systems, etc. Particle Dynamics, Flow through Fixed and Fluidised Beds.				10
4	Gas – liquid Two phase flow: types of flow regimes, Regime maps, estimation of pressure drop and hold-up				2
5	Fundamentals of mass transfer: Molecular diffusion in fluids, mass transfer coefficients, and interface mass transfer, steady state theories of mass transfer, Whitman's two-film theory, and its variations.				10
6	Heat conduction in Cartesian, cylindrical and spherical coordinate systems. Convective heat transfer in laminar and turbulent boundary layers. Theories of heat transfer and analogy between momentum and heat transfer.				8
7	Design aspects of exchangers like: Double pipe heat exchangers: Concurrent, counter-current and cross flows, mean temperature difference. Shell and tube heat exchangers: Basic construction and features. Design methods for shell and tube heat exchangers, Finned tube exchangers.				10
8	Introduction to Compact Exchangers				2
9	Heat transfer aspects in condensers, reboilers and evaporators.				4
10	Heat transfer in agitated vessels: coils, jackets, limpet coils, calculation of heat transfer coefficients, heating and cooling times, applications to batch reactors and batch processes				4
List of textbooks/ Reference Books					
1	Transport Processes and Separation Process Principles: Geankoplis, C.J.				
2	Unit Operations of Chemical Engineering, McCabe W.L., Smith J.C.,				

	Harriot P	
3	Coulson and Richardson's CHEMICAL ENGINEERING, Volume 1	
4	Heat Transfer: Principles and Applications: Dutta, B.K	
5	Principles of Mass Transfer and Separation Processes Transport Phenomena: Brodkey, R.S	
7	Fluid Mechanics: Kundu, P.K.	
8	Fluid Mechanics: Subramanya, K	
9	Fluid Dynamics and Heat Transfer: Knudsen and Katz	
10	Process Heat Transfer: Kern, D.Q	
11	Heat Exchangers: Kakac, S., Bergles, A.E., Mayinger	
12	Process Heat Transfer: Hewitt, G	
Course outcomes(students will be able to.....)		
1	Understand the colour perception and the effect of various parameters on it. (K1,K2)	
2	Understand various systems to specify uniquely a colour stimulus and use them to do so.(K1,K2,K3)	
3	Understand various systems to specify uniquely a colour stimulus and use them to do so.(K1,K2,K3)	
4	Use knowledge of such colour systems to predict recipe (K2, K3)	
5	Understand colour harmony to study various colour contrasts. (K1, K2)	
6	Understand various colour harmony theories and the use of colour wheel. (K1, K2, K3)	

	and nodal analysis, Basic elements R, L and C. Concept of self and mutual inductance.	
2	Network theorems: super position, Thevenin's theorems	2
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	3
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	3
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

List

Course Code:	Course Title: Basic Electrical Engineering and Electronics (Marks 50)	Credits =3		
GET 1105		L	T	P
Semester: IV	Total contact hours: 40	2	1	0

List of Prerequisite Courses

XIIth Standard Physics and Mathematics courses,

List of Courses where this course will be prerequisite

Course objectives

1. Students will get an insight to the importance of Electrical Energy in Chemical Plants.
2. The students will understand the basics of electricity,
3. They will get basic knowledge about Transformer and selection of different types of drives for a given application process.
4. They will get basic knowledge as regards to electronic devices and their application in Power supplies, amplifiers and other circuits.

S.No.	Topic	Hrs.
1	Basic Laws: Kirchoff's current and voltage law, Simple series and parallel connections, star and delta transformation. Mesh	6

of Text Books/ Reference Books

Electrical Engineering Fundamentals by Vincent Deltoro
Electronic devices and circuits by Boylestad, Nashelsky
Electrical Machines by Nagrath, Kothari
Electrical Machines by P.S. Bhimbra
Electrical Technology by B.L. Theraja, A.K. Theraja vol I,II,IV
Thyristors and their applications by M.Ramamurthy
Power Electronics by P.S. Bhimbra

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

Understand the basic concepts of D.C circuits. Solve basic electrical circuit problems
Understand the basic concepts of single phase and three phase AC supply and circuits.
Understand the basic concepts of transformers and motors used as various industrial drives.
Understand the basic concepts of electronic devices and their applications

Semester V

Sr. No.	Course Code	Subjects	Hours/week (L+T)	Marks	Credits
1		Chemical Engineering Operations	2+1	50	3
2		Chemical Reaction Engineering	2+1	50	3
3	OLT 1104	Chemistry of Oils, Lipids, Essential Oils and their Applications	3+1	100	4
4	OLT 1105	Oil and Fat Production and Edible Oil Processing	3+1	100	4
5	OLT 1108	Technology of Perfumery Chemicals	2+1	50	3
TOTAL			17	350	17
6	OLP 1203	Processing of Oleochemicals & Waxes and Cosmetics Formulations	8	100	4
7	OLP 1204	Analysis of Surfactants	2	50	2
Total Practicals			10	150	6
			27	550	23

	Course Code: OLT 1104	Course Title: OLT 1104: chemistry of oils, lipids, essential oils and their applications (Marks 100)	Credits = 4		
			L	T	P
	Semester: V	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Chemistry of Oils, Technology of Oleochemicals, Cosmetics Science, Oil and fat production,				
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 the its applications in various fields according to the chemistry involved.					
	Course Contents (Topics and subtopics)				Reqd. hours

1	Glyceride Synthesis, acylation procedures, introduction and removal of protecting groups, 1-monoglycerides, 2-monoglycerides, 1,2-diglycerides, 1,3-diglycerides, triglycerides, optically active glycerides, phosphoglyceride synthesis. Trans fatty acids	10
2	Advanced methods of analysis of oils: Chromatography of oils, fats and derivatives. Packed column gas chromatography. Thin layer Chromatography, WCOT (capillary), Ultra Violet spectroscopy, Infra Red Spectroscopy	10
3	Gas Liquid Chromatography. High performance liquid chromatography, Mass spectrometry of triglycerides and related compounds. Stereospecific analysis of triacyl glycerols. Application of wide line NMR in the oil and fat industry.	10
4	Essential oils: extraction from different sources, separation and purification. Enflurage, Maceration, solvent extraction, supercritical extraction, water distillation, water steam distillation and steam distillation. Deterpenation of oils. analysis of essential oils for RI, optical rotation, density, solubility, boiling point, melting point.	10
5	Role of different constituents of essential oil in the formulations. Stability studies of essential oils in cosmetics, soaps and toiletries. Evaluation and testing of essential oils by sensory hedonic and substantively and GC tests.	5
6	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 jui chameli oils etc. Role of essential oil in aroma therapy	15

List of Text Books/ Reference Books

1	<u>Chemical constitutions of natural fats</u> by T.P. Hilditch and P.N. Williams 4 th ed.,
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
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	
1	Able to understand the basic process of glyceride synthesis, optically active glycerides and allied products.
2	Able to select the process for the manufacture of monoglyceride, diglycerides, and
3	Understand the advanced method of analysis of oils and lipids like GC, MS, HPLC, NMR
4	Understand the basic process of extraction of essential oils from various natural sources and different types of Essential Oils.
5	To find out the applications of essential oil in cosmetics formulations, aroma therapy and

Course Code: OLT 1201	Course Title: Technology of Oil and Fat Production and Edible Oil Processing (Marks 100)	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 60	3	1	0

List of Prerequisite Courses

Chemistry of Oils and Fatty Acids	

List of Courses where this course will be prerequisite

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

Students will understand the mechanism, theory and practice of oil extraction. They will be able to explain refining of oils/ fats, fat modification processes.

	Course Contents (Topics and subtopics)	Reqd. hours
1	Natural sources of oils and fats, domestic and world production, trade and marketing of oilseeds and oils. Newer sources of oils and fats	4
2	Storage, sampling, grading, cleaning, crushing, and heat treatment of oilseeds	5
3	Mechanical expression, solvent extraction, rendering and other methods of recovering oils and fats. Economic aspects of these processes.	7
4	Specific methods for the production of palm oil, palm kernel oil and rice bran oil.	2
5	technical refining of oils for industrial uses, detoxification and technical products from oil cakes, edible products from oil meals, synthetic fatty material.	6
6	Antinutritional constituents of oilseeds. General methods of upgrading and utilization of oils, oil cakes and other products, Protein concentrates and isolates from oil meal	6
7	Processes and plants employed for refining, bleaching, deodorization,	7
8	hydrogenation and winterization of oils or edible purposes,	5

9	manufacture and evaluation of auxiliary materials such as activated earth and carbon, Ni catalysis and hydrogen	4
10	newer techniques of refining of oils and fats	4
11	manufacture of butter, margarine and ghee, Vanaspati, bakery and confectionery fats and fatty foods	5
12	composition and properties of these spoilage during storage of fats, and fat products, protection against auto oxidation	5

List of Text Books/ Reference Books

1	Bailey's Industrial Oil and Fat Products Volume I to V by Daniel Swern, A Wiley Interscience Publication (1979)
2	Palm oil by F. D. Gunstone, John Wiley and Sons (1987)
3	Oils and Fats Manual (Vol. I & II) by A. Karleskind and J. P. Wolff, Lavoisier Publishing (1996)
4	Oils, Fats and fatty foods by K. A. Williams, J. A. Churchill Ltd. (1966)
5	Journal of American Oil Chemists' Society, International News on Fats, Oils and Related Materials, Lipids.
6	Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)
7	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
8	Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)
9	Natural fatty acids and their sources by E. H. Pryde
10	Hydrogenation of fats and oils by H. Patterson, Applied Science publishers (1983)

Course Outcomes (students will be

1	Able to understand fundamental knowledge on basics of post harvest technology for oilseeds, chemistry involved in the oil /fat production and refining
2	Able to describe the plant and processes for oil/ fat extraction
3	Able to understand and explain the meal composition, upgradation of meal/ cake and antinutritional factors and detoxification
4	Able to explain various fat modification processes and auxiliary materials
5	Able to explain the fat storage, auto oxidation and spoilage

	Course Code: OLT 1106	Course Title: production and Application of Soap, Surfactants and Detergents (Marks 100)	Credits = 4		
			L	T	P

	Semester: V	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Chemistry of Oils and Fatty Acids, Chemistry of Surfactants and Oleochemicals				
List of Courses where this course will be prerequisite					
	Technology of Oleochemicals				
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the mechanism, theory and practice of Surfactant production. They will be able to explain types of soaps, detergents and their formulations					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Raw materials for the soap industry, classification and selection of raw materials, properties of soaps and soap solution. Phases in soap boiling, processes employed in the manufacture of soap, various types of soaps and cleaning preparations, Testing and evaluation, Indian Standard Institution methods, essential oils and other ingredients for soaps.				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
List of Text Books/ Reference Books					
1	Soaps by Prof. J. G. Kane				
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
3	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)				
4	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)				

5	Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)
Course Outcomes (students will be	
1	Able to understand basics of soaps, surfactants and detergents
2	Able to describe the plant and processes for soaps, surfactants and detergents extraction
3	Able to understand and raw materials and formulations of all types of surfactants, soaps and detergents
4	Able to explain new generation of surfactants and quality standards of soaps, surfactants and detergents
5	Able to explain the industrial applications of soaps and surfactants

	Course Code: OLP 1203	Course Title: Processing of Oleochemicals and Waxes and Cosmetics Formulations (Marks 100)	Credits = 4		
	Semester: V		Total contact hours: 60	L	T
			0	0	4

List of Prerequisite Courses

	Chemistry of Oils and Fatty Acids, Production and Application of Soaps, Surfactants and Detergents	

List of Courses where this course will be prerequisite

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

Students will understand the mechanism, theory and synthesis of oleochemicals and waxes formulations.

They will be able to understand/ explain types of cosmetics and their formulations

	Course Contents (Topics and subtopics)	Reqd. hours
1	Methyl esters from oil, fatty acids, acid oil, frying oil etc. preparation and properties	8
2	Selective hydrogenation of oil for preparation of Vanaspati	4
3	Fatty acids by saponification and acidulation, high pressure fat splitting	8
4	metallic soap by double decomposition and fusion method	6
5	Rice bran wax processing (separation of fatty acid and fatty alcohol)	4
6	Study in esterification reaction of butyl esters, reaction kinetics	4
7	Alkyd resins and Wax esters	6

8	Formulation and physical quality/ efficacy parameters for cosmetics formulations : Lipstick, Men's hair dressing cream, After shave lotion, Shaving cream, Cleansing milk, Foundation lotion, Eye shadow, Nail polish, Face scrub, Vanishing cream, Toothpaste, Mouthwash, Anti-Dandruff shampoo	10
List of Text Books/ Reference Books		
1	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)	
2	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)	
3	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)	
4	Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)	
5	Poucher's Perfumes, Cosmetics and Soaps by Hilda Butler	
Course Outcomes (students will be		
1	Able to understand basics of oleochemical synthesis	
2	Able to describe the reaction chemistry, synthesis of various oleochemicals	
3	Able to understand properties and quality parameters of oleochemicals	
4	Able to explain various cosmetics formulations	
5	Able to explain the properties/ physical quality parameters and efficacy of cosmetics formulations	

	Course Code: OLP 1204	Course Title: Analysis of Surfactants (Marks 50)	Credits = 2			
			L	T	P	
	Semester: V	Total contact hours: 30	0	0	2	
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						
Students will understand the various analytical and chemical/ wet analysis of surfactants						
	Course Contents (Topics and subtopics)					Reqd. hours
1	Analysis of basic ingredient of surfactants: LABS, soap, non-ionic, LAS, alkylsulphate etc. Analysis of detergents for active matter, water/alcohol insolubles, free alkalinity etc.					3
2	Qualitative analysis of types of surfactants: analysis of types – pinacryptol yellow/ anionic, cationic, nonionic, amphoteric surfactants					3
3	Elemental analysis and class of surfactants: carboxylates, sulfates, sulfonates, types of hydrophobes in these anionics specifically sulfates, sulfonates, Spot tests for various functional groups					5
4	Cationics: quarternary ammonium compounds, amine salts, characterization of amines					3
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					5
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					4
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.					4

8	Detergency tests: standard soiling and tergotometer, instrumental methods of analysis. Analysis of Detergents – including PO ₄ S, silicate, actives, enzymes, bleaches, polymers	3
List of Text Books/ Reference Books		
1	Handbook of Surfactants, Porter, M. R., Springer Science and Business Media (1993).	
2	Surfactants in Consumer Products: Theory, Technology and Applications, Ed. J. Falbe, Springer-Verlag, Berlin (1987).	
3	Industrial Applications of Surfactants-II, D. R. Karsa, Royal society of Chemistry (1990).	
Course Outcomes (students will be		
1	Able to understand basic analytical techniques for surfactants	
2	Able to describe the wet analytical techniques and elemental analysis for surfactants	
3	Able to understand physical properties of surfactants	
4	Able to explain separation techniques for surfactants	
5	Able to explain the analysis of detergents	

Semester VI

Sr. No.	Course Code	Subjects	Hours/week (L+T)	Marks	Credits
1	OLT 1107	Cosmetics Science	3+1	100	4
2	OLT 1106	Production and Applications of Soaps, Surfactants and Detergents	3+1	100	4
3	OLT 1109	Elective I: Supramolecular Chemistry of Nanomaterials	2+1	50	3
4	Humanities/Management Subject II	Humanities / Management Subject II	2+1	50	3
5	Humanities/Management Subject III	Humanities / Management Subject III	2+1	50	3
TOTAL			17	350	16
6	OLP 1205	Evaluation and Testing of Soaps and Detergents	4	100	4
7	OLP 1206	Biochemistry and Microbiology Lab I and II	2	50	2
8	OLP 1207	Paint Technology Laboratory	2	50	2
Total Practicals			08	200	8
			25	550	24

	Course Code:	Course Title: OLT 1107: Cosmetics Science (Marks 100)	Credits = 4		
	OLT 1107		L	T	P
	Semester: VI	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Analysis of Soaps and Detergents, Production and applications of soaps, surfactants, Technology of Perfumery Chemicals. Technology of Oleochemicals.				
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry raw materials and other ingredients. They will be able to explain its applications in various creams, personal care products according to the chemistry involved.					
	Course Contents (Topics and subtopics)				Reqd. 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 straighteners.	15
3	Formulations of skin creams, hand cream, moisturizers, nail polish, lipsticks. Stability tests and product specifications Nail polish, lipsticks, face powders, baby toiletries	15
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	5
6	Concept of product design, labeling, claiming and claim support understanding of current needs, translation of current needs to products	5

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 (1970)
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

Course Outcomes (students will be

1	Able to understand the basic formulation of cosmetics.
2	Able to selects the various ingredients and manufacturing processes for various cosmetics.
3	Understand the advance method of analysis of cosmetics
4	Able to identify the specific reactions for stability studies of cosmetics.
5	To find out the current market needs and product design.

	Course Code: OLT 1108	Course Title: Technology of Perfumery Chemicals (Marks 50)	Credits = 3		
			L	T	P
	Semester: VI	Total contact hours: 30	2	1	0
List of Prerequisite Courses					
	Chemistry of Oils, Lipids and 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. (dyes) Programme					
Students will understand the mechanism, theory and practice of oil extraction. They will be able to explain refining of oils/ fats, fat modification processes.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Study of reactions like hydrogenation, oxidation, reduction, epoxidation, hydrolysis, esterification, aldol condensation for perfumery chemicals etc.				5
2	Preparation of terpeneless and sesqui terpenless oils. Technology of preparation for alcohols, esters, aldehydes, ketones				5
3	Synthetic geraniol, geraniol esters, synthesis of terpene alcohols and their esters. Citronellol and their esters. Synthetic citroleool chemical route. Chemical synthesis of citronellol esters. Alpha terpenol: chemical synthesis.				10
4	Terpenyl acetate and other esters. Linalool nerol, menthol: chemical synthesis and their esters. Synthesis if vanillin, heliotropin, terpene ketone, ionones, methyl ionones, janmon, benzyl acetate, acetophenone, terpene aldehydes, citral				10
List of Text Books/ Reference Books					
1	Common flavours and fragrance materials by Kurt Bauer et.al.				
2	Flavor Technology				
Course Outcomes (students will be					
1	Able to understand fundamental knowledge on perfumery chemicals				
2	Able to describe the reaction chemistry for various aroma chemicals				
3	Able to understand and explain various reactions used for synthesis of perfumery chemicals				
4	Able to explain the technological aspects for various perfumery chemicals				

5	Able to explain the applications of perfumery chemicals
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	Course Code: OLP 1205	Course Title: Evaluation and Testing of Soaps and Detergents (Marks 100)	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 30	0	0	4

List of Prerequisite Courses

	Chemistry of Oils and fatty acids, Production and Applications of soaps, surfactants and detergents	

List of Courses where this course will be prerequisite

	Processing of Soaps, Surfactants and Detergents and Triboapplications laboratory	
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Description of relevance of this course in the B. Tech. (dyes) Programme

Students will understand the evaluation and testing of soaps and detergents

	Course Contents (Topics and subtopics)	Reqd. hours
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1	<p>Preliminary evaluations of soap, Bathing soap: Determination of i) TFM, ii) Combined alkali, iii) Anhydrous soap. iv) moisture content, v) Wetting, vi) Foam stability</p> <p>Determination of chloride content, Determination of glycerol content by SMP method and unsaponifiable matter, Determination of synthetic surface active agents in given soap sample, To determine mushiness and cleaning efficiency of given soap sample</p> <p>For laundry soap: Determine i) TFM, ii) Unsaponifiable matter, iii) alkalinity and condensed phosphate, Iv) carbonate and total phosphate</p>	10
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2	Evaluation of detergent i) Moisture content, ii) Total available oxygen, iii) Foam stability, iv) Disc wetting, v) Acid value, vi) Bulk density, vii) Sodium silicate content	10
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3	To determine the borax content of given sample, To determine cloud point of given sample, Analysis of various cream: Physical evaluation and determine i) Total fatty matter, ii) Unsaponifiable matter, To study the principle of bottle , leaning	10
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List of Text Books/ Reference Books

1	BIS methods for testing of soaps and detergents
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Course Outcomes (students will be

1	Able to understand soap analysis
2	Able to describe the detergent analysis
3	Able to understand performance properties of soaps and detergents
4	Able to explain the composition of soaps and detergents
5	Able to explain the significance of various tests for soaps and detergents

Course Code: OLP 1206	Course Title: OLP 1206: biochemistry and microbiology lab (Marks 100)	Credits = 4		
		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

Biotechnology, Bioprocess Technology, Enzyme Technology, Biochemistry and Microbiology.	
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Description of relevance of this course in the B. Tech. (Oils) Programme

Since research being done in this institute is interdisciplinary and covers a wide area of objectives, this course will help students to understand practical biochemistry and microbiology in a better way. Also, students will get a hands on experience in handling microorganisms, understand their growth kinetics and other related aspects. Understanding of enzyme kinetics forms a basis of greener approach in surfactants and oil based reactions. These aspects will also be covered in the mentioned practical course.

	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction to microbiology	2
2	Basic laboratory tools and equipment. (Microscopy, sterilization techniques, etc)	2
3	Preparation of liquid and solid media. (Different media preparation for cultures: nutrient agar, nutrient broth, differential media preparation etc.)	3
4	Preparation of mixed cultures from air, water and soil sample.	3
5	Isolation of pure culture from mixed culture	3
6	To perform Gram staining	3
7	To perform basic staining	2
8	To perform negative staining	2
9	Growth curve estimation	3

10	Antibiotic sensitivity test	3
11	Extracellular enzyme isolation from microbial source	3
12	Lipase catalyzed esterification reaction	3
13	Fermentation of simple carbohydrates	3
14	Protein estimation by Lowry's method.	3
15	Estimation of reducing sugar by DNS method.	3
16	Extraction of amylase enzyme from potato and qualitative detection by starch iodide method	3
17	Estimation of amylase activity by DNS method	3
18	Effect of pH on enzyme activity	3
19	Immobilization of amylase enzyme in sodium alginate system	3
20	Thin layer chromatography of amino acids	3
21	Stain removal by enzymes	2
22	Isoelectric precipitation of protein: Casein from milk	2

List of Text Books/ Reference Books

1	Laboratory Manual of Microbiology for Biotechnology Students by Kanakam E
2	Laboratory Manual of Microbiology & Biotechnology by K.R Aneja
3	Microbiology and practical microbiology by Prescott
4	Laboratory manual in microbiology by P. Gunasekaran
5	Laboratory Manual of Biochemistry Methods And Techniques by R S Sengar
6	Laboratory manual of Biochemistry by Arun K Zingare
7	Laboratory manual in biochemistry by J.Jayaraman

Course Outcomes (students will be

1	Handle microbial strains
2	Perform enzyme catalyzed reactions
3	Study rate kinetics
4	Estimate biomolecules in sample by different tests.
5	Get acquainted with different biochemistry and microbiology tools and equipment.

	Course Code: OLP 1207	Course Title: Paint Technology Laboratory (Marks 50)	Credits = 2		
			L	T	P
	Semester: VI	Total contact hours: 30	0	0	4
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Technology of Olochemicals, Chemistry and Technology of Drying Oils and Resins, Processing of paints and printing inks.				
Description of relevance of this course in the B. Tech. (Oils) Programme					
This laboratory will help to understand students the chemistry of different drying oils and resins. They will be able to explain the its applications in surface coating/ paints etc. according to the chemistry involved.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	To prepare alkyd resin and its analysis				3
2	Preparation and evaluation of short oil/long oil resin varnishes				3
3	Preparation and evaluation of Epoxy resin				3
4	Analysis of resins for Acid value, Hydroxy value % solids, Viscosity, Drying, Adhesion, Hardness and resistance characteristics.				3
5	To prepare the red oxide metal primer and evaluation of its properties				3
6	Analysis of paint properties like hiding power, drying, DPUR etc				3
7	Preparation of varnishes and preliminary analysis of products.				3
8	Analysis of General purpose air-drying paint as per the specification.				3
9	Formulation of wall finishes and its analysis.				3
10	Preparation and Analysis of Emulsion paint as per the IS specification.				3
11	Preparation and Analysis of Aluminum paint as per the IS specification				3
List of Text Books/ Reference Books					
1	The Testing of Paints, Vol – V, Paint Technology Manual,.Dunkley F.G. and Collier, C.W., Chapman and Hall.London				
2	Paint film defects and their remedies, Manfred, H., Chapman and Hall Ltd. London.				

3	Introduction to paint chemistry – Principles of paint technology, Turner G.P.A., Chapman and Hall , London
4	OCCA Surface Coating Technology Vol, 1 & 11
5	Paint Technology Manuals., Oil and color chemists Association, Vol-I – Vol. VIII, Chapman and Hall , London
Course Outcomes (students will be	
1	Able to understand fundamental knowledge on basics of chemistry involved in the Paints
2	Able to describe the types of resins, Pigments and additives with their applications
3	Able to understand and explain the physical properties of different types of resins in paints and inks.
4	Able to explain the methods used for manufacture for different paints.
5	Able to explain the different properties of paints on the basis of application,

	Course Code: OLT 1109 Elective 1	Course Title: Supramolecular Chemistry of Nanomaterials (Marks 50)	Credits = 3		
	Semester: VI		Total contact hours: 30	L	T
			2	1	0
List of Prerequisite Courses					
	Basic Organic, Inorganic and Physical Chemistry				
List of Courses where this course will be prerequisite					
	Production and applications of soaps, surfactants, perfumery chemicals etc., Advanced Materials and Nanotechnology				
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry of supramolecules and the importance of supramolecular interactions for the assembly of nanomaterials, self-assembly of stimuli-responsive nanoparticles etc..					
	Course Contents (Topics and subtopics)				Reqd. 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, Hydrophobic interactions. Concepts of host–guest chemistry and self-assembly				5

2	Self-assembly processes in organic systems - Catenanes, rotaxanes. Self-assembly processes in metal-containing compounds - Self-assembled supramolecular cages	5
3	Self-assembled Monolayers (SAMs) on flat and curved	5
4	Synthesis, structure and important properties of metal nanoparticles	10
5	Molecular switches and machines. Self-assembly of stimuli-responsive nanoparticles	5

List of Text Books/ Reference Books

1	"Core Concepts in Supramolecular Chemistry and Nanochemistry", Jonathan W. Steed, David R. Turner, Karl Wallace, Wiley, 2007 (ISBN: 978-0-470-85867-7)
2	"Supramolecular Chemistry: An Introduction", Fritz Vogtle, Wiley, 1991 (ISBN: 047192802X)
3	References that would be provided during lectures

Course Outcomes (students will be

1	The students will be able to identify the main supramolecular forces involved in supramolecular assemblies
2	The students will be able to understand the importance of intermolecular forces to define the "chemistry beyond the molecule"
3	The students will be able to recognize the main types of supramolecular assemblies and to rationalise the formation of complex nanomaterials
4	The students will be able to understand the chemistry of nanoparticles
5	The students will be able to know the chemistry of 'molecular switches' and self-assembly of stimuli-responsive nanoparticles

Semester VII

Sr. No.	Course Code	Subjects	Faculty	Hours/week (L+T)	Marks	Credits
1		Instrumentation and Process Control		2+1	50	3
2	OLT 1110	Technology of Drying Oils and Resins	RDK	3+1	100	4
3	OLT 1114	By Products Utilization and Waste Management	APP	2+1	50	3
4	OLT 1112	Technology of Oleochemicals	CSM	2+1	50	3
5		Humanities / Management Subject I		2+1	50	3
		TOTAL		16	300	16
		Chem. Eng. Laboratory		2	50	2
	OLP 1208	Seminar	All Faculty	2	50	2
	OLP 1209	Project I	All Faculty	4	100	4
		Total Practicals		08	200	8
				24	500	24

	Course Code: OLT 1110	Course Title: Chemistry and Technology of Drying Oils and Resins (Marks 100)	Credits = 4		
			L	T	P
	Semester: VII	Total contact hours: 60	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.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Classification of non drying, semi drying and drying oils. Processing of semidrying and drying oils. Acid refining, oxidative and thermal polymerization of oils and its mechanisms. Stand oils, blown oils, bodied oils. Chemistry of driers (Pb, Co, Mn, Zr, Fe, etc.) Dimer acids				15

2	Synthesis of alkyd resins. Fatty acid route, mono glyceride route, solvent process, fusion process, classification of alkyd resins according to oil length (short/ medium/ long oil), choice of polybasic acid	10
3	Chemical and physical modification of alkyd resins, uralkyd, epoxy esters, alkyl polyamide, silicon modified alkyd	10
4	Natural resins Natural resins classification, composition, physical and chemical properties of Rosin, shellac, Copl, manila	10
5	Synthetic Resins - Amino resins, urea formaldehyde, epoxy resins, and their application, polyamide resin, chlorinated rubber	
5	vinyl resins. Polyurethanes, classification, properties and application	15

List of Text Books/ Reference Books

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

Course Outcomes (students will be

1	Able to understand fundamental knowledge on basics of chemistry involved in the drying Oils
2	Able to describe the types of drying Oils, resins and their applications
3	Able to understand and explain the physical properties of natural resins and synthetic resins.
4	Able to explain the synthetic methods used for manufacture of alkyd resins,
5	Able to explain the types of resins and drying Oils on the basis of application,

	Course Code: OLP 1112	Course Title: OLT 1112 Technology of oleochemicals (Marks 50)	Credits = 4		
			L	T	P
	Semester: VII	Total contact hours: 30	2	1	0
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Chemistry of Oils and Lipids, Chemistry of Oils, Cosmetics Science, Oil and fat production, Analysis of soaps and surfactants				
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry and technology of oleochemicals They will be able to explain its applications in various processes, techniques and schemes according to the chemistry involved.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Fatty acids, theory and practice of fat splitting, and purification of products				5
2	Separation of fats and fatty acids				4
3	Miscellaneous applications of these in food, pharmaceutical, textile, plastic, leather and other industries				7
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 glycerin				5
5	Miscellaneous fat-based produced: Manufacture and utilization of nitrogen, phosphorous and sulfate containing products				5
6	Products obtained by interesterification, hydrogenation, oxidation and pyrolysis. Metallic soaps				4
List of Text Books/ Reference Books					
1	Glycerin, Key cosmetic ingredient by Eric Jugermann, Marcel Dekker Inc., (1991)				
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
3	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				

	Fatty Acids by Markley K. S. Vol. I to IV, Robert E. Krieger publishing Co. (1973)
	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)
	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)
5	Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)
Course Outcomes (students will be	
1	Able to understand the basic process of manufacture of different oleochemicals like fatty acid, glycerine, methyl esters and other derivatives.
2	Able to select the advance process for the manufacture of oleochemicals
3	Understand the advance method of analysis of oleochemicals.
4	Able to choose the specific method for the identification of particular oleochemical and understand its properties.
5	To find out the applications of different oleochemicals in food, pharmaceuticals, textile, leather industries.

	Course Code: OLT 1114	Course Title: Byproducts Utilization and Waste Management (Marks 50)	Credits = 3		
			L	T	P
	Semester: VII	Total contact hours: 30	2	1	0
List of Prerequisite Courses					
	Chemistry of Oils and fatty acids, Chemistry of Surfactants and Oleochemicals				
List of Courses where this course will be prerequisite					
	Project II				
Description of relevance of this course in the B. Tech. (dyes) Programme					
Students will understand the utilization of byproduct and waste management					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Disposal and utilization of by-products from oil processing industries: gums, soap-stock, acid oil, spent bleaching earth, deodorizer distillates and fatty acid distillates, spent nickel catalyst, glycerin and fatty acid distillation residues/pitch.				8
2	Protein based surfactants, microbial surfactants				4
3	Utilization of oilseed hulls (groundnut, sunflower), husk (rice bran), shell (coconut, cottonseed) and residues, production of surfactants from protein residues				6
4	Utilization of Waste frying oils, glycerin from bio-diesel industry				6
5	Primary, secondary and tertiary treatments for waste water. Aerobic and non aerobic treatment, Chemical, biological and total oxygen demand, Carbon adsorption				4
List of Text Books/ Reference Books					
1	Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)				
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula Vol. I & II, Industrial Consultants (India), (1994)				
3	Natural fatty acids and their sources by E. H. Pryde				
Course Outcomes (students will be					

1	Able to understand basics of waste management
2	Able to describe the possible utilization and value addition to the byproducts
3	Able to understand and explain synthesis of novel oleochemicals from waste streams/byproducts
4	Able to explain the various techniques for waste water treatments and pollution control
5	Able to explain the technology for futuristic applications of byproducts

	Course Code: OLT 1110	Course Title: Processing of Paints and Printing Inks (Marks 50)	Credits = 3		
	Semester: VII		Total contact hours: 30	L 2	T 1
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Technology of Olochemicals, Chemistry and Technology of Drying Oils and Resins , Paint technology laboratory.				
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry behind the paint formulation and printing ink. 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	Composition of paints: pigments, polymers, additive, solvents and their role. Classification of paints: i) primer, undercoat, upcoat ii) decorative vs industrial iii) water borne, solvent borne/ powder etc.				5
2	Inorganic and organic pigments (TiO ₂ , CaCO ₃ , carbon black, pthalocyanin blue, toludine red, red oxide etc.				5
3	Additives: wetting, dispersing, antimicrobial, antifoaming, thixotropic, antisetling etc.				3
4	Processing machinery: ball mill, bead mill, high speed disperser, triple roll mill, typical lay out, paint processing plant				5

5	Different paint products archtechnical coating, DEM paints, Appliance, finishes, powder coatings, electro deposition coatings etc.	7
6	Manufacture Process- characteristics- raw materials- formulations for printing ink, problem and their solution,	5

List of Text Books/ Reference Books

1	Outline of paint technology, Morgans, W.M. Edward Arnold Publishers, ,London
2	Protective and Decorative Coatings, Paint, Varnishes, Lacquers, and Inks, Mattiello, J. J., John Wiley and Sons, New York.
3	Organic Coating Technology Vol, 1 & 11 by, Payne, H.Y.
4	Paint Technology Manuals., Oil and color chemists Association, Vol-I – Vol. VIII, Chapman and Hall , London
5	Pigment Hand book Vol. 1 – Vol. VIII,. Patton, T. C., Wiley-Inter science Publications,New York.
6	Introduction to paint chemistry – Principles of paint technology, Turner G.P.A.,, Chapman and Hall , London

Course Outcomes (students will be

1	Able to understand fundamental knowledge on basics of chemistry involved in the Paints
2	Able to describe the types of Paints, Pigments and additives with their applications
3	Able to understand and explain the physical properties of different types of paints and inks.
4	Able to explain the synthetic methods used for manufacture of printing inks.
5	Able to explain the types of processing of paints and inks on the basis of application,

Semester VIII

Sr. No.	Course Code	Subjects	Faculty	Hours/week (L+T)	Marks	Credits
1		Project Engineering and Economics		3+1	100	4
2	OLT 1113	Functional Fluids and Performance Chemicals	APP	2+1	50	3
3	OLT 1116	Nutraceuticals	JSW	2+1	50	3
4	OLT 1115	Petroleum Technology	VF/ Dr. Rajeev Churi	3+1	100	4
5	OLT 1112	Elective III: : Structural Elucidations by Advanced Spectroscopy	PKK	2+1	50	3
		TOTAL		17	350	17
6	OLP 1210	Project II	All Faculty	4	100	4
7	OLP 1211	Processing of Soaps, Detergents & Surfactants and Triboapplications Laboratory	APP/ PKK	4	100	4
		Total Practicals		08	200	8
				25	550	25

	Course Code: OLT 1113	Course Title: Functional Fluids and Performance Chemicals (Marks 50)	Credits = 3			
			L	T	P	
	Semester: VIII	Total contact hours: 30	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					5

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	5
3	Petroleum based, synthetic and vegetable oil based lubricants: properties and applications	6
4	Re-refining of waste lube oils: physical and chemical processes. Advantages and limitations	2
	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.	4
	Greases: definition, types, classification, raw material, manufacturing process, specifications and applications.	3
	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.	3
	Engine coolants: purpose, composition (glycerol, polyglycerol and MEG based), manufacturing process, properties.	2

List of Text Books/ Reference Books

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

Course Outcomes (students will be

1	Able to understand basics of lubricants and functional fluids
2	Able to describe the properties and functions of various types of base oils (petroleum and biobased)
3	Able to understand and explain synthesis and properties of performance chemicals
4	Able to explain the various properties and applications of functional fluids and performance chemicals
5	Able to explain the technology for regeneration of waste lube oil, engine coolants and greases

Course Code: OLT 1111	Course Title: Nutraceuticals (Marks 50)	Credits =		
		3		
		L	T	P
Semester: VII	Total contact hours: 30	2	1	0

List of Prerequisite Courses		
	Chemistry of Oils and fatty acids, chemistry of oils, lipids and Essential Oils	
List of Courses where this course will be prerequisite		
	Advanced nutrition	
Description of relevance of this course in the B. Tech. (dyes) Programme		
Students will understand the micronutrients in oils and fats and will be able to explain methods of separation and applications of it.		
	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction to nutraceuticals: definitions, synonymous terms, claims for a compound as nutraceutical, regulatory issues.	10
2	Study of Properties, structure and functions of various Nutraceuticals, such as carotene, lycopene, omega fatty acids, phytosterols etc, formulation of functional food, stability, analysis.	5
3	Manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids.	5
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
Course Outcomes (students will be		
1	Able to understand basics of nutraceuticals and regulatory issues	
2	Able to describe the properties and functions of nutraceuticals	
3	Able to understand and explain manufacturing of nutraceuticals	
4	Able to explain the nutritional genomics and market information	
5	Able to explain the applications, Consumers' views on nutraceuticals, Labeling and claims for Nutraceuticals products of perfumery chemicals	

	Course Code: OLT 1115	Course Title: Petroleum Technology (Marks 100)	Credits = 4		
			L	T	P
	Semester: VIII	Total contact hours: 60	3	1	0

List of Prerequisite Courses		
	Functional Fluids and Performance Chemicals	
List of Courses where this course will be prerequisite		
	Project II	
Description of relevance of this course in the B. Tech. (dyes) Programme		
Students will understand the petroleum refining operation and technology for petrochemicals		
	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction to crude oil, Sour crude and sweet crude, physicochemical properties, composition. National and global petroleum scenario	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
4	Processing of Light and Heavy Distillates, Thermal cracking, Catalytic cracking, Visbreaking, Coking, Hydroprocessing	6
5	Processing heavy residue fraction using solvents. Source of such solvents. Process diagram for Atmospheric distillation unit (ADU) and vacuum distillation unit (VDU).	8
6	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
List of Text Books/ Reference Books		
1	Crude Oil Chemistry by Vastly Simanzhenkov and Raphael Idem	
2	Petroleum Refining <i>Technology and Economics</i> (Fourth Edition) by James H. Gary and Glenn E. Handwerk	

3	Refining processes Handbook by Surinder parkash
Course Outcomes (students will be)	
1	Able to understand basics of crude oil, national and international scenario
2	Able to describe the processes for petroleum refining
3	Able to understand and explain the plant and processes for petrochemicals
4	Able to explain the key processes and products from petroleum
5	Able to explain the various applications of petrochemicals

	Course Code: OLT 1211	Course Title: Processing of soaps and detergents and surfactants and Triboapplications Laboratory (Marks 100)	Credits = 4		
	Semester: VIII	Total contact hours: 60	L	T	P
			0	0	4

List of Prerequisite Courses

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

List of Courses where this course will be prerequisite

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

Students will understand soap, detergent formulations and its evaluation. Luricant testing

Course Contents (Topics and subtopics)

		Reqd. hours
1	Analysis of soap noodles, and commercial toilet soap, bathing bar, laundry soap, liquid soap, transparent soap, shaving soap. Analysis of linear alkyl benzene sulphonic acid and commercial detergents	
2	Synthesis various anionic, cationic, nonionic and amphoteric surfactants like naphthalene sulphonates, turkey red oil, sulphated oils. DEG, PEG and poly glycerol, condensation products of ethanol amides, benzalkonium chloride, Quarternary ammonium compounds, betains and sulphobetains etc.	
3	Application of surfactants: Formulation using surfactants like floor cleaner, detergent, cosmetics, etc.	

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.)	
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.	

List of Text Books/ Reference Books

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

Course Outcomes (students will be

1	Able to understand raw materials and soap formulation and its analysis
2	Able to describe the synthesis of various types of surfactants
3	Able to understand and explain the detergent formulation and its analysis
4	Able to explain the applications of surfactants for various home and personal care products
5	Able to explain the various testing methods for lubricants

	Course Code: OLT 1121	Course Title: Spectroscopy of Organic Molecules (Marks 50)	Credits = 3		
			L	T	P
	Semester: VIII	Total contact hours: 30	2	1	0

List of Prerequisite Courses

Basic Organic Chemistry, Basic Principles of Quantum Theory

List of Courses where this course will be prerequisite

Oils Chemistry and Technology. Dyes Chemistry and Technology

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 which will pave the way to identify organic compounds.		
	Course Contents (Topics and subtopics)	Reqd. 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 (FT spectrometer), correlation charts and tables, identification of functional groups, hydrogen bonding etc.	8
3	Ultraviolet–Visible (UV-Vis) Spectroscopy: Principles, instrumentation, presentation of spectrum, chromophore etc. Studies of conjugated and extended conjugated systems, solvent effects, Beer-Lambert law.	5
4	Nuclear Magnetic Resonance (NMR) Spectroscopy: Basic concepts and principles, mechanism of resonance, diamagnetic anisotropy, chemical shift, factors that influence ¹ H-NMR chemical shifts. Spin-spin splitting, coupling constant, factors influencing coupling constant. Notations (AB, AX, ABC, ABX, AMX etc.). Typical ¹ H-NMR spectra of different compounds.	15

List of Text Books/ Reference Books	
1	D. L. Pavia et al., Introduction to Spectroscopy, 5 th ed., Cengage learning, 2015.
2	P. S. Kalsi, Spectroscopy of Organic Compounds, 6 th ed, New age international publishers, 2007.
3	C. N. Banwell, Fundamentals of Molecular Spectroscopy, 3 rd ed., TMH, New Delhi, 1983.
4	W. Kemp, Organic Spectroscopy, 3 rd Ed., MacMillon, 1994.
Course Outcomes (students will be	
1	The students will be able to learn basic principles of IR spectroscopy
2	The students will be able to learn principles of UV-visible spectroscopy
3	The students will be able to learn basic principles of NMR spectroscopy
4	The students will be able to elucidate structure of organic compounds via these <i>advanced tools</i> (infrared spectroscopy, ultra-violet spectroscopy, nuclear magnetic resonance and mass spectrometry).