

**H.B. Technological Institute, Kanpur-208002**

**M. Tech. Chemical Technology (With Specialization in Oil Technology)**

*Course Structure & Evaluation Scheme*

**(Recommended by B.O.S. w.e.f. 2013-14)**

**STREAM - A - I Semester**

**(For candidates with B. Tech. Degree in Oil Technology)**

S. No.	Course Code	Subject	Periods L T P	Evaluation Scheme					Subject Total		
				Sessionals				Examination			
				CT	Attendance	TA	Total				
1	QCH-109	Advance Modeling and Simulation of chemical engineering system	3	1	0	30	10	10	50	100	150
2	QCH-103	Advance Chemical Reaction Engineering and Catalysis	3	1	0	30	10	10	50	100	150
3	QOT-101	Advances in Oleochemicals	3	1	0	30	10	10	50	100	150
4	QOT-102	Advances in Emulsion Technology	3	1	0	30	10	10	50	100	150
		<b>Total</b>	<b>12</b>	<b>4</b>	<b>0</b>				<b>200</b>	<b>400</b>	<b>600</b>

**H.B.Technological Institute, Kanpur-208002**

**M. Tech. Chemical Technology (With Specialization in Oil Technology)**

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**(Recommended by B.O.S. w.e.f. 2013-14)**

**STREAM - B - I Semester**

**(For candidates with B.Tech. Degree in Engineering other than Oil Technology)**

S. No.	Course Code	Subject	Periods L T P	Evaluation Scheme					Subject Total
				Sessionals				Examination	
				CT	Attendance	TA	Total		
1	QCH-103BC	Process Calculation	3 1 0	30	10	10	50	100	150
2	QOT-103	Chemistry & Technology of Oil & Allied Products	3 0 2	30	10	10	50	100	150
3	QOT-104	Quality Control Techniques in Oil and Allied Industries	3 0 2	30	10	10	50	100	150
4	QOT-105	Interfacial Science and Engineering	3 1 0	30	10	10	50	100	150
		<b>Total</b>	<b>12 2 4</b>				<b>200</b>	<b>400</b>	<b>600</b>



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**(Recommended by B.O.S. w.e.f. 2013-14)**

**M. Tech. Chemical Technology (With Specialization in Oil Technology)**

**STREAM -C - I Semester**

**(For candidates with M. Sc. Degree in Chemistry)**

S. No.	Course Code	Subject	Periods L T P	Evaluation Scheme					Subject Total
				Sessionals				Examination	
				CT	Attendance	TA	Total		
1	PCH-103BC	Process Calculation	3 1 0	30	10	10	50	100	100
2	QOT-103	Chemistry & Technology of Oil & Allied Products	3 0 2	30	10	10	50	100	150
3	QOT-104	Quality Control Techniques in Oil and Allied Industries	3 0 2	30	10	10	50	100	150
4.	QOT-106 QMA-101C	Elective i) Lipid Biotechnology ii) Engineering Mathematics	3 1 0	30	10	10	50	100	150
		<b>Total</b>	<b>12 2 4</b>				<b>200</b>	<b>400</b>	<b>600</b>

**M. Tech. Chemical Technology (With Specialization in Oil Technology)**

**II Semester (Common to All Streams)**

S. No.	Course Code	Subject	Periods L T P	Evaluation Scheme					Subject Total
				Sessionals				Examination	
				CT	Attendance	TA	Total		
1	QOT-201	Modern Processing Technology of Oil-bearing Materials	3 1 0	30	10	10	50	100	150
2	QOT-202	Technology of Modified and Specialty fats & Oils	3 1 0	30	10	10	50	100	150
3	QOT-203	Modern Processing Technology of Oils	3 1 0	30	10	10	50	100	150
4	QOT-204  *QOT-205	Elective i) Processing Plants and Their Designs ii) Soaps and Synthetic Detergents	3 0 2	30	10	10	50	100	150
5.	QOT-206	Audit Course  Critical review of research publications on one relevant topic	0 2 0						
6.	QOT-207	Audit Course  Research Methodology and IPR	2 1 0						

		<b>Total</b>	<b>14 6 2</b>				<b>200</b>	<b>400</b>	<b>600</b>
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\* For B and C streams only

