# SEMESTER WISE COURSE STRUCTURE
# & EVALUATION SCHEME

**for**

# B. TECH. DEGREE PROGRAMME
# IN
# CHEMICAL TECHNOLOGY OIL TECHNOLOGY
## (Effective from the session 2019-20)



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

# Department of Chemical Technology-Oil Technology

## I) Vision

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

## II) Mission

We are committed to:

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

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

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

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

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

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

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

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

| Programme Outcomes(POs) | | Graduate Attributes (GAs) |
|---|---|---|
| **PO1.** | Apply the knowledge of mathematics, science, engineering fundamentals and Engineering concepts for the solution of complex Engineering problems | Engineering Knowledge |
| **PO2.** | Identify, formulate, review literature and analyze complex problems related to Chemical Technology-Oil Technology reaching substantiated conclusions using first principles of mathematics and engineering sciences. | Problem Analysis |

| | | |
|---|---|---|
| **PO3.** | Design solutions for complex problems in Chemical Technology-Oil Technology and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations | Design/Development of solutions |
| **PO4.** | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. | Conduct Investigations of complex problems |
| **PO5.** | Create, select, and apply appropriate techniques, resources, and modern engineering tools such as optimization techniques, simulations , including prediction and modeling to complex process Engineering problems with an understanding of their limitations. | Modern Tool Usage |
| **PO6.** | Apply contextual knowledge with justification to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering and Chemical Technology-Oil Technology professional practice | The Engineer & Society |
| **PO7.** | Understand the impact of the professional engineering and Chemical Technology-Oil Technology solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development | Environment and Sustainability |
| **PO8.** | Apply ethical principles and commit to professional ethics adhering to the norms of the engineering and Chemical Technology-Oil Technology practice | Ethics |
| **PO9.** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings | Communication |
| **PO10.** | Communicate effectively on complex engineering and Chemical Technology-Oil Technology activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions | Individual and Team work |
| **PO11.** | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change | Life long Learning |
| **PO12.** | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage engineering and Chemical Technology-Oil Technology projects and in multi disciplinary environments. | Project management & Finance |

**SEMESTER WISE COURSE STRUCTURE & EVALUATION SCHEME**

**B. TECH. CHEMICAL TECHNOLOGY- OIL TECHNOLOGY**

## Semester-I

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab. | Total | | |
| 1 | BSC | Engineering Chemistry | BCY | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | BSC | Mathematics I | BMA | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | ESC | Electronics & Instrumentation Engineering | EET | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | ESC | Engineering Graphics | ECE | 3 | 0 | 0 | 6 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | ESC | Computer Concepts & Programming | ECS | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 6 | ESC | Workshop Practice | EWS | 2 | 0 | 0 | 4 | -- | 20 | 30 | 50 | 50 | 100 |
| 7 | MC (Non Credit) | Environment & Ecology | ECE | 0 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | **Total Credits 20** | | | | | | | | | | | **600** |

## Semester-II

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks ESE | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab | Total | | |
| 1 | BSC | Physics | BPH | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | BSC | Mathematics II | BMA | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | ESC | Electrical Engineering | EEE | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 4 | ESC | Engineering Mechanics | EME | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | HSMC | English Language & Composition | HHS | 2 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | HSMC | Professional Communication | HHS | 3 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| | | **Total Credits 20** | | | | | | | | | | | **600** |

## Semester-III

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab | Total | | |
| **1.** | BSC | Mathematics III | BMA | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| **2.** | PCC | Chemistry of Oil & Allied Products | TOT 251 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| **3.** | PCC | Chemistry of Oil & Allied Products Lab | TOT 253 | 2 | 0 | 0 | 4 | - | 20 | 30 | 50 | 50 | 100 |
| **4.** | ESC | Fluid Mechanics and Mechanical operation | TOT 255 | 5 | 3 | 1 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| **5.** | PCC | Materials & Energy Balance | TOT 257 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| **6.** | HSMC | Organizational Behaviour | HHS | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| **7.** | MC (Non Credit) | Cyber Security | ECS | 0 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | **Total Credits 22** | | | | | | | | | | | | **600** |

## Semester-IV

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab | Total | | |
| 1 | BSC | Modern Analytical Techniques | BCY | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | BSC | Computer Oriented Numerical Methods | BMA | 4 | 2 | 1 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 3 | PCC | Source, Composition, Characterization of Oils Fats & Waxes | TOT 252 | 5 | 3 | 1 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 4 | ESC | Heat Transfer Operations | TOT 254 | 3 | 2 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | PCC | Chemical Engineering Thermodynamics | TOT 256 | 3 | 2 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | HSMC | Engg Economics & Management | HHS | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 7 | MC (Non Credit) | Indian Constitution | HHS | 0 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | **Total Credits 22** | | | | | | | | | | | | **600** |

