

**CURRICULUM AND DETAILED
SYLLABI**

FOR

B. Tech Chemical Technology-Oil Technology Degree

FOR THE STUDENTS ADMITTED FROM

THE ACADEMIC YEAR 2017-2018

ONWARDS

Harcourt Butler Technical University

Kanpur –208002, UP, India

Web: www.hbtu.ac.in

Harcourt Butler Technical University

DEPARTMENT OF OIL TECHNOLOGY,

SCHOOL OF CHEMICAL TECHNOLOGY

I) Vision

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

II) Mission

We are committed to:

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

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

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

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

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

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

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

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

Programme Outcomes(POs)		Graduate Attributes (GAs)
PO1.	Apply the knowledge of mathematics, science, engineering fundamentals and Engineering concepts for the solution of complex Engineering problems	Engineering Knowledge
PO2.	Identify, formulate, review literature and analyze complex problems related to Chemical Technology-Oil Technology reaching substantiated conclusions using first principles of mathematics and engineering sciences.	Problem Analysis
PO3.	Design solutions for complex problems in Chemical Technology-Oil Technology and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	Design/Development of solutions
PO4.	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	Conduct Investigations of complex problems
PO5.	Create, select, and apply appropriate techniques, resources, and modern engineering tools such as optimization techniques, simulations, including prediction and modeling to complex process Engineering problems with an understanding of their limitations.	Modern Tool Usage
PO6.	Apply contextual knowledge with justification to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering and Chemical Technology-Oil Technology professional practice	The Engineer & Society
PO7.	Understand the impact of the professional engineering and Chemical Technology-Oil Technology solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	Environment and Sustainability
PO8.	Apply ethical principles and commit to professional ethics adhering to the norms of the engineering and Chemical Technology-Oil Technology practice	Ethics
PO9.	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	Communication

PO10.	Communicate effectively on complex engineering and Chemical Technology-Oil Technology activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Individual and Team work
PO11.	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	Life long Learning
PO12.	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage engineering and Chemical Technology-Oil Technology projects and in multi disciplinary environments.	Project management & Finance

TOT-201 CHEMISTRY OF OILS & ALLIED PRODUCTS**L : T: P****3 : 0: 6****Preamble:**

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

Prerequisite:

Students are required to have basic knowledge of Chemistry.

Course Outcome:

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

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

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	L	L	L	L	S	S	L
CO2	L	M	M	L	L	S	L	L	L	L	S	L
CO3	M	S	M	M	M	M	L	S	M	M	S	L
CO4	S	S	M	M	S	S	M	M	S	S	S	L
CO5	S	S	S	S	S	S	S	S	S	S	S	L

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

History and general introduction

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

Module –II

Non-glyceride components, important minor constituents and contaminants

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

Module– III

Physico-chemical characteristics of natural oils, fats and fatty acids

Oiliness and viscosity, cloud point, titre, density and coefficient of expansion, melting point, plasticity of fats & plastic range, smoke, flash and fire points, Boiling point; solubility and miscibility, refractive index, Acid value, saponification value, Iodine value, thiocyanogen value, diene value, acetyl and hydroxyl value Riechert Miessel and Polensky values, and Kirshner value, Peroxide Value, Anisidine Value, Oxirane Value, TBA value, Totox value, unsaponifiable matter. BIS methods for testing of oils and fats

Module–IV

Adulteration tests for vegetable and animal fats and oils and their chemistry

Bouffard's Test, Holde Test, Halphens test, Hexa Bromide Test, Ammonium Molybdate test, Belliers Turbidity Test, Test for the presence of Argemone, Sal Neem Kusum, Karanja, Animal fat, Allyl isothiocyanate test, Detection of rice bran oil in other oils and other relevant test.

Module–V

Brief introduction to chemical reactions of fats and fatty acids

Esterification, interesterification, saponification, hydrolysis: reactions involving the carboxyl groups e.g., formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc.: alkoxylation, pyrolysis:

reactions in the fatty acid chain; hydrogenation, dehydrogenation, halogenation, addition of sulphur, phenols, cresols, hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds, Rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants

Module- VI

Laboratory work

Determination of physical characteristics of oils and fats as per BIS- Specific gravity, Refractive Index, Color, Viscosity by Ford cup and Ostwald Viscometer, Titre

Determination of chemical characteristics of oils and fats as per BIS- Acid value, Saponification value, Iodine Value, Hydroxyl and acetyl Value, Peroxide value

Detection of adulteration in oils and fats as per BIS- Boudiens Test, Holde Test, Halphens test, Hexa Bromide Test, Ammonium Molybdate test, Belliers Turbidity Test, Test for the presence of Argemone, Adulteration of rice bran in mustard oil

Reference Books and suggested readings:

1. Bailey's Industrial Oil and Fat Products, Edition 6 Vol-1 (2005), Edited by Feireidoon Shahidi
2. A text book of oil and fat analysis By Cocks & Reid
3. An introduction to chemistry & Bio chemistry of Fatty acids & their glyceride By F.D. Gunstone.
4. Oils and Fats Manual Vol- I, 1996, Edited by A. Karleskind
5. Chemistry and Technology of Oils and Fats, 2003, Edited by M.M. Chakraborty
6. BIS specifications; IS- 548, part I,II& III
7. Food Lipids; Chemistry Nutrition and Biotechnology by Casimir C. Akoh & David B. Min
8. Lipid Analysis of Oils &Fats, P.J. Hamilton, Liver pool, John Moores Univ., Liver Pool (UK)
9. Modern Technology in Oils and Fats Industry, Vol-II, OTAI (NZ)
10. Handbook of Oil Technology by AOCS
11. BIS specifications; IS- 548, part I, II
12. A text book of oil and fat analysis By Cocks & Reid
13. Food Lipids; Chemistry Nutrition and Biotechnology by Casimir C. Akoh & David B. Min
14. Lipid Analysis of Oils & Fats, P.J. Hamilton, Liver pool, John Moores Univ., Liver Pool (UK)
15. Modern Technology in Oils and Fats Industry, Vol-II, OTAI (NZ)
16. Analysis of Oil & Fats by Bookenhoogen

Course Objective:

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

Course Outcome:

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

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	History and general introduction	
1.1	Oils, fats, waxes, mineral oils, essential oils, their sources	2
1.2	Composition and structures of Oils, fats, waxes, mineral oils, essential oils.	2
1.3	Constituents of natural fats Glycerides and fatty acids, their nomenclature, classification and principle sources.	2
1.4	Theories of glyceride structure.	1
1.5	Production and consumption pattern of various Oils & Fats in the Country vis-à-vis world.	1
2.	Non-glyceride components, important minor constituents and contaminants	
2.1	Phosphatides, sterols, gossypol, carotenoids, hydrocarbons	2
2.2	Coloring matter, natural pigments, vitamins, antioxidants, Fatty Alcohols	1
2.3	Sterols, Tocopherols, Tocotrinols, Oryzanols, Triterpine Alcohols Waxes etc. Gossypol, Sesamol and Sesamoline, Flavoring compounds	2
2.4	Some minor important constituents of oilseeds: ricin, sinigrin, linamarine, saponin, allylisoithiocyanate, gossypol, sesamol and sesamoline; environmental contaminants.	2
3.	Physico-chemical characteristics of natural oils, fats and fatty acids	
3.1	BIS methods for testing of oils and fats	1
3.2	Oiliness and viscosity, cloud point, titre, density and coefficient of expansion	1
3.3	Melting point, plasticity of fats & plastic range, smoke, flash and fire points, Boiling point	1
3.4	Solubility and miscibility, refractive index	1
3.5	Acid value, saponification value, Iodine value, unsaponifiable matter.	2
3.6	Thiocyanogen value, diene value, acetyl and hydroxyl value Riechert Miessel and Polensky values, and Kirshner value.	2
3.7	Peroxide Value, Anisidine Value, Oxirane Value, TBA value, Totox value.	1
4.	Adulteration tests for vegetable and animal fats and oils and their chemistry	
4.1	Boudiens Test, Holde Test, Halphens test.	1
4.2	Hexa Bromide Test, Ammonium Molybdate test, Belliers Turbidity Test	2
4.3	Test for the presence of Argemone, Sal Neem Kusum, Karanja, Animal fat, Allylisoithiocyanate test.	3
4.4	Detection of ricebran oil in other oils and other relevant test.	1
5.	Brief introduction to chemical reactions of fats and fatty acids	
5.1	Esterification, interesterification, saponification, hydrolysis: reactions involving the carboxyl groups.	2
5.2	formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc.	1
5.3	alkoxylation, pyrolysis.	1
5.4	hydrogenation, dehydrogenation, halogenation.	1
5.5	addition of sulphur, phenols, cresols, hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds.	2
5.6	Rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants	2
Total		40

TOT-202 Sources, Composition, Characterization of Oils, Fats and Waxes**L : T: P
3 : 0: 3****Preamble:**

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

Prerequisite:

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

Course Outcome:

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

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

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	M	L	M	L	M	S	S	L
CO2	L	M	M	L	L	S	M	L	M	L	S	L
CO3	M	S	M	L	M	M	L	S	M	L	S	L
CO4	S	S	M	M	S	S	M	M	S	S	S	L
CO5	S	S	M	S	S	M	S	S	S	M	S	L

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

Composition characteristics and use:

1. Natural waxes
2. Synthetic waxes.

Syllabus:

Module-I

Natural sources of oils and fats

Global and National production, demand and supply scenario of oilseed and oils, Import and export of oils, oilseeds and oil cake, Past trends and future projections in fluctuations of production and price and their reasons.

Module-II

Handling and Storage of Oils and oilseeds

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

Module-III

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

Coconut, palm, palm kernel, olive, cocoa butter, sunflower, safflower, sesame, groundnut, mustard, rape-seed, canola, soybean, niger seed, linseed, castor, rice-bran, cottonseed, corn, tung, oiticica, neem, mahua, kusum, karanja, sal, mango kernel, tobacco, shea fat, watermelon, wheat germ, algae oils, chiaseed oil, jatropha etc. Genetically modified oilseeds

Module-IV

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

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

Module-V

Natural and synthetic waxes characteristics, composition and utilization

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

Module- VI**Laboratory work**

Analysis of oilseeds and cakes as per FSSAI/ BIS methods- Moisture Content, Oil Content, Nitrogen/ Protein Content, Crude fiber Content, Ash Content

Analysis of extracted oils/ de-oiled cake- FFA, MIV, Color, Flash Point, Phosphatides & wax, pop test, protein, sand & silica, urease activity.

