Third Year Oil Technology (OT) Syllabus (Effective from 2016-17)

B. Tech. 3rd Year (Oils, Fats and Waxes Technology) Revised Syllabus w.e.f. 2016-17							
Course Code	**Title of Course**	**Teaching Hours**	**Tutorial**	**Credits**	**Practical Hours**	**Credits**	**Total Credits**
	Fifth Sem.						
CHL308	Mass Transfer Operations	04		04			4.0
CHP 309	Mass & Momentum Transfer Operations				03	1.5	1.5
CHC-310	Instrumentation and Process Control	04		04	03	1.5	5.5
OTC-301	Refining of Oils and Fats	04		04	05	2.5	6.5
OTC-302	Quality Control Techniques in Oils and Fats	04		04	03	1.5	5.5
ELECTIVE	Elective-I	04		04	-	-	04
Total		**20**		**20**	**14**	**7.0**	**27.0**
	Sixth Sem.						
CHL-311	Reaction Engineering	04		04	-	-	04
HML-301	Industrial Management & Economics	03		03	-	-	03
HML-302	Managerial Behaviour: Psycho-social Dimensions	03		03	-	-	03
OTL-303	Technology of Fat Splitting and Soaps	04		04			04
OTL-304	High Fat Products and Industrial Hydrogenation	04		04	-	-	4.0
OTP -305	Processing and Analysis of Soaps and High Fat allied Products	-		-	06	3.0	3.0
ELECTIVE	Elective-II	04		04	-	-	04
Total		**22**		**22**	**06**	**3.0**	**25.0**

Department	**: Department of Oil Technology**
Course code	**: CHL-308**
Course Title	**: Mass Transfer Operations. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Course Objectives:

At the end of the course student will understand the basic fundamental of mass transfer operations carried out in chemical industries, design of plate and packed column used for mass transfer operations, Distillation, Liquid-liquid extraction, Solid-liquid operation, Crystallization and Adsorption drying operation.

Course Content:

Unit-I

Diffusion

Principles of diffusion, Fick's law, diffusion in binary mixture, equimolecular counter diffusion, mass transfer through stationary gas, mass transfer velocities, gas phase mass transfer cases, thermal diffusion, Maxwell law, diffusion in solids, Diffusion in liquids: Mass transfer across phase boundary, penetration theory, two film theory, surface renewal theories, film-penetration theory of mass transfer, mass transfer coefficients & correlation,

Unit-II

Distillation

Distillation methods, Vapour liquid equilibria, ideal and non-ideal systems, relative volatility, partial vaporisation/condensation, calculation of number of theoretical plates by McCabe Thiele method. Importance of reflux ratio, minimum reflux ratio, optimum reflux ratio. Murphree plate efficiency and overall plate efficiency. Effect of feed condition of 'q' line.

Unit-III

Absorption

Mechanism of absorption, choice of solvent for absorption, rate of absorption & material balance over absorption tower, minimum gas-liquid ratio for absorber, The absorption with & without chemical reaction,

Packed towers: General construction & working, types of packing merits & demerits, operational difficulties, pressure drop & limiting gas-liquid flow rates, Determination of height of columns, transfer units, capacity.

Plate towers: General construction & working, types of plates merits & demerits, operational difficulties

Unit-IV

Extraction

Liquid-Liquid Extraction: Principle, selection of solvent for extraction, estimation of mass transfer coefficients, triangular diagram representation, Equipment for liquid-liquid extraction. (Mixer settler, Rotating Disc Contractor, Packed column, spray column). Single stage extraction calculation.

Adsorption: Fundamentals, adsorbent, adsorption equilibria and isotherms.

Unit-V

Drying:

Drying characteristics of material, theory and mechanism of drying, Performance of batch and continuous dryer, time of drying.

Crystallization

Crystallization:-Principle, Super saturation, methods of achieving super saturation, phenomenon of crystal formation, crystal structure, material & heat balance over crystalliser & related problems

References:

1. Treybal R.E. “Mass Transfer Operations” McGraw Hill Book Co., New York 1980
2. McCabe W.L. and Smith J.C. & Harriot, “Unit Operations of Chemical Engineering”, McGraw Hill Book Co., New York 1980
3. Principles of Unit Operations: Foust A.S.

4. Coulson J.M. and Richardson J.F., “Chemical Engineering Vol. I, II & III”, Pergamon Press, New York 1977
5. Unit Operation: Mc Cetta Vol. I
6. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, Tata McGraw Hill Book Co.
7. Chattopadyay P., “Unit Operations of Chemical Engineering”, Vol. 1 & 2, Khanna Publishers, New Delhi.

Course Outcomes:

1. Students will learn about the fundamentals of diffusional mass transferin solids and fluids.
2. Student will understand the application of mass transfer theories in various unit operations.
3. Student will understand the mechanism and operation of absorption/stripping column.
4. Student will understand the design of binary plate and packed distillation column.
5. Student will understand the designliquid-liquid and solid-liquid extraction column.
6. Student will understand the design crystallization and adsorption column.

Department : Department of Oil Technology
Course code : CHP-309
Course Title : Mass and Momentum Transfer Operations. (PR)
Course Type : Practical
Total Hrs : 03
Course credit :1.5

Experiments: (Minimum 10 experiments)

1. Determination of vapour diffusivity
2. Study of Liquid –liquid diffusion through porous pot.
3. Batch/Tray drying.
4. Wetted wall column.
5. To verify Rayleigh's equation,
6. To study boiling point diagram/ vapour-liquid equilibria.
7. To study distribution coefficient in liquid-liquid. Extraction.
8. To Construct bimodal curve for ternary system.
9. Laboratory Batch Crystallisation,
10. To Study Burnoullistheorem
11. To calculate coefficient of discharge of Venturimeter, orifice meter.
12. To study the type of flow using Reynold's experiment.
13. To calculate various losses through pipe fittings
14. To calculate coefficient of discharge through triangular/trapezoidal/rectangular notches.

Department	**: Department of Oil Technology**
Course code	**: CHC-310**
Course Title	**: Instrumentation and Process Control. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Course Objectives:

To study the different Instruments like temperature , pressure, level and flow measuring instruments and their working and applications. The utilization of chemical process control and dynamics in automatic , advanced chemical process and study of response of various forcing functions for first, second and higher order control system and study of various types of control mechanism for optimize control of chemical process and their stability

Course Content:

Unit- I **(10hrs)**

Measuring instruments:

Elements of measuring instruments, Static and dynamic characteristics of measuring instruments

Temperature measurement: Temperature scales, Thermocouples, bimetallic thermometer, resistance thermometer, vapour pressure thermometer, mercury in glass thermometer, constant volume gas thermometer, radiation and optical pyrometers.

Pressure measurement: Manometers, Elastic pressure transducers: Bourdon tube, diaphragm, and bellows; Electrical pressure transducer.

Unit -II **(10hrs)**

Level measurement: Direct and indirect methods, float type, bubbler systems, air purgemethod.

Laplace transform: Inversion by Partial Fractions, first order control system, Mercury thermometer, development of transfer function and response, forcing functions- step, impulse, ramp, sinusoidal and their responses.

Unit -III **(10hrs)**

Physical examples of first order systems – Liquid level and mixing process, Interacting and non interacting systems and their transient response and numericals based on theory.

Unit -IV **(10hrs)**

Second order control systems- transfer function of damped vibrator and U-tube manometer and development of step response equations for underdamped overdamped and critical damped system,

Unit -V **(10hrs)**

Linear closed loop system, simple control system negative feedback vs. positive feedback, Servo problems, regulator problem, development of Block diagrams representing transfer functions.

Pneumatic and electronic controllers and final control elements, choice of controllers, On off, Proportional, PI, PID & PD.

Reference Books

1. Process Systems Analysis and Control: Donald R. Coughanowr
2. Industrial Instrumentation: Eckman
3. Process Control and Instrumentation: R.P. Vyas

Course Outcomes:

1. Students will able to know the construction, working, application and advantages and disadvantages of temperature, pressure, level and flow measuring instruments.
2. From the course the students will able to know the complete dynamics of the chemical process and understand the different kinds of forcing function and responses.
3. The student will understand the method for obtaining the transfer function, response equation and physical behavior of first, second and higher order control system.
4. Students understand feedback control system and various types of control actions like ON OFF, P, PI, PD, PID and their applications and usefulness in the different chemical process and Industries.

Department	**: Department of Oil Technology**
Course code	**: CHC-310**
Course Title	**: Instrumentation and Process Control. (PR)**
Course Type	**: Practical**
Total Hrs	**: 03**
Course credit	**: 1.5**

Course Objectives:

To study the basic controls systems through the experiments of first order and second order control systems. How the systems responds to change in inputs.

Experiments:

1. To study the Dynamic study of mercury thermometer and determine time constant
2. To study step response in Single tank liquid level system
3. To Study the liquid level two tank Non-interacting systems
4. To Study the liquid level two tank Interacting systems
5. To Study the control system of mixing Process and to determine time constant
6. To study linear and equal control valve characteristics
7. To study the dynamic response of second order system (U-Tube manometer etc.)
8. To study response of mercury thermometer and bimetallic thermometer
9. To determine the time constant and damping coefficient of second order system (U-Tube manometer etc.)
10. To study impulse response in Single tank liquid level system

Course Outcome:

Students come to know by performing various practical, how the basic control systems and instruments are applicable in chemical process industries.

Department	**: Department of Oil Technology**
Course code	**: OTC-301**
Course Title	**: Refining of Oils and Fats. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites for course:

Post Harvest Technology of Oil Bearing Materials (OTC-202),

Mechanical Operations (CHC-202),

Process Calculations (CHL-204).

Course objectives:

The course is prepared with intent of catering the important conventional techniques for refining of crude vegetable oils. Also, current and conceptual advanced methods of refining will be introduced. Awareness about the treatment of effluent from refining plant for environment safety will be discussed.

Course content:

Unit - I

Minor components and contaminants of crude fatty oils, Dewaxing and De-sliming of oils, Degumming of oils and Lecithin recovery.

Unit -II

De-acidification of oils: batch and continuous methods, refining loss, effect of operating variables on chemical refining, Miscella refining, Physical refining.

Unit- III

Bleaching of oils: Different types of coloring matters in oils, Theory and principle of beaching, Bleaching agents, Batch and continuous methods of beaching, Recovery of oil from spent earth.

Deodorization of oils: Flavor and odor releasing substances, Principles of deodorization, Influence of various parameters, Deodorization equipment, Recovery of byproducts from deodorizer distillate.

Unit- IV

Advance techniques of refining: De-acidification by Zenith process, Enzymatic degumming, Bio-deacidification, Membrane degumming, Membrane deacidification.

Unit- V

Treatment of effluents from refining plant, Energy conservation in oil processing industries, Packaging of oils, fats and allied products.

Course Outcome:

1. Understand the fundamentals of the various impurities associated with crude oils and able to perform the mass balance calculations at different stages of refining.
2. Describe and distinguish the applicability of conventional refining methods against the advanced one.
3. Apply the theoretical engineering principals for defining the nature of impurities removal from crude oils.
4. Identify and propose the different core chemical engineering operations in designing of refining units.
5. Understand the technical knowledge of other discipline contributing as green technological applications into refining process.
6. Understand the oil industry effluent treatment methods and the environmental issues.
7. Describe the energy conservation techniques in oil processing industries.

Department	**: Department of Oil Technology**
Course code	**: OTC-301**
Course Title	**: Refining of Oils and Fats. (PR)**
Course Type	**: Practical**
Total Hrs	**: 05**
Course credit	**: 2.5**

Pre-requisites for course:

Post Harvest Technology of Oil Bearing Materials (OTC-202),

Mechanical Operations (CHC-202),

Process Calculations (CHL-204).

Course objectives:

The course provides the opportunity to the students to integrate many of the skills and principles they learned from curriculum in understanding the different stages of refining process. It also makes students work productively and enhance their problem solving skills.

Experiments:

1. Laboratory degumming and dewaxing of crude oils.
2. Laboratory alkali refining of crude oils using aqueous-alkali, alcoholic alkali and Miscella-alkali deacidification.
3. Bleaching of crude oils using different adsorbents.
4. Analysis of fuller's earth and activated carbon.
5. Soapstock acidulation to produce acid oil.
6. Determination of unsaponifiable matter in oil and fat.
7. Treatment of phospholipids gums for Lecithin recovery and its purification method.
8. Treatment of spent bleaching for oil recovery.
9. Analysis of processed oils and other oil products for-
    (a) Soap content
    (b) Phosphatides content
    (c) Iron content
    (d) Wax content

Course Outcome:

1. Design and conduct the experiment to analyze the efficacy of activated carbon in removal of coloring matter from crude oil samples.
2. Examine the earth/carbon for their proximate properties.
3. Demonstrate the degumming methods in laboratory to test the hypothetical knowledge.
4. Calculate the molar alkali requirement for neutralization of FFA in oil sample.
5. Develop the lab scale deodorization process for removal of foul odors from crude oil.
6. Exhibits the team work and problem solving skills.

Department	**: Department of Oil Technology**
Course code	**: OTC-302**
Course Title	**: Quality Control Techniques in Oils and Fats.(TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites for course:

Organic chemistry-I (BSC-102),

Physics (BSC-105),

Chemistry and Technology of Oils and Fats (OTC-201).

Course Objectives:

This course is designed to give a thorough knowledge of different methods to analyse and control the quality of oils, soaps and detergents. Knowledge about different modern analytical equipments is also to be given.

Course Content:

Unit -I

Significance of Quality Control; Techniques of separation of glycerides and fatty acids: Liquid - liquid extraction; fractional distillation; low temperature crystallization; separation as lead and lithium soaps, urea complexes etc; Dilatometers of fats: Theory and Practice, Special dilatometric investigation; Determination of colour of crude and refined oils

Unit -II

Application of chromatographic techniques in the quality control and quality assurance of oils, fats and related products ; History, theoretical developments and various techniques e.g., thin layer chromatography, column chromatography, gas-liquid chromatography, HPLC and Super critical Chromatography; their principles, practices and specific applications in the analysis of oils and allied products.

Unit –III

Spectroscopy and its application; Ultra-violet, visible, infrared and near infrared spectroscopy

techniques: principles, practices and application to the analysis of oils and allied products. Nuclear magnetic resonance spectroscopy: principle, high resolution spectra of fats and fatty acids, adsorption of special groups, analysis of spectra and quantitative applications.

Unit –IV

Use of ion exchangers in the analysis of Detergents; Specific quality control methods viz. nickel content of hydrogenated oils; iron, sulphur and phosphatide content of crude and refined vegetable oils; wax content of vegetable oils; amino acid analysis by chemical and instrumental method etc.; Testing of DOC and Oil beyond conventional testing for the purpose of export; Polymorphism of fats and fatty acids.

Unit –V

Quality assurance; Definition and its scope; Agmark, Bureau of Indian Standards ,ISI specifications and procedures IUPAC, ASTM and AOCS specifications and methods for the analysis of oils and fats Procedures and norms for the ISO certification for oil, oleo chemicals and allied industries. Application of TLC-FID analyzer, GC-MS, SFC-GC, LC-MS, Induced Coupled Plasma-MS in the analysis of oils and fats.

Course Outcome:

1. Apply the principles of Oil Technology reactions to understand the parameters which are changing and measurable.
2. Acquire the thorough knowledge of basic techniques like Chromatography, Spectroscopy, Dilatometry, Hyphenisation etc. and identify the application and utility of these characterization techniques in Industrial production and Research.
3. Understand the procedure and applications of International and National norms, and Bodies for Quality Assurance like ISO, BIS, AOCS, and IUPAC.
4. Gain the vital information on Quality assurance Techniques for the treatment of byproducts and effluents.
5. Determine Iron and metal content, like residual nickel in Vanaspati, trans content of saturated fats with due emphasis on health and Environment issues.
6. Use the principles of basic sciences like Physics and Chemistry in the input and output areas of the instruments.
7. Test DOC and oils beyond conventional norms for the purpose of export.

Department	**: Department of Oil Technology**
Course code	**: OTC-302**
Course Title	**: Quality Control Techniques in Oils and Fats (PR)**
Course Type	**: Practical**
Total Hrs	**: 03**
Course credit	**: 1.5**

Pre-requisites for course:

Organic chemistry-I (BSC-102), Chemistry and Technology of Oils and Fats (OTC-201), Organic chemistry-II (BSC-202).

Course Objectives:

This course is designed to give complete at hand knowledge and practice for quality control of oils, fats, and allied products; along with the analytical equipments requirements for the same.

Experiments:

1. Separation of saturated and unsaturated fatty acids by low temperature crystallization, urea adducts method.
2. Determination of fatty acid composition of oils and fats by GLC method.
4. Determination of glyceride composition/distribution by following techniques.
5. Solvent crystallization, Lipase hydrolysis, GLC, HPLC etc.
6. Determination of conjugation by UV spectrophotometer.
7. Analysis of oilseeds and oil bearing materials by NIR analyzer.
8. Determination of *trans*-fatty acid content of hydrogenated oils by IR Spectrophotometer.
9. Dilatometric measurements.
10. Analysis of toxic constituents present in oilseeds.
11. Determination of phosphorus and metal content of oils and fats

Course Outcome:

After finishing this course the student will be able to

1. Apply the basic Science, Engineering, and Oil Technology principles for the analysis during production and quality control of the end product.
2. Identify and use the appropriate analysis technique for the characterization of products like oil bearing materials, oil, and target product and by products.

3. Understand the level of calibration and least count of the instruments as per the current consumer requirement and environmental laws.
4. Determine the conjugation, trans fat analysis, melting point, and other parameters using instrumental techniques.
5. Understand the controlling parameters for different processes of manufacturing on the basis of studied QC techniques.

Department	**: Department of Oil Technology**
Course code	**: OTL-306**
Course Title	**: Biochemistry and Biotechnology of Lipids. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisite for course :

Chemistry and technology of oils & fats (OTC-201),

Post harvest technology of oil bearing materials (OTC-202).

Course Objectives:

This course is designed to gain the insights about various bio-simulated reactions, pathways, and mechanisms in natural way. Also, the use of enzymes for synthetic modification and applications several fatty products will be studied. Environmental issues from bio-technological industries will also be discussed.

Course content:

Unit-I

Biosynthesis of fatty acids and phospholipids in plants and animals; Mechanism of chain elongation and desaturation of acyl chains; Biological Utilization of fats and their role in human nutrition; Atherosclerosis.

Unit-II

EFA,MUFA, PUFA –Their sources and biological activities in human health; Biochemical aspects of the role of vitamins and hormones in nutrition; Toxic constituents in oilseeds and oils-sources, structures, toxicological effects and methods of detoxification.

Unit-III

Microbial Production of fats and other lipids, Biotransformation of fats and lipids using Whole Microbial Cells.

General Aspects of Microbial Lipase: Sources, Production, Isolation, and Purification, Properties and Reactions, Industrial Applications, Enzymes for Pretreatment of Oilseeds prior to Oil Extraction,

Unit-IV

Enzymatic Interesterification: Chemistry, Reaction in aqueous organic solvent systems, Immobilization of enzymes, Factors Affecting Immobilized Lipase Activity, Enzyme Kinetics, Enzymatic Interesterification Reactors.

Structured lipids: Synthesis, analysis and applications

Unit-V

Genetic applications for lipid modification: Physical, Chemical and nutritional functionality modifications.

Environmental biotechnology concepts and application: Industrial waste management, air quality and control, bio-waste management.

Course Outcome:

1. Acquire the fundamental knowledge of scholarly discourse in fatty acids and other lipid synthesis.
2. Able to understand the biological roles of important fatty and non-fatty components.
3. Identify and describe the toxicity effects and method of remediation.
4. Apply the theories and concepts of microbial lipase in industrial applications.
5. Possess the critical thinking skills for solving the reaction kinetics and optimizing the process.
6. Able to identify ethical issues rose by environmental sciences and analyze the consequences of various professional dilemmas.

Department	**: Department of Oil Technology**
Course code	**: Elective-I, OTL-307**
Course Title	**: Technological Advances in Perfumery and Cosmetics. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites for course:

Physical chemistry (BSC-103),

Material Technology (ESL-106),

Organic chemistry-II (BSC-202).

Course Objectives:

This course will cover the raw material and characterizations of different cosmetics and perfumery materials along with production. The perfume blending for different applications will also be studied.

Course Content:

Unit - I

General Chemistry of essential oils. Raw materials for essential oils, general methods of their manufacture. Different types of essential oil bearing materials.

Unit -II

Physical and Chemical characteristic of essential oils-colour, specific gravity, refractive index, optical rotation, solubility, acid value and ester value. Analysis of essential oils for free alcohols, aldehyde and ketones. Grading and standardization of essential oils, common adulterants and their detection.

Unit- III

Production, properties and composition of important Indian Essential Oils viz Rose, jasmine, khus, sandalwood, keora, palmarosa, lemongrass, peppermint, lemon, clove oil, orange oil, eucalyptus oil, etc.

Unit- IV

The history of perfumery, Perfumery and its function, the mechanism of smelling, classification of perfume ingredients. Blending of perfumes. Important isolates, synthetic perfumery materials and fixatives e.g. menthol, camphor, thymol, citral, geraniol, terpin oil, vanillin, cumarin, musk, benzyl acetate, benzyl benzoate etc.

Unit -V:

Production techniques, functions of ingredients and desirable characteristics of cosmetic products like: Face creams, Face powders, Talcum powders, Hair oil & dyes, Shampoos, Tooth pastes & powders, Shaving creams, Lipsticks, Nail polishes, Depilatories, etc

Course Outcome:

1. Describe the general chemistry of essential oils including the different types of essential oil bearing materials and the method of their manufacture.
2. Understand the principles behind the physical and chemical analytical techniques associated with essential oils.
3. Understand the principles and current practices of production of essential oils.
4. Explain the concepts of perfumery, blending of perfumes and outline the use of synthetic perfumery materials.
5. Describe the production techniques and functions of ingredients in cosmetic products.
6. Use the knowledge acquired from the course for set-up of small and medium scale industries.

Department	**: Department of Oil Technology**
Course code	**: CHL-311**
Course Title	**: Reaction Engineering. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Course Objective:

At the end of the course student will understand the basic fundamental of reaction engineering, design and performance of batch, CSTR and plug flow reactor, methods of analysis of reactor data to solve the problem aroused in chemical industry.

Course content:

Unit -I **(10 hrs)**

Kinetics: Rate of reaction, types of reactions, Variables affecting the rate of reaction, order and molecularity,Temperature and concentration dependency of rate equation, theories of temperature dependency- Arrhenius theory, Bimolecular theory and Transition state theory, comparison between various theories of temperature dependancy of rate equation.

Unit -II **(10 hrs)**

Interpretation of kinetic data in batch and flow systems, integral and differential methods of analysis, kinetics of unimolecular, bimolecular reactions, series, parallel, reversible, autocatalytic reactions, constant volume batch reactor, variable volume batch reactor. Rate equation.

Unit -III **(10 hrs)**

Introduction to reactor design. Single ideal reactors: Ideal batch reactor, space time and space velocity, steady state mixed flow reactor, steady state plug flow reactor. Holding time & space time for flow systems.Comparison between mixed and plug flow reactor advantages and limitation in application.

Unit -IV **(10 hrs)**

Plug flow reactors in series and or in parallel, equal size mixed reactors in series, mixed flow reactors of different sizes in series. Reactors of different types in series, recycle reactor,

autocatalytic reactions.Principles of reactor stability and optimization. Residence time distribution: Residence time function and relation amongst their application to ideal reactors.

Unit -V **(10 hrs)**

Catalysis:

Concept of catalyst selection, classification and characteristics of catalyst, preparation of a catalyst and its deactivation, poisoning of catalyst and regeneration. Different types of isotherms, determination of catalyst surface area By BET method.

Solid-catalyzed reaction:

Rate equations, diffusion within porous catalyst, experimental methods for finding rates, product distribution in multiple reactions.

Reference Books:

1. Chemical Reaction Engineering,Wiley Eastern : O. Levenspiel
2. Chemical Reaction Engineering. : Fogler
3. Chemical Reaction Engineering. : S. D. Dawande
4. Chemical Reaction Kinetics. : J.M. Smith

Course Outcome:

1. To enhance the ability of students to understand the classification of reactions, effects of various parameters on rate of reactions with different reaction rate theories.
2. To get the students well acquainted with collection and analysis of rate data using integral, differential, half-life method of analysis of rate data. To understand the kinetics of fast reactions.
3. To enhance the knowledge of students about ideal reactors, autocatalytic reactor, various parameters affecting the reactor performance, combine reaction system and comparison of various reactors.
4. The get the students well acquainted with thermal characteristics of reactors, residence time distribution, catalysis and modeling of real systems.
5. To enhance the ability of students to identify and solve various engineering problems during product optimization.

Department	**: Department of Oil Technology**
Course code	**: HML-301**
Course Title	**: Industrial Management and Economics (TH)**
Course Type	**: Theory**
Total Hrs	**: 03**
Course credit	**: 03**

Course Objective

Upon successful completion of this course the student will be able to:

1. Identification and selection of management & administration with aspect towards the Production planning and management Quality control and maintenance. Processes/operations according to job requirement in various departments.

2. Identification, selection and understanding of Financial Management capital structure Sources of Industrial finance including institutional feature inside the organisation as well as outside the organisation.

3. Understanding Cost Analysis Cost statement and sheet Cost control and various type of approach of the Industrial relation Quality management techniques Entrepreneurship Development Management information

4. Identification, understanding Micro and Macro economics Demand and Supply factors of market economy Functions of money w.r.t. organisation.

Course Content:

Unit-I

Introduction meaning management & administration Functions of Management Planning and ,Organising staffing c monitoring and leading co-ordinating & communication tool Functional of management Production Material Finance personnel Marketing Management concept of productivity wages .Production planning and management Quality control and maintenance.

Unit-II

Types of management Different approaches of management Functional areas of management Forms of business organisation production management work study productivity measurement material management Inventory analysis Financial Management capital structure Sources of Industrial finance including institutional feature.

Unit-III

Marketing management consumer satisfaction sales and advertising Marketing Research personnel management Industrial relation Quality management techniques Entrepreneurship Development Management information system Information technology In Management Cost Analysis Cost statement and sheet Cost control , Cost projection.

Unit-IV

Nature and significance of Economics Basic problem in Economics Introduction of Micro and Macro economics Demand and Supply factors of market economy Functions of money Banking types and Functions

Unit-V

Indian Economy Liberalisation privatisation and Globalisation Mixed Economy Public Sector Reforms National income determinants Economic planning nature and Entrepreneurship small scale Industries and SSI.

References:

1. Modern Economics by H.L.Ahuja.
2. Modern economics theory by K.K.Dewett.
3. Monitory economics by M.L.Seth.
4. Industrial Management by I.K. Chopde, A.M. Sheikh.
5. Business Organisation and Management by S.A. Sherlekar.
6. Marketing Management by Philip Kotler.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Identification and selection of management & production management work study productivity with aspect towards the material management &Inventory analysis Production planning Quality control and maintenance. Processes/operations according to job requirement in various departments in organisation.

2. Identification, selection and understanding the meaning and utility of Marketing management, consumer satisfaction, sales and advertising Marketing Research personnel management features of the organisation.

3. Understand the importance of Cost Analysis Cost statement and sheet Cost control and various type of approach of the Industrial relation Quality management techniques Entrepreneurship Development Management information system

4. Identification, understanding Micro and Macro economics Demand and Supply factors of market economy National income determinants Economic planning nature and Entrepreneurship Functions of money w.r.t. organisation

5. Identification, selection and understanding according to requirement in Different organisation Financial Management, capital structure Sources of Industrial finance including institutional feature. Understanding of the working principle of Entrepreneurship Development and S.S.I.

Department	**: Department of Oil Technology**
Course code	**: HML-302**
Course Title	**: Managerial Behaviour and Psychosocial Dimension (TH)**
Course Type	**: Theory**
Total Hrs	**: 03**
Course credit	**: 03**

Course Objectives:

This subject aims at developing students with the required commitment and competencies for working towards the objectives within an organizational framework in order to improve both individual and organizational performance.

Course content:

Unit -I

Psychosocial dimension of work in organisation Introduction and background

Unit -II

Approaches in Organisational analysis Organisational behaviour approach

Unit -III

Early practises in Management Theories of Organisation Organisational process and Function The structural variables context. Environment of work organisation Socio-cultural Environment Its impact on Organisation Social dimension of organisational and Behaviour Formal and Informal organisation Group Dynamics and terms

Unit -IV

Motivational Process and Theories Communication Technology and Interpersonnel process Leadership process and style. and T.Q.M.

Unit -V

Decision making behaviour, Decision making techniques creativity.

References:

1. Psychosocial Dimensions for managementby T.V.Rao

2. Appraising and Developing Managerial Performance Management and Organisational Behaviour by Laurie J. Mullins

3. Managerial Behaviour and Effectiveness by E Ananda Raja, N R V Prabhu, P Kameshwara Rao.

4. Managerial Behaviour by O.P. Khanna

Course Outcome:

1. It emphasis on understanding of the issues, problems and practice of managing, working and organising across cultures in organisations.
2. It develops the understanding of psychosocial dimensions in people of organization to sustain relationship.
3. It contributes in developing interpersonal behaviours.
4. The subjects helps students to learn organizational whesiveness, pursuing goal and understand behaviour.

Department	**: Department of Oil Technology**
Course code	**: OTL-303**
Course Title	**: Technology of Fat Splitting and Soaps. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites for course:

Refining of oils and fats (OTC-301),

Mechanical Operations (CHC-202),

Process Calculations (CHL-204),

Instrumentation and Process Control (CHC-309).

Course Objectives:

This course exhaustively covers the methods of fat splitting to obtain fatty acids and treatment methodology for recovery of glycerin as by-product. Also, different soap making processes are introduced to orient the students to industrial framework. Application of the various chemical engineering operations in these processes is to discussed.

Course Content:

Unit – I

Chemistry of fat splitting; Composition of partially split fat; Degree of fat splitting; Effect of temperature, pressure, catalyst and ratio of reactants in fat splitting.

Plants and processes employed for fat splitting: Twitchell process, Enzymatic fat splitting, High-pressure batch and continuous splitting.

Fatty acid separation: Fractional Distillation, Solvent crystallization.

Unit – II

Production of glycerin from natural sources; plants and processes for treatment of sweet waters and spent lye; concentration/evaporation systems for treated liquors to crude glycerin; distillation and refining of crude glycerin; Grades of glycerin, properties, analysis and utilization of glycerin; Chemical route for synthetic glycerin.

Unit – III

Chemistry and classification of soaps; cleaning action of soaps; physical and functional properties of soaps; Raw material for soaps and their selection: Role of INS factor, solubility ratio and hardness number; Quality specifications and soap making properties of oils and fats;

Pretreatment and upgradation of oils and fats; principle of fat blend formulations; Soap base by cold, semi-boiled, full boiled and jet saponification process.

Unit – IV

Continuous saponification processes: Sharples, Delaval and Monsavon process; Selection and functions of non-fatty raw materials in soap making; Soap finishing line: drying, milling, plodding and billeting; Manufacture of soaps from fatty acids; Analysis of soaps.

Unit – V

Modern plants and processes (Colgate-Palmolive and Lever-Rexona Process) for the production of household and toilet soaps; Manufacture of specialty soaps *viz.* soft soaps, liquid soaps, transparent and translucent soaps, superfatted soaps, medicated soaps, floating soaps etc; Soap powders by spray-chilling and spray-drying; Packaging of soaps; Effluents treatment methods in soap industry.

Course Outcome:

1. Understand the chemistry of fat splitting, preparation of specialty soaps and production of glycerin *via* different chemical routes.
2. Describe the several plant and process of fat splitting along with the fatty acid separation techniques.
3. Correlate the core chemical engineering techniques such as distillation, fractionation, crystallization, autoclave operations, evaporation, blending, chilling and drying etc during the complete continuous industrial production of finished soap from raw fat/oil.
4. Use the engineering knowledge in preparing the plant layout and suggest the typical machineries for soap manufacture.
5. Understand the selection criteria of fatty and non-fatty raw materials of soap making.
6. Formulate the fat blend and propose the pretreatment methodologies to achieve soap making properties of oil/fat.
7. Understand the analysis methods of the quality determination of products such as soaps and glycerin.
8. Understand the safety, pollution and effluent treatment related issues in soap manufacturing industry.
9. Propose the less energy intensive biotechnological applications and economization methods in fat splitting and soap industry.

Department	**: Department of Oil Technology**
Course code	**: OTL-304**
Course Title	**: High Fat Products and Industrial Hydrogenation. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites for course:

Workshop Technology (EHC-101), Chemistry and Technology of Oils and Fats (OTC-201), Post Harvest Technology of Oil Bearing Materials (OTC-202).

Course Objectives:

The objective of this course is to apply the chemical engineering principles of heat and mass transfer and the mechanical engineering phenomenon of stirring and mixing of multiphase system, to get solid fat. The principle, process and application of the modification of vegetable oils are also to be understood.

Course Content:

Unit – I

Processing plants and equipments for hard oils; industrial applications of hard oils e.g. soaps, lubricating greases etc.; Manufacture techniques and process plants for shortening, margarine, butter, bakery and confectionery fats; Selection of fats and their blends for shortening and margarine; different types of plastic shortening agents; shortening and cocoa butter substitute by interesterification; chilling equipments for bakery shortening; Selection of additives and their requirements; specifications for industrial hard oils

Unit – II

Cooking oils, Salad and dressings: Natural and processed salad and cooking oils; Additives for salad and cooking oils; Stability and quality evaluation of salad and cooking oils; Nutrition-oriented applications of cooking oils and salad; Oil-based dressings eg. Mayonnaise-composition, manufacturing and quality control and stability measurements. Dewaxing, fractionation and winterization of oils: Theory and different techniques of dewaxing, winterization & fractionation; Commercial plant and processes; Industrial utilization of winterized and fractionated oils/fats

Unit – III

Hydrogenation of oils: Theory and importance of hydrogenation, kinetics of reaction, operating variables and their effect on rate of hydrogenation, selectivity and isomer formation.

Hydrogenation catalysts: Theory of catalyst structure, catalyst poisons and promoters, properties of catalysts e.g. porosity, selectivity, activity and other properties, different types of catalysts employed for hydrogenation of oils and fats, methods of catalyst manufacture, regeneration of nickel catalyst. Manufacture of hydrogen: Various methods of production and its purification for hydrogenation purposes, storage of hydrogen and handling of by-products of hydrogen production.

Unit – IV

Commercial plants and processes employed for hydrogenation of oils and fats; Design of hydrogenating vessels; High-pressure hydrogenation for production of fatty alcohol; conjugated hydrogenation; Hydrogenation of fatty acids: importance of operating variable and feed stock purity, batch and continuous methods, loop reactors.

Unit – V

Quality control of modified fats, dilatometry- theory and practice, Trans-unsaturated fatty acids and polyunsaturated fatty acids in nutrition and health. Energy conservation in hydrogenation process, Frying & stability characteristics, nutrition & health aspects, Diacylglycerols as low calorie fats.

Course Outcome:

1. Acquire the detailed knowledge of the principle behind manufacturing hard oils for edible and other commercial applications
2. Describe the commercial processes of Batch and continuous type supplied by different manufacturers along with operating parameters in detail.
3. Understand the effects of process conditions on the properties of the final product.
4. Outline the energy Conservation and Safety aspects of the process
5. Understand the design considerations of Hydrogenation vessel and modifications.
6. Describe the Frying and Stability characteristics of high fat products.
7. Discuss the energy efficient Separation techniques like dewaxing, filtration and winterization of oils.
8. Apply the Chemical Engineering and Mechanical Engineering principle for smooth and efficient running of the hydrogenation plant.

Department	**: Department of Oil Technology**
Course code	**: OTP-305**
Course Title	**: Processing and Analysis of Soaps and High Fat Allied Products. (PR)**
Course Type	**: Practical**
Total Hrs	**: 06**
Course credit	**: 03**

Pre-requisites for course :

Chemistry and technology of oils and fats (OTC-201),

Refining of oils and fats (OTC-301),

Quality control techniques in oils & fats (OTC-302),

Instrumentation and process control (CHC-309).

Course Objectives:

This course provides hand-on demonstrations for soap based product preparations. Importance of analysis of soap product for different properties is to be understood. Also, high fat allied experimentation and quality evaluation is to be performed.

Experiments:

1. Laboratory Preparation of
    a) Toilet/laundry soap
    b) Metallic soaps
    c) Transparent Soaps
    d) Medicated Soaps
    e) Shaving Soaps
    f) Liquid Soaps (Shampoo)
    g) Turkey Red oil

2. Analysis of household washing and toilet soaps for
    a) Active matter
    b) Moisture and volatile matter content
    c) Free alkali
    d) Total alkali
    e) Total fatty matter

f) Chloride content

g) Glycerol content

h) Titre of fatty acids of soaps

i) Alcohol soluble & insoluble

3. Treatment and recovery of glycerol from spent soap lye
4. Laboratory hydrogenation of oils
5. Analysis of activated carbon and nickel catalyst
6. Inter-esterification of oils.
7. Quality evaluation of Margarine for Color, Peroxide value, Free fatty acids, Moisture and SFI.

Course Outcome:

1. Demonstrate and conduct the laboratory preparations of specialty soaps based on the knowledge acquired through theoretical coursework.
2. Analyze the soap samples for their chemical characteristics/specification.
3. Apply the technical details to execute the glycerol recovery experimentation in lab scale setup.
4. Evaluate the quality of margarine sample and interpret the analysis results.
5. Perform the experimental computing and summarize the results.
6. Organize the experimental runs in safer manner.

Department	**: Department of Oil Technology**
Course code	**: Elective- II, OTL-308**
Course Title	**: Advances in Oil Chemistry and Oleochemicals (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites for course:

Chemistry and technology of oils & fats (OTC-201),

Organic chemistry-I (BSC-102),

Organic chemistry-II (BSC-202),

Quality control techniques in oils & fats (OTC-302).

Course Objectives:

This course comply the essential content of advanced theories, modification methodologies and production of industrially engineered oleochemicals. Also, eco-friendly, energy efficient processes along with waste management methods in development of oleochemicals will be studied.

Course content:

Unit-I

Advanced theories of glyceride structure of natural fats; determination of glyceride structure; synthesis of glycerides; estimation of mono-, di-, and tri-glycerides; Stereo-specific analysis; lipase hydrolysis; Polymorphism of fats and fatty acids; Chemical synthesis of fatty acids and their derivatives

Unit-II

Mechanism of important chemical and biochemical reactions of fats and fatty acids; esterification, inter-esterification, isomerisation, polymerization, dehydration, pyrolysis and oxidation; Fatty acid esters and other oleo-chemicals derived from fats and fatty acids; products and by-products from castor oil, soybean oil , rapeseed oil, neem oil, mahua, cottonseed etc.; Stabilization of distilled fatty acids

Unit-III

Fatty alcohols and amines: Methods of production and their utilization; Manufacture of sulphated and sulphurised oils, properties, specifications and plant and processes employed; Textile auxiliaries, Leather chemicals , Polymer additives , Paint additives , Lubricant additives.

Unit-IV

Chemistry of drying oils: Modification of oils for surface coating industry; Thermal and chemical modification methods, properties of modified oils, changes in drying oils during heat bodying and oxidative polymerization, Processes and plants employed for their commercial production, Malenised oils, epoxidised oils ,boiled oils , blown oils ,stand oils , urethane oils.

Unit-V

Industrial transformations of vegetable oils; Modified and Novel Fatty acids, Improving meat nutrition from modified fatty acid profiles; Advances in shortening and margarine processing; High purity fatty acid products blend distillation; Eco-friendly and energy efficient processes in development of Oleochemicals; Engineering bio-fuels from oil plants; Advances in oilseed extraction and oil processing; Advances in industrial utilization of vegetable oil industry waste/by-products.

Course Outcome:

1. Utilize the current scientific literature, including advanced theories of glyceride, mechanism of lipid reactions, industrial modifications of fatty oils etc.
2. Explain the various transformations reactions such as esterification, inter-esterification, isomerisation, polymerization, dehydration etc.
3. Describe the production methods of oleochemicals from fatty oils.
4. Apply the theoretical knowledge of thermal and chemical modification methods for development of drying oils.
5. Demonstrate the ability to find appropriate eco-friendly and energy efficient processes of industrial importance.

Department	**: Department of Oil Technology**
Course code	**: Elective- II, OTL-309**
Course Title	**: Modified and Tailor Made Oils. (TH)**
Course Type	**: Theory**
Total Hrs	**: 04**
Course credit	**: 04**

Pre-requisites For Course

Organic chemistry-I (BSC-102)

Organic chemistry-II (BSC-202)

Chemistry and technology of oils & fats (OTC-201)

Course Objectives:

To apply the basic principles of chemistry and technology for the modification of oils and fats. This helps in producing w.r.t. effective and better tailormade products for edible and non-edible applications.

Course Content:

Unit – I

Chemistry of drying oils, natural and synthetic drying oil, modification of oils for surface coating industry, thermal and chemical modifications methods, properties of modified oils such as blown, stand oil, boiled oil, malenized, isomerised oil , etc. Process & plant employed for their commercial production. Chemistry & Technology of Alkyd resins: Classification on the basis of oil length, Selection of ingredients. Fatty acids & monoglyceride routes, fusion & Solvent process. Their merits & demerits.

Unit – II

Plants & process of manufacture of alkyd resin. Modification of alkyd resin. Oil modified synthetic resin: Chemistry, formulation & manufacture, oleoresinuous varnishes, epoxy esters, urethane oils, polyamides, polyester amides, etc.

Unit – III

Application of oils, modified oils, oil modified resins in surface coating industry. Brief review of paint formulation & application. Plants, Processes & applications of metallic soaps, lubricating oils and greases, cutting oil, Hydraulic oils, etc.

Unit – IV

Transesterification: Classification of transesterification: Acidolysis, Alcoholysis, Interesterification / Intraesterification. Mechanism of interesterification (directed and random). Different types of chemical and enzyme catalysts for transesterification. Plants for production of methyl ester, monoglyceride, interesterification products, etc.

Unit – V

Confectionery and Bakery Fats: Raw material for confectionery fats: Cocoa butter, processing of Cocoa butter, composition and properties of Cocoa butter, polymorphism and crystal behaviour of cocoa butter. Methods of obtaining cocoa butter substitutes, replacer, equivalents and extenders. Plastic shortening agents: different types of plastic shortening agents, selection of blends with reference to specific requirements and application in bakery products.

Course Outcome:

1. Understand the chemistry underlying the drying mechanism of oils.
2. Describe the plant and process for modifications of oil for surface coating industry.
3. Outline the paint formulation and applications of lubricating oils, metallic soaps etc.
4. Understand the classification and mechanism of major esterification reactions for synthesis of industrially important products like MG, ME etc.
5. Distinguish between the terminologies related to confectionary and bakery fat; describe the polymorphism and crystal behavior of cocoa butter and discuss the methods of cocoa butter substitute preparations.