## Semester-V

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab | Total | | |
| 1 | PCC | Technology of Soaps & Fat Splitting | TOT 351 | 5 | 3 | 1 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | PCC | Expression & Extraction Technique of Oil Bearing Materials | TOT 353 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3. | PCC | Biotechnology of Oils & Oil Seeds | TOT 355 | 2 | 2 | 0 | 0 | - | 20 | 30 | 50 | 50 | 100 |
| 4 | PCC | Mass Transfer Operations | TOT 357 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | PCC | Chemical Reaction Engineering | TOT 359 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | OEC (Humanities) | Open Elective Course -I | HHS | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | **Total Credits 22** | | | | | | | | | | | | **600** |

## Semester-VI

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MSE | TA | Lab. | Total | | |
| 1 | PCC | Hydrogenation & Modification of Oils | TOT 352 | 3 | 2 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | PCC | Technology of Surfactants & Synthetic Detergents | TOT 354 | 3 | 2 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | PCC | Refining of Oils | TOT 356 | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 4 | PCC | Quality Assurance of Oils & Allied Products | TOT 358 | 3 | 2 | 1 | 0 | 30 | 20 | 0 | 50 | 50 | 100 |
| 5 | PCC | Environmental Aspects of Oils & Allied Industries | TOT 360 | 3 | 3 | 0 | 0 | 30 | 20 | 0 | 50 | 50 | 100 |
| 6 | PCC | Instrumentation & Process Control | TOT 362 | 3 | 2 | 1 | 0 | 30 | 20 | 0 | 50 | 50 | 100 |
| 5 | OEC (Maths) | Open Elective Course - II | BMA | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | **Total Credits 22** | | | | | | | | | | | **700** |

## Semester-VII

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab | Total | | |
| 1 | PCC | Quality Assurance of Oils & Allied Products Lab | TOT 451 | 2 | 0 | 0 | 4 | 30 | 20 | - | 50 | 50 | 100 |
| 2 | PCC | Essential Oils & Cosmetics | TOT 453 | 3 | 2 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 3 | PEC | Programme Elective Course I (Advanced Oil Chemistry & Oleochemicals OR Petroleum Products & Petrochemicals) | TOT 455 OR TOT 457 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | PEC | Programme Elective Course II (Commerce, Process Economics, and Safety Management in Oil Industries OR Lipid Biotechnology) | TOT 459 TOT 461 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | OEC (Oil Tech.) | Open Elective Course -III | OOT 491 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | | Industrial Training | TOT 493 | 2 | 0 | 0 | 4 | - | 50 | - | 50 | 50 | 100 |
| 7 | | Seminar | TOT 495 | 2 | 0 | 0 | 4 | - | 50 | - | 50 | 50 | 100 |
| 8 | | Project | TOT 497 | 4 | 0 | 0 | 8 | - | 50 | - | 50 | 50 | 100 |
| | | | **Total Credits** | **22** | | | | | | | | | **800** |

## Semester-VIII

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | CT | TA | Lab | Total | | |
| 1 | PEC | *Programme Elective Course III (Packaging of Oils, Fats & Allied Industries OR Fuel & Green Lubricants) | TOT 452 OR TOT 454 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 2 | PEC | *Programme Elective Course IV (Process Modeling & Simulation OR Computer Aided Equipment Design) | TOT 456 OR TOT 458 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | OEC | *Open Elective Course –IV (Transport Phenomena) | TOT 460 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | | Project | TOT 498 | 10 | 0 | 0 | 20 | - | 50 | - | 50 | 50 | 100 |
| | | | **Total Credits** | **22** | | | | | | | | | **400** |

*** Online Courses**

## List of Programme Elective Courses

| S. No. | PEC Names | Subject Name | Subject Code | C ( L-T-P) |
|---|---|---|---|---|
| 1. | Programme Elective Course I | Advanced Oil Chemistry & Oleochemicals | TOT 455 | 3 (3-0-0) |
| | | Petroleum Products & Petrochemicals | TOT 457 | |
| 2. | Programme Elective Course II | Commerce, Process Economics, and Safety Management in Oil Industries | TOT 459 | 3 (3-0-0) |
| | | Lipid Biotechnology | TOT 461 | |
| 3. | Programme Elective Course III | Packaging of Oils, Fats & Allied Industries | TOT 452 | 4 (3-1-0) |
| | | Fuel & Green Lubricants | TOT 454 | |
| 4. | Programme Elective Course IV | Process Modeling & Simulation | TOT 456 | 4 (3-1-0) |
| | | Computer Aided Equipment Design | TOT 458 | |