Reference Book

1. Bailey's Industrial Oil and Fat, Edition 6 Vol-2 (2005), Edited by Feireidoon Shahidi
2. Oils & fats Technology Edited by E. Bernardini
3. Neem: A wonder tree Edited by R.K. Suri & Mehrotra
4. Non Traditional oilseeds and oils in India, (1987) Edited by N.V. Bringi
5. Rapeseed cultivation, composition, processing and utilization Edited by L.A. Appelquist & R.Ohlson
6. Deep Frying; Chemistry, Nutrition and Practical Application, Michel D.Erickson IIInd Edition
7. Tree borne oil seeds, KVIC, Mumbai.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Natural sources of oils and fats	
1.1	Global and national production of oil seeds and oil	2
1.2	Demand and supply scenario of oils and oil seed	2
1.3	Import and export of oils	1
1.4	Import and export of oil seeds	1
1.5	Import and export of cake	1
1.6	Fast trends and future projections in fluctuation of production and price and their reasons	2
2.	Handling and Storage of Oils and oilseeds	
2.1	Handling of oil seeds and oil bearing material and crude oils	2
2.2	Storage of oil seeds	1
2.3	Grading and evaluation of oil seed and oil bearing material as per BIS/Codex	1
2.4	Drying of oil seeds	2
3.	Commercial oils, oilseeds, cultivation, characteristics, composition and utilization from plant sources	
3.1	Coco nut, palm, kernel	1
3.2	Olive, Cocoa butter, sun flower	1
3.3	Safflower, sesame, ground nut	1
3.4	Mustard rape-seeds canola, niger seed	1
3.5	Soybean, linseed, castor	1
3.6	Rice bran cotton seed, corn, tung,	1
3.7	Oiticica, neem, mahua, kusum	1
3.8	Karanja, Sal, Mango kernel, tobacco	1
3.9	Shea fat, watermelon, wheat germ	1
3.10	Alage oils, Chiaseed oil, jatropha	1

3.11	Genetically modify oil seeds	1
4.	Production, characteristics, composition and utilization of oils from animal sources	
4.1	Milk fats and butter	1
4.2	Animal fats, lard tallow	1
4.3	Emu oil and greases	1
4.4	Fish and marine oils: halibut, herring, shark	1
4.5	Menhaden, whale	1
4.6	Sardine oil, fish liver oils, krill oil	1
4.7	Different methods of rendering	1
5.	Natural and synthetic waxes characteristics, composition and utilization	
5.1	Natural waxes such as bees wax, shellac wax	1
5.2	Carnauba wax, sugar cane wax	1
5.3	Montana wax, Jojoba wax	1
5.4	Sperm oil, rice bran	1
5.5	Sunflower and spermaceti	1
5.6	Synthetic waxes their occurrence and classifications	2
5.7	General properties and uses of synthetic waxes	1
	Total	41

**TOT-301 EXPRESSION AND EXTRACTION TECHNIQUES
OF OIL BEARING MATERIALS**

L : T: P

3 : 0: 0

Preamble:

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

Prerequisite:

Knowledge of various oil bearing materials oil seeds cakes etc.

Course Outcome:

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

(CO1)	Acquire the knowledge of various oil bearing materials, oil seeds, cakes and their processing for oil extraction the need of analytical methods for better oil contents quality.	Understand
(CO2)	Select processes for seed preparation.	Apply
(CO3)	Select methods of oil expression & extraction, their performances, preventive maintenances, product quality, adoption of green technologies.	Apply
(CO4)	Assess quantity and quality of extracted oil& de-oiled cake, Impact on environment.	Analyze
(CO5)	Evaluate quality of end products viz extracted oils, de-oiled cake and process cost.	Evaluate

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	M	L	M	L	M	S	S	M
CO2	S	M	S	M	M	S	M	L	M	L	S	M
CO3	M	S	S	M	M	M	L	M	M	L	S	S
CO4	S	S	M	M	S	S	M	M	S	S	S	M
CO5	S	S	M	S	S	M	S	M	S	M	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

Pre-treatments of oil bearing materials:

Cleaning, delinting(for cotton seeds), dehulling, decortication, size reduction, pre-pressing, flaking, extrusion, pelletization, stabilization (for rice bran), etc. Plants, processes and the machinery used.

Module-II

Production of Oil by mechanical expression:

Machinery employed for expression/ mechanical extraction of oils viz. Ghansis, hydraulic presses, screw presses, low pressure and high pressure expellers, expander- extruder system fruit processing for oil recovery, processing of palm & coconut and by products.

Module-III

Production of Oil by solvent extraction:

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

Module-IV

De-solventization of meals:

Equipments and plants employed for de-solventization from extracted meal and recovery of solvent from micella, current trends, storage & detoxification of oil cakes, production of protein products, concentrates and isolates

Module-V

Alternative extraction processes:

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

Reference Book and suggested readings:

Bailey's Industrial Oil and Fat, Edition 6 Vol-5 (2005), Edited by Feireidoon Shahidi

1. Oil and Fat Technology Edited by E. Bernardini
2. Solvent extraction of vegetable oil by Parikh
3. Oilseed and Oil Milling in India
4. Proceedings of AOCS
5. Handbook of SEA
6. Oil Extraction & Analysis (critical issue and comparative studies) , D.L. Luthria, US
7. Department of Agriculture Behtsville, Maryland
8. Solvent extraction of Oils, Monogram by Dr. R.K. Trivedi
9. Chemical Process safety by Crowl
10. A text book of oil and fat analysis By Cocks & Reid
11. Food Lipids; Chemistry Nutrition and Biotechnology By Casimir C. Akoh & David B. Min
12. Lipid Analysis of Oils & Fats, P. J. Hamilton, Liver pool, John Moores Univ., Liver Pool (UK)
13. Modern Technology in Oils and Fats Industry, Vol-II, OTAI (NZ)
14. Analysis of Oil & Fats by Bookenhoogen
15. Analysis of Oil & Fats by Malhenbacher
16. Official methods of AOCS
17. Handbook of FSSAI

Course contents and Lecture schedule:

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

TOT-303 TECHNOLOGY OF SOAPS & FAT SPLITTING L : T : P
3 : 0 : 6

Preamble:

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

Prerequisite:

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

Course Outcome:

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

(CO1)	Have basic knowledge of various surface active agents, their effectiveness and applications.	Understand
(CO2)	Select raw materials on the basis of their properties and the requirement of finished products	Apply
(CO3)	Select method of Soap Manufacture, builders, fillers and additives.	Apply
(CO4)	Evaluate quality of raw materials and finished products	Evaluate
(CO5)	Assess process for saponification and develop formulation, to make it cost effective	Create

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	L	S	M	L	M	L	S	L	S	L
CO2	S	M	S	S	S	S	M	S	S	M	S	M
CO3	S	S	M	L	S	M	S	S	M	L	S	M
CO4	S	S	M	S	S	M	S	S	S	M	S	S
CO5	S	S	S	M	S	S	M	M	S	S	S	M

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

3. Knowledge of equipments and machineries required.

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

Fundamentals of soaps:

History and background of soaps, General principles of soap-making, chemistry of cleaning action in soaps. Study of saponification reaction, velocity and temperature. Raw material for soaps and their selection: role of INS factor, solubility ratio and hardness number, quality specifications and soap making properties of oils and fats. Selection and functions of builders, fillers and other auxiliary raw materials, Upgradation of raw materials including fractionation .

Module-II

Manufacture of household soaps:

Machinery employed and quality specifications with emphasis on effect on quality of milling and plodding, Production of soap base by traditional methods in single vessel, saponification in presence of catalysts and/or at high temperature and high pressure and Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes, phase behavior, Manufacture of soaps from fatty acids & methyl esters.

Module-III

Continuous processes of soap manufacture:

Principles related to the production of extruded soaps-solidification and high shear reaction system, drying, extrusion, solid-solid co-extrusion, homogenization and plastic working. Modern process and plant for the production of household and toilet soaps viz. cascade, mazzoni. Specifications of soaps and fatty acids as per BIS standards.

Module-IV

Manufacture of specialty soaps:

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

Module-V

Fat splitting and fatty acid distillation:

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

Module -VI

Laboratory work

Analysis of household washing and toilet soaps as per BIS- Moisture and volatile matter, Free alkali, Total alkali, Total fatty matter, Sodium chloride content, Glycerol content, Titre of fatty acids, Alcohol soluble & Insoluble, Analysis of P_2O_5 content in STPP, Analysis of Glycerin as per BIS/AOCS Method, Karl-Fischer method for determination of moisture, Analysis of synthetic detergent powders as per BIS; Active matter content, Moisture and volatile matter, Matter insoluble in water & alcohol, Active alkalinity, Chloride content, Analysis of alkyl benzene sulphonic acid as per methods of BIS, Determination of performance characteristics of surfactants and detergent products; Foaming power, Dispersing power, Relative detergency, Surface tension and Interfacial tension, Critical miscelle concentration, Detergency test.

