# Course Structure and Syllabus for 2-years 4-semester M. Tech. Course in Oil Technology

(With effect from Academic year 2024-2025)

1st Semester:

| Paper No | Sub Code | Subject | Periods | | | Cr | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | IA | UE | TM |
| Theory | | | | | | | | | |
| I | **CHT101** | Process Modelling and Simulation | 3 | 1 | - | 4 | 30 | 70 | 100 |
| II | **OLT102** | Technology of Fats and Fat Based Products | 3 | 1 | - | 4 | 30 | 70 | 100 |
| III | **OLT103** | Technology of Surface Coating | 3 | 1 | - | 4 | 30 | 70 | 100 |
| Practical | | | | | | | | | |
| IV | **CHT104** | Computer Application in Chemical Industries | - | - | 8 | 4 | 60 | 40 | 100 |
| V | **OLT105** | Oil Technology Laboratory I | - | - | 8 | 4 | 60 | 40 | 100 |
| | | Total | 9 | 3 | 16 | 20 | 310 | 290 | 500 |

2nd Semester:

| Paper No | Sub Code | Subject | Periods | | | Cr | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | IA | UE | TM |
| Theory | | | | | | | | | |
| VI | **CHT201** | Optimization | 3 | 1 | - | 4 | 30 | 70 | 100 |
| VII | **OLT202** | Technology of Fat Based Surfactants | 3 | 1 | - | 4 | 30 | 70 | 100 |
| VIII | **OLT203** | Technology of Essential Oils | 3 | 1 | - | 4 | 30 | 70 | 100 |
| IX | **OLT204** | Oil Technology | 3 | 1 | - | 4 | 30 | 70 | 100 |
| Practical | | | | | | | | | |
| X | **OLT205** | Oil Technology Laboratory II | - | - | 8 | 4 | 60 | 40 | 100 |
| | | Total | 12 | 4 | 8 | 20 | 180 | 320 | 500 |

3rd Semester:

| Paper No | Sub Code | Subject | Periods | | | Cr | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | IA | UE | TM |
| XI | **CHT301** | Research Methodology | - | 2 | - | 2 | 15 | 35 | 50 |
| XII | **OLT 302** | a. Project Feasibility – Report | - | 2 | 8 | 6 | 90 | 60 | 150 |
| | | b. Project Feasibility – Viva Voce | - | - | - | 4 | - | 100 | 100 |
| XIII | **OLT 303** | Mini Project with seminar | - | 4 | - | 4 | - | 100 | 100 |
| XIV | **OLT 304** | Thesis: Foundation | - | - | - | 4 | - | 100 | 100 |
| | | Total | - | 8 | 8 | 20 | 105 | 405 | 500 |

4th Semester:

| Paper No | Sub Code | Subject | Periods | | | Cr | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | IA | UE | TM |
| XV | **OLT 401** | a. Thesis: Final-Report | - | 4 | 16 | 12 | - | - | 300 |
| | | b. Thesis: Final-Viva Voce | - | - | - | 4 | - | 100 | 100 |
| XVI | **OLT 402** | General Viva Voce | - | - | - | 4 | - | 100 | 100 |
| | | Total | - | 4 | 16 | 20 | - | 500 | 500 |

**Total Credit Point:** 20 + 20 + 20 + 20 = 80; **Grand Total:** 2000

IA: Internal Assessment; UE: University Examination; TM: Total Marks

# SYLLABI OF 2 YEARS (FOUR SEMESTER) M.TECH. COURSE IN OIL TECHNOLOGY

***First Semester***

**Paper I**

**Course CHT 101** **100 Marks/ 4 credits**

**Process Modeling & Simulation**

**Module 1:** Mathematical Modeling Fundamentals: Art of modeling, laws, assumptions, degrees of freedom, consistent modeling, synthesis, analysis and optimization. General purpose modeling, specific purpose modeling, scientific modeling, engineering modeling.

**Module 2:** Models of equipment, unit operation/unit process; material & energy balance, property relations, Constraints, steady state and unsteady state models. Specific Equipment Design models: Batch reactor, continuous tank reactor, Continuous tubular, catalytic reactor, heat exchanger, Distillation column.

**Module 3**: Plant modeling, stream variable and stream properties, tear stream and tear variable, modular approaches: sequential, simultaneous and equation solving approaches. Sequencing and ordering of solving equations.

Plant modeling: A plant with/without a recycle stream, plant with controlling elements.

**Module 4:** Solution algorithm and flow chart development for various mathematical models.

Computer simulation**:** Programming languages, sequences and algorithm development.

Specific simulators**:** Binary distillation column, Heat exchanger, reactor, flasher.

Plant flowsheeting: Three CSTR in series, Propylene dimerization plant, sulfuric acid plant, etc.

**Paper II**

**Course OLT 102** **100 Marks/ 4 credits**

**Technology of Fats and Fat Based Products**

**Module 1:** Genetically modified oils and their properties and applications, Single cell lipids: their production and applications. Valuable products from oils by microbial fermentation technology. Production of enzymes in lipid processing.

**Module 2:** Biotechnology in refining fats and oils (biodegumming, biorefining, biobleaching, etc). Biotechnology in processing fats and oils to produce oleochemicals and derivatives, (biohydrolysis, bioalcoholysis, bioesterification, biooxidation, biepoxydation) with isolated enzymes and whole cell microbes. Enzymatic interesterification of fats and oils and other fatty materials

**Module 3:** Modifications to produce specialty fats (structured fats, nutraceuticals, and confectionary). Metathesis and co metathesis reactions of fats and oils and their application in oleo chemical industry. Hydroformylation reaction, decarboxylation, cracking of fatty acids and fatty acid esters.

Telomer acids and their applications. Fat substitute and their nutritional significance. Stability and frying characteristics of natural and modified fats. Recent trends in dietary fats and dietary guidelines. Modern techniques for analysis of oils and fats and their derived products.

**Module 4:** Modern trends in extraction of oils and fats, Supercritical extraction technology in processing oil bearing materials.
Membrane technology in processing fats and oils.
Liquid – liquid extraction technology in processing of oils and fats.
Wipe film evaporation process technology in producing oils & fats.
Nanotechnology in processing fats and oils, proteins and polysaccharides for edible and industrial applications. Encapsulation technology and its application.

**Paper III**
**Course OLT 103** **100 Marks/ 4 credits**
**Technology of Surface Coating**
**Module 1:** Modern development in binder systems, recent development in clear & pigmented coatings, thermosetting acrylics, epoxy modified phenolic resins, hudroxylated acrylic resins, polyesters, polyurethane, modified alkyd resins, group transfer polymerization, microemulsion & inversed microemulsion polymerization.
**Module 2:** Interpenetrating polymer network system, control & optimization of coating process, Zn-rich epoxy primers, Etch primers, primer surfaces, coil coating, curtain coating, flow coating. Modern analytical aspects & coating specification. Copolymer and copolymer systems, copolymer composition equation, monomer reactivity ratio, water borne coating.
**Module 3:** Mechanism of corrosion, recent development in coating system to prevent corrosion.
**Module 4:** Biotechnology in coating industry

**Paper IV**
**Course CHT 104** **100 Marks/ 4 credits**
**Lab.-1**
**Computer Applications in Chemical Industries**
Writing computer program to solve complex design and modeling problems like heat exchangers, flashers, reactors, distillation columns, plant simulation problems etc.

**Paper V**
**Course OLT 105** **100 Marks/ 4 credits**
**Lab.-II**
**Oil Technology Lab. I**
**Oils and Fats:** Enzymatic inter esterification of fats and oils to vanaspati substitute, bakery fats, coco butter substitute etc. enzymatic esterification and trans esterification to produce esters, emulsifiers, wetting agents. Preparation of modified lecithin by fractionation, enzymatic interesterification etc. Biorefining of fats and oils and recovery of glycerols. Preparation of biodiesel and its characteristics. Preparation of single cell oils for GLA and PUFA.
Processing of oil mills to produce protein and dietary fiber by enzymatic and nonenzymatic hydrolysis, processing of refinery byproducts like fatty acid distillates, deodorizer distillates to produce value added products.

*Second Semester*

**Paper VI**

**Course CHT 201** **100 Marks/ 4 credits**

**Optimization**

**Module 1:** Indroductory concepts : Objective function, single valued function, multivalued function, non-linear function, linear function, stationary point, relative and absolute extreme, convex, concave and unimodal functions, gradient reduction method, jacobian and hessian matrix.

**Module 2:** Optimization of univariate system using analytical method. Search techniques, quadratic interpolation, cubic interpolation. Optimization of multivariate unconstrained system using.

**Module 3:** Search techniques. First order methods and second order methods. Optimization of multivariate constrained systems using Lagrange multipliers, penalty function, linear programming and non-linear programming.

**Module 4**: Computer programming of optimization of specific problems related with chemical industry.

**Paper VII**

**Course OLT 202** **100 Marks/ 4 credits**

**Technology of Fat Based Surfactants**

**Module 1:** Recent development of surfactant technology, surface activity properties of anionic, cationic, nonionic and ampholytic surfactants, including biosurfactants, in aqueous & non aqueous media. Silicone surfactants, Gemini surfactants, fluorinated surfactants, polymeric surfactants.

**Module 2:** Physicochemical aspects of micellization, solubilization, wetting, leveling, foaming, emulsification, dispersion, detergency etc. solvent properties of surfactants solution, polymer surfactants interaction, visco-elustic properties of surfactants. Role of surfactants in different process units.

**Module 3:** Concept of HLB, PIT, CER, micro emulsion, multiple emulsion system, nanoemulsion system. Polymerisable surfactants, enzymatic surfactants, cleavable surfactants. Role of various surfactants used in pigment dispersion & mechanism.

**Module 4:** Surfactants used in pigment modification, biological properties of surfactants. Dermatological activity, toxicity, bactericidal effects, biodegradation, waste water purification etc. modern analytical techniques and specifications of surfactants.

**Paper VIII**

**Course OLT 203** **100 Marks/ 4 credits**

**Technology of Essential Oils**

**Module 1:** Biotechnology in producing essential oil-bearing materials of improved oil content and composition.

New methods for extraction of essential oils (liquid and super critical gases, enzymatic extraction).

**Module 2:** Manufacture of synthetic perfumery ingredients like cyclohexadiene, flower and woody flovours, sandal wood oil, chromans and isochromans etc by chemical route.
**Module 3:** Perfume technology (theory and practice), blending of perfumes.
Perfumery biotechnology (synthesis of perfumery chemicals by microbial enzymes both isolated and whole cell microbes).
**Module 4:** Modern analytical techniques, specification related to essential oils and derived products.

**Paper IX**
**Course OLT 204** **100 Marks/ 4 credits**
**Design, Process equipment and control – related to oil processing industry**
**Module 1:** Design, process equipment and control, cost and effluent control in oil and fat based industries. Design aspects (material and energy balance, reactor design, plant layout).
**Module 2:** Process equipments and control. Cost aspects (estimate of total cost of extraction, refining, hydrogenation, interesterification, fractionation, fats splitting, resin production, production of paints, soap, detergent, essential oils.).
**Module 3:** Feasibility studies on extraction of particular oils and production of different edible and industrial fats products.
**Module 4:** Effluent control (refining plants, extraction plants, soap plants etc).

**Paper X**
**Course OLT 205** **100 Marks/ 4 credits**
**Lab. III**
**Oil Technology Lab. II**
**Surfactants and Essential Oils:**

A. **Surfactants:**
Technical analysis of various industrial surfactant composites.
Preparation of different types of soaps and synthetic surfactants and their application properties e.g. foaming, wetting etc., preparation of metallic soaps and their utilization in grease and lubricant formulations.
Isolation and evaluation of some naturally occurring surfactants like soap nuts, etc.
Determination of various physical properties of cationic, anionic and nonionic surfactants like HLB,PIT, etc. instrumental method of analysis of anionic, cationic ,nonionic and amphoteric surfactants, synthesis and evaluation of various types of co surfactants and additives.
Preparation and evaluation of biosurfactants.

B. **Essential oils:**
Isolation of essential oil and their characterization by chemical methods and by chromatographic techniques.
Preparation of synthetic perfumery materials by chemical and biotechnological routs. Blending of perfumes, selection of surfactants in cosmetic formulations, analysis of commercial cosmetic personal care products by chemical and instrumental methods, utilization of herbal materials in cosmetic products

*Third Semester*

**Paper XI**
**Course CHT 301** **50 Marks/2 credits**
**Research Methodology**

***Module 1: Introduction:***
Definition of Research Methodology. Different types of methods for research. Approaches of investigation of solutions for research problem, Effective literature studies approaches, (Discuss in class Web Search: Introduction to Internet. Use of Internet and www. Using of search engines and advanced search tools.)
Data Collection and Simulation

***Module 2: Data Analysis***
Analysis tools: Review of Basic Statistical Measures (mean, median, mode, quartile, percentile, variance, covariance, correlation, regression), Probability Distributions (Binomial, Poisson, Uniform, Exponential, Normal), Central Limit Theorem, ANOVA, Latin Square Design, Sampling (Chi-square Distribution, F- Distribution), Test of Hypothesis.

**Module 3: Reporting**
Technical report writing, Technical paper writing, Plagiarism and citation. Major contribution, outcome of the research, patent possibilities. Patent writing, Patent filing, IPR
Introduction to presentation tool, features and functions, creating presentations, customising presentation using Microsoft PowerPoint, Open Office etc.
Introduction to spread-sheet applications, features and functions, using formulae and functions, data storing, features for statistical data analysis, generating charts/graphs and other features.

**References:**

1. Research Methodology 2nd Edition, R. Panneerselvam, PHI Publishers.
2. Research Methodology Methods and Techniques, 2nd revised edition, C. R. Kothari, New Age International Publishers.
3. A Guide to LATEX: Document Preparation for Beginners and Advanced Users, 3rd Edition, Helmut Kopka, Patrick W. Daly, Addison-Wesley, 1999.
4. Intellectual Property Rights, Neeraj Pandey, Khushdeep Dharni, PHI Learning Pvt. Ltd., 2014.
5. Microsoft Office Word 2013: A Skills Approach, Inc. Triad Interactive, McGraw-Hill Education, 2014.
6. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"


**Paper XII**
**Course OLT 302** **(150+100) Marks/(6+4) credits**

**a) Project Feasibility**

Each student shall be required to submit two bound type written copies of a project report on a proposed chemical plant manufacturing product/products related to one's course/subject to be

worked out under the supervision of a faculty member. The report shall include mass and energy balances, type and capacity of equipment selected and recommended, plant layout, feasibility analysis highlighting market survey, pattern of assistance available from the central and state government agencies, bank and financial institutions. Assistance for technology, raw materials, finance.
Legal obligation.

b) The student is to appear in a **Viva-Voce** examination.

**Paper XIII**
**Course OLT 303** **100 Marks/4 credits**
**Mini Project with seminar**

Each student will be required to prepare and submit an assay or review paper on selected technological topic related to subject under the supervision of a faculty member. He/She shall give a talk based on his/her paper before the Seminar. The attendance in the seminar is compulsory for all the students.

**Paper XIV**
**Course OLT 304** **100 Marks/4 credits**
**Thesis: Foundation**

Each student shall be required to carry out under the supervision of Faculty member (s) and/or External member as the case may be, an original investigation on an industrial problem related to one's course/subject. She/he shall submit two typewritten bound copies of a report on Research Work at least 15 days before the commencement of final semester examination and shall defend her/his report in a Viva-voce Examination.

***Fourth Semester***

**Paper XV**
**Course OLT 401** **(300+100) Marks/ (12+4) credits**
**Thesis: Final**

(a) Each student shall be required to carry out under the supervision of a faculty member original investigation on an industrial problem related to subject. He/She shall submit three type-written bound copies of thesis embodying the results of his/her investigations
(b) The student shall defend his/her thesis in a **viva-voce** examination.

**Paper XVI**
**Course OLT 402** **(100) Marks/ (4) credits**
**General Viva Voce**

Each student shall be required to appear General Viva Voce Examination.