## List of Open Elective Courses

| S. No. | OEC Names | Subject Name | Subject Code | C ( L-T-P) |
|---|---|---|---|---|
| 1. | Open Elective Course II (Humanities) | Entrepreneurship Development | HHS | 3 (3-0-0) |
| 2. | Open Elective Course II (Maths) | Operations Research | BMA | 3 (3-0-0) |
| 3. | Open Elective Course III (Oil Technology) | Technology of Oils, Oil Seeds & Surfactants | OOT 491 | 3 (3-0-0) |
| 4. | Open Elective Course IV | Transport Phenomenon | TOT 460 | 4 (3-1-0) |

Head,
Department of Oil Technology
School of Chemical Technology

# B. Tech. Chemical Technology - Oil Technology
# Semester 1

## BCY151 ENGINEERING CHEMISTRY

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

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

| | | |
|---|---|---|
| CO1 | Interpret UV-Visible and IR-Spectra | Understand, Analyze |
| CO2 | Describe reaction rates for reactions of various orders | Understand, Apply, Analyze |
| CO3 | Understand different aspects of corrosion and thermodynamic view of electrochemical processes, reversible and irreversible cells | Understand, Apply |
| CO4 | Understand the stereochemistry of molecules and identify organic reactions on the basis of their mechanism | Remember, Apply, Analyze |
| CO5 | Distinguish between different polymeric structures, classify polymers, and analyze the polymerization mechanism and use of polymers in different walks of life. Knowledge of conductivity of polymer, biodegradable polymers and fibre reinforced plastics. Acquire knowledge about water and treatment of municipal water | Understand, Apply, Evaluate, Create |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-

| **BCY101/ 102** | PO 1 | PO 2 | PO 3 | PO4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 3 | 2 | - | 2 | - | - | - | - | 3 | 1 | 2 |
| CO2 | 3 | 3 | 1 | 3 | 2 | - | 2 | - | - | - | - | 3 | 2 | 2 |
| CO3 | 3 | 3 | 1 | 3 | 2 | - | 2 | - | - | - | - | 3 | 1 | 2 |
| CO4 | 3 | 3 | 1 | 3 | 2 | - | 2 | - | - | - | - | 3 | 2 | 2 |
| CO5 | 3 | 3 | 1 | 3 | 2 | - | 2 | - | - | - | - | 3 | 1 | 2 |
| Average | 3 | 3 | 1 | 3 | 2 | - | 2 | - | - | - | - | 3 | 1.4 | 2 |

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**SYLLABUS**

**Module I**
**(i) Bonding:** CFT, Electronic Spectra and Ligands (strong and weak field), Phosphorescence and Fluorescence, Jablonski diagram, hydrogen bonding and their effect on physical properties, Metallic bonds, Classification and Applications of Liquid crystals, Band Theory of Solids and superconductors.

(Lectures: 7-8)

**(ii) Spectroscopy**: Basic Principles, Instrumentation and Applications of UV-VIS and IR Spectroscopy.

(Lectures: 5-6)

**Module II**
**(i) Chemical Kinetics**: Second order reactions. Determination of order, Fast and slow reaction, steady state approximation, Temperature effect, Concept of Activated Complex/Transition State: Energy of activation, Potential energy surface, Theories of reaction rate: Collision and Transition State theories

in terms of enzyme catalysis. (Lectures: 4-5)

**Module III**

**(i) Electrochemistry**: Dry and fuel cells, electrochemical cell, Solar cells, Disensitized cell, Photovoltaic cell. (Lectures: 3-4)

**(ii) Environmental Chemistry:** Air and Water Pollution, analysis of gaseous effluents oxides of Nitrogen, oxides of Sulphur and $H_2S$, chemical analysis of effluents liquid streams, BOD, COD, control of pollution, Depletion of ozone layer. (Lectures: 5-6)

**Module IV**

**(ii) Stereochemistry:** Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers & Diastereomers, E-Z nomenclature, R-S configuration, Atropisomerism, and Optical isomerism in Allenes, biphenyl and Spiranes, Circular Dichroism. (Lectures: 5-6)

**(i) Reaction Mechanism**: Inductive, Electromeric and Mesomeric effects. Study of reaction intermediates (Carbanion, carbocation, carbene, nitrene and benzyne). Mechanism of nucleophilic and electrophilic substitution reactions. Mechanism and application of following reactions:

a) Suzuki-Miyaura Cross coupling reaction
b) Fries and Photo-Fries Rearrangement
c) Wagner- Meerweir Rearrangement
d) Umpolung Reactions
e) Reaction of vision **(**Lectures: 4-5)

**Module V**

**(i) Polymers**: Introduction and their classifications, types of polymerization, Free radical, anionic and cationic polymerization, Preparation, Rheological properties and uses of some common polymers. Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Conducting and Biodegradable polymers. (Lectures: 4-5)

**(ii) Water Analysis:** Introduction; Hardness of Water- cause, types, units, Disadvantages of using hard water for domestic and industrial purposes, Softening of hard water, Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness, Numerical based on determination of hardness.