Reference Books and suggested readings

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

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Fundamentals of soaps	
1.1	History and background of soaps, chemistry of cleaning action	1
1.2	General principles of soap-making	1
1.3	Raw material for soaps and their selection	3
1.4	Quality specifications and soap making properties of oils and fats	1
1.5	Selection and functions of builders, fillers and other auxiliary raw materials	2
1.6	Upgradation of raw materials including fractionation	1
2.	Manufacture of household soaps	
2.1	Machinery employed for soap manufacture	2
2.2	Quality specifications for toilet & laundry soaps	1
2.3	Machinery for milling and plodding	1
2.4	Production of soap base by traditional methods in single vessel	1
2.5	Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes	2
2.6	Manufacture of soaps from fatty acids & methyl esters	1
3.	Continuous processes of soap manufacture	
3.1	Production of extruded soaps-solidification	1
3.2	High shear reaction system	1
3.3	Modern process and plant for the production of household and toilet soaps	3
3.4	Cascade, mazzoni processes for the production of household and toilet soaps	2
3.5	Specifications of soaps and fatty acids as per BIS standards	1
4.	Manufacture of specialty soaps	
4.1	Soft soaps, liquid soaps	1
4.2	Transparent and translucent soaps	1
4.3	Super fatted soaps, medicated soaps	2
4.4	Floating soaps, multi coloured soaps	1
4.5	Soap powders like spray-chilled and spray-dried powders	2
5.	Fat splitting and fatty acid distillation	
5.1	Hydrolysis of oils and fats	1
5.2	Effect of temperature, pressure, catalyst and ratio of reactants in hydrolysis of fats	1
5.3	Plants and processes employed for fat splitting	2
5.4	Twitchell process	1
5.5	Enzymatic fat splitting, low, medium and high pressure autoclave processes	1
5.6	Semi-continuous and continuous processes of fat splitting	2
5.7	Fatty acid distillation, crystallization, fractionation, high purity fatty acid products blends distillation	2
5.8	Specifications of fatty acids and glycerin as per BIS, Recovery of glycerin from spent soap lye & sweet water	1

	Total 43
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TOT-302 Refining of Oils**L : T: P****3 : 0: 3****Preamble:**

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

Prerequisite:

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

Course Outcome:

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

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

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	L	S	M	L	M	L	S	L	S	L
CO2	S	M	S	S	S	S	M	S	S	M	S	M
CO3	S	S	M	L	S	M	S	S	M	L	S	M
CO4	S	S	S	M	S	S	M	M	S	S	S	M
CO5	S	S	M	S	S	M	S	S	S	M	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

Pretreatment of oils:

Impurities of crude oils & micronutrients: Effect of refining and other processing on specific impurities. Washing of crude cotton seed oil, degumming of oils and fats: Mechanism of degumming, various methods employed for degumming, Px series of separators, De-waxing of oils: Principle and methods of de-waxing of individual oils, Winterization in oils.

Module-II

De-acidification of oils and fats:

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

Module-III

Bleaching of oils and fats:

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

Module-IV

Deodorization of oils and utilities:

Components responsible for odor, flavor reversion, principle of deodorization, batch and continuous methods of deodorization; effect of operating variables; deodorization losses, commercial deodorizer design, thin film deodorization, Thermic fluid heater, thermo-syphoning, vacuum systems and their applications, steam generation, cooling tower.

Module-V

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

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

Module-VI

Laboratory work

Experiment for degumming, refining (alkali neutralization), bleaching of vegetable oils. Analysis of intermediate and by products; acid oils, neutral oil, soap stock, wash water, spent earth. Iron content and Wax content.

Reference Books and suggested readings:

1. Technology and refining of oil and fats by T.L. Mahatta
2. Bailey's Industrial Oil and Fat, Edition 6 Vol-5 (2005), Edited by Feireidoon Shahidi
3. Bleaching & purifying fats and oils; Theory & Practice Edited by H.B.W. Patterson
4. Practical guide in vegetable oil processing by Manoj K. Gupta
5. Chemistry & Technology of Oils & Fats by M.M. Chakarobarty
6. Fats & Oils Handbook by Michael Bockich
7. Fats & Oils handbook vol. 1 AOCS press
8. Fats & Oils by Richard O' brien

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Pretreatment of oils	
1.1	Micro Nutrients	1
1.2	Impurities of crude oil and methods of removal	1
1.3	Degumming of oil	1
1.4	Mechanism of degumming	1
1.5	Various methods- water, acid, dry, enzymatic	2
1.6	Super, top, alpha, special degumming, membrane filters	2
1.7	De-waxing	1
1.8	Winterization	1
2.	De-acidification of oils and fats	
2.1	De-acidification-chemical method	1
2.2	Alkali-type, strength and calculation of alkali requirement	2
2.3	Equipment used viz. mixers, separators, heat exchanger	1
2.4	Refining loss calculation, utilities	1
2.5	Miscella refining	1
2.6	Zenith refining	1
2.7	Physical refining, equipments used for physical refining	1
3.	Bleaching of oils and fats	
3.1	Treatment and disposal of gums, soap stocks	1
3.2	Theory of adsorption, bleaching components in oils	2
3.3	Bleaching earth physical and chemical characteristics	1
3.4	Bleach ability of oils/clay	1
3.5	Batch and continuous process of bleaching	1
3.6	Filtration techniques, Utilities	1
4.	Deodorization of oils and utilities	
4.1	Deodorization of oils	1
4.2	Components responsible for order, flavor reversion	1
4.3	Principle, batch and continuous de-odorisers	1
4.4	Operating variables, losses, Utilities	1
4.5	Deod Designs-thin films, packed column, soft column type	3
4.6	Vacuum systems and their applications, Energy conservation	1
4.7	Physical refining comparison over chemical refining	1
5.	Membrane technology, Biotechnology and other separation processes of crude vegetable oils and specification of refined oils	
5.1	Membrane process	1
5.2	Fractionation process	1
5.3	Water effluent treatment plant using bio technology	1
5.4	Micronutrients present in vegetable oil and effect of processing on micronutrients Nutritional significance.	1
5.5	Blending of oils; significance and specifications.	1
5.6	Specifications of oils as per FSSAI, permissible limits of additives	1
	Total	40

TOT-304: Quality Assurance of Oils and Allied Products**L : T: P****3 : 0: 6****Preamble:**

The subject deals with the study of techniques used for controlling and assuring the quality parameters of oil, fats and allied products. The detailed discussion of various techniques of chromatography and spectroscopy helps the students to work efficiently in the R&D and QC sections of the industries. The subject also expose the students to the safety measures and good manufacturing practices.

Prerequisite:

Fundamental knowledge of fatty acid composition of oils and chromatographic & spectroscopic techniques.

Course Outcome:

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

(CO1)	Understand the quality parameters of oils and allied products.	Understand
(CO2)	Use the acquired knowledge for controlling and assuring the quality parameters of oils and allied products.	Apply
(CO3)	Use the chromatographic & spectroscopic techniques for analysis of oils, oleo chemicals and allied products	Analyze
(CO4)	Use the knowledge for developing and confirming the composition of developed products.	Create
(CO5)	Use modern techniques for ensuring good manufacturing practices.	Apply

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	L	S	M	S	M	M	S	L	S	L
CO2	S	S	S	S	S	S	M	S	S	M	S	M
CO3	S	S	M	L	S	M	S	S	M	L	S	M
CO4	S	S	S	M	S	S	M	M	S	S	S	M
CO5	S	S	M	S	S	M	S	S	S	M	S	M

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Quality control and quality assurance in oils and allied industries.
2. Good manufacturing practices in the industry.
3. Hazard analysis and critical control points in oils and allied industries.

Course Outcome 2(CO2)

1. Role of chromatographic techniques in quality control of oils and fats.
2. Principle and application of GLC, HPLC & SFC.

Course Outcome 3(CO3)

1. Role of spectroscopic techniques in quality control of oils and fats.
2. Principle and application of UV-VIS, FTIR & NMR.

Course Outcome 4(CO4)

1. Estimation of metallic impurities in oils.
2. Estimation of vitamin A, D & E(natural & fortified).

Course Outcome 5(CO5)

1. Principle and application of hyphenated technique like TLC-FID/FPD, LCMS etc..
2. Working of mass spectrophotometer.

Syllabus

Module -I

Quality control and Quality Assurance:

Concept of quality assurance and quality control in relation to oil industry; quality management systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP); role of international organisations such as ISO; IDF; CAC; AOAC; WTO and national organisations like BIS; and Agmark; FSSAI and APEDA (Agricultural and Processed Foods Export Development Authority) in oil industry; guidelines for setting up quality control laboratory. Legislation on oils and allied products

Module-II

Chromatographic Techniques:

Theoretical developments of various techniques viz. thin layer chromatography, column chromatography, gas-liquid chromatography, HPLC and Super critical Chromatography; their principles, practices and their applications in the quality control and quality assurance of oils, fats and allied products.

Module -III

Spectroscopic Techniques;

Ultra-Violet, Visible, FTIR, NIR and NMR, Mass spectroscopic techniques: principles, practices and their application in the analysis of oils and allied products; Interpretation of spectra and quantitative applications.

Module -IV

Special quality control methods:

Nickel content of catalyst and hydrogenated oils; iron, sulphur and phosphatide content of crude and refined vegetable oils; wax content of vegetable oils; Vitamin A, D & E(natural & fortified); residual pesticide and solvent analysis, chlorophyll content, amino acid analysis by chemical and instrumental method etc.

Module -V

Hyphenated techniques:

TLC-FID/FPD, GC-MS, SFC-GC, LC-MS, ICP-MS, AAS in analysis of oils and fats.

Module –VI

Laboratory work

Determination of DOBI value for palm oil, Preparation of methyl esters from crude oils, Determination of fatty acid composition and detection of adulteration by Chromatographic techniques, Determination of mono, di and tri glyceride, Determination of di-ene and tri-ene content by UV-Visible, analysis of oils and fats using GC, GC-MS etc..