**M. Tech. Chemical Technology (With Specialization in Oil Technology)**

**III Semester (Common to All Streams)**

S. No.	Course Code	Subject	Periods L T P	Evaluation Scheme					Subject Total
				Sessionals				Examination	
				CT	Attendance	TA	Total		
1	QOT-301	Novel Surfactants- Production and Industrial Applications	3 1 0	30	10	10	50	100	150
2	QOT-302 QOT-303	Elective Nutraceuticals and Functional Foods Perfumery and Cosmetics	3 0 2	30	10	10	50	100	150
3	QOT-304	Dissertation/ Project*	0 8 0	-	-	-	100	-	100
4	QOT-305	Seminar	0 2 0		-	-	-	-	-
		<b>Total</b>	<b>6 11 2</b>				<b>200</b>	<b>200</b>	<b>400</b>

\* 100 marks for Dissertation work will be evaluated during IV Semester

**M. Tech. Chemical Technology (With Specialization in Oil Technology)**

**SEMESTER –IV (Common to all Streams)**

S. No.	Course Code	Subject	Periods L T P	Evaluation Scheme					Subject Total
				Sessionals				Examination	
				CT	Attendance	TA	Total		
1.	QOT-401	Dissertation (Research Project)	- - 18	-	-	-	200*	200	400
		<b>Total</b>	<b>- - 18</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>200</b>	<b>200</b>	<b>400</b>

\* 100 marks for Project-Dissertation work of III Semester are included in these marks.

## QCH 301/ CH-11 PROCESS CALCULATION

**L:T:P**  
**3:1:0**

### **UNIT 1**

Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions, Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

### **UNIT2**

Stoichiometric principles, application of material balance to unit operations like distillation, evaporation, crystallization, drying etc., Material balance with chemical reaction, Limiting and excess reactants, recycle, bypass and purging

### **UNIT 3**

Unsteady state material balances, calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, use of humidity in condensation and drying, Humidity chart, dew point.

### **UNIT 4**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels, calculation of excess air from orsat technique and problems, heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

### **UNIT5**

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction, effect of pressure and temperature on heat of reaction, Energy balance for systems with and without chemical reaction, unsteady state energy balances. Introduction to Computer aided calculations-steady state material and energy balances.

### **BOOKS:**

1. Bhatt, B.L., VORA, S.M., "Stoichiometry ", Tata McGraw-Hill, 1976.
2. Hougen, O.A., Watson, K.M and Ragatz, R.A., " Chemical Process Principles Part-I ",John Wiley and Asia Publishing, 1970.
3. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering ",Fourth Edition, Prentice Hall Inc., 1982.
4. Whitwell, J.C., Tone, R.K. "Conservation of Mass and Energy ", McGraw-Hill, 1973.
5. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.



### **OCH-103 : Advanced Chemical reaction engineering**

**L:T:P**  
**3:1:0**

Catalysis and catalytic process , catalyst formation, adsorption on solid surfaces, physical - chemical adsorption model, multiplayer adsorption theory; catalytic reaction kinetic model, real and ideal surface models; various models for data analysis, adsorption enhancement, multi step rate control, significances of dual rate – determining step and non equilibrium kinetic model, catalyst deactivation, catalyst classification.

Fixed bed catalytic reactor; reactor and reaction parameter, chemical and physical dimensionless parameters, radial pecelet, aspect and biot numbers, velocity variance, adiabatic and non adiabatic fixed bed reactor, design and modeling of fixed bed reactors

Fluidized bed catalytic reactor; character and quality of fluidization, fluid bed reactor modeling; Davidson Harrison model, Kunii - Levenspiel model, anatomy of overall rate coefficient, Olsons’s fluid bed reactor analysis. Introduction and performance of catalytic gaze reactor, trickle bed reactor, catalyst deactivation in fixed bed, batch fluid bed, moving bed and continuous fluid bed reactors, comparison of fixed moving and fluid beds; reactor poisoning in terms of spm, thermal waves in fixed bed regeneration, optimization of regeneration cycles.

#### Books & References:

1. James J. Carberry: Chemical and catalytic reaction engineering McGraw Hill.
2. J.M.Smith, “ Chemical Engineering Kinetics”, McHill.
3. O.Levenspiel, “Chemical Reaction Engineering”, Wiley Eastern, 2nd ed, 1972
4. Froment G.F., Bischoff K.B.; Chemical Reactor Analyser and design, John Wiley & Sons.