(Lectures: 4-5)

**List of Experiments:**

1. Determination of alkalinity in given water sample.
   a. Sodium Carbonate & Sodium Bicarbonate
   b. Sodium Carbonate & Sodium Hydroxide
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of Chloride content of water by Mohr's Method.
4. Determination of Chlorine content in Bleaching powder.
5. Determination of strength of supplied Ferrous Ammonium Sulphate (FAS) solution in using external, internal indicators.
6. Determination of viscosity of a given liquid by Ostwald's viscometer.
7. Determination of surface tension of a given liquid by Stalagmometer.
8. pH determination of given sample.
9. Determination of iron content of water by Mohr's Method.
10. Determination of Dissociation constant of weak acids by conductometric Titration.

**Reference Books:**


1. Advance Organic Chemistry by Jerry March, Third Edition Wiley Eastern Limited, New Delhi.
2. Organic Chemistry by Morrision & Boyd, Allyn and Bacon, Inc. Boston.
3. Physical Chemistry by Puri, Sharma & Pathania, Peter Atkins & Julio de Paula, Arun Bahl, B.S. Bahl & G.D.Tuli.
4. Textbook of Physical Chemistry by S. Glasstone, Macmillan and Co. Ltd., London.
5. Chemical Kinetics and Reaction Dynamics by Puri, Sharma & Pathania.
6. Principles of Polymerization by George Odian.
7. Polymer Science by V. R. Gowarikar, N. V. Vishwanathan and J. Shridhar, Wiley Eastern Ltd., New Delhi.
8. Principles of Instrumental Analysis by Douglas and Skoog, Saunder College Publishing Co., New York.
9. Engineering Chemistry by Jain & Jain, Dhanpat Rai Publication Co., New Delhi.
10. Application of Absorption Spectroscopy of Organic Compounds by John R. Dyer, Prentice Hall of India Pvt. Ltd., New Delhi.
11. Spectroscopy of Organic Compounds by P.S. Kalsi, Y.R. Sharma.

# BMA 151 MATHEMATICS –I

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVE: The objective of this course is to educate the students about:**

- the convergence of infinite series, improper integrals and differential calculus.
- partial differentiation, multiple integrals and Beta, Gamma functions.
- vector calculus, matrices, linear algebra and optimization techniques.

**Course Outcome**

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

| | | |
|---|---|---|
| CO1 | find nth derivative, determine the expansion of functions and find convergence of series and improper integrals. | Understand, Apply |
| CO2 | find partial differentiation and evaluate area and volume using multiple integrals. | Apply, Evaluate |
| CO3 | convert line integrals to surface integrals and volume integrals, determine potential functions for irrotational force fields. | Apply, Evaluate |
| CO4 | solve linear system of equations and determine the eigen vectors of the matrix. | Apply, Analyze Evaluate, |
| CO5 | learn concept of optimization and optimization techniques. | Apply, Analyze, Evaluate, |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | **1** | **2** |
| CO2 | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 1 |
| CO4 | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 2 |
| Average | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 1.8 | 1.6 |

**Detailed Syllabus:**

**Unit I- <u>Functions of One Real Variable:</u>**

Successive differentiation, Leibnitz theorem, Mean value theorems, sequences and series, Expansion of functions, Improper integrals and their convergence.

**Unit II- <u>Functions of Several Real Variables:</u>**

Limit, Continuity, Partial differentiation, Total differential and approximations, Jacobian, Euler's theorem Expansion of functions, Beta and Gamma Functions, Multiple integral, Change of order, Change of variables, Applications to area, volume, mass, surface area etc. Dirichlet's Integral & applications.

**Unit III- Vector Calculus:**

Point functions, differentiation, Gradient, Directional derivative, Divergence and Curl of a vector and their physical interpretations, Solenoidal & irrotational fields, Integration, Line, Surface and Volume integrals Green's. Stoke's and Gauss Divergence theorems (without proof) and applications.