Reference Books and suggested readings:

1. Technology and refining of oil and fats by T.L. Mahatta
2. Bailey's Industrial Oil and Fat, Edition 6 Vol-5 (2005), Edited by Feireidoon Shahidi
3. Bleaching & purifying fats and oils; Theory & Practice Edited by H.B.W. Patterson
4. Practical guide in vegetable oil processing by Manoj K. Gupta
5. Chemistry & Technology of Oils & Fats by M.M. Chakarobarty
6. Fats & Oils Handbook by Michael Bockich
7. Fatty acids; Their chemistry, properties, production and uses Part – III Edited by K.S. Markley
8. Principles of Instrumentation analysis, Edition- III (1985) Edited by Douglas A. Skog
9. Standard methods of analysis CODEX, BIS, AOCS, ISO, FSSAI.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Quality control and Quality Assurance	
1.1	Concept of quality assurance and quality control in relation to oil industry	1
1.2	Quality management systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP)	2
1.3	Role of international organizations such as ISO; IDF; CAC; AOAC; WTO and national organizations like BIS; and Agmark; FSSAI and APEDA (Agricultural and Processed Foods Export Development Authority) in oil industry	2
1.4	Guidelines for setting up quality control laboratory. Legislation on oils and allied products	2
2.	Chromatographic Techniques	
2.1	Theoretical developments of various chromatographic techniques	2
2.2	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of thin layer chromatography	1
2.3	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of column chromatography	1
2.4	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of gas-liquid chromatography	2
2.5	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of HPLC	2
2.6	Principles, practices and applications in the quality control and quality	2

	assurance of oils, fats and allied products of Super critical Chromatography	
3.	Spectroscopic Techniques	
3.1	UV-VIS spectroscopic technique; Principle and its application in the analysis of oils and allied products	2
3.2	FTIR spectroscopic technique; Principle and its application in the analysis of oils and allied products	2
3.3	NIR spectroscopic technique; Principle and its application in the analysis of oils and allied products	1
3.4	NMR spectroscopic technique; Principle and its application in the analysis of oils and allied products	1
3.5	Mass spectrophotometer; Principle and its application in the analysis of oils and allied products	2
3.6	Interpretation of spectra and quantitative applications	1
4.	Special quality control methods	
4.1	Determination of Nickel content of catalyst and hydrogenated oils	1
4.2	Determination of Iron content of crude and refined vegetable oils	1
4.3	Determination of sulphur and phosphatide I content of crude and refined vegetable oils	1
4.4	Determination of wax content of vegetable oils	1
4.5	Determination of Iron content of vegetable oils	1
4.6	Determination of Vitamin A, D & E(natural & fortified); residual pesticide and solvent analysis, chlorophyll content, amino acid analysis by chemical and instrumental method	3
5.	Hyphenated techniques	
5.1	Role of TLC-FID/FPD in analysis of oils and fats	1
5.2	Role of GC-MS in analysis of oils and fats	1
5.3	Role of SFC-GC in analysis of oils and fats	1
5.4	Role of LC-MS in analysis of oils and fats	1
5.5	Role of ICP-MS in analysis of oils and fats	1
5.6	Role of AAS in analysis of oils and fats	1
Total hours		40

TOT-306: ESSENTIAL OILS & COSMETICS

L : T: P
3 : 0: 6

Preamble:

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

Prerequisite:

Knowledge of basic sciences organic chemistry, oils & fats.

Course Outcome:

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

(CO1)	Understand various essential oils, their sources & grades.	Understand
(CO2)	Characterize various essential oils in various applications as per their physico-	Analyze

	chemical properties	
(CO3)	Isolate various active components of essential oils and their recovery by different suitable process.	Apply
(CO4)	Synthesize and formulate various perfumery materials for different applications.	Create
(CO5)	Formulate various cosmetic products for different applications.	Create

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	M	M	M	L	M	L	S	S	S	M
CO2	M	M	M	M	M	S	M	L	S	L	S	M
CO3	M	S	M	M	M	M	L	M	M	L	S	S
CO4	S	S	S	M	S	S	M	S	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	M	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

3. Blending of various volatile oils and isolates.

Course Outcome 5(CO5)

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

Syllabus:

Module –I

Sources, classification and chemistry of essential oil bearing materials

Different methods of manufacturing essential oils, Grading and standardization of essential oils

Module -II

Physico-chemical characteristics of essential oils

Specific gravity, refractive index, optical rotation, solubility, acid value, ester value, Analysis of essential oils e.g. free alcohol, total alcohol, aldehyde and ketone content, phenol content, common adulterants and their detection

Module -III

Production, properties and composition of important Indian essential oils

Rose, jasmine, khus, sandal wood, keora, palmarosa, lemon-grass, peppermint, lemon, spices oils, clove oil, orange oil, eucalyptus oil, natural fats and bi additives compounds etc.

Module -IV

Important isolates, synthetic perfumery materials and fixatives

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

Module -V

Production of cosmetic products

Face creams(cold and vanishing creams), Face powders, Talcum powders, Hair oil, Hair cream & dyes, Shampoos, Tooth pastes & powders, Shaving creams, body gels Lipsticks, Nail polishes, Depilatories, aroma therapeutic products and herbal products etc; related plant and machinery.

Module -VI

Laboratory preparation for Metallic soaps, Turkey Red Oil, Toilet soaps, Cold Creams, Vanishing Creams, Tooth Pastes, Tooth Powders, Face Powders, Talcum Powders, Hair Oils & Shampoos

Reference Book

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

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Sources, classification and chemistry of essential oil bearing materials	
1.1	Sources from different parts of natural essential oil plants, availability, timing,	3

	etc.	
1.2	Different methods of manufacturing essential oils from various parts and according to the characteristics of flowers etc.	4
1.3	Grading and standardization of essential oils	1
2.	Physico-chemical characteristics of essential oils	
2.1	Specific gravity, refractive index, optical rotation, solubility, acid value, ester value	2
2.2	Analysis of essential oils e.g. free alcohol, total alcohol, aldehyde and ketone content	2
2.3	Phenol content, common adulterants and their detection	3
3.	Production, properties and composition of important Indian essential oils	
3.1	Rose, jasmine, khus, sandal wood, keora	3
3.2	Palmarosa, lemon-grass, peppermint, lemon	2
3.3	spices oils, clove oil	3
3.4	orange oil, eucalyptus oil , natural fats and bi additives compounds etc	2
4.	Important isolates, synthetic perfumery materials and fixatives	
4.1	Menthol, camphor, thymol, geraniol, citral	2
4.2	eugenol, terpeniol, vanillin, coumarins, musk:Natural	2
4.3	Synthetic & Artificial, benzyl acetate, benzyl benzoate etc	2
4.4	Synthesis;Esters of geraniol, citraniol & terpenols, ionones, Hydroxy citronellol etc.	2
4.5	Castor oil based perfumery chemicals, blending of perfumes	2
5.	Production of cosmetic products	
5.1	Face creams(cold and vanishing creams), Face powders, Talcum powders, Hair oil, Hair cream & dyes	3
5.2	Shampoos, Tooth pastes & powders, Shaving creams, body gels	2
5.3	Lipsticks, Nail polishes Depilatories, aroma therapeutic products and herbal products etc.	2
5.4	Related plant and machinery for cosmetics & improvement design of essential oils and isolates manufacturing plants.	3
Total		45

TOT-401 HYDROGENATION AND MODIFICATION OF OILSL : T: P
3 : 0: 3**Preamble:**

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

Prerequisite:

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

Course Outcome:

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

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

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	L	S	M	L	M	L	S	L	S	L
CO2	S	M	S	S	S	S	M	S	S	M	S	M
CO3	S	S	M	L	M	M	S	S	M	L	S	M
CO4	S	S	S	M	S	S	M	M	S	S	S	M
CO5	S	S	M	S	M	M	S	S	S	M	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

Hydrogenation of oils:

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

Module-II

Hydrogenation catalysts and hydrogen production:

Catalyst structure, catalyst poisons and promoters, theory of catalysis, properties of catalysts e.g.porosity, selectivity, activity and other properties, different types of catalysts employed for hydrogenation of oils and fats, methods of catalyst manufacture, regeneration of nickel catalyst, Manufacture of hydrogen: methods of production and purification, storage of hydrogen, distribution through manifold & direct gasification in hydrogenation vessel. Estimation of purity of hydrogen and oxygen gas. Hydrogen gas requirements for hydrogenation of different oils.

Module-III

Commercial plants and processes for hydrogenation of oils:

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

Module-IV**High-pressure hydrogenation:**

Production of fatty alcohols, Hydrogenation of fatty acids: importance of operating variable and feed stock purity, commercial fatty alcohols and their industrial applications.

Module-V**Modification of oils and their applications:**

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

Module VI**Laboratory work**

Vanaspati product analysis- MIV, Color, FFA, Capillary slip point, Ni content, Peroxide value, active Ni content, Bleaching earth/ Carbon analysis, In process analysis- Gum PPM in degummed oil, soap PPM in washed oil, adulteration of Animal body fat in deshi ghee.

Reference Book

1. Bailey's Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi
2. Hydrogenation of Oil & Fat Edited by H.B.W. Patterson
3. Markley Fatty Acid Vol. II
4. Oils & Fats Analysis by Cocks & Reid
5. Fats and oils formulation and for application by Richard D.O. Brien
6. BIS 10633

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Hydrogenation of oils:	
1.1	Principle of hydrogenation	1
1.2	Importance of hydrogenation & its kinetics	1
1.3	Parameters And their effects on rate of hydrogenation	1
1.4	Selectivity an isomer formation	1
1.5	Trans-fat and its effect on products	1
1.6	World wide trends and regulations in hydrogenation	1
2.	Hydrogenation catalysts and hydrogen production:	
2.1	Catalyst structure, poisons and promoters	2
2.2	Theory of catalysis	1
2.3	Properties of catalysts	1
2.4	Types of catalysts employed for hydrogenation of oils and fats	1
2.5	Methods of catalyst manufacture & regeneration	1
2.6	Manufacture of hydrogen gas	1
2.7	Hydrogen distribution through manifold & direct gasification	1

2.8	Estimation of purity of hydrogen and oxygen gas	1
2.9	Hydrogen gas requirements for hydrogenation of different oils	1
3.	Commercial plants and processes for hydrogenation of oils:	
3.1	Commercial plants for hydrogenation	1
3.2	Design of hydrogenation vessels	1
3.3	Filtration Techniques- Plate & frame filters, candle filters	1
3.4	Chilling equipment for shortening	1
3.5	Nitrogen gas based hydrogenation plants.	1
3.6	Batch and continuous methods, Loop reactors, impellers	1
3.7	Manufacture of salad oils and salad dressing	1
3.8	Shortening, margarine, butter, bakery and confectionery fats	1
3.9	Cocoa butter substitute	1
3.10	Hard oils for industrial applications	1
4.	High-pressure hydrogenation:	
4.1	Production of fatty alcohols	2
4.2	Hydrogenation of fatty acids	2
4.3	Commercial fatty alcohols and their industrial applications	2
5.	Modification of oils and their applications:	
5.1	Analysis of modified fats	1
5.2	Dilatometry- theory and practice	1
5.3	Trans, unsaturated fatty acids and polyunsaturated fatty acids in nutrition and health	1
5.4	Energy conservation in hydrogenation process	1
5.5	Frying & stability characteristics, nutrition & health aspects	1
5.6	Inter esterification as low calorie fats	1
5.7	Fractionation, winterization as low calorie fats	1
5.8	Diacylglycerols as low calorie fats	1
Total hours		40

TOT-403 TECHNOLOGY OF SURFACTANTS & SYNTHETIC DETERGENTS

L : T: P
3 : 0: 0

Preamble:

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

Prerequisite:

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

Course Outcome:

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

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

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	L	M	L	M	L	M	M	S	M
CO2	S	S	M	S	S	M	S	M	S	S	S	S
CO3	S	S	M	S	M	S	M	S	M	S	S	S
CO4	M	M	S	M	M	S	M	M	M	M	S	M
CO5	S	S	S	S	S	M	S	S	S	S	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus

Module-I

Surface active agents:

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

Module –II

Classification, synthesis and applications of surfactants:

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

Module –III

Plants and manufacturing processes of surfactants:

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

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

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

Module –V

Evaluation of detergent products:

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

Reference Book

1. The manufacture of soaps other detergents and glycerin Edited by Edgar Woollatt
2. Synthetic detergent Edited by Milwidsky
3. Bailey's Industrial Oil and Fat Products Vol-1 Fourth Edition, Edited by Daniel Swern
4. Soaps & detergent Edited by K.S. Parasuram
5. Synthetic Detergents Edited by Davidson
6. BIS – IS: 4955-1978; Specification for Synthetic Detergent Powders for household use
7. Gemini Surfactants: Synthesis interfacial and Application
8. Handbook of Detergent; Part A, B, C, D

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Surface active agents	
1.1	Theory of surface action; effect and behavior of surface active agents on the interfaces; solid- liquid, gas-liquid, liquid-liquid	2
1.2	Bulk properties of surfactant solutions and methods of their measurements: micelle properties, foaming, wetting, emulsification, dispersion	2
1.3	Measurement of critical micelle concentration, foaming power and foam stability	2
1.4	Measurement of wetting power, emulsifying power, stability of dispersion and detergency	2
2.	Classification, synthesis and applications of surfactants	
2.1	Anionic surfactants: sulfated and sulfonated surfactants e.g. sulfated oils, alkyl sulfates, alkyl ether sulfates, sulfated mono-glycerides, alkyl glyceryl ether sulfonates, sulfated derivatives alkanolamides, ester and amide sulfonates, sulfonated poly-carboxylic acid surfactants, alkyl aryl sulfonates, olefin sulfonates, methyl ester sulfonates, mahogany and petroleum sulfonates and other miscellaneous anionic surfactants.	3
2.2	Cationic surfactants: Non-quaternary nitrogen bases e.g. amines, nitriles and their: quaternary nitrogen bases and miscellaneous cationic surfactants	2
2.3	Nonionic surfactants: Poly-ethoxy ethers and esters and poly-hydroxy nonionic surfactants	2
2.4	Amphoteric surfactants,	1
2.5	Bio surfactants and Novel surfactants	2
3.	Plants and manufacturing processes of surfactants	
3.1	Plants and manufacturing processes of anionic surfactants viz. alcohol sulfates, alkyl aryl sulfonates, alpha olefin sulfonates, sulfated and sulfonated oils, methyl esters sulfonates etc	3
3.2	Plants and manufacturing processes of nonionic surfactants viz. Poly-ethoxy ethers and esters, poly-hydroxy surfactants etc	2
3.3	Plants and manufacturing processes of cationic surfactant e.g. quaternary ammonium compounds	2
4.	Builders, fillers and auxillary materials, production of detergent products	
4.1	Inorganic and organic builders and fillers used in the manufacture of synthetic detergents and their functions	2
4.2	Polymers, optical brighteners, enzymes and other performance additives used in the manufacture of synthetic detergents and their functions	2
4.3	Various physical forms of synthetic detergents: Solid, liquid, and non/liquid forms	1
4.4	Plants and processes employed for manufacture of powder, liquid, cake and other forms	2
5.	Evaluation of detergent products	
5.1	Analytical techniques employed for analysis of synthetic detergents as per BIS Methods	2
5.2	Analytical techniques employed for analysis of surfactants as per BIS Methods	2
5.3	Environmental impact and toxicity of surfactants	2
5.4	Methods for determination of efficacy of surfactants	2
	Total	40

TOT-405 ADVANCE OIL CHEMISTRY AND OLEO CHEMICALS L : T: P
2 : 0: 0

Preamble:

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

Prerequisite:

Knowledge of oil chemistry.

Course Outcome:

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

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

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	L	S	M	L	M	M	S	L	S	L
CO2	M	M	S	S	S	S	M	S	S	M	S	M
CO3	S	S	M	L	S	M	S	S	M	L	S	M
CO4	S	S	S	M	M	S	M	M	S	S	S	M
CO5	S	M	M	S	S	S	S	S	S	M	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Advance theories of glyceride structure.

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-1

Glyceride structure :

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

Module-2

Mechanism of important chemical and biochemical reaction of fats and fatty acids:

Esterification, inter-esterification, isomerisation, polymorphism, dehydration, pyrolysis and oxidation of fatty acid esters and other oleo chemicals derived from fats and fatty acids, products and byproducts from castor oil, ,soybean oil, rapeseed oil, neem oil, mahua oil, cotton seed oil etc.

Module-3

Oil derivatives and their applications:

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

Module-4

Chemistry and applications of drying oils:

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

Module-5

Production and applications of methyl ester:

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

Reference Book

- 1.Fatty acid Vol.-1-5 by K.S.Markley
- 2.Bailey's industrial oil and fat,Part -1-5 by bailey

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Glyceride structure	
1.1	Advanced theories of glyceride structure	2
1.2	Determination of glyceride structure	3
1.3	Synthesis of fatty acid and their derivatives	1
1.4	Estimation of mono – diglycerides	1
1.5	Polymorphism of fats and fatty acid, glycerides synthesis, reaction mechanism, oleo-chemicals, bye-products utilization	2
2.	Mechanism of important chemical and biochemical reaction of fats and fatty acids	
2.1	Mechanism of designing, inter-esterification, isomerisation	1
2.2	Oxidation, saponification, important oleo-chemicals.	2
2.3	Inter-esterification	2
2.4	Polymorphism	1
2.5	Oleo-chemicals	3
2.6	Bye-products Utilization	2
3.	Oil derivatives and their applications	
3.1	Production and utilizations of fatty nitriles	2
3.2	Production and utilization of fatty amine	2
3.3	Sulphated and sulphurised oils	1
3.4	Textile chemicals, leather chemicals	1
3.5	Polymer additives, paint additives, lubricants additives,	2
4.	Chemistry and applications of drying oils	
4.1	Modification of oils for surface coating industries, thermal and chemical modification method	2
4.2	Properties of modified oils ,changes by heat bodying and oxidative polymerization	1
4.3	Process of maleinised, epoxidized oils	1
4.4	Process of boiled oils, stand oils, blown oil	1
4.5	Urethane oils, alkyds	1
4.6	Evaluation of surface coating materials	1
5.	Production and applications of methyl ester	
5.1	Various methods of production	2
5.2	Specifications as per STM, BIS & determination thereof	1
5.3	Sulphated & sulphonated methyl ester & their application	2

Total	40
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**TOT-407: Commerce and Process Economics; Food Safety
and Environmental aspects of Oil Industry**

L : T: P
2 : 0: 0

Preamble:

The course provides necessary knowledge of GST(Goods and Service Tax) and import/export duties on oil seeds and oils, procurement of oil seeds and oil at different level(national/international), preparation of techno-economic feasibility report required for entrepreneurship, treatment of effluents, safety and environmental, eco-friendly and green technology aspect of oil processing industry.

Prerequisite:

Knowledge of engineering operations & oil processing industry.

Course Outcome:

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

(CO1)	Understand GST and import-export duties, procurement of oil seeds/oil at different level. Able to start-up MSME along with latest technology and eco-friendly Environmental aspects	Understand
(CO2)	Prepare TEFR(Techno-Economy Feasibility Report) of industries other than oil processing industries.	Apply
(CO3)	Prepare production planning & plant layout of processing plant.	Apply
(CO4)	Assess utilization of by-products of oil seed & oil industry by value addition.	Apply
(CO5)	Assess and apply appropriate effluent treatment process and latest eco-friendly processes and green technology.	Apply

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	L	S	L	S	M
CO2	S	M	S	S	S	S	M	S	S	M	S	M
CO3	S	S	M	L	S	M	S	S	M	L	S	M
CO4	S	S	M	S	S	M	S	S	S	M	S	S
CO5	S	S	S	M	S	S	M	M	S	S	S	S

Assessment Pattern:

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

Evaluate	20	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Different mechanism involved in procurements of oil seeds and oil.
2. Knowledge of GST and import-export duties on oil seeds and oil.
3. Practices of sale of bulk/packaged oils with supply chain management.

Course Outcome 2(CO2)

1. Estimation of capital cost or project of oil processing unit.
2. Technical appraisal of plants.
3. Human resource planning.

Course Outcome 3(CO3)

1. Financial projection of TEFR.
2. Financial analysis such as BEP(Break Even Point), ROR(Rate of Return), PBP(Pay Back Period).
3. Plant layout.

Course Outcome 4(CO4)

1. Processing of by-product such as phospholipids, lecithin/gums.
2. Manufacturing of cattle/poultry feed and protein concentrate.
3. Trans-esterification for production of biodiesel.

Course Outcome 5(CO5)

1. Segregation of deodorizer distillate and isolation of value added products.
2. Classification of effluents and its treatments.
3. Fire protection and safety HAZOP guidelines and eco-friendly environmental.

Syllabus:**Module- I****Procurement process for oilseeds and oils:**

Different mechanisms, Agencies involved in procurement at national and international level. GST and import/export duty structure for oilseeds, oils – crude and refined, edible as well as non edible. Components of transport, loading/unloading, insurance and storage involved in cycle of procurement. Present day practices of sale through bulk/ packaged imports, with supply chain management.

Module II**Components of Costing and Human resource development:**

Capital cost of project for establishing oil mills, solvent extraction plant, oil refinery plant, & other plant related to oil industries, Technical appraisal of plants. Human resource Planning: Importance and processes, Job analysis and Engagements, Training need analysis.