## **OCH-109 :Modeling and Simulation of Chemical Engineering Systems**

**L:T:P**  
**3:1:0**

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.

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

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

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.

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.

Books:

1. W.L.Luyben, Process Modeling, Simulation and Control for Chemical Engineers, McGraw-Hill, New York (1990).
2. M.M.Denn, Process Modeling,
3. C.D.Holland, Fundamentals and Modeling of Separation Processes,

## QOT 101 : Advances in Oleochemicals

L T P  
3 1 0

### Unit-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.

### Unit-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.

### Unit-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.

### Unit-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.

### Unit-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)

### Reference book:

1. ----- by Doherties & Malieur

## QOT-102 Advances in Emulsion Technology

L T P

3 1 0

### UNIT-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. [6]

### UNIT-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. [8]

### UNIT-3

Microemulsions. Macroemulsions and nanoemulsions: Introduction of dielectric polarization, dielectric spectroscopy, dielectric properties of microemulsion, nonequilibrium colloidal systems, dielectric study of human blood cell. [8]

### UNIT-4

Electroacoustic characterization of emulsions, acoustic spectroscopy of emulsion, surface forces and emulsion stability, double emulsion for controlled release application, environmental . emulsion.heavy hydrocarbon emulsion. [8]

### UNIT-5

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. [10]

### Reference books:

1. Encyclopedic Handbook of Emulsion Technology edited by Johan Sioblom published by Marcel Dekker. Inc. ( 2001)
2. Surfactants and Interfacial Phenomena edited by Milton .1. Rosen published by Wiley Interscience (2004)

Unit-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, Rancidity and mechanism of chemical and auto oxidation (primary and secondary), natural & synthetic antioxidants

Unit-2

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

Major commercial oilseeds, oil – bearing materials and their oils: Production, characteristics, composition and utilization; 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.

Unit-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.

Unit-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.

Unit-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-1 by 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 Michael Bockish: AOCS Press, Champaign, Illinois

Unit-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

Unit-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.

Unit-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.

Unit-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.

Unit-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.

**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<sup>th</sup> and 15<sup>th</sup> 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. Spectrometric Identification of Organic Compounds, by Robert M. Silver, Francis \*Websiter & David Kiemle, John Wiley & Sons 7<sup>th</sup> 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)

## QOT-105 Interfacial Science and Engineering

L T P

3 1 0

### Unit-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.

### Unit-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.

### Unit-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.

### Unit-4

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

### Unit-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.

Reference books

1. Novel surfactants- Kristen Holmberg of Surfactant Science Series
2. Soaps and detergents- Parashuram
3. Soaps - J.G. Kane

## **QOT 106 Lipid Biotechnology**

**L T P**  
**3 1 0**

### **Unit-1 Sources**

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

### **Unit-2**

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

### **Unit-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.

### **Unit-4**

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

### **Unit-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



## QOT-201 : Modern Processing Technology of Oil bearing Materials

L T P  
3 1 0

### Unit-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, oil bearing materials and crude oils as per BIS methods.

### Unit-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.

### Unit-3

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

### Unit-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.

### Unit-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 Feireidoon Shahidi
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

## QOT-202: Technology of Modified and Specialty Fats & Oils

**L T P**  
**3 1 0**

### **Unit-1**

Commercial production and recent technological 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

### **Unit-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.

### **Unit-3**

Modifications of oils for leather and textile industries viz. fat liquors. Leather chemicals, textile chemicals etc. Sulfated, sulfonated and sulphited oils; chemistry, manufacture and applications in leather industry

### **Unit-4**

Modification of oils and fats for the 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

### **Unit-5**

Metal sulfonates; Their manufacture and uses in various lubricant formulations, additives and other fat based lubricant for petroleum industry

#### Reference Books:

1. Organic Coatings Technology by H.F. Payne
2. Bailey's Industrial Oils & Fats Products Vol. I to IV
3. Lubricating Oil & Greases By C.J. Bonner

## QOT-203: Modern Processing Technology of Oils

L T P  
3 1 0

### Unit-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.

### Unit-2

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.

### Unit-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.

### Unit-4

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.

### Unit-5

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

### Reference Books:

1. Technology and Refining of Oils by T. L. Mahatta
2. Bailey's Industrial Oils and Fats, 6<sup>th</sup> edition, vol-5 ( @ ) ) Edited by Feireidoon Shahidi
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

## **OOT-204 : Processing Plants and their Designs**

**L T P**  
**3 1 0**

### **Unit-1**

Design aspects of major oil processing equipments of vegetable oil refinery , Effect of oil processing parameters on the designs of these equipments. Batch vessels, viz. neutralizer, bleacher, deodorizer, autoclave etc.

### **Unit-2**

Continuous processing equipments, centrifuges for separation of gums and soap-stock from oil, continuous bleacher, different types of continuous deodorizers, physical deacidification vessels etc

### **Unit-3**

Designing of fat splitting autoclaves, fatty acids distillation plants, miscella distillation column, desolventisation vessel for deoiled meal etc.

### **Unit-4**

Designing of soap kettle, continuous saponification equipments. Sulphonation reactors-batch and continuous. Design of spray- drying tower.

### **Unit-5**

Design of various auxiliary equipments e.g. storage tank, heat exchangers, filter presses etc., Safety aspect of all above equipment, plant layouts, safety processing

### **Reference Book :**

1. Plant Design & Economics for Chemical Engineers by H.S.Peler & K.D. Timmerhans, Mc Graw Hill:11,2004
2. Handbook of Heat Transfer Media by P.L. Geiringer, 1977 Remhold Publication
3. P.M. Goodall, The Efficient Use of Steam,1980, Westbury House
4. Parry's Handbook of Chemical Engineering
5. Process Safety Fundamentals with Application by D.A. Crowl & J.F. Lauver, Prentice Hall, U.S.A., 1996
6. Principles of Processing Engineering by S.M. Handerson & R.L.Perry & J.H. Young, 4<sup>th</sup> Edition, 1993

## QOT-205 Soaps and Synthetic Detergents

L T P  
3 0 2

### Unit-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.

### Unit-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 lye and sweet water.

### Unit-3

Raw materials for synthetic detergents:

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

### Unit-4

Production of active detergents:

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

### Unit-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

**QOT-206 Audit Course**

**L T P**  
**0 2 0**

Student has to do critical review of research publications on one relevant topic

## **QOT301 NOVEL SURFACATANTS; PRODUCTION AND INDUSTRIAL APPLICATIONS**

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### **Unit-1**

Introduction:

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

### **Unit-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

### **Unit-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

### **Unit-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

### **Unit-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:

1. Novel Surfactants: Preparation, Applications and Biodegradability, II Edition, edited by Krister Holmberg

## QOT - 302 Nutritional and functional foods

L T P  
3 1 0

### Unit-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.

### Unit-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.

### Unit-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

### Unit-4

Various food constituents responsible for functional effects:

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

### Unit-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 ( 2<sup>nd</sup> Edition, 2002), Oxford University
2. Encyclopedia of human nutrition ( 1998) , London: Academic press
3. Modern nutrition in health and disease, 9<sup>th</sup> edition edited by Shils, Olson, Shike and Ross
4. Nutritional Biochemistry and \metabolism, 2<sup>nd</sup> edition edited by Linder (1991)



## QOT-303 PERFUMERY AND COSMETICS

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### Unit –I

#### Sources, classification and chemistry of essential oil bearing materials

Different methods of manufacturing essential oils, Grading and standardization of essential oils 06

### Unit -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 08

### Unit -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. 08

### Unit -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, citraniel & terpenols,ionones, Hydroxy citronellol etc. Castor oil based perfumery chemicals, blending of perfumes. 08

### Unit -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.

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### Reference Book

1. Essential oils –Vol. I –V by Guenther
2. Perfume Cosmetics & Soaps Vol.-I –III by W.A. Poucher
3. Manufacture of perfumes and essence by Kalicharan
4. The essential oils book Edited by Colleen K. Dodt
5. Conditioning agent for hair and skin Edited by Randyschuller and Perry Romanowski
6. Glycerin Edited Vol -11 (1991)by Eric Jungermann & Norman O.V. Sonntag

**QOT-304 Dissertation**

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Students have do literature survey on assigned topic and prepare a report on the same

**QOT-305 Seminar**

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**Students have to prepare a report on a topic and make power point presentation of the same**

### QOT-306 Research Methodology and IPR (Audit Course)

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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, questionnaire, opinionnaire Data analysis: Parametric and non parametric data, Hypothesis testing Descriptive and inferential analysis, Statistical analysis of data including standard deviation, student test, f test,

ANOVA, 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)