**Unit IV- Matrices and Linear Algebra:**

Vector space and subspace, linear dependence, dimensions and basis, Linear transformation and its matrix representation, Elementary transformations, Echelon form, rank & nullity, Consistency of linear system of equations and their solutions, characteristic equation, Cayley Hamilton theorem, Real and complex eigenvalues and eigenvectors, diagonalisation, quadratic forms, complex, orthogonal, and unitary matrices, Application to Cryptography, discrete, Compartmental models and system stability.

**Unit V- Optimization:**

Engineering applications of optimization, statement and classification of optimization problems, Optimization techniques, single variable optimization, multi variable optimization with no constraint, with equality and inequality constraints, Linear Programming Problems, Graphical method and Simplex method.

**Books Recommended:**

**1.** R.K. Jain & S. R. K. lyengar; Advanced Engineering Mathematics, Narosa Publishing House 2002.
**2.** Erwin Kreyszig: Advanced Engineering Mathematics. John Wiley & Sons 8th Edition.
**3.** Dennis G. Zill & Michael R Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers, 2nd Edition.
**4.** S.S. Rao; Optimization: Theory & application Wiley Eastern Limited.
**5.** T.M. Apostol, calculus, Vol. I, 2nd ed., Wiley 1967.
**6.** T.M. Apostol, Calculus, Vol. II, 2nd ed**.,** Wiley 1969.
**7.** Gilbert Strang, Linear Algebra & its applications, Nelson Engineering 2007.
**8.** Calculus & Analytic Geometry, Thomas and Finny.

# EET 151/152 Electronics & Instrumentation Engineering

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OUTCOMES:**
**Upon Completion of the course the students will be able to:**

1. To understand the basic concept of diodes, transistor, and Operational Amplifier.
2. To apply the knowledge in the calculation of the parameters of the diode, transistor, and Operational Amplifier.
3. To design the simple digital circuits.
4. Having the basic knowledge of measurement and applying it in the transducer.
5. To apply the knowledge of measurement with the help of electronic instruments and displaying it on electronic devices.

**Syllabus**

P-N Junction Diode, V-I Characteristics, Diode Application as Rectifier (Half Wave & Full Wave), Zener Diode and its Applications.
Introduction to Bipolar Junction Transistor, Operational Amplifier and FET: Applications, demo, explanation, Applications
Boolean Algebra, Logic Gates, Concept of Universal Gate, Minimization using K map, Number system
Basic Combinational Circuits: Adder, Subtractor.
Sequential Circuits: Flip-Flops, Registers.
Functional Elements of Instruments, Classification & Characteristics, Types of Errors, Active and Passive Transducers and their Characteristics
Display Devices: Seven Segment Display, Alphanumeric Display, LCD, LED, Plasma, Projectors.
Electronic Ammeter and Voltmeter, Digital Multi-meter, Digital Storage Oscilloscope (DSO)

**Text Books**:


1. Malvino, A.P. / "Electronics Principles" / Tata McGraw-Hill.
2. Boylestad, Robert &Nashelsky, Louis / "Electronic Devices & Circuit Theory" / Prentice Hall of India.
3. H.S. Kalsi / "Electronic Instrumentation" / Tata McGraw-Hill
4. Malvino& Leach / "Digital Principles & Applications" / Tata McGraw-Hill.


**Reference Books:**


1. Sedra, Adel S., Smith, Kenneth C. / "Microelectronic Circuits"/ Oxford University Press.
2. Sawhney AK/ "Electrical and electronic Measurement and Instrumentation"/ DhanpatRai& sons.
3. Lectures of NPTEL


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# ECE 151/152 ENGINEERING GRAPHICS (ECE 101/102)

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 6 | 3 |

**Syllabus**

**Unit-I**
**Lettering and Dimensioning:** Introduction, lettering practice, Elements of dimensioning - systems of dimensioning.
**Geometric Constructions:** Free hand sketching, Conic sections, Special curves.
**Engineering Scales**

**Unit-II**
**Projection of Points**: First and Third Angle Projections; Projection of points.
**Projection of Lines:** Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both planes, true length and true inclinations.

**Unit-III**
**Projection of Solids and Section of Solids**
Projection of solids: Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane. Sections of Solids: Right regular solids and auxiliary views for the true shape of the sections.

**Unit-IV**
**Development of Surfaces**
Development of surfaces for various regular solids.
**Isometric Projection and Perspective Projection**
**Isometric Projection:** Isometric scales, Isometric projections of simple and combination of solids;
**Perspective Projection:** Orthographic representation of a perspective views – Plane figures and simple solids - Visual ray method.

**Unit-V**
**Orthographic Projection**
Conversion of pictorial view into orthographic Projection.
Introduction to auto CAD

**References:**


1. K. Venugopal and V. Prabhu Raja, "Engineering Graphics", New AGE International Publishers, 2015.
2. N. D. Bhatt, Engineering Drawing, Charotar Publishing House.
3. K.V.Natarajan, A Text book of Engineering Graphics, Dhanalakshmi Publishers, 2012.
4. K.L.Narayana, P. Kannaiah & K.Venkata Reddy New Age International Publishers.