Module- III**Utilities & Production planning:**

Financial projections- calculation of cost of production for oil mills, solvent extraction plant, oil refinery plant & other plant related to oil industries Break Even Point, Rate of Return, Pay Back Period, Depreciation etc. Energy conservation in oil processing industry, concept of variable frequency drive, PLC & SAP. Factory lay out: Principles, general considerations, typical flow diagrams, single & multi storied buildings, different sections of a oil refinery factory and their locations, Instrumentation and automation in oil refinery. Machine layout of solvent extraction and oil refinery plant.

Module-IV**By- products of oil and oilseed processing industry and their utilization:**

Phospholipids, production of industrial and edible grade Lecithin, gums. Manufacture of cattle and poultry feed; production of protein concentrates and isolates. Re-esterification of fatty acid with glycerin and its trans-esterification for production of biodiesel. Utilization of deteriorated deep fried oil for industrial utilization.

Module- V**Safety measures, Effluents and their treatment:**

Segregation of deodorizer distillate and isolation of value added products by conventional and molecular distillation and other plants and machinery involved. Classification of effluents of oil and allied industries, Safety considerations in storage of hazardous and inflammable raw materials. Fire Protection and safety: Sources, types, Fire & explosion index, safety measures for protection. Health and Hazards: Resources, competence & regulations, systems & tools, HAZOP guidelines, Environment: Eco-friendly, waste minimization & waste disposal, Effluent Treatment Plants, system efficiency, respiratory protective equipments. GOI specifications of effluents, eco-friendly processes and green technologies.

Reference Books and suggested readings:

1. Plant Design & Economics by Peter Timmer House
2. Air & Water by Giringer
3. Efficient use of Steam by Goodall
4. Handbook on Project Appraisal & follow-up by D. P. Sarda

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Procurement process for oilseeds and oils	
1.1	Different mechanism involved in procurement of oil-seeds and oil at national-international level	1
1.2	GST and import-export duty structure on oil-seeds and oil	1
1.3	Component of transport labor insurance and storage involve in cycle or procurement	1
1.4	Present day practices of sale through bulk/package	1
1.5	Supply chain management for sale of oils	1
2.	Components of Costing and Human resource development	
2.1	Working out the capital cost of project for establishing oil mills and solvent extraction plant	2
2.2	Working out the capital cost of project for establishing of oil refinery and other plant related to oil industries	2
2.3	Technical appraisal of plants	2
2.4	Human resource planning	1
2.5	Job analysis, engagements and training analysis	1
3.	Utilities & Production planning	
3.1	Financial projection i.e. calculation of cost of production for oil mill and solvent extraction plant	2
3.2	Financial projection i.e. calculation of cost of production for oil refinery and other plant related to oil refinery plant and other plants related to oil industries	2
3.3	Energy conservation in oil processing industry	1

3.4	Financial analysis i.e. break-even point and rate of return	1
3.5	Financial analysis i.e. pay-back period and depreciation	1
3.6	Factory layout of solvent extraction and oil refinery	1
3.7	Machine layout in solvent extraction and oil refinery	1
3.8	Instrumentation and automation in oil refinery	1
4.	By- products of oil and oilseed processing industry and their utilization	
4.1	Phospholipids, production of industrial and edible grade Lecithin gums	2
4.2	Manufacture of cattle and poultry feed	1
4.3	Production protein concentrates and isolates	1
4.4	Re-esterification of fatty acid with glycerin	1
4.5	Trans-esterification for production of bio-diesel	2
4.6	Utilization of deteriorated deep fried oil for industrial utilization	1
5.	Safety measures, Effluents and their treatment	
5.1	Segregation of deodorizer distillate and isolation of value added product by conventional and molecular distillation	2
5.2	Classification of effluents of oil and allied industry	2
5.3	Safety consideration in storage of hazardous and inflammable raw materials	1
5.4	Fire protection and safety	1
5.5	Health and hazard regulations	1
5.6	HAZOP guidelines	1
5.7	Environment eco-friendly, waste minimization and waste disposal	1
5.8	Effluent treatment plants, system efficiency etc.	1
5.9	GOI specification of effluents, eco-friendly processes and green technology	2
Total		43

TOT- 415: TECHNOLOGY OF OILS, OLEO CHEMICALS AND SURFACTANTS

L : T: P
3 :0 : 0

Preamble:

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

Prerequisite:

Basic concept of chemistry.

Course Outcome:

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

(CO1)	Understand fundamental chemistry of oils, oleo chemicals and allied products.	Understand
(CO2)	Understand industrial importance of chemicals derived from oils and fats.	Understand
(CO3)	Understand expression and extraction techniques of oil from oil bearing materials.	Understand
(CO4)	Understand the process of refining of crude oils and its importance from	Understand

	health point of view.	
(CO5)	Understand the role and importance of various ingredients in manufacturing soaps and detergents.	Understand

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	M	L	M	L	L	L	S	L
CO2	M	M	L	M	L	M	M	L	L	M	S	M
CO3	L	L	M	L	L	M	L	M	M	L	M	M
CO4	M	M	M	L	M	M	L	M	L	M	S	S
CO5	L	L	L	M	L	L	M	M	L	L	S	M

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

Introduction to oils & fats

Introduction to oils & fats, types of glycerides, theories of glyceride structure, determination of glyceride structure, non-glyceride components of oils, component fatty acids of oils & fats.

Module-II

Chemical reactions of oils & fats

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

Module-III

Post harvest technology of oilseeds

Post harvest technology of oilseeds, handling and storage of oilseeds, different methods for extraction of oils from oil-bearing materials.

Module-IV

Refining of oils

Degumming, de acidification, bleaching hydrogenation, deodorization, physical refining, Fractionation, De waxing, Winterization of oils. Nutraceuticals derived from oils

Module-V

Introduction to surface active agent

Saponification of oils, different methods of soap manufacture, selection of raw materials, analysis of soaps. Types of surfactants and Manufacturing processes, fat based surfactants.

Reference Books

1. Bailey's Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi
2. Oil & Fats Technology Edited by E. Bernardini
3. Soaps & detergent Edited by K.S. Parasuram
4. Soaps: Their chemistry & Technology by J.G. Kane
5. Chemistry and Technology of Oils and Fats, 2003, Edited by M.M. Chakraborty

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
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1.	Introduction to oils & fats	
1.1	In production to oils and fats types of glycerides	2
1.2	Theory of glycerides structure and determination	1
1.3	Non-glyceride components of oils	2
1.4	Components fatty acids of oils and fat	2
2.	Chemical reactions of oils & fats	
2.1	Chemical reactions of oils and fat-industrial importance	2
2.2	Physico-chemicals characteristics of oils and fat	2
2.3	Classification of oils	1
2.4	Adulterations of oils	1
3.	Post harvest technology of oilseeds	
3.1	Harvest technology of oil seeds	1
3.2	Handling and storage of oil seeds	1
3.3	Different methods of extraction from oil bearing materials	1
3.4	Expeller, expander	1
3.5	Solvent extraction principle, selection of solvent	2
3.6	Different methods of solvent extraction	3
4.	Refining of oils	
4.1	Degumming	2
4.2	Neutralization	1
4.3	Bleaching	1
4.4	Hydrogenation	1
4.5	De-waxing & deodorization	3
4.6	Fractionation	2
4.7	Winterization	1
5.	Introduction to surface active agents	
5.1	Saponification of oils, methods of soap manufacture	2
5.2	Selection of raw material	1
5.3	Soap analysis	1
5.4	Surfactants/fat based surfactants	3
Total hours		40

TOT- 461 Industrial Training**L : T : P****0 : 0: 4**

Objective: Students are allotted to work as trainee in different industries of the field for a period of 6 weeks. The basic objectives are as follows:

1. To aware with the industrial environment, movement of raw materials upto finished products, human behavior, industrial relation, manpower management & efficient management of the manpower.
2. To have a proper knowledge of the manufacturing process of different products, their quality control procedure, utilities, and various techniques of quality control in terms of raw material, in process parameters and finished products as per norms of BIS, FSSAI and other statutory bodies.
3. To gain knowledge of water treatment, effluent treatment and air pollution control devices. Proper analysis of fuel and other utilities.

4. Students are allotted to work on project assign in that particular industries for controlling the losses, utilities consumption & other inputs for reducing cost of production.
5. To understand proper maintenance of the equipment's in the plants, i. e. regular, preventive and other schedule maintenance.
6. To understand the stores activities of procurement, storage & issue of spare-parts, packaging materials and various consumables & raw materials get conversant with FIFO system.
7. To understand the industrial drawings like layout, P&ID, line diagrams, electrical & instrumentation, civil drawings.
8. The students must understand the costing of various inputs on different section basis so as to have a knowledge of total cost of production.
9. To understand the R&D activities being carried out by the industries or intent to carry by the company & share their knowledge.
10. They should also aware the applicable the tax structure.

Seminar- Every student will be required to make a presentation on allotted topic of their choice.

OUT COMES

1. This training provides a basic backbone for students for future industrial working environment.
2. Students after training gain a lot for appearing in campus placement activities.
3. Presentation enhances communication skill of the student.

TOT-471 SEMINAR

L : T: P

0 : 0 : 4

The student will be required to prepare and deliver a seminar as well as submit a written report on the topic assigned to him/her

TOT-497 Project

L : T: P

0 : 0: 8

Objectives

1. Specific topic for project are allotted to students to explore the possibilities of entrepreneurs development right from literature survey, raw materials availability, plant & machinery suppliers, cost analysis, marketing strategy etc.
2. Students make use of their knowledge and skills in the dissertation, techno-economic feasibility study. They implement their entire technical & commercial talent for the project.
3. Equipment design enables use of unit operation principles.

Outcomes

The students are aware of MSME (Micro Small Medium Enterprises) entrepreneurs.

TOT-417 Educational Tours (Audit Course)

L : T: P
0 : 0: 0

Objectives

1. The objective of educational industrial tour is to facilitate students to get exposed to industrial environment. Faculty members also accompany the students for demonstration.
2. The exposure of process house enables the student to understand the technology being adopted in the industry.
3. Students get opportunity to get exposed to other departments like quality control, storage, packaging, utilities, ETP etc.
4. Exposure of human resource policy & supply chain management.

Outcomes

1. Students become motivated & their moral confidence increases for further campus placement activities.
2. Students have a better understanding of the subjects, process techniques by practical orientation.

TOT-402: BIO-TECHNOLOGY OF OILSEED AND OILS**L : T: P****3 : 0: 0****Preamble:**

This course has been designed to utilize knowledge of bio-technology for oil bearing materials and oils. Scenario of GM crops along with application of bio- technology for edible oils, foods and lipid sciences for better value addition.

Prerequisite:

Basic science and engineering and oil technology

Course Outcome:

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

(CO1)	Understand GM crops, oil bearing GM crops, their composition and Characteristics, Non-GM crops, word trend and scenario of GM crops.	Understand
(CO2)	Apply bio-technology specially to lipid sciences like bio-degumming by use of enzyme, bio-deacidification, bio bleaching, bio-inter-esterification	Apply
(CO3)	Apply knowledge of bio-technology for inter- esterification for production of structured lipids, margarine And shortening, cocoa-butter substitutes, esters etc. More over oleo-chemicals, bio-surfactants And other medicine products. Production of bio-diesel by cheaper materials, application of bio chemicals process in Water effluent treatment plant, preparation of polyol and other esters.	Apply
(CO4)	Understand and analyze modification processes of oil seed such as canola oil production, low Erucic mustard oil, low linoleic soybean oil, high oleic sun flower oil and low linolenic Canola oil.	Analyze
(CO5)	Evaluation of the products produced by bio-chemical process with conventional Process to evaluate the merits and de-merits of the same.	Evaluate

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	S	L	M	M	M	M	S	M
CO2	M	S	M	M	S	M	S	M	S	S	S	M
CO3	M	S	M	S	S	S	M	S	M	S	S	M
CO4	M	M	M	M	S	S	M	M	M	M	S	M
CO5	S	S	M	S	S	M	S	S	S	S	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. GM crops to be evaluated with Non-GM crops for yield and other parameters to know the further expansion of the product
2. Evaluation and comparison of characteristics.
3. Knowledge of processing and plant required for production of the same.

Course Outcome 2(CO2)

1. Bio-processing technology for effective and efficient process like enzymatic degumming to be adopted to control cost of production and better yield in terms of quality and quantity.
2. Other process like bio-deacidification, inter-esterification to be done with proper dose of enzyme.
3. To increase the use of bio-technology for other value added products for food and medicinal purpose.

Course Outcome 3(CO3)

1. Production of bio-diesel by cheaper materials,
2. Application of bio chemicals process in water effluent treatment plant.
3. Preparation of polyol and other esters.

Course Outcome 4(CO4)

1. Control over manufacture of products like low linolenic canola, low erucic mustard oil, high oleic sun flower oil to explore markets for these specialty products
2. Inter-esterified fats and other products like cocoa-butter substitutes quality and availability at lower cost.
3. Proper knowledge of plant and machine required at cost effective parameters.

Course Outcome 5(CO5)

1. Product manufactured by bio-technology process must confirm to specification fixed and effective control over different parameters is required.
2. Bio-diesel is very good alternative to our naturally obtained petroleum products. Only sustainable and cost effective processing is required.
3. Special product manufactured by bio-technology route are being popular and have good marketing scope.

Syllabus:

Module-I Introduction to GM crops

Genetically modified crops for oil bearing materials, composition, characteristics, composition of GM and non-GM crops, certification of GM crops, global scenario in GM crops.

Module-II Enzymes and their Technology

Types of enzymes, sources and their isolation and their applications, immobilized enzymes, assay of enzymes for oil application

Module –III Bio processing of Oils & Fats

Bio Processing of Oils: Bio degumming, Bio de-acidification, Bio bleaching, Chemistry and technology of bio-interesterification, bio-hydrogenation interesterified fats vis-a-vis bio-interesterified fats/hydrogenated fats .

Module –IV Specialty fats & Oils

Structured Lipids, Margarine and Shortening, Production of plastic fats, Cocoa butter substitute, Food emulsions, Medicinal applications, Preparation of de-acylglycerols, polyol and other oleo chemicals.

Module –V GM Oilseeds

Canola (rapeseed), Linola (flax), High Oleic sunflower, Low-linolenic soyabean etc.

Reference Book

1. Biotechnology for the Oils & fats industry (1983) Edited by Colin Ratledge, Peter Dawson and James Rattray
2. Bioactive Lipids
3. Modifying Lipids for use in Foods
4. Biocatalysts and Biotechnology for Functional Foods

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Introduction to GM crops	
1.1	Genetically modified crops for oil bearing materials	2
1.2	Composition, characteristics, composition of GM and non-GM crops	3
1.3	Certification of GM crops	2
1.4	Global scenario in GM crops	2
2.	Enzymes and their Technology	
2.1	Types of enzymes, sources and their isolation	2
2.2	Application of enzymes	2
2.3	Immobilized enzymes	1
2.4	Assay of enzymes for oil application	1
2.5	Enzymatic degumming, process, advantage over conventional degumming	2
3.	Bio processing of Oils & Fats	
3.1	Bio Processing of Oils: Bio degumming	2
3.2	Bio de-acidification	2
3.3	Bio bleaching, Chemistry	2
3.4	Bio-interesterification	1
3.5	Interesterified fats vis-a-vis bio-interesterified fats/hydrogenated fats.	2
4.	Speciality fats & Oils	
4.1	Structured Lipids	1
4.2	Margarine and Shortening	1
4.3	Production of plastic fats	2
4.4	Cocoa buttersubstitute	1
4.5	Food emulsions	1
4.6	Medicinal applications	1
4.7	Preparation of de-acylglycerols, polyol and oleo-chemicals	1
5.	GM Oilseeds	
5.1	Canola (rapeseed)	2
5.2	Linola (flax)	1
5.3	High Oleic sunflower	1
5.4	Low- linolenic soybean	1
5.5	Low linoleic canola	1
	Total	40

TOT-404 PACKAGING OF OILS, FATS AND ALLIED PRODUCTS

L : T: P
3 :0: 0

Preamble:

This course has been designed to provide knowledge for packaging of oils, fats, soaps detergent, cosmetics and allied products. Awareness of packed edible oils/other products reduces the chances of adulteration.

Prerequisite:

Basic knowledge of engineering & technology, material science, oil and oil based products.

Course Outcome:

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

(CO1)	Understand the elements of packaging and different types of packaging materials.	Understand
(CO2)	Select packaging materials to pack the products considering the environmental aspects and cost.	Apply
(CO3)	Select materials and methods for printing on packaging materials surfaces.	Apply
(CO4)	Analyze the influence of packaging on the consumers.	Analyze
(CO5)	Assess environmental aspects of plastic material for packaging and future road map to eco-friendly packaging materials.	Evaluate

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	L	M	M	M	L	M	M	S	M
CO2	S	S	M	S	S	M	S	M	S	S	S	S
CO3	S	S	M	S	M	S	S	S	M	S	S	S
CO4	M	M	S	M	M	S	S	M	M	M	S	M
CO5	S	S	S	S	S	M	S	S	S	S	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

- 1.Elements of packaging and its influence on customers.
2. Scope and function of a package.
3. Comparison of glass and plastic packaging.

Course Outcome 2(CO2)

1. Compatibility with the material to be packed.
2. Properties of various packaging materials, essential components & criteria for selection of packaging materials
3. Edible packaging and eco-friendly alternative to the plastic .

Course Outcome 3(CO3)

1. Different forms of packing rigid, semi-rigid and flexible.
2. Types of polymers use as a packaging materials.
3. Useful commercial blend of polymers for packaging..

Course Outcome 4(CO4)

1. Co-extrusion, extrusion Coatings and laminations process technology of the packaging.
2. Typical laminates film's constructions and its benefits & application.
3. Coating weight "Neck-in" and drawdown in extrusion Coatings and laminations.

Course Outcome 5(CO5)

1. Packaging materials use for soap, detergent & cosmetics.
2. Limitation of solid waste management practices.
3. Physical & chemical tests of packing materials

Syllabus:

Module I Introduction to Packaging

Elements of packaging & its influence on customers, scopes and functions of a package. Materials used for packaging: paper and paperboards; films and foils; glassware; metals plastics; wood; miscellaneous other materials. Comparison of glass & plastic packaging.

Module II Criteria and selection of packing material

Requirements of packaging surfaces for oils and allied products viz. Compatibility with the material to be packed, properties of various packaging materials and their specifications, & essential components for selection of packaging materials, essential criteria for selection of packaging materials, Different packaging and sealing machine for liquid /semisolid packaging. Edible packaging & eco friendly alternative to the plastic

Module III Forms of packaging:

Folded cartons/boxes; corrugated board boxes, metal containers bags and envelopes, aerosols. Tubes, cans and different forms of plastics, types of polymers use as packaging materials & useful commercial blend of polymers packaging.

Module IV Printing of packaging surfaces

Requirements of Printing and evaluation of printed surfaces, co-extrusion, extrusion Coatings and laminations of the packaging surfaces, types and properties of coatings and limitations, different types of laminating machines. Typical laminates film's constructions and its benefits & application. Coating weight "Neck-in" and drawdown in extrusion Coatings and laminations.

Module V Packaging of various products

Oils and fats, soaps and detergents; cosmetics; petrochemicals, wax and wax products; essential oils and perfumes; lubricating oils and greases; by products of oils, soaps and allied industries. Food packaging & its environmental impacts. Limitation of solid waste management practices. Types of packaging material and environmental issues, advantages and disadvantages. Minimizing environmental impact. Physical & chemical tests of packing materials.

Reference Books and suggested readings

1. Journal of Applied Packaging Research.
2. Journal of Indian Food Industry.
3. Central Food Technological Research Institute Mysore.
4. Qenos Technical Guides.

5. Journal of Food Science & Technology.
6. Journal of pharmaceutical & Scientific Innovation.
7. Journal of Indian Food Industry.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Introduction to Packaging	
1.1	Elements of packaging and its influence on customers	2
1.2	Scope and function of a package	1
1.3	Materials used for packaging i.e. paper and paperboards	1
1.4	Materials used for packaging i.e. Films and Foils	1
1.5	Materials used for packaging i.e. glassware, metals, plastics	1
1.6	Materials used for packaging i.e. wood and miscellaneous other materials	1
1.7	Comparison of glass & plastic packaging	1
2.	Criteria and selection of packing material	
2.1	Compatibility with the material to be packed	1
2.2	Properties of various packaging materials and their specifications	2
2.3	Essential components for selection of packaging materials	1
2.4	Essential Criteria for selection of packaging materials	1
2.5	Different packaging and sealing machine for liquid/semi-liquid packaging	2
2.6	Edible packaging & eco friendly alternative to the plastic	1
3.	Forms of packaging	
3.1	Different forms of packaging i.e. folded cotton/boxes corrugated boxes	1
3.2	Different forms of packaging i.e. metal containers, bags and envelopes, aerosols.	1
3.3	Different forms of packaging i.e. Tubes cans	1
3.4	Different forms of packaging i.e. rigid, semi-rigid and flexible plastic packaging	2
3.5	Polymers used for packaging materials	1
3.6	Useful commercial blend of polymers packaging	1
4.	Printing of packaging surfaces	
4.1	Requirement of printing and evaluation of printed surfaces	1
4.2	Co-extrusion, extrusion coating and extrusion laminations of the packaging	2
4.3	Different types of lamination machine	2
4.4	Typical laminates film's constructions and its benefits & application	2
4.5	Coating weight "Neck-in" and drawdown in extrusion Coatings and laminations.	1
5.	Packaging of various products	
5.1	Packaging of soap and detergents	1
5.2	Packaging of cosmetics	1
5.3	Packaging of petro-chemical, wax and wax-products	1
5.4	Packaging of essential oils and perfumes	1
5.5	Packaging of lubricating oils and grease	1
5.6	Packaging of bye-product and allied industries	1
5.7	Limitation of solid waste management practices.	1
5.8	Types of packaging material and environmental issues, advantages and disadvantages.	1
5.9	Minimizing environmental impact.	1
5.10	Physical & chemical tests of packing materials.	1
	Total	41

**TOT-406: ENVIRONMENTAL ASPECTS OF
OILS AND ALLIED INDUSTRIES**

**L : T: P
3 :0: 0**

Preamble:

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

Prerequisite:

Knowledge of engineering and oil processing.

Course Outcome:

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

(CO1)	Understand the various pollutants and effluents generated in processing of oils and allied products.	Understand
(CO2)	Analyze various characteristics of effluent streams.	Analyze
(CO3)	Apply the best treatment option available among the various pollution control methods.	Apply
(CO4)	Apply various waste minimization options available for reduction, recovery, reuse & recycle principles.	Apply
(CO5)	Apply Pollution prevention and environment management system. Waste audit, different regulations & acts for air, water & solid pollution control.	Apply

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	M	M	S	M	M	M	S	M
CO2	S	S	M	S	S	M	S	M	S	S	S	S
CO3	S	S	M	S	M	S	S	S	M	S	S	S
CO4	M	M	S	M	M	S	S	M	M	M	S	M
CO5	S	S	S	S	S	M	S	S	S	S	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Review theories of water and air pollution.
2. Study sources and global impact of pollution and legislation to control them.

3. Study of by-product utilization.

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

Syllabus:

Module-I

Industrial pollution and its impact

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

Module-II

Environmental Management Policy and Regulations

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

Module-III

Waste Management

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

Module-IV

Liquid Effluent Treatment Technology

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

Module-V

Solid & Gas Effluent treatment

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

Text Books:

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

Reference Book:

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

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Industrial pollution and its impact	
1.1	Magnitude of industrial waste, Legislative regulations	3
1.2	Recycle and reuse of waste water	2
1.3	Recovery of bye-product from industrial effluents	3
2.	Environmental Management Policy and Regulations	
2.1	Environmental policy global and Indian scenario	2
2.2	Scope of air and water pollution problems	2
2.3	Economic considerations of waste disposal	2
2.4	Separation and segregation of wastes, gaseous, liquid and solid waste disposal with special reference to oils and allied product processing CPCB/ state pollution control board guidelines and regulations	2
3.	Waste Management	
3.1	Pollution prevention and environment Management system ISO 14000, Waste audit	3
3.2	Quality management systems	2
3.3	Different regulation means & acts for air, water & solid pollution control	3
4.	Liquid Effluent Treatment Technology	
4.1	Pretreatment methods, centrifugation filtration, evaporator and concentrator, extraction and distillation	2
4.2	Treatment of dilute waste water. Treatment requirements, Neutralisation liquid-solid separation, biological oxidation	2
4.3	Plant control programme, absorption, liquid phase system	2
4.4	Reclamation of waste water effluent and by-product recovery, ion exchange system	2
4.5	Acid and alkali purification, continuous ion-exchange, Case studies on vegetable oil processing, soaps and detergents	2
5.	Solid & Gas Effluent treatment	
5.1	Waste gas treatment: spent earth, catalyst, fly ash boiler ash	2
5.2	Air pollution control by mechanical method: mechanical collectors, electrostatic precipitator	2
5.3	Filters, wet scrubbers, vapour phase system, activated carbon. Typical air purification system	2
Total		40

TOT-408: PETROLEUM PRODUCTS AND PETROCHEMICALS**L : T: P**
3 :0: 0**Preamble:**

The course provides basic knowledge of Petroleum, its occurrence in the crust of earth, various theories of formation & its relevance, products & various petrochemicals.

Prerequisite:

Knowledge of basic chemistry of hydrocarbons, synthesis processes, applications of petrochemicals.

Course Outcome:

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

(CO1)	Understand the occurrence of crude petroleum, its exploration, distillation & exposure of products & by-products	Understand
(CO2)	Understand processing of crude petroleum viz desalting, atmospheric & vacuum distillation etc.	Understand
(CO3)	Apply various conversion processes from small carbon chain to large/complex carbon chain including isomerisation, polymerization, condensation to get variety of products.	Apply
(CO4)	Assess quality of crude, selection of method of refining and manipulating the yield of particular fraction.	Analyze
(CO5)	Apply knowledge to synthesize specific polymer products .	Apply

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	M	L	M	L	M	L	M	M	S	M
CO2	M	M	M	M	S	M	S	M	S	S	S	M
CO3	M	M	M	M	M	S	M	S	M	S	S	M
CO4	M	M	S	M	M	S	M	M	M	M	S	M
CO5	S	S	S	S	S	M	S	S	S	S	S	S

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

- 1.Survey of oil reserves in country and the world.
2. Knowledge of various refineries and their capacities in India and abroad.

3. Knowledge of test methods and evaluation of oil stocks.

Course Outcome 2(CO2)

1. Selection of process for processing of crude petroleum.
2. Distillation processes e.g. Atmospheric & vacuum.
3. Various distillation products e.g. natural gas, gasoline, fuel oils, lubricating oils, waxes, tar & asphalt .

Course Outcome 3(CO3)

1. Conversion processes for converting long carbon chain to small carbon chain products.
2. Conversion processes for converting small carbon chain to long carbon chain products.
3. Study of various feed stocks for the conversion processes.

Course Outcome 4(CO4)

1. Extraction of waxes-paraffin, micro crystalline .
2. Extraction of asphalt from the residues.
3. Process like vis-breaking enabling feed stock for further processes.

Course Outcome 5(CO5)

1. Manufacture of basic raw material for polymerization like ethylene.
2. Manufacture of alkyl aryl compounds, ethylene oxide condensation products.
3. Manufacture of benzene, toluene, xylene & styrene.

Syllabus:

Module I

Introduction to mineral oils:

Origin and mode of occurrence. Oil resources and refineries in India. Composition of petroleum, Refinery products and their test methods. Evaluation of oil stocks

Module II

Processing of petroleum;

Processing of crude oil distillation, refinery products and their applications, natural gas, gasoline, naphtha kerosene, fuel oils and gas oils, petroleum waxes, lubricating oils, tar and asphalt.

Module III

Petroleum refining processes and operations:

Thermal cracking, catalytic cracking, hydro-forming, catalytic reforming, alkylation, polymerization, isomerisation.

Module IV

Auxiliary processes:

Vis-breaking, de-waxing and de-asphalting operations. Manufacture of paraffin wax and microcrystalline waxes.

Module V

Petrochemicals;

Manufacture of alkyl aryl compounds, ethylene oxide condensation products benzene, toluene, xylene, buta-di-enes, vinyl chloride and styrene etc.

Reference Book

1. Petroleum Products Hand Book by V. B. Guthrie
2. Petroleum processing hand book (1967) Edited by Bland & Davidson
3. Petroleum refinery Engineering edited by Nelson
4. Petroleum refining technology Edited By Dr. Ramprasad

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	Introduction to mineral oils:	
1.1	Introduction & origin of crude	1
1.2	Occurrence in earth crust	1
1.3	Refineries in India	1
1.4	Composition of petroleum	1
1.5	Refinery products	2
1.6	Test Methods	3
1.7	Oil Stock evaluation	1
2.	Processing of petroleum;	
2.1	Crude oil distillation	2
2.2	Refinery products and applications	2
2.3	Natural gas	1
2.4	Gasoline	1
2.5	Naphtha	1
2.6	Fuel oils & gas oils	1
2.7	Petroleum waxes	1
2.8	Lubricating oils	1
2.9	Tar & asphalt	1
3.	Petroleum refining processes and operations	
3.1	Thermal cracking	1
3.2	Catalytic cracking	1
3.3	Hydro-forming, Catalytic reforming	1
3.4	Alkylation	1
3.5	Polymerization	1
3.6	Isomerisation	1
4.	Auxiliary processes	
4.1	Vis- breaking	1
4.2	De-waxing and manufacture of paraffin & micro crystalline wax	3
4.3	De-asphalting	1
5.	Petrochemicals	
5.1	Manufacture of alkyl aryl compounds	1
5.2	Ethylene oxide condensation products	1
5.3	Manufacture of benzene	1
5.4	Manufacture of toluene	1
5.5	Manufacture of xylene	1
5.6	Manufacture of butadiene	1
5.7	Manufacture of vinyl chloride	1
5.8	Manufacture of styrene	1
Total		40

TOT-498 PROJECT (DTEFR)

L : T: P

0 : 0: 16

Objectives

1. Students are required to work on the allotted topic for submission of the project report.
2. Students make use of their knowledge and skills in the dissertation, techno-economic feasibility study. They implement their entire technical & commercial talent for the project.
3. Equipment design enables use of unit operation principles.

Outcomes

Students will get an exposure and gain knowledge for establishing industrial enterprises and design of equipments.