SEMESTER WISE COURSE STRUCTURE & EVALUATION SCHEME

for

M. TECH. DEGREE PROGRAMME

IN

CHEMICAL TECHNOLOGY (OIL TECHNOLOGY)

(Effective from the session 2023-24)

DEPARTMENT OF OIL TECHNOLOGY
SCHOOL OF CHEMICAL TECHNOLOGY
HARCOURT BUTLER TECHNICAL UNIVERSITY
KANPUR-208002
UTTAR PRADESH

Department of Oil Technology
SCHOOL OF CHEMICAL TECHNOLOGY
Harcourt Butler Technical University Kanpur

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 M Tech Oil Chemical Technology (Oil Technology) Programme:

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

PEO2. Post 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 Post Graduates of the programme will accept and create innovations in providing solution for sustainable technology development

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

Programme Outcomes (POs) of M. Tech Chemical Technology (Oil Technology)

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

Programme Outcomes(POs)		**Post Graduate**
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

HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR
SCHOOL OF CHEMICAL TECHNOLOGY
DEPARTMENT OF OIL TECHNOLOGY

Semester wise Course Structure

M. Tech. Chemical Technology (Oil Technology)

(Applicable from Session 2023-2024 for new entrants)

Year I, Semester I

(A Stream Only for students having B. Tech. in Oil Technology background)
(B Stream Only for students having B. Tech. in other than Oil Technology background)
(C Stream Only for students of M. Sc (Chemistry/Applied Chemistry /Industrial Chemistry) background)

Stream A

Sr. No.	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1.	PCC	NOT 501	Advances in Oleo Chemicals	4	3	0	2	15	20	15	50	50	100
2.	PCC	NOT 503	Advanced Chemical Reaction Engineering	4	3	1	0	30	20	-	50	50	100
3.	PCC	NOT 505	Nutraceuticals and Functional Foods	4	3	1	0	30	20	-	50	50	100
4.	PEC	NOT 507 NOT 511	**a)** Perfumery and Cosmetics **b)** Safety Hazard and Risk Analysis	4	3	1	0	30	20	-	50	50	100
		Total		**16**							**200**	**200**	**400**

OR

Stream B/C

Sr. No.	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1.	PCC	NOT 513	Chemistry and Technology of Oil and Allied Products	4	3	1	0	30	20	-	50	50	100
2.	PCC	NOT 515	Quality Control	4	3	0	2	15	20	15	50	50	100

			Techniques in Oil and Allied Industries										
3.	PCC	NOT 517	Interfacial Science and Engineering	4	3	0	2	15	20	15	50	50	100
4.	PEC	NOT 519 NOT 521	**a)** Lipid Biotechnology **b)** Modern Processing Tools related to Oil and Allied Industries	4	3	1	0	30	20	-	50	50	100
5.	*MC (Non Credit)	BMA	Engineering Mathematics	0	2	0	0	-	-	-	-	-	-
		Total		**16**							**200**	**200**	**400**

*Only for students of Non-mathematics background at graduation level

HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR
SCHOOL OF CHEMICAL TECHNOLOGY
DEPARTMENT OF OIL TECHNOLOGY
Semester wise Course Structure
M. Tech. Chemical Technology (Oil Technology)
Applicable from Session 2023-2024 for new entrants)

Year I, Semester II

	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1.	PCC	NOT502	Modern Processing Technology of Oil-bearing Materials	4	3	1	0	30	20	-	50	50	100
2.	PCC	NOT504	Modern Processing Technology of Oils	4	3	0	2	15	20	15	50	50	100
3.	PCC	NOT 506	Modelingand Simulation of Chemical Processes	4	3	1	0	30	20	-	50	50	100
4.	PEC	NOT 508 NOT 510 NOT 512	**a)** Statistical Design of Experiments **b)** Nanomaterials in Science & Engineering **c)** Soaps and Synthetic Detergents	4	3	1	0	30	20	-	50	50	100
5.	MC (Non Credit)	NOT514	Research Methodology (Audit Course)		2	1	0						
		Total		**16**							**200**	**200**	**400**

HARCOURT BULTER TECHNICAL UNIVERSITY KANPURSCHOOL OF CHEMICAL TECHNOLOGY
DEPARTMENT OF OILTECHNOLOGY

Semester wise Course Structure

M. Tech. Chemical Technology (Oil Technology)

Applicable from Session 2024-2025

Year II, Semester III

Sl. No.	CourseType	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1.	PEC	NOT-601 NOT-603	Novel Surfactants-Production and Industrial Applications Advance in Emulsion Technology	4	3	1	0	30	20	-	50	50	100
2.	OEC	NOT-605	Technology Modified and Specialty fats & Oils	3	3	0	0	30	20	-	50	50	100
3.	Seminar	NOT-607	Seminar	1	0	0	2	-	50	-	50	50	100
4.	Dissertation-I	NOT-609	*Dissertation -I	8	0	0	16	-	50	-	50	50	100
		Total		**16**							**200**	**200**	**400**

*Dissertation to be continued in fourth semester.

HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR
SCHOOL OF CHEMICAL TECHNOLOGY
DEPARTMENT OF OILTECHNOLOGY

Semester wise Course Structure

M. Tech. Chemical Technology (Oil Technology)

(Applicable from Session 2024-2025)

Year II, Semester IV

Sl. No.	CourseType	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1.	Dissertation-II	NOT-602	Dissertation-II	16	0	0	32	-	50	-	50	50	100
		Total		**16**					**50**		**50**	**50**	**100**

NOT-501 ADVANCES IN OLEO CHEMICALS[A]

L: T: P:C
3 : 0: 2:4

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

(CO1)	Understand glyceride and non glyceride structure of natural fats & oils.	Understand
(CO2)	Understand industrial application of important chemical reactions of fats and fatty acids	Understand
(CO3)	Apply Industrial utilization of oleochemicals	Apply
(CO4)	Analyze Chemical synthesis of fatty acids and glycerides	Analyze
(CO5)	Apply advance chemistry and technology of major oleochemicals, fatty alcohols& allied products	Apply

Mapping with Program Outcomes

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

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. Advanced knowledge on glyceride structure of natural fats & oils
2. Non glyceride components of important oils
3. Production and utilization of rice bran wax and sunflower wax

Course Outcome 2(CO2)

1. Advances and industrial application of important chemical reactions of fats and fatty acids
2. Esterification, Inter-esterification, Isomerisation

Course Outcome 3(CO3)

1. Advanced technology in recovery and refining of glycerine from oils and fats
2. Industrial utilization of oleochemicals from glycerine
3. Production of synthetic glycerol

Course Outcome 4(CO4)

1. Advance production technologies of fatty acids and their purification
2. Chemical synthesis of fatty acids and glycerides
3. Oil based additives for food, printing ink and packaging industry

Course Outcome 5(CO5)

1. Advances in chemistry and technology of major oleochemicals, fatty alcohols
2. Biodiesel alfa olefins using triglyceride route, polyols
3. Reactive extractions, green diesel

Syllabus:

MODULE-1

Advanced knowledge on glyceride structure of natural fats & oils. Non glyceride components of important Indian oils. Oleochemicals from palm, palm kernel, coconut, neem, mahua, mustard, sunflower, soybean, safflower, cotton seed and castor oil. Production and utilization of rice wax and sunflower wax.

MODULE-2

Advances and industrial application of important chemical reactions of fats and fatty acids; esterification, interesterification, isomerisation, polymerization, pyrolysis, dehydrogenation, sulphation, sulphonation, sulphitation, alkoxylation, epoxidation etc.

MODULE-3

Advances in recovery and refining of glycerine from oils and fats, plants and processes, Industrial utilization and oleochemicals from glycerine. Production of synthetic glycerol.

MODULE-4

Newer production technologies of fatty acids and their purification. Chemical synthesis of fatty acids and glycerides. Oil based additives for food, printing ink and packaging industry.

MODULE-5

Advances in chemistry and technology of major oleochemicals; fatty alcohols, fatty amines, fatty amides , methyl esters, Biodiesel, alfa olefins using triglyceride route, polyols, plasticizers and other derivatives, reactive extractions, green diesel (deoxy hydrogenation)

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 book:

1. Oleochemicals by Doherties & Malieur
2. Fatty acids; Their chemistry, properties, production and uses Part – III Edited by K.S. Markley
3. Principles of Instrumentation analysis, Edition- III (1985) Edited by Douglas A. Skog
4. Standard methods of analysis CODEX**,** BIS, AOCS, ISO, FSSAI.

Course contents and Lecture schedule:

Module No.	**Topic**	**No. of Lectures**
1.		
1.1	Advanced knowledge on glyceride structure of natural fats & oils	1
1.2	Non glyceride components of important Indian oils	1
1.3	Oleochemicals from palm, palm kernel, , soybean	2
	Oleo chemicalsfrom coconut neem, mahua, mustard, sunflower	2
	Oleo chemicalsfromsafflower, cotton seed and castor oil	2
1.4	Production and utilization of rice wax and sunflower wax	1
2.		
2.1	Advances and industrial application of important chemical reactions of fats and fatty acids	3
2.2	Esterification, interesterification	2
2.3	pyrolysis, dehydrogenation	1
2.4	sulphation, sulphonation	1
2.5	sulphitation, alkoxylation, epoxidation	2
3.		
3.1	Advances in recovery and refining of glycerine from oils and fats	2
3.2	Industrial utilization and oleochemicals from glycerine	1
3.3	Production of synthetic glycerol	1
4.		
4.1	Newer production technologies of fatty acids and their purification	2
4.2	Chemical synthesis of fatty acids and glycerides	3
4.3	Oil based additives for food, printing ink and packaging industry	2
5.		
5.1	Advances in chemistry and technology of major oleochemicals	2
5.2	Fatty alcohols, fatty amines, fatty amides	2
5.3	Methyl esters, Biodiesel, alfa olefins using triglyceride route	3
5.4	Polyols, plasticizers and other derivatives	2
5.5	Reactive extractions, green diesel (deoxy hydrogenation)	2
	Total	**40**

NOT -503 ADVANCED CHEMICAL REACTION ENGINEERING

	L	T	P	C
Syllabus	**3**	**1**	**0**	**4**

Module 1 (6 Lectures)

Kinetics of heterogeneous catalytic reactions, rate equations, model discrimination and parameter estimation. Module 2 (7 Lectures) Deactivating catalysts, mechanisms of catalyst deactivation, the rate and performance equations, design.

Module 3 (7 Lectures)

Mass Transfer and Reaction in a packed bed, Stoichiometric table, Pressure drop in a Reactor, Ergun's equation, Flow through a packed bed.

Module 4 (10 Lectures)

Types of multiphase reactors, mass transfer reactors, mass transfer equations, Interfacial surface area, mass transfer between phases, multiphase reactor equations, equilibrium between phases, membrane reactors, falling film reactors, bubble column reactors.

Module 5 (10 Lectures)

Falling film catalytic wall reactor, trickle bed reactors, multiphase reactors with catalysts, other multiphase reactors, reactor-separator integration, catalytic distillation, chromatographic reactors, iron ore refining, petroleum refinery.

Suggested Text Books

1. O. Levenspiel, "Chemical Reaction Engineering, Wiley India, (1998).

2. G. F. Froment and K. B. Bischoff, "Chemical Reactor Analysis and Design", John Wiley and Sons, (1979).

Reference Books

1. H. S. Fogler, "Elements of Chemical Reaction Engineering",
2. 2nd edition, PrenticeHall, (2000). 2. Lanny D. Schmidt, "The Engineering of Chemical Reactions", 2nd edition, Oxford University Press, (2010).

NOT -505 NUTRITIONAL AND FUNCTIONAL FOODS

L :T :P:C
3 :1 :0:4

Preamble:
This course has been designed to provide knowledge of human nutrition and role of nutrition in growth & health through the life cycle. The course also provide awareness of nutritional importance of oil & fats function in food and various food constitute responsible for functional effects and processing of health & foods.

Prerequisite: In depth, the knowledge of nutrition, its role and importance in growth & health of human life cycle.

Course Outcome:

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

(CO1)	Understand requirement of major nutrients for human nutrition & nutrient status in individual and populations	Understand
(CO2)	Role of nutrition in growth and health through the life cycle	Understand
(CO3)	Nutritional importance of oils/fats function of oil & types of health and functional foods and their properties	Apply
(CO4)	Various food constituents responsible for functional effects	Analyze
(CO5)	Processing of health and functional foods	Apply

Mapping with Program Outcomes

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

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Dietary sources, intake levels, physiological role, and requirement of major nutrients

2. Biological determinants of nutrient requirements and the assessment of nutrient status in individuals and populations

3. Lipid oxidation in different matrix

Course Outcome 2(CO2)

1. Rationale for the development of dietary guidelines and of nutrition policies in different countries
2. Role of diet in the development of chronic diseases, such as cardiovascular disease, cancer, diabetes, etc

Course Outcome 3(CO3)

1. Tenderness - Texture - Flavor - Emulsion :Introduction – definition, status and scope of health and functional foods in India
2. Definition of nutraceuticals and their importance
3. Types of health and functional foods and their properties

Course Outcome 4(CO4)

1. Anti-carcinogenic, hypocholesterolemic and hypoglycemic foods
2. Dietatic foods,- Fortified foods,- Biofedic and probiotic foods
3. Low and non-calorie sweetening agents, -Fat replacers

Course Outcome 5(CO5)

1. Criteria for selection of raw materials, and their processing,Storage, packaging and labeling of health and functional food
2. Marketing and legal aspects of health and functional foods
3. Organic foods and Genetically Modified (GM) foods in relation to health

Syllabus:

MODULE-1

Principles of Human Nutrition

Dietary sources, intake levels, physiological role, and requirement of major nutrients. The biological determinants of nutrient requirements and the assessment of nutrient status in individuals and populations, lipid oxidation in different matrix.

MODULE-2

The role of nutrition in growth and health through the life cycle

The rationale for the development of dietary guidelines and of nutrition policies in different countries. The role of diet in the development of chronic diseases, such as cardiovascular disease, cancer, diabetes, etc.

MODULE-3

Nutritional importance of oils and fats function of oil and fats in food:

Tenderness - Texture - Flavor - Emulsion :Introduction – definition, status and scope of health and functional foods in India. Definition of nutraceuticals and their importance. Types of health and functional foods and their properties

MODULE-4

Various food constituents responsible for functional effects

Anti-carcinogenic, hypocholesterolemic and hypoglycemic foods - Dietatic foods,- Fortified foods,- Biofedic and probiotic foods , Low and non-calorie sweetening agents, -Fat replacers

MODULE-5

Processing of health and functional foods

Criteria for selection of raw materials, and their processing, Storage, packaging and labeling of health and functional food. Marketing and legal aspects of health and functional foods. Organic foods and Genetically Modified (GM) foods in relation to health

Reference Books:

1. Essentials of human nutrition by J. Mann and S. Truswell (2nd Edition, 2002), Oxford University
2. Encyclopedia of human nutrition (1998) , London: Academic press
3. Modern nutrition in health and disease, 9th edition edited by Shils, Olson, Shike and Ross
4. Nutrional Biochemistry and \metabolism, 2nd edition edited by Linder (1991)

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Principles of Human Nutrition**	
1.1	Dietary sources, intake levels, physiological role	2
1.2	Requirement of major nutrients	2
1.3	Biological determinants of nutrient requirements	2
1.4	Assessment of nutrient status in individuals and populations	2
1.5	Lipid oxidation in different matrix	2
2.	**The role of nutrition in growth and health through the life cycle**	
2.1	Rationale for the development of dietary guidelines	2
2.2	Nutrition policies in different countries	2
2.3	Role of diet in the development of chronic diseases, such as cardiovascular disease, cancer, diabetes, etc	3
3.	**Nutritional importance of oils and fats function of oil and fats in food**:	
3.1	Tenderness - Texture - Flavor - Emulsion	2
3.2	Introduction – definition, status and scope of health and functional foods in India	2
3.3	Definition of nutraceuticals and their importance	2
3.4	Types of health and functional foods and their properties	2
4.	**Various food constituents responsible for functional effects**	
4.1	Anti-carcinogenic, hypocholesterolemic and hypoglycemic foods	2
4.2	Dietatic foods,- Fortified foods	2
4.3	Biofedic and probiotic foods	2
4.4	Low and non-calorie sweetening agents, -Fat replacers	2
5.	**Processing of health and functional foods**	
5.1	Criteria for selection of raw materials, and their processing	2
5.2	Raw materials storage, packaging and labeling of health and functional food	2
5.3	Marketing and legal aspects of health and functional foods	2
5.4	Organic foods and Genetically Modified (GM) foods in relation to health	2
	Total	**41**

NOT-507 PERFUMERY AND COSMETICS

L :T :P:C
3 :1 :0:4

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:

Advance 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- chemical properties	Analyze
(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

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

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 of geraniol, citraniol & terpenols, ionones, Hydroxycitronellol 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.

Reference Book

1. Essential oils –Vol. I –V by Guenther
2. Perfume Cosmetics & Soaps Vol.-I –III byW.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. Gylcerin Edited Vol -11 (1991)by Eric Jungermann & Norman O. V. Sonntag

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, etc.	3
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**

NOT -513 CHEMISTRY AND TECHNOLOGY OF OILS AND ALLIED PRODUCTS[BC]

L:T :P:C
3 :1: 0:4

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

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

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. Importance of oils, fats and their derivatives, theories of glyceride structure, classification of oils and fats
2. Status of production of oilseeds, oil-bearing materials, oils and fats. non-glyceride components of natural oils and fats
3. Esterification, interesterification saponification, hydrolysis
4. Hydrogenation, dehydrogenation, halogenation, hydrogensulphide and mercaptans: sulphation and sulphonation

Course Outcome 2(CO2)

1. Production, characteristics, composition andutilization ofCoconut, palm, palm kernel, olive, cocoa butter, sunflower, safflower, sesame
2. Production, characteristics, composition and utilization of groundnut, mustard, rapeseed, canola, soybean, linseed, castor , rice-bran, cottonseed, corn, tung
3. Production, characteristics, composition and utilization of Oiticica, neem, mahua, kusum,karanja, sal, mango kernel ,tobacco, shea fat, watermelon, maize germ, jatropha etc

Course Outcome 3(CO3)

1. Production, characteristics, composition and utilization of minor oilseeds and oils
2. Analysis of oilseeds, oils &cakes
3. Detection of adulteration and identification of oils by chemical methods including chemistry involved

Course Outcome 4(CO4)

1. Production, characteristics, composition and utilization of milk fats and butter
2. Production, characteristics, composition and utilization of animal fats such as lard andtallow, fish and marine oils

Course Outcome 5(CO5)

1. Natural waxes, their occurrence classification and general properties and uses of synthetic and vegetable waxes
2. Specification for different vegetable oils and oilseeds as per BIS.

Syllabus:

MODULE-1

Sources, Structure and composition of oils and fats:

Importance of oils, fats and their derivatives, theories of glyceride structure, classification of oils and fats, Status of production of oilseeds, oil-bearing materials, oils and fats. non-glyceride components of natural oils and fats. 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,

hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds, Rancidityand mechanism of chemical and auto oxidation (primary and secondary), natural & synthetic antioxidants

MODULE-2

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

Major commercial oilseeds, oil – bearing materials and their oils: Production, characteristics, composition andutilization; Coconut, palm, palm kernel, olive, cocoa butter, sunflower, safflower, sesame, groundnut, mustard, rapeseed, canola, soybean, linseed, castor , rice-bran, cottonseed, corn, tung, oiticica, , neem, mahua, kusum, karanja, sal, mango kernel ,tobacco, shea fat, watermelon, maize germ, jatropha etc. genetically modified oilseeds and oils.

MODULE-3

Minor oilseeds and adulteration of oils:

Production, characteristics, composition and utilization of minor oilseeds and oils.Analysis of oilseeds, oils &cakes. Detection of adulteration and identification of oils by chemical methods including chemistry involved, specification of cake, export parameter of oil meal and quality checks for meal.

MODULE-4

Milk and animal fats:

Production, characteristics, composition and utilization of milk fats and butter, animal fats such as lard and tallow, fish and marine oils.

MODULE-5

Waxes:

Natural waxes, their occurrence classification and general properties and uses of synthetic and vegetable waxes. Specification for different vegetable oils and oilseeds as per BIS

Reference Books

1. Fatty acids Vol-1by K. S. Markley
2. Bailey's Industrial Oil and Fat, Part-1-V
3. Chemistry and Technology of Oils & Fats by M. M. Chakarobarty
4. A text book of oil and fat analysis by Cocks & Reid
5. An introduction to Chemistry & Biochemistry of Fatty acids & their glyceride by F. D. Gunstone
6. Fats and Oils Hand book by Michaell Bockish: AOCS Press, Champaign, Illinois

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Sources, Structure and composition 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.	**Commercial oilseeds, oils, cultivation, characteristics, composition**	

	and utilization from plant sources	
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.	**Minor oilseeds and adulteration of oils**	
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	Algae oils, Chia seed oil, jatropha	1
3.11	Genetically modify oil seeds	1
4.	**Milk and animal fats**	
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 lever oils, krill oil	1
4.7	Different methods of rendering	1
5.	**Waxes**	
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**

NOT -515 QUALITY CONTROL TECHNIQUES IN OIL AND ALLIED INDUSTRIES [BC]

L :T :P:C
3 :0 :2:4

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

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

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	30	30	30	20
Apply	10	20	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. Concept of quality assurance and quality control in relation to oil industry ISO 9000; total quality management (TQM)
2. Hazard analysis of critical control points (HACCP) & good manufacturing practices (GMP)
3. Role of international organizations such as ISO, IDF, CAC, AOAC, WTO & BIS, Agmark, FSSAI and APEDA
4. Guidelines for setting up quality control laboratory& Legislation on oils and allied products

Course Outcome 2(CO2)

1. Thin layer chromatography, paper chromatography, column chromatography, gas-liquid chromatography and H.P.L.C.
2. Super critical chromatography; their principles, practices and applications to the analysis of oils and allied products
3. Detection of adulteration by chromatographic techniques

Course Outcome 3(CO3)

1. Ultra-violet, visible, infrared and near infrared spectroscopy techniques: principles, practices and application to the analysis of oils and allied products
2. Nuclear and magnetic resonance spectroscopy: principle, high resolution spectra of fats and fatty acids
3. Adsorption of special groups, analysis of spectra and quantitative applications
4. Dilatometry of fats Solid fat index, congealing point of fats; calorimetry of fats

Course Outcome 4(CO4)

1. Iron and phosphatide content of crude and refined oils
2. Nickel content of hydrogenated oils, wax content of vegetable oils
3. Analysis of intermediate products and by-products of oil processing

Course Outcome 5(CO5)

1. Application of TLC-FID analyzer AAS, GC-MS, SFC-GCLC-MS, ICP
2. MS for trace meta analysis in analysis of oils and fats
3. Legislation on fats and oils, packaging laws and testing of packaged materials

Syllabus:

MODULE-1

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 organizations like BIS; Agmark; significance of oil and allied products order, 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-2

Chromatographic techniques and their applications in oils and fats:

Thin layer chromatography, paper chromatography, column chromatography, gas-liquid chromatography and H.P.L.C. and super critical chromatography; their principles, practices and applications to the analysis of oils and allied products Detection of adulteration by chromatographic techniques.

MODULE-3

Spectral methods of analysis and their applications in oils and fats:

Ultra-violet, visible, infrared and near infrared spectroscopy techniques: principles, practices and application to the analysis of oils and allied products. Nuclear and magnetic resonance spectroscopy: principle, high resolution spectra of fats and fatty acids, adsorption of special groups, analysis of spectra and quantitative applications, Dilatometry of fats Solid fat index, congealing point of fats; calorimetry of fats.

MODULE-4

Special quality control methods:

Iron and phosphatide content of crude and refined oils, nickel content of hydrogenated oils, wax content of vegetable oils. Analysis of intermediate products and by-products of oil processing.

MODULE-5

Hyphenated techniques:

Application of TLC-FID analyzer AAS, GC-MS, SFC-GCLC-MS, ICP (Induction Coupled Plasma)-MS for trace meta analysis in analysis of oils and fats. Legislation on fats and oils, packaging laws and testing of packaged materials.

Module- 6

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:

1. Fatty acids; Their chemistry, properties, production and uses Part-III Edited by K.S. Markley
2. Principles of Instrumentation analysis, Edition- III (1985) Edited by Douglas A. skog
3. CODEX/ BIS
4. PFA
5. Agmark
6. Prevention of Food Adulteration Act (PFA) 1954 and PFA Rules. 1955 Official methods of A.O.A.C. (11^{th} and 15th editions)
7. ISI Handbook of Food Analysis S.P. 18(Part II) 1981 ISI Specifications (concerned)(ISI)
8. Ralph Early, Guide to Quality Management System for Food Industry; Heinz Bullworth, Establishment and Implementation of HACCP Personal Hygiene Practices
9. Spectromstric Identification of Organic Compounds, by Robert M. Silver, Francis *Websiter & David Kiemle, John Wiley & Sons 7th Edition, (2005)
10. Vogel Organic Analysis
11. Application of Absorption Spectroscopy of Organic Compounds by J.R.Dyer, PHI (2005)
12. FASSR
13. Official methods of A.O.A.C. (11th and 15th editions)
14. ISI Handbook of Food Analysis S.P. 18 (Part II) 1981 ISI Specifications (concerned) (ISI)

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 ISO 9000; total quality management (TQM)	2
1.2	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 & BIS, Agmark, FSSAI and APEDA	2
1.4	Guidelines for setting up quality control laboratory& Legislation on oils and allied products	2
2.	**Chromatographic techniques and their applications in oils and fats:**	
2.1	Thin layer chromatography, paper chromatography	2
2.2	column chromatography, gas-liquid chromatography and H.P.L.C	2
2.3	Super critical chromatography; their principles,	2
2.4	practices and applications to the analysis of oils and allied products	2
2.5	Detection of adulteration by chromatographic techniques	3
3.	**Spectral methods of analysis and their applications in oils and fats:**	
3.1	Ultra-voilet, visible, infrared and near infrared spectroscopy techniques:	2
3.2	principles, practices and application to the analysis of oils and allied products	2
3.3	Nuclear and magnetic resonance spectroscopy: principle, high resolution spectra of fats and fatty acids	2
3.4	Adsorption of special groups, analysis of spectra and quantitative applications	2
3.5	Dilatometry of fats Solid fat index, congealing point of fats; calorimetry of fats	1
4.	**Special quality control methods:**	
4.1	Iron and phosphatide content of crude and refined oils	2
4.2	Nickel content of hydrogenated oils, wax content of vegetable oils	2
4.3	Analysis of intermediate products and by-products of oil processing	2
5.	**Hyphenated techniques:**	
5.1	Application of TLC-FID analyzer AAS, GC-MS, SFC-GCLC-MS, ICP	2
5.2	MS for trace meta analysis in analysis of oils and fats	2
5.3	Legislation on fats and oils, packaging laws and testing of packaged materials	2
	Total	**40**

NOT-517 INTERFACIAL SCIENCE AND ENGINEERING BC

L : T: P:C
3 : 0: 2:4

Preamble:

The subject deals with the study of role of surface active agents on the interfaces, their behavior and thermodynamic properties. Role of surfactants in micro emulsion and nano emulsions and the effect of mixture of surfactants on the detergency is also discussed in the course.

Prerequisite:

Fundamental knowledge of fatty acid composition of oils, their chemistry and surfactant science.

Course Outcome:

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

(CO1)	Understand the role of surface active agents on the interfaces	Understand
(CO2)	Understand the impact of surfactants on the environment	Apply
(CO3)	Apply the knowledge acquired in professional career for serving the industry	Apply
(CO4)	Use the knowledge to select suitable combinations of surfactants for different industrial applications	Evaluate
(CO5)	Evaluate the performance of the surfactants in emulsions	Evaluate

Mapping with Program Outcomes

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

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	30
Analyze	30	20	20	20
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Definition and classification of surface active agents.
2. Biodegradability and toxicity of surfactants

Course Outcome 2(CO2)

1. Theory of adsorption of surfactant on solid- liquid interfaces.

2. Theory of adsorption of surfactant on liquid- liquid interfaces

Course Outcome 3(CO3)

1. Factors affecting CMC in aqueous media.
2. Thermodynamic parameter of micellization.
3. Plants and machineries for production of nonionic surfactants .

Course Outcome 4(CO4)

1. Effect of surfactant on wetting in micro emulsions.
2. Effect of surfactant on foaming in micro emulsions.

Course Outcome 5(CO5)

1. Detergency and its modification by surfactants.
2 Synergistic effect of surfactants on detergency.

Syllabus

Module-1

Surfactants: Definition, classification, characteristic features and uses of commercial surfactants: Anionic, Cationic, Nonionic, Zwitterionic and newer surfactants based on renewable raw materials. Environmental effects of surfactants, surfactants biodegradability and toxicity.

Module -2

Adsorption of surface active agent at interfaces: The electrical double layer, adsorption at the solid – liquid (S/L) interface and adsorption at liquid – gas (L/G) and liquid – liquid (L/L) interfaces.

Module -3

Micellar formation by surfactants: Critical micelle concentration and type, micellar aggregation number and factors effecting CMC in aqueous media. Thermodynamic parameter of micellization and mixed micelle formation in mixture of two surfactants and solubilization by solution of surfactants.

Module -4

Reduction of surface and interfacial tension by surfactants: Wetting, foaming and emulsification by surfactants with special reference to microemulsion and nanoemulsion.

Module -5

Dispersion and aggregation of solids in liquid media by surfactants: Detergency and its modification by surfactants and molecule interaction and synergism in mixture of two surfactants.

Module -6

Lab Component:

Reference books

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. Novel surfactants- Kristen Holmberg of Surfactant Science Series
6. Soaps; Their Chemistry and Technology - J.G. Kane

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Surfactants**	
1.1	Definition, classification, characteristic features and uses of Anionic surfactants	2
1.2	Definition, classification, characteristic features and uses of Cationic surfactants	2
1.3	Definition, classification, characteristic features and uses of Nonionic surfactants	2
1.4	Definition, classification, characteristic features and uses of Zwitterionic surfactants	2
1.5	Definition, classification, characteristic features and uses of newer surfactants based on renewable raw materials..	2
1.6	Environmental effects of surfactants, surfactants biodegradability and toxicity	3
2.	**Adsorption of surface active agent at interfaces**	
2.1	The electrical double layer theory	2
2.2	Adsorption at the solid – liquid (S/L) interface	2
2.3	Adsorption at liquid – gas (L/G) interface	2
2.4	Adsorption at liquid – liquid (L/L) interface	2
3.	**Micellar formation by surfactants**	
3.1	Critical micelle concentration and its type	2
3.2	Micellar aggregation number and factors effecting CMC in aqueous media	2
3.3	Thermodynamic parameter of micellization and mixed micelle formation in mixture of two surfactants and solubilization	3
4.	**Reduction of surface and interfacial tension by surfactants**	
4.1	Wetting, foaming and emulsification by surfactants	2
4.2	Micro emulsion	2
4.3	Nano emulsion.	2
5.	**Dispersion and aggregation of solids in liquid media by surfactants**:	
5.1	Detergency and its modification by surfactants	2
5.2	Molecule interaction in mixture of two surfactants	2
5.3	Synergism in mixture of two surfactants	2
	Total hours	**40**

NOT – 519 LIPID BIOTECHNOLOGY [BC]

L :T: P:C
3 :1: 0:4

Preamble:

Advance Knowledge of plant lipid sources, bio chemical organization, enzyme, protein synthsis and synthesis and inter conversion of fatty acids.

Prerequisite:

Advance science and engineering and oil technology

Course Outcome:

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

(CO1)	Understand plant lipid & animal lipid, and lipids in human nutrition and soluble vitamins	Understand
(CO2)	Understand Bio chemicals organization of cell lipids and GM, oils, properties and applications	Understand
(CO3)	Apply knowledge of production of enzyme and its applications	Apply
(CO4)	Analyze protein synthesis and its metabolism	Analyze
(CO5)	Evaluate synthesis and inter conversion of fatty acid and determination of glycerides structure of fats by enzymatic methods	Evaluate

Mapping with Program Outcomes

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

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. Animal lipid sources
2. Lipids in human nutrition
3. The lipid soluble vitamins

Course Outcome 2(CO2)

1. Single cell lipids their production and applications

2. Genetically modified oils their properties
3. Genetically modified oil's applications & ethical values

Course Outcome 3(CO3)

1. Isolation of stains from different sources
2. Production of enzymes Mechanism of enzyme action, determination of enzyme assay
3. Immobilization of enzymes, Reaction kinetics & application of enzymes

Course Outcome 4(CO4)

1. Structure, isolation of proteins
2. Isoelectric PH and function
3. Gene protein relationship & protein metabolism

Course Outcome 5(CO5)

1. Synthesis of triglycerides & Regulation of lipid metabolism
2. Phosphoglycerides, Sphingolipids and sterol metabolism
3. Determination of glyceride structure of fats by enzymatic methods

Syllabus:

MODULE-1

Plant lipid sources

Animal lipid sources.Lipids in human nutrition.The lipid soluble vitamins.

MODULE-2

Biochemical Organization

Single cell lipids their production and applications, genetically modified oils their properties and applications, ethical values.

MODULE-3

Enzymes their classification

Isolation of stains from different sources, Production of enzymes Mechanism of enzyme action, determination of enzyme assay, immobilization of enzymes, Reaction kinetics, application of enzymes.

MODULE-4

Protein synthesis

structure, isolation of proteins, Isoelectric PH and function, gene protein relationship, protein metabolism.

MODULE-5

Synthesis and inter-conversion of fatty acids

Synthesis of triglycerides. Regulation of lipid metabolism,
Phosphoglycerides, Sphingolipids and sterol metabolism, Disturbance of lipid metabolism.
Determination of glyceride structure of fats by enzymatic methods.

Reference Books:

1. Biotechnology by Lehninger
2. Biotechnology by Stryer
3. Biotechnology by J.L.Jain
4. Encyclopedia of Biotechnology

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Plant lipid sources**	

1.1	Animal lipid sources	2
1.2	Lipids in human nutrition	3
1.3	The lipid soluble vitamins	3
2.	**Biochemical Organization**	
2.1	Single cell lipids their production and applications	3
2.2	Genetically modified oils their properties	3
2.3	Genetically modified oil's applications & ethical values	3
3.	**Enzymes their classification**	
3.1	Isolation of stains from different sources	2
3.2	Production of enzymes Mechanism of enzyme action, determination of enzyme assay	3
3.3	Immobilization of enzymes, Reaction kinetics & application of enzymes	3
4.	**Protein synthesis**	
4.1	Structure, isolation of proteins	2
4.2	Isoelectric PH and function	2
4.3	Gene protein relationship & protein metabolism	2
5.	**Synthesis and inter-conversion of fatty acids**	
5.1	Synthesis of triglycerides & Regulation of lipid metabolism	3
5.2	Phosphoglycerides, Sphingolipids and sterol metabolism	3
5.3	Determination of glyceride structure of fats by enzymatic methods	3
	Total	**40**

NOT-521 MODERN PROCESSING TOOLS RELATED TO OIL AND ALLIED INDUSTRIES BC

L :T: P:C
3 :1: 0:4

Unit 1: Accounting& Data Management Tools
Introduction to MS Office, SAP, Origin and their applications in oil and allied industries
Unit 2: Designing Tools
Introduction to Design Expert, Statistics, Autocad, Chemcad, Chem draw and their applications in oil and allied industries
Unit 3: Automation Tools
Introduction to Plc programming, SCADA, Distributed control system, Programming logic control and their applications in oil and allied industries
Unit 4: Simulation Tools

Introduction to Advanced Simulation Library, Simulink, Aspen, Chemcad, Matlab and their applications in oil and allied industries
Unit 5: Application to Artificial Intelligence (AI)
Introduction to AI: history, definitions, branches and challenges of AI, AI techniques: search, knowledge representation, reasoning, planning, learning and natural language processing, AI applications: expert systems, decision support systems, computer vision, robotics and machine learning, AI in edible oil and allied industries: use cases, benefits, limitations and ethical issues of AI in various domains such as oil extraction, refining, quality control, marketing and waste management.
Reference books:
1. Self-Service Data Analytics and Governance for Managers, Nathan E. Myers, Gregory Kogan, 2021.
2. Introductory Statistics, Barbara Illowsky, Susan Dean, 2017.
3. Introduction Practical PLC (Programmable Logic Controller), Dilip Patel, 2018.
4. SCADA: Supervisory Control and Data Acquisition, Stuart A. Boyer, 2010.
5. Artificial Intelligence (AI): Recent Trends and Applications, S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, 2021

BMA ENGINEERING MATHEMATICS C

L: T: P:C

2: 0: 0: 0

OBJECTIVE: The objective of this course is to provide conceptual understanding of:

- Various mathematical tools like vector algebra and their applications.
- Concepts and principle of complex analysis in solvingvarious Differentiation and numerical differentiation
- Various methods and tests for analyzing experimental data.

Course Outcome

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

CO1	Matrix and vector algebra with applications	Apply
CO2	Numerical solutions of algebraic and transcendental equation, interpolation	Understand, Apply
CO3	Differentiation and numerical differentiation	Apply
CO4	Integration and numerical integration, curve fitting	Apply
CO5	Regression and correlation catalysis statistical quality control charts algorithms and C/C++ programme of the numerical Statistical method.	Understand, Apply

Mapping with Program Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 13	
CO1	3	2	3	2	2	1	2	1	1	2	1	2	2	2
CO2	2	2	2	3	2	1	2	1	1	1	1	3	2	1
CO3	3	3	2	3	2	1	2	1	1	2	1	3	2	1
CO4	2	3	3	2	1	1	2	2	2	1	2	2	2	2
CO5	3	2	2	3	1	2	3	2	2	1	1	2	2	2

Unit 1

Matrix and vector algebra with applications

Unit 2

Numerical solutions of algebraic and transcendental equation, interpolation

Unit 3

Differentiation and numerical differentiation

Unit 4

Integration and numerical integration, curve fitting

Unit 5

Regression and correlation catalysis statistical quality control charts algorithms and C/C++ programme of the numerical Statistical method.

Books Recommended:

1. Dennis G, Zill & Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.

2. R.K. Jain & S.R.K. Iyengar; advanced Engineering Mathematics, Narosa Publishing House, 2002.

3 Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons 8th Edition.

4. 6. H.C. Saxena, Practical Mathematical Statistics, S. chand & Co., 2000.

5. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

NOT -502 MODERN PROCESSING TECHNOLOGY OF OIL BEARING MATERIALS

L:T:P:C
3 :1:0:4

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 cost.	Evaluate

Mapping with Program Outcomes

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

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. Introduction to oilseeds of tree origin and other minor oil bearing materials.
2. Various methods of storage of oil seeds and conditions of storage .
3. Grading and evaluation of oilseeds, oilbearing materials and crude oils as per BIS methods.

Course Outcome 2(CO2)

1. Machinery employed for handling and pre treatment of oil seeds.
2. Machinery employed for production of oils

Course Outcome 3(CO3)

1. Techniques of production of various oils from oilseeds
2. Production of oils from coconut, olive, palm and palm kernel.

Course Outcome 4(CO4)

1. Extrusion pretreatment of oilseeds and oil bearing materials
2. Recent trends in preparation of oilseeds and oil bearing materials for solvent extraction

Course Outcome 5(CO5)

1. Latest extraction processes and plants
2. Desolventisation processes for meal and miscella
3. Use of super critical fluid and liquefied gases for oilseed extraction andoleoresin preparations

Syllabus:

MODULE-1

Introduction to oilseeds of tree origin and other minor oil bearing materials:

Storage of oilseeds various methods, conditions of storage and their effect on oil yield and its characteristics. Grading and evaluation of oilseeds, oilbearing materials and crude oils as per BIS methods.

MODULE-2

Handling and pre treatment of oilseeds:

Machinery employed for handling and pre treatment of oil seeds viz. conveyers, elevators, seed cleaning machines, decorticator, disintegrators, reduction rolls and high roll etc. Machinery employed for production of oils viz. ghanies, hydraulic pressures, screw presses, low and high pressure expellers etc. Filter presses, and centrifuges.

MODULE-3

Techniques of production of various oils from oilseeds :

Mustard, rapeseed, groundnut, cottonseed, sunflower, sesame, linseed, castor, neem and sal.Production of oils from coconut, olive, palm and palm kernel.

MODULE-4

Extrusion pretreatment of oilseeds and oil bearing materials :

Expander-extruder system, Recent trends in preparation of oilseeds and oil bearing materials for solvent extraction.

MODULE-5

Latest extraction processes and plants:

Desolventisation processes for meal and miscella Equipments and plants employed; current trends with comparison of each. Alternative solvents for oil extraction; their principle and comparison with conventional solvents. Use of super critical fluid and liquefied gases for oilseed extraction and oleoresin preparations, HCF extraction, Aqueous extraction. Enzymatic extraction.**Reference Book**

1. Bailey's Industrial Oil and Fat, Edition 6 Vol-5 (2005), Edited by FeireidoonShahidi
2. Oil and Fat Technology Edited by E. Bernardini
3. Solvent extraction of vegetable oil by Parikh
4. Oilseed and Oil Milling in India
5. Proceedings of AOCS
6. Handbook of SEA
7. Oil Extraction &Analysis (critical issue and comparative studies) , D.L. Luthria, US Department of Agriculture Behtsville, Maryland

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Introduction to oilseeds of tree origin and other minor oil bearing materials**	
1.1	Storage of oilseeds various methods	2
1.2	Conditions of storage and their effect on oil yield and its characteristics	2
1.3	Grading and evaluation of oilseeds	2
1.4	Grading and evaluation of oil seeds as per BIS methods	2
2.	**Handling and pre treatment of oilseeds**	
2.1	Machinery employed for handling and pre treatment of oil seeds	3
2.2	Machinery employed for production of oils	3
3.	**Techniques of production of various oils from oilseeds**	
3.1	Techniques of production of various oils from oilseeds Mustard, rapeseed, groundnut, cottonseed	3
3.2	Techniques of production of various oils from oilseeds sunflower,sesame, linseed, castor, neem and sal	3
3.3	Production of oils from coconut, olive, palm and palm kernel	3
4.	**Extrusion pretreatment of oilseeds and oil bearing materials**	
4.1	Extrusion pretreatment of oilseeds and oil bearing materials Expander-extruder system	3
4.2	Recent trends in preparation of oilseeds and oil bearing materials for solvent extraction	3
5.	**Latest extraction processes and plants**	
5.1	Desolventisation processes for meal and miscella	2
5.2	Current trends with comparison of each for Equipments and plants employed	2
5.3	Alternative solvents for oil extraction their principle and comparison with conventional solvents	3
5.4	Use of super critical fluid and liquefied gases for oilseed extraction and oleoresin preparations	2
5.5	HCF extraction, Aqueous extraction. Enzymatic extraction	2
	Total	**40**

NOT -504 MODERN PROCESSING TECHNOLOGY OF OILS

L :T: P:C
3: 0: 2 :4

Preamble:

The course provides modern techniques of refining of Oils and 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:

Knowledge of various modifications processes involved in oils& fats and their quality parameters.

Course Outcome:

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

(CO1)	Acquire the knowledge of modern processing techniques of oil & fats	Understand
(CO2)	Acquire the knowledge of modification processes in oils like degumming, neutralization, bleaching, de-odourisation, physical refining, fractionation, de-waxing and winterization.	Understand
(CO3)	Acquire the knowledge of bio-processing of oils & fats.	Understand
(CO4)	Analyze wastes & by products in oil processing and environmental considerations	Analyze
(CO5)	Analyze process of bio-diesel production by trans esterification.	Analyze

Mapping with Program Outcomes

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

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. Modern techniques of oil pretreatment
2. Technologies of dewaxing, degumming deacidification &bleaching of oils

3. Steam generation & other utilities.
4. Processes like dewaxing and winterization

Course Outcome 2(CO2)

1. Deodorization; soft column & physical refining
2. Inter-esterification, hydrogenation &fractionation of oils.
3. Margarine, and bakery fat.

Course Outcome 3(CO3)

1. Bio degumming, bio neutralization, bio bleaching, bio inter-esterification.
2. Membrane technology for processing of oils and fats.
3. Blended oils & hydrogenatedfats

Course Outcome 4(CO4)

1. Utilization of wastes and by products.
2. Effluent treatment plants(ETP).
3. Energy audit and energy conservation practices.

Course Outcome 5(CO5)

1. Processing of oils for production of bio-diesel.
2. Trans esterification of oils.

Syllabus:

MODULE-1

Processing of Oils:

Modern techniques of oil pretreatment, newer technologies of dewaxing, degumming deacidification, bleaching of oils, coloring pigments, their coloring effects, steam generation & utilities (air, water& electrical energy), refrigeration system for dewaxing and winterization, Processing conditions during refining of different oils.

MODULE-2

Refining & hydrogenation of oils :

Deodorization, soft column, physical refining, effect of various operating variables, design consideration of deodorizer, inter-esterification, hydrogenation of oils, fractionation(dry & wet), trans free fats and fat products, margarine, and bakery fat, crystal behavior and polymorphism.

MODULE-3

Bio-processing of oils :

Bio degumming, bio neutralization, bio bleaching, bio inter-esterification membrane technology for processing of oils and fats, blended oils, specification of blended oils, refined oils & hydrogenated fats as per FSSAI rules.

MODULE-4

Environmental considerations :

Utilization of wastes and by products produced in oil processing industry, environmental considerations like effluent treatment (ETP) plants of oilseed and oil processing industries, energy audit and energy conservation practices in oil processing industry.

MODULE-5

Bio-diesel production :

Processing of oils for production of biodiesel by trans esterification of oils using heterogeneous and homogeneous processes.

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:

1. Technology and Refining of Oils by T. L. Mahatta
2. Bailey's Industrial Oils and Fats, 6th edition, vol-5 (@))%)Edited by FeireidoonShahidi
3. Bleaching & purifying fats and oils : Theory & Practice 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. Chakarborty
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.	**Processing of Oils**	
1.1	Modern techniques of oil pretreatment	3
1.2	Technologies of dewaxing, degumming deacidification &bleaching of oils	3
1.3	Steam generation & other utilities	3
1.4	Processes like dewaxing and winterization	2
2.	**Refining & hydrogenation of oils**	
2.1	Deodorization; soft column & physical refining	3
2.2	Inter-esterification, hydrogenation &fractionation of oils.	3
2.3	Margarine, and bakery fat.	2
3.	**Bio-processing of oils**	
3.1	Bio degumming, bio neutralization, bio bleaching, bio inter-esterification	3
3.2	Membrane technology for processing of oils and fats.	2
3.3	Blended oils & hydrogenatedfats	3
4.	**Environmental considerations**	
4.1	Utilization of wastes and by products	3
4.2	Effluent treatment plants (ETP)	2
4.3	Energy audit and energy conservation practices	3
5.	**Bio-diesel production**	
5.1	Processing of oils for production of bio-diesel.	3
5.2	Trans esterification of oils.	2
	Total	**40**

NOT-506 MODELING AND SIMULATION OFCHEMICAL PROCESSES

	L	T	P	C
Syllabus	**3**	**1**	**0**	**4**

Module 1 (10 Lectures)

Fundamentals of mathematical modeling-Principles of formulations, Fundamental laws: Continuity equations, energy equation, equation of motion, transport equations, equation of state, equilibrium, chemical kinetics; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models Simple vs. rigorous, lumped parameter vs. distributed parameter, Steady state vs. dynamic, Transport phenomena based vs. Statistical; Concept of degree of freedom for steady state and unsteady state systems.

Module 2 (8 Lectures)

Mathematical models of heat-transfer equipments: Double pipe heat exchanger, Shell & tube heat exchangers, Evaporators, Fired heaters, Partial condensers

Module 3 (6 Lectures)

Mathematical models of mass-transfer equipments: Batch and continuous distillation columns, Reactive distillation columns, packed absorption columns, Dehumidifiers

Module 4 (8 Lectures)

Mathematical models of reactors: Batch reactors, Continuous-stirred tank reactors, Plug-flow reactors, Industrial reactors-Ammonia converter, Sulphuric acid converter, Methanol reactor, FCC reactor, Claus reactor, etc.

Module 5 (8 Lectures)

Numerical methods: Linear and non-linear simultaneous algebraic equations, Ordinary differential equations-Initial-value problems & boundary-value problems, Partial-differential equations Different approaches to flow sheet simulation- Sequential modular approach, Simultaneous modular approach, Equation oriented approach; Review of thermodynamic procedures and physical property data banks.

Suggetsed Text Books:

1. Luyben, W.L., “Process Modeling, Simulation, and Control for Chemical Engineering”, Wiley.

2. M.M. Denn, “Process Modelling”, Wiley, New York, (1990).

3. Hussain Asghar, “Chemical Process Simulation”, Wiley Eastern Ltd., New Delhi, (1986)

4. C.D. Holland and A.I. Liapis, “Computer Methods for Solving Dynamic Separation Problems”, McGraw Hill, (1983).

Suggested Reference Books:

1. C.D. Holland, “Fundamentals of Modelling Separation Processes”, Prentice Hall, (1975)

2. S. M. Walas, “Modelling with Differential Equations in Chemical Engineering”, Butterworth, (1991)

Preamble:

NOT-508 DESIGN OF EXPERIMENTS

Assessment:

Sessional: 50 marks

End Semester: 50 marks

L	T	P	C
3	0	0	3

Course Objectives

Main objective of this course is to introduce various standard experimental designs and methods to analyze the data. To analyze and design the parameters of the systems such that the measure of performances are optimized.

Course Outcomes:

Students completing the course will be able to

CO1	Understand the importance of randomization and replication of experimental data set.	Understand, Apply,
CO2	Estimate statistical variance and perform analysis of variance, regression analysis, correlation analysis on a given experimental data.	Apply, Evaluate
CO3	Design full factorial and two factor complete factorial experiments and analyse the data.	Analyze, Evaluate
CO4	Understanding optimization and gradient optimization method.	Apply, Evaluate
CO5	Response surface designs and mixture experiments.	Apply, Evaluate

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	3				1		1	1	2	3	1
CO2	3	3	3	2	3				1		1	1	2	3	1
CO3	3	2	3	3	3				2		1	1	2	2	1
CO4	2	2	3	3	3				2		1	1	2	2	2
CO5	2	2	3	2	2				2		1	1	3	3	2
Avg	2.4	2.2	2.8	2.6	2.8				1.6		1	1	2.2	2.6	1.4

Module 1 (6hours)

Introduction to statistics for engineers: Simplest discrete and continuous distributions, Statistical inference, Statistical estimation, tests and estimates on statistical variance, Analysis of variance, Regression analysis (Simple linear, multiple, polynomial, nonlinear), Correlation analysis (Correlation in linear regression, correlation in multiple linear regression). Generalized matrix method for regression model.

Module 2 (6hours)

Introduction to design of experiments, Preliminary examination of subject of research, Screening experiments. Basic experiment-mathematical modeling, Introduction to ANOVA, completely randomized design, randomized completely block design, latin square design

Module 3 (6hours)

Complete factorial experiment, two factor complete factorial experiment, 2^n factorial experiment, Fractional factorial design, Box Wilson design. Statistical analysis: Determination of experimental error, Significance of the regression coefficients, Lack of fit of regression models.

Module 4 (6hours)

Experimental optimization of research subject: Problem of optimization, Deterministic and Stochastic optimization problems. Gradient optimization method, efficiency of gradient method, canonical analysis.

Module 5 (6hours)

Response surface methodology, central composite design. Box Benken design for fitting response surface, Mixture experiments, Steps of Mixture experiments.

Suggested Text Bookss

1 Lazic, Z.R."Design of Experiments in Chemical Engineering: A Practical Guide, Wiley 2005.

NOT- 509 PRINCIPLES OF NANOSCIENCE AND NANOMATERIALS

Assessment:

Sessional: 50 marks

End Semester: 50 marks

Course Objectives

This course aims to provide a broad overview of fundamental principles and laws governing the properties at nanometer scale. Students will learn various top down and bottom up approaches for nanostructure synthesis and experimental techniques to characterize them. This course will also introduce various applications of nanotechnology in chemical engineering.

Course Outcomes:

Students completing the course will be able to

CO1	Describe the basic science behind the novel and superior properties of materials at the nanometer scale	Remember, Understand
CO2	Demonstrate a comprehensive understanding of the state-of-the-art nanofabrication methods	Understand, Apply
CO3	Compare and select suitable techniques for characterization of a given nanomaterial	Remember, Understand, Apply
CO4	Explain how nanotechnology can be put to use in varied areas of science and engineering	Apply, Analyze
CO5	Evaluate the impact of nanotechnology on society and environment. Evaluate current constraints such as regulatory, ethical, political, social and economic; when putting nanotechnology to use.	Understand, Apply, Analyze, Evaluate

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1										3	3	2	2
CO2	3	2	1				1					2	3	3	2
CO3	3		1	1	3							2	3	3	1
CO4	2	1					1	1				3	3	3	2
CO5	2	1	1			1	1	1				2	3	3	3
Avg	2.4	1.25	1	1	3	1	1	1				2.4	3	2.8	2

Module 1 (6 hours)

Introduction to Nanotechnology - its emergence and challenges, Nanomaterials and its classification, Properties of individual nanoparticles, Methods of synthesis, Reactivity of nanoparticles, List of stable carbon allotropes extended, Synthesis of carbon Bucky balls, Fullerenes, Metallofullerenes, solid C60, Bucky onions, Nanotubes, Nanowires, Nano cones, Carbon nanostructures,

Graphene.

Module 2 (6 hours)

Methods of synthesis of Nanomaterials: Bottom-up (building from molecular level) and top-down (breakdown of bulk/microcrystalline materials) approaches. Manufacturing of nanoscale materials: Chemical vapor deposition of carbon nano tubes, Plasma deposition of ultra-thin functional films on Nano materials, Solution based Synthesis of Nanoparticles, Vapour Phase Synthesis & Synthesis with framework, Nanolithography, Dip Pen Lithography. Artificially Layered Materials: Quantum Well, Quantum Dots, Super lattices & Layered Structures, core shell nano structure.

Module 3 (6 hours)

Top down approach vs Bottom up approach, Optical Microscopy, Electron Microscopy, Secondary electron scattering, back scattering, Scanning Probe Microscopes, Focused Ion Beam Technique, X-ray imaging, Transmission Electron Microscope (TEM), Scanning Probe Microscope (SPM)- Atomic Force Microscope (AFM), Scanning Tunneling Microscope (STM).

Module 4 (6 hours)

Surface Tension and Interfacial Tension, Surfaces at Equilibrium, Surface Tension Measurement, Contact Angles, Colloidal Stability, Electrical Phenomena at Interfaces, Vander Waals Forces between Colloidal Particles, Photo catalysis Nanostructured materials, Self-assembly and Catalysis.

Module 5 (6 hours)

Nano biotechnology : Drug Delivery, Nano clay, Nanocomposites, Surface coatings, Self-cleaning Materials, Hydrophobic Nanoparticles, Biological nanomaterials, Nano electronics, Nano machines & Nano devices, Nano hydrogel, Photocatalytic reactors, Nano clay Synthesis, Polymer nanocomposite, Waste Water Treatment, Societal, Health and Environmental Impacts, Introduction to industries which produces commercial nanomaterials.

Suggested Text Books

1. Hornyak, G.L., Dutta, J., Tibbals, H.F. and Rao, A.K. “Introduction to NanoScience”, CRC Press of Taylor and Francis Group, 2008
2. Pools, C.P. and Owens, F.J., “Introduction to Nanotechnology”, Wiley-Interscience, 2003.
3. Cao, G. “Nanostructures and Nanomaterials, Synthesis, Properties and Applications”, Imperial College Press, 2004.

Suggested Reference Books

1 Bhusan B., Springer Handbook of Nanotechnology, 4th Ed., 2017

NOT- 512 SOAPS AND SYNTHETIC DETERGENTS

L: T :P:C
3 :1 : 0:4

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 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

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

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. Advance chemistry of soap Manufacturing and, raw materials selection.
2. Continuous processes of soap manufacture.
3. Quality specifications as per BIS and specialty soaps

Course Outcome 2(CO2)

1. Effect of temperature, pressure, catalyst and ratio of reactants on hydrolysis of fat.
2. Medium and high pressure autoclave processes.
3. Batch, semi continuous and continuous processes of fat splitting.

Course Outcome 3(CO3)

1. Active surfactants &organic builders.
2. Active surfactants &inorganic builders.
3. Fillers and other auxiliary materials.

Course Outcome 4(CO4)

1. Processes for production of linear alkyl benzene sulfonate.
2. Manufacture of alcohol sulfates, alkyl acyl sulfonates, α-olefinsulfonates, sulfated oils.
3. Polyethenoxy ethers and esters, poly-hydroxy surfactants and quaternary ammonium compound

Course Outcome 5(CO5)

1. Plants and processes employed for powders.
2. Plants and processes employed forliquids and cakes etc.
3. Analysis of synthetic detergents as per BISmethods.

Syllabus:

MODULE-1

Soaps:

Principle and chemistry of soap boiling, raw materials and their selection, manufacture of soap base for household and toilet soap by cold, semi boiled and full boiled processes. Continuous processes of soap manufacture. Processes and plants employed for production of household and toilet soaps. Quality specifications as per BIS and specialty soaps.

MODULE-2

Fat splitting:

Effect of temperature, pressure, catalyst and ratio of reactants on hydrolysis of fat, degree of splitting, plants and processes employed viz. Twitchell process, enzymatic fat splitting, low , medium and high pressure autoclave processes. Batch, semi continuous and continuous processes of fat splitting, recovery of glycerin from spent soap lyeand sweet water.

MODULE-3

Raw materials for synthetic detergents:

Active surfactants, organic and inorganic builders, fillers and other auxiliary materials .

MODULE-4

Production of active detergents:

Plants and processes for production of linear alkyl benzene sulfonate, alcohol sulfates, alkyl acyl sulfonates, α-olefinsulfonates, sulfated and sulfonated oils, polyethenoxy ethers and esters, poly hydroxy surfactants and quaternary ammonium compounds.

MODULE-5

Manufacture of household synthetic detergents:

Plants and processes employed for powders, liquids and cakes etc. Analysis of synthetic detergents as per BIS methods.

Reference Book :

1. Manufacture of soaps other detergents: Edgar Woollatt.
2. Synthetic detergents: Milwidsky.

3. Bailey Industrial oils & fat products VOL. 1: Daniel Swern.
4. Soaps and detergents: K. S. Parasuram.
5. Synthetic detergent: Davidson.
6. BIS-IS: 4955-1978 Specification for synthetic detergent powders for households use.
7. Gemini surfactants: Synthesis, interfacial and applications.
8. Handbook of detergents, Part A, B, C, D
9. CRC surfactants series

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Soaps**	
1.1	Principle and chemistry of soap boiling, raw materials and their selection	2
1.2	Manufacture of soap base for house hold and toilet soap by cold, semi boiled and full boiled processes	2
1.3	Continuous processes of soap manufacture	2
1.4	Processes and plants employed for production of household and toilet soaps	1
1.5	Quality specifications as per BIS and specialty soaps	2
2.	**Fat splitting**	
2.1	Effect of temperature, pressure, catalyst and ratio of reactants on hydrolysis of fat	2
2.2	Degree of splitting, plants and processes employed viz. Twitchell process, enzymatic fat splitting, low , medium and high pressure auto clave processes	2
2.3	Batch, semi continuous and continuous processes of fat splitting	2
2.4	Recovery of glycerin from spent soap lye and sweet water	2
3.	**Raw materials for synthetic detergents**	
3.1	Active surfactants, organic builders	2
3.2	Active surfactants inorganic builders	2
3.3	Fillers and other auxiliary materials	2
4.	**Production of active detergents**	
4.1	Plants and processes for production of linear alkyl benzene sulfonate	2
4.2	Plants and processes for production of alcohol sulfates, alkyl acyl sulfonates, α-olefinsulfonates, sulfated and sulfonated oils	3
4.3	Plants and processes for production of Polyethenoxy ethers and esters, poly hydroxy surfactants and quaternary ammonium compounds	3
5.	**Manufacture of household synthetic detergents**	
5.1	Plants and processes employed for powders	3
5.2	Plants and processes employed for liquids and cakes etc	3
5.3	Analysis of synthetic detergents as per BIS methods	3
	Total	**40**

NOT-514 RESEARCH METHODOLOGY (AUDIT COURSE)

L : T: P:C

Preamble: **2 : 1: 0:0**

The Objective of this course to pay attention to the most important dimension of Research i.e. Research Methodology. It will enable the Researchers to develop the most appropriate methodology for their Research Studies. The ultimate mission of the course is to impart research skills to the beginners and help improve the quality of Research conducted by them.

Prerequisite:

The basic knowledge of science and advance knowledge of area of specialization.

Objective :

Objective of this course is to equip researchers with research methodology essential for pursuing research based programme of Masters in Technology. The objective of course is also to enable researchers in writing various research reports, thesis, dissertation, research papers, articles, essays.

The Course Structure is designed in a way that the learning of Research Methodology can move from Mugging up syndrome to fun-practical method; from a teaching process to an experimental process, from memorizing to brainstorming, from clearing the examination to feedback learning, from knowledge transfer to knowledge creation, from competitive learning to collaborative learning. Few other important objectives will be

- To verify and test important facts
- To analyse an event or process or phenomenon to identify the cause and effect relationship
- To develop new scientific tools, concepts and theories to solve and understand scientificand non scientific problems
- To find solutions to scientific, non scientific and social problems and
- To overcome or solve the problems occurring in our everyday life.

Syllabus:

Research meaning, Objective of research, types of research Selecting a problem and preparing research proposal for different types of research Literature survey: Use of library, books and journals, use of internet (different useful sites) patent search Methods and tools in research: Qualitative and quantitative studies enquiry forms, questionary, opionnarie Data analysis: Parametric and non parametric data, Hypothesis testing Descriptive and inferential analysis, Statistical analysis of data including standard deviation, student test, final test. Statistical tools, i.e.,multiple regression and correlation coefficient Documentation.Research paper/ Thesis writing: Different parts of the research paper Presentation: Oral, poster Sources of procurement of research grants Industrial Institution Interaction Introduction to intellectual property and its relation with regulations Introduction to patent, patent system in India and worldwide (Paris convention and TRIPS agreement)

Outcome: The outcome of course will enable students to have efficiency in the following;

I. Article Writing
II. Essay Writing
III. Research Paper Writing
IV. Book Review
V. Laboratory Research

VI. Marketing Research
VII. Legislative Drafting
VIII. Thesis; Dissertation Writing
IX. Book Writing
X. Citation Methods and Styles
XI. Research Grant Proposals Writing

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.1	Research meaning	2
1.2	Objective of research	3
1.3	Types of research	3
2.1	Selecting a problem and preparing research proposal for different types of research	3
2.2	Patent search Methods and tools in research	3
2.3	Qualitative and quantitative studies enquiry forms	3
3.1	Questionary, opionnarie Data analysis	2
3.2	Parametric and non parametric data, Hypothesis testing Descriptive and inferential analysis	3
3.3	Statistical analysis of data including standard deviation, student test, final test	3
4.1	Statistical tools, i.e., multiple regression and correlation coefficient Documentation. Research paper/ Thesis writing	2
4.2	Different parts of the research paper Presentation: Oral, poster	2
4.3	Sources of procurement of research grants Industrial Institution	2
5.1	Interaction Introduction to intellectual property and its relation with regulations	3
5.2	Introduction to patent	3
5.3	patent system in India and worldwide	3
	Total	**40**

NOT-601 NOVEL SURFACATANTS; PRODUCTION AND INDUSTRIAL APPLICATIONS

L : T: P:C
3 : 1: 0:4

Preamble:

The subject deals with the study of role of novel surface active agents, method of production and their 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, their chemistry and basics of surfactant science.

Course Outcome:

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

(CO1)	Understand the role of novel surface active agents in day to day life	Understand
(CO2)	Apply the knowledge acquired in professional career for serving the industry	Apply
(CO3)	Use the knowledge to develop eco efficient products	Apply
(CO4)	Use the knowledge to replace the traditional surfactants with the eco efficient surfactants	Evaluate
(CO5)	Evaluate the performance and impact of the surface active agents on the environment	Evaluate

Mapping with Program Outcomes

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

Assessment Pattern:

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

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Definition and role of novel surface active agents.
2. Effect of novel surfactants on the interfaces

Course Outcome 2(CO2)

1. Bulk properties and their measurement.
2. Concept of HLB

Course Outcome 3(CO3)

1. Chemistry and technology of production of novel surfactants.
2. Industrial applications of novel surfactants..

Course Outcome 4(CO4)

1. Manufacturing process of novel surfactants.
2. Significance and industrial uses of novel surfactants.

Course Outcome 5(CO5)

1. Classification of biosurfactants.
2 Production of biosurfactants..
3. Properties and applications of biosurfactants .

Syllabus

Module-1

Introduction:

Definition, amphiphilic nature of surfactants, classification of novel surfactants, raw material for novel surfactants based on petrochemical and oleo chemical origin

Module -2

Properties of novel surfactants:

Surface and interfacial tension, hydrophilic lipophilic balance, critical micelle concentration, cloud point, kraft point, HLB Temp/ phase inversion temperature, foaming, wetting, dispersing and emulsification properties and their measurements, properties of novel surfactants mixtures, polymer- novel surfactants interactions

Module -3

Chemistry and Technology for production of various novel surfactants and their industrial applications:

N- alkanoyl-N-alkyl-1-glycamines, Alkyl polyglycosides, sugar fatty acid esters, sucrose ester based surfactants, saccharide based surfactants, methyl ester ethoxylates

Module -4

Technology for the manufacture and their applications:

Amino acid based surfactants, esterquats, imidazoline surfactants, cleavable surfactants, Gemini surfactants, polymerizable and polymeric surfactants, silicone surfactants

Module -5

Biosurfactants:

Classification of bio surfactants, production of biosurfactants from various natural sources, properties and applications of biosurfactants , Surfactants produced by micro organisms

Reference Books:

2. Bailey's Industrial Oil and Fat Products Vol-1 Fourth Edition, Edited by Daniel Swern
3. Soaps & detergent Edited by K.S. Parasuram
4. Synthetic Detergents Edited by Davidson

5. Novel Surfactants: Preparation, Applications and Biodegradability, II Edition, edited by Krister Holmberg
6. Gemini Surfactants : Synthesis interfacial and Application

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Introduction**	
1.1	Definition, amphiphilic nature of surfactants	1
1.2	Classification of novel surfactants	2
1.3	Raw material for novel surfactants based on petrochemical and oleochemical origin	2
2.	**Properties of novel surfactants**	
2.1	Surface and interfacial tension	1
2.2	Hydrophilic lipophilic balance	1
2.3	Critical micelle concentration	1
2.4	Cloud point and kraft point	1
2.5	HLB Temp/ phase inversion temperature	1
2.6	Foaming, wetting, dispersing and emulsification properties and their measurements	2
2.7	Properties of novel surfactants mixtures	1
3.	**Chemistry and Technology for production of various novel surfactants and their industrial applications**	
3.1	Chemistry and Technology for production of N- alkanoyl-N-alkyl-1-glycamines and its industrial applications	2
3.2	Chemistry and Technology for production of Alkyl polyglycosides and its industrial applications	2
3.3	Chemistry and Technology for production of sugar fatty acid esters and its industrial applications	2
3.4	Chemistry and Technology for production of sucrose ester based surfactants and its industrial applications	2
3.5	Chemistry and Technology for production of saccharide based surfactants based surfactants and its industrial applications	2
3.6	Chemistry and Technology for production of methyl ester ethoxylates and its industrial applications	2
4.	**Technology for the manufacture and their applications**	
4.1	Technology for manufacturing Amino acid based surfactants and its application	1
4.2	Technology for manufacturing esterquats and its application	1
4.3	Technology for manufacturing imidazoline surfactants and its application	1
4.4	Technology for manufacturing cleavable surfactants and its application	1
4.5	Technology for manufacturing Gemini surfactants and its application	1
4.6	Technology for manufacturing polymerizable and polymeric surfactants and its application	2
4.7	Technology for manufacturing silicone surfactants and its application	1
5.	**Biosurfactants**	

5.1	Classification of bio surfactants	1
5.2	Production of biosurfactants from various natural sources	2
5.3	Properties and applications of biosurfactants	2
5.4	Surfactants produced by micro organisms	2
	Total hours	**40**

NOT-603 ADVANCES IN EMULSION TECHNOLOGY

L : T: P:C
3 : 1: 0:4

Preamble:

The subject deals with the study of adsorption behavior of surface active agents. Emphasis is laid upon the study of emulsions, micro emulsions, macro emulsions and nano emulsions. The application of emulsion technology in various industries is also discussed in the course .

Prerequisite:

Fundamental knowledge of surfactant science.

Course Outcome:

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

(CO1)	Understand the role of surfactants in micro, macro and nano emulsions	Understand
(CO2)	Apply the knowledge acquired in professional career for serving the industry	Apply
(CO3)	Use the knowledge to establish small scale enterprises	Apply
(CO4)	Evaluate the performance and impact of the type of emulsions on the environment	Evaluate
(CO5)	Use the knowledge to develop suitable formulations of specific products	Evaluate

Mapping with Program Outcomes

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

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. Types of adsorption isotherms.
2. Concept of HLB and its role in emulsion stability

Course Outcome 2(CO2)

1. Properties for producing stable emulsion.
2. Factors for coalescence in o/w emulsions.

Course Outcome 3(CO3)

1. Dielectric properties of micro emulsions.
2. Properties of macro and nano emulsions.

Course Outcome 4(CO4)

1. Characterization of emulsions.
2. Role of emulsions in heavy crude oil recovery .

Course Outcome 5(CO5)

1. Role of emulsions in food and cosmetic eindustries.
2 Role of demulsification in petroleum industry.

Syllabus

Module- 1

Characterization of water/oil interfaces: Introduction. Adsorption isotherms. Dynamic interfacial tension. Extremely low interfacial tension, surfactant transfer across the interface. Interfacial Dilational Rheology, Interfacial shear rheology. HLB concept.

Module -2

Properties and behavior of emulsions: Introduction phase diagrams and emulsion stability. Evaporation from emulsions. Structure and stability of emulsion: coalescence and flocculation in dilute o/w emulsions.

Module -3

Micro emulsions. Macro emulsions and nano emulsions: Introduction of dielectric polarization, dielectric spectroscopy, dielectric properties of micro emulsion, non-equilibrium colloidal systems, dielectric study of human blood cell.

Module -4

Characterization of emulsions:

Electroacoustic characterization of emulsions, acoustic spectroscopy of emulsion, surface forces and emulsion stability, double emulsion for controlled release application, environmental emulsion, heavy hydrocarbon emulsion.

Module -5

Industrial applications:

Application of emulsion technology in various fields viz. food, cosmetics, petroleum, lubricants etc. Chemical demulsification of stable crude oil and bitumen emulsion in petroleum recovery.

Reference hooks:

1. Encyclopedic Handbook of Emulsion Technology edited by Johan Sioblom published by Marcel Dekker. Inc. (2001)
2. Encyclopedic Handbook of Emulsion Technology edited by Paul Becher published by Marcel Dekker. Inc.

3. Surfactants and Interfacial Phenomena edited by Milton .1. Rosen published by Wile y Interscience (2004)

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Characterization of water/oil interfaces:**	
1.1	Introduction to adsorption isotherms.	1
1.2	Introduction to dynamic interfacial tension	1
1.3	Introduction to extremely low interfacial tension	1
1.4	Surfactant transfer across the interface	1
1.5	Interfacial Dilational Rheology	1
1.6	Interfacial shear rheology	1
1.7	HLB concept	1
2.	**Properties and behavior of emulsions:**..:	
2.1	Introduction phase diagrams and emulsion stability	1
2.2	Evaporation from emulsions	2
2.3	Structure and stability of emulsion for coalescence in dilute o/w emulsions	2
2.4	Structure and stability of emulsion for flocculation in dilute o/w emulsions.	2
3.	**Micro emulsions. Macro emulsions and nano emulsions:**, , , ,	
3.1	Introduction of dielectric polarization	1
3.2	Introduction of dielectric spectroscopy	1
3.3	Dielectric properties of micro emulsion	1
3.4	Non-equilibrium colloidal systems	1
3.5	Dielectric study of human blood cell.	2
4.	**Characterization of emulsions:**	
4.1	Electroacoustic characterization of emulsions	2
4.2	Acoustic spectroscopy of emulsion	2
4.3	Surface forces and emulsion stability	2
4.4	Double emulsion for controlled release application	2
4.5	Environmental emulsion and heavy hydrocarbon emulsion	2
5.	**Industrial applications:**	
5.1	Application of emulsion technology in cosmetics industry	2
5.2	Application of emulsion technology in petroleum industry	2
5.3	Application of emulsion technology in lubricants industry	2
5.4	Application of emulsion technology in food industry	2
5.5	Chemical demulsification of stable crude oil and bitumen emulsion in petroleum recovery.	2
	Total hours	**40**

NOT-605 TECHNOLOGY OF MODIFIED AND SPECIALTYFATS & OILS

L:T: P:C
3:0 :0:3

Preamble:

The subject deals uses of modified oils in surface coating, grease manufacturing, fat liquor, pharmaceutical and cosmetic industry. bio-diesel production from used oils and metal sulfonate.

Prerequisite:

Advance technology for modification of oils

Course Outcome:

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

(CO1)	Advance technology for modification of oils used in surface coating	Understand
(CO2)	Modification of oils to manufacture metallic soap, lubricant and grease.	Understand
(CO3)	Advance technology to manufacture leather and textile chemical.	Apply
(CO4)	Advance technology for modification of oils and fed for the used in pharmaceutical and cosmetic.	Analyze
(CO5)	Uses of advance technology for lubricant formulation	Apply

Mapping with Program Outcomes

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

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	30	30	30	30
Analyze	20	20	20	20
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Advance technique in modification of oils for application in surface coating industry.
2. Uses of polymerized oil such as boiled oils, stand oils etc in paint industry.
3. Uses of epoxidised oils, urethane oils, plasticizers and driers for paints

Course Outcome 2(CO2)

1. Modification of oils for manufacture of fatty acids, metallic soaps
2. Modification of oils for manufacture of lubricants, greases and hydraulic fluids. Blown oils
3. Modification of oils for manufacture of mould releasing agents, wire-drying lubricants etc.

Course Outcome 3(CO3)

1. Modifications of oils for leather fat liquors and Leather chemicals
2. Modifications of oils for textile chemicals

Course Outcome 4(CO4)

1. Use of modified oils and fats in pharmaceuticals and cosmetic industry.
2. Technology of manufacture of edible films and coatings from protein sources
3. Technology for the production of biodiesel and green diesel.

Course Outcome 5(CO5)

1. Lubricant formulations,
2. Additives for lubricants
3. Fat based lubricants

Syllabus:

MODULE-1

Commercial production and recent technology :

Advancements in modification of oils for application in surface coating industry, polymerized oil such as boiled oils, stand oils etc. Epoxidised oils, urethane oils, plasticizers and driers for paints

MODULE-2

Modification of oils :

For manufacture of fatty acids, metallic soaps, lubricants, greases and hydraulic fluids. Blown oils, mould releasing agents, wire-drying lubricants etc.

MODULE-3

Modifications of oils for leather and textile industries :

Fat liquors. Leather chemicals, textile chemicals etc. Sulfated, sulfonated and sulphited oils; chemistry, manufacture and applications in leather industry

MODULE-4

Modification of oils and fats :

Use in pharmaceuticals and cosmetic industry. Technology for the manufacture of edible films and coatings from protein sources. Technology for the production of biodiesel and green diesel by modification of oils and fats; specifications, commercial plants and processes

MODULE-5

Metal sulfonates;

Manufacture and uses in various lubricant formulations, additives and other fat based lubricant for petroleum industry

Reference Books:

2. Organic Coatings Technology by H.F. Payne
3. Bailey's Industrial Oils & Fats Products Vol. I to IV

4. Lubricating Oil & Greases By C.J. Bonner

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Commercial production and recent technology**	
1.1	Advance technique in modification of oils for application in surface coating industry.	3
1.2	Uses of polymerized oil such as boiled oils, stand oils etc in paint industry	2
1.3	Uses of epoxidised oils, urethane oils, plasticizers and driers for paints	3
2.	**Modification of oils**	
2.1	Modification of oils for manufacture of fatty acids, metallic soaps	2
2.2	Modification of oils for manufacture of lubricants, greases and hydraulic fluids. Blown oils	3
2.3	Modification of oils for manufacture of mould releasing agents, wire-drying lubricants etc	3
3.	**Modifications of oils for leather and textile industries**	
3.1	Modifications of oils for leather fat liquors and Leather chemicals	3
3.2	Modifications of oils for textile chemicals	3
4.	**Modification of oils and fats**	
4.1	Use of modified oils and fats in pharmaceuticals and cosmetic industry.	3
4.2	Technology of manufacture of edible films and coatings from protein sources	3
4.3	Technology for the production of biodiesel and green diesel.	3
5.	**Metal sulfonates**	
5.1	Lubricant formulations,	3
5.2	Additives for lubricants	3
5.3	Fat based lubricants	3
	Total	**40**

NOT-607 Seminar

L : T: P:C
0: 0: 2:1

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

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 students

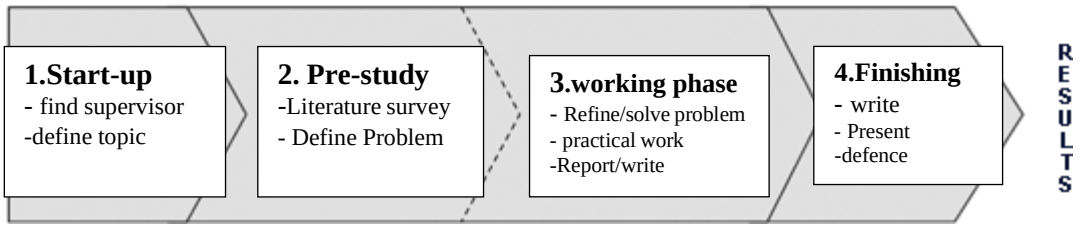
NOT-609 DISSERTATION-I

L : T: P:C
0: 0: 16:8

Preamble:
The purpose of a Dissertation (Research Project)thesis is to enable the student to develop deeper knowledge, understanding, capabilities and attitudes in the context of the programme of study. The thesis should be written at the end of the programme and offers the opportunity to delve more deeply into and synthesize knowledge acquired in previous studies. A thesis for a Master of Technology in Engineering programmes should place emphasis on the technical/scientific/artistic aspects of the subject matter.

Objective:
The overall objective of the dissertation/thesis is for the student to display the knowledge and capability required for independent work as a Master of Technology in Engineering.

Master's programme is completed with a Master's dissertation thesis which usually comprises 16 credits (4 credits in IIIrd Semester + 12 Credits in IV the Semester).
The Master's dissertationthesis takes the form of a written report with an oral presentation.The overall goal of the thesis is for the student to display the knowledge and capability required for independent work as a Master of Technology in Engineering. The learning objectives for a thesis are based on the objectives for Master of Technology in engineering degrees.
Four phases in a master dissertation thesis process



1. Start up
In this phase, the students shall define their topic and decide whether to work as industry joint project or pre research based project, which includes to find the supervisors from industry as well as university.

2. Pre-study

Students need to have literature survey on selected topic and prepare a dissertation report before they really start their thesis work. step 1 and step2 are conducted in 3rd semester. The first dissertation report is done in third semester. After this report work of final semester for research thesis/dissertation will be decided and place of work will be also decided. Usually student will propose a project plan agreed by both industry and University, in case of industry based joint project.

3. Working phase

When producing the Master's dissertation/thesis, students need to follow the template to design and publish. The actual research work will be carried out in this phase.

4. Finishing

To finish the dissertation/thesis, a student needs to:

- Present his/her thesis in a seminar, in first step it will be evaluated internally by faclty members of department. The final evaluation will be done in presence of external examiner.

OUTCOME:

Specific learning outcomes for a Master's thesis are for the student to demonstrate:

• Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.

• Deeper knowledge of methods in the major subject/field of study.

• A capability to contribute to research and development work.

• The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.

• The capability to plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.

• The capability to create, analyse and critically evaluate different technical/architectural solutions.

• The capability to critically and systematically integrate knowledge.

• The capability to clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings in written and spoken English.

• The capability to identify the issues that must be addressed within the framework of the specific dissertation/thesis in order to take into consideration all relevant dimensions of sustainable development.

• A consciousness of the ethical aspects of research and development work.

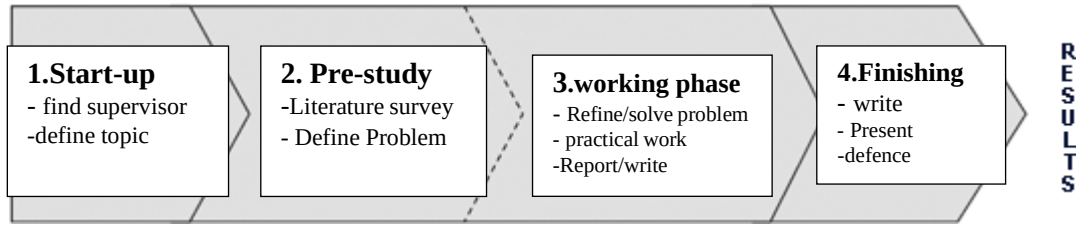
NOT-602 DISSERTATION-II

L : T: P:C
0: 0: 32:16

Preamble:
The purpose of a Dissertation (Research Project)thesis is to enable the student to develop deeper knowledge, understanding, capabilities and attitudes in the context of the programme of study. The thesis should be written at the end of the programme and offers the opportunity to delve more deeply into and synthesize knowledge acquired in previous studies. A thesis for a Master of Technology in Engineering programmes should place emphasis on the technical/scientific/artistic aspects of the subject matter.

Objective:
The overall objective of the dissertation/thesis is for the student to display the knowledge and capability required for independent work as a Master of Technology in Engineering.

Master's programme is completed with a Master's dissertation thesis which usually comprises 16 credits (4 credits in IIIrd Semester + 12 Credits in IV the Semester).
The Master's dissertationthesis takes the form of a written report with an oral presentation.The overall goal of the thesis is for the student to display the knowledge and capability required for independent work as a Master of Technology in Engineering. The learning objectives for a thesis are based on the objectives for Master of Technology in engineering degrees.
Four phases in a master dissertation thesis process



5. Start up
In this phase, the students shall define their topic and decide whether to work as industry joint project or pre research based project, which includes to find the supervisors from industry as well as university.

6. Pre-study
Students need to have literature survey on selected topic and prepare a dissertation report before they really start their thesis work. step 1 and step2 are conducted in 3rd semester. The first dissertation report is done in third semester. After this report work of final semester for research thesis/dissertation will be decided and place of work will be also decided. Usually student will propose a project plan agreed by both industry and University, in case of industry based joint project.

7. Working phase
When producing the Master's dissertation/thesis, students need to follow the template to design and publish. The actual research work will be carried out in this phase.

8. Finishing
To finish the dissertation/thesis, a student needs to:

- Present his/her thesis in a seminar, in first step it will be evaluated internally by faclty members of department. The final evaluation will be done in presence of external examiner.

OUTCOME:
Specific learning outcomes for a Master's thesis are for the student to demonstrate:

• Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.

• Deeper knowledge of methods in the major subject/field of study.

• A capability to contribute to research and development work.

• The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.

• The capability to plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.

• The capability to create, analyse and critically evaluate different technical/architectural solutions.

• The capability to critically and systematically integrate knowledge.

• The capability to clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings in written and spoken English.

• The capability to identify the issues that must be addressed within the framework of the specific dissertation/thesis in order to take into consideration all relevant dimensions of sustainable development.

• A consciousness of the ethical aspects of research and development work.