# ECS 151/152 COMPUTER CONCEPTS & PROGRAMMING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Outcomes:**

1. Identify the parts of the computer system and explain the functioning of its componentsalongwith the process of problem solving. (Remember, Understand)
2. Design an algorithmic solution for a given problem and translate it into a program. (Design)
3. Understand different operating systems, related concepts and their functions. (Understand)
4. Use the appropriate control statements to solve the given problem. (Apply)
5. Implement different Operations on arrays and use functions to solve the given problem. (Apply)
6. Understand pointers, structures and unions &Implement file Operations in C programming. (Understand, Apply)

| | | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **Statement** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** |
| CO1 | | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | **1** | **2** |
| CO2 | | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 1 |
| CO3 | | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 1 |
| CO4 | | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 2 |
| CO5 | | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 2 |
| CO6 | | 3 | 3 | 2 | 1 | 2 | - | - | 1 | - | 1 | - | 3 | 2 | 1 |
| Average | | 3 | 3 | 2 | 1 | 2 | | | 1 | | 1 | | 3 | 1.8 | 1.3 |

**Course Content:**

**Unit-1:**

Introduction to Computers: Computer hardware Components, peripherals and their functions, Number Systems and conversion methods, Concept of an algorithm; termination and correctness. Algorithms to programs: specification, top-down development and stepwise refinement, Introduction to programming environment, use of high level programming language for the systematic developmentof programs. Introduction to the design and implementation of correct, efficient and maintainable programs, Structured Programming, Trace an algorithm to depict the logic.

**Unit-2:**

Basic operating System Concepts: Introduction of MS-DOS, WINDOWS, and LINUX Operating Systems, Functional Knowledge of these operating systems, Introduction of basic commands of LINUX and Editors, Managing Files and Directories in LINUX, Programming Environment in LINUX, Writing and executing programs in LINUX.

**Unit-3:**

Programming in C: History, Introduction to C Programming Languages, Structure of C programs, compilation and execution of C programs, Debugging Techniques, Data Types and Sizes, Declaration of variables, Modifiers, Identifiers and keywords, Symbolic constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.

**Unit-4:**

Operators: Unary operators, Arithmetic & logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation. Control statements: if-else, switch, break, and continue, the comma operator, goto statement. Loops: for, while, do-while. Functions: built-in and user-defined, function declaration, definition and function call, and parameter passing: call by value, call by reference, recursive functions, Multi-file programs. Arrays: linear arrays, multidimensional arrays, passing arrays to functions, Arrays and strings.

**Unit-5:**

Structure and Union: definition and differences, self-referential structure. Pointers: value at (*) and address of (&) operator, pointer to pointer, Dynamic Memory Allocation, calloc and malloc functions, array of pointers, function of pointers, structures and pointers. File Handling in C: opening and closing a data file, creating a data file, read and write functions, unformatted data files.

**Lab Work:**

1. Write C program to find largest of three integers.
2. Write C program to check whether the given string is palindrome or not.
3. Write C program to find whether the given integer is
    a. (i). a prime number
    b. (ii). an Armstrong number.
4. Write C program for Pascal triangle.
5. Write C program to find sum and average of n integer using linear array.
6. Write C program to perform addition, multiplication, transpose on matrices.
7. Write C program to find Fibonacci series of iterative method using user-defined function.
8. Write C program to find factorial of n by recursion using user-defined functions.
9. Write C program to perform following operations by using user defined functions:

(i) Concatenation
(ii) Reverse
(iii) String Matching

1. Write C program to find sum of n terms of series: n – n*2/2! + n*3/3! - n*4/4! + .....
2. Write C program to interchange two values using
    a. (i). Call by value.
    b. (ii). Call by reference.
3. Write C program to sort the list of integers using dynamic memory allocation.
4. Write C program to display the mark sheet of a student using structure.
5. Write C program to perform following operations on data files:
    a. Read from data file.
    b. Write to data file.
6. Write C program to copy the content of one file to another file using command line argument.

**Text and References Books:**


1. Kernighan, Ritchie, "The C Programming Language", PHI
2. V. Rajaraman, "Fundamentals of Computers", PHI
3. Peter Norton's, "Introduction to Computers", TMH
4. Gottfried, "Programming in C", Schaum's Series, Tata McGraw Hill
5. YashwantKanitkar, "Working with C", BPB
6. E. Balagurusamy, "Programming in ANSI C", TMH

# EWS 151 / 152 WORKSHOP PRACTICE

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Objective :** The objective of this course is to educate and impart basic knowledge of various hand tools and equipments and their use in different shops, day to day industrial work and domestic life. Students able to understand safety precautions in the workshop. Student acquires skills of application oriented task.

Course Outcome

- Acquire skills in basic engineering practice
- Identify the hand tools and instruments.
- Obtain practical skills in the trades.
- Gain measuring skills.

| Course Outcome ( CO ) | | Bloom's Knowledge Level (KL) |
|---|---|---|
| At the end of the course the student should be able to : | | |
| CO 1 | Study and practice on machine tools and their operations | Understand |
| CO 2 | Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry, black - smithy and welding work | Apply |
| CO 3 | Identify and apply suitable tools for machining processes including plain turning, step turning, taper turning, facing, thread cutting operations | Analyze |
| CO 4 | Understand and practice welding and forging operations | Understand |
| CO 5 | Select the appropriate tools required for specific operation | Understand, Apply |
| CO 6 | Comprehend the proper safety measures required to be taken while using different tools. | Remember, Understand |

Note : K1 - Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO( | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | - | - | 1 | 1 | 1 | - | - | - | - | - | 1 | **1** | **2** |
| CO2 | 2 | - | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 | 1 |
| CO3 | 2 | - | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 | 1 |
| CO4 | 2 | - | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 | 2 |
| CO5 | 2 | - | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 | 2 |
| Avg. | 2 | - | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 1.8 | 1.6 |

1. Slight ( Low ) 2. Moderate ( Medium ) 3. Substantial ( High )

**Course level Assessment Question :**

Course Outcome 1 ( CO1 )

1. Working principle of lathe machine
2. Parts and operations on lathe machine
3. Tool geometry of single point cutting tool

Course Outcome 2 ( CO2 )

1. Study and practice of different tools used in Fitting shop, Carpentry shop and Foundry shop.
2. Study and practice of different tools used in Black-smithy shop, Sheet metal shop and Welding shop.

Course Outcome 3 ( CO3 )

1. Explanation and demonstration of various processes like plain turning and step turning.
2. Explanation and demonstration of various processes like taper turning and facing.
3. Explanation and demonstration of various processes like thread cutting, knurling and chamfering.

Course Outcome 4 ( CO4 )

1. Classification of different welding processes with the help of flow chart.
2. Explanation and demonstration forging operations.
3. Safety precautions during actual forging and welding.

Course Outcome 5 ( CO5 )

.1 Selection of proper drilling tool for drilling operation.
2 Selection of proper tap for internal thread cutting operation.
3 Selection of power hacksaw blade, wood cutting cutter , snips, chisels etc.

Course Outcome 6 ( CO6 )

1. Proper demonstration of safety precautions to be taken for example leather apron, leather hand gloves, welding shield etc.
2. Description of different safety tools and precautions in workshop.

## Semester 2

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

# BPH: 151/152 PHYSICS (Theory & Lab)

**Sessional Marks: 50**
**End Semester Exam Marks: 50**

**Course Objectives (COs)**

| | |
|---|---|
| **Pre-requisites** | Basic knowledge of Maths ($12^{th}$ level) |

| | | |
|---|---|---|
| **CO 1** | To understand and apply principle of conservation of momentum, theory of relativity | **Understand and apply** |
| **CO 2** | To understand the basics of quantum mechanics and apply its principles to learn the phenomena that occur at subatomic dimensions. | **Understand and analyze** |
| **CO 3** | To understand the Maxwell's equations of electromagnetic theory with aim to apply in communication systems. | **Understand and analyze** |
| **CO 4** | To apply the fundamentals of material Science especially dielectric materials, semiconducting materials and nano-materials, to apply them in different areas | **Understand and apply** |
| **CO 5** | To understand the statistical behavior of the constituent particles and apply the principles of statistical mechanics and basics of laser | **Apply** |

**CO – PO Matrix**

| Course | CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BPH 101/102** | CO1 | 3 | 3 | 1 | 2 | 1 | 2 | | | | | | 1 | **2** | **2** |
| | CO2 | 3 | 3 | 1 | 2 | 1 | 2 | | | | | | 1 | 2 | 2 |
| | CO3 | 3 | 3 | 1 | 2 | 1 | 2 | | | | | | 1 | 2 | 2 |
| | CO4 | 3 | 3 | 1 | 2 | 1 | 2 | | | | | | 1 | 2 | 2 |
| | CO5 | 3 | 3 | 1 | 2 | 1 | 2 | | | | | | 1 | 2 | 2 |
| | Average | 3 | 3 | 1 | 2 | 1 | 2 | | | | | | 1 | 2 | 2 |

**Syllabus**

**MODULE- 1 (Lectures: 08)**

**Introductory Mechanics & Theory of Relativity:** Potential energy function $F = -\text{grad}\ (V)$, equipotential surfaces, meaning of gradient, divergence, curl and their physical significance,

Conservative and Non-Conservative forces, Curl of a force, Central forces, Examples of Central forces, Conservation of Angular Momentum,.

Inertial and Non- Inertial Frames of reference, Galilean transformation, Michelson Morley Experiment, Lorentz Transformation, Length contraction, Time dilation and Evidences for time dilation, Relativistic velocity addition formula, Relativistic variation of mass with velocity, Evidence of mass variation with velocity, Einstein's Mass energy equivalence, Examples from nuclear physics, Relativistic energy momentum relation.

**MODULE -2 (Lectures: 08)**

**Quantum Mechanics-Schrodinger Equation and its Applications:**

Dual Nature of matter & Radiation, Heisenberg's uncertainty Principle and their applications, wave group concept, Davisson Germer experiment, Postulates of quantum mechanics, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases.

Application of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional), Simple harmonic oscillator (one dimensional).

**MODULE – 3 (Lectures: 08)**

**Electromagnetic Theory:** Ampere's law and Faraday's law of electromagnetic induction, Maxwell's equations, Correction of Ampere's law by Maxwell (concept of displacement current), transformation from integral to differential form, Physical significance of each equation,Poyntingtheorem, Maxwell's equations in free space, velocity of electromagnetic wave, Transverse character of the wave and orthogonality of **E**, **H** and **v** vectors, Maxwell's equation in dielectric medium and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media, Solution of differential equation in this case,penetration depth, its significance.

**MODULE – 4 (Lectures: 09)**

**Materials of Technological Importance:**

**Dielectric Materials:** Electric field in presence of dielectric medium,concept of electric polarization, different types of polarizations, dielectric in a.c. field,concept of dielectric loss and loss energy.

**Semiconducting Materials:** Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors.

**Nano Materials:** Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

**MODULE: 5 (Lectures: 09)**

**Statistical Mechanics & Lasers:** Phase space, the probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applicationsof Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above case, Bose-Einstein

Statistics, application to black body radiation, distribution law of energy, Planck's radiation formula and Stefan's law. Fermi – Dirac statics, application in case of free electrons in metals, energy distribution, Fermi energy.

**Lasers:** Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, properties of laser beams, mono-chromaticity, coherence, directionality, and brightness, applications of lasers

**References:**


1. Physics, Marcelo Alonso, J. Finn Edwards, Addison Wesley
2. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill
3. Engineering Physics, R. K.Shukla, Pearson Education
4. Electrical Engineering Materials, R.K.Shukla, McGraw Hill
5. Introduction to Electrodynamics, David Griffiths, Cambridge University Press
6. Principles of Engineering Physics, R.K.Shukla, Ira Books
7. Introduction to Solid State Physics, Charles Kittel, Willey


**List of Experiments:(Any ten experiments)**

1. To determine the energy of band gap of a N-type Ge-semiconductor using four probe method
2. Verification of Stefan's fourth power law for black body radiation, determination of the exponent of the temperature
3. Study of thermoelectricity: Determination of thermo-power of Copper-constantan thermo-couple
4. To study the variation of magnetic field with distance along the axis of current carrying coil and then to estimate the radius of the coil
5. Study of Carrey Foster's bridge: determination of resistance per unit length of the bridge wire and of a given unknown resistance
6. Determination of specific charge (charge to mass ratio; e/m) for electron
7. Study of tangent galvanometer: determination of reduction factor and horizontal component of earth's magnetic field
8. Determination of the wavelength of sodium light using Newton Rings' method
9. To determine the concentration of sugar solution using half shade polarimeter
10. Determination of wavelength of spectral lines of mercury (for violet, green, yellow-1 and yellow-2) using plane transmission grating
11. Determination of charge sensitivity and ballistic constant of a ballistic galvanometer
12. To determine the wavelength of spectral lines of hydrogen & hence to determine the value of Rydberg Constant
13. Draw the V-I characteristic of Light Emitting Diode (LED) and determine the value of Planck's constant

# EEE-151/152 Basic Electrical Engineering

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**OBJECTIVE:** The objective of this course is to educate the students about:
Various electrical components, connections, DC circuit analysis and basic network theorems applicable to dc network
Single-phase AC fundamentals and its analysis
Three-phase AC circuit connections and analysis under various load conditions
Various measuring instruments with construction, working principle and applications
Basic structure of power system
Concept of magnetic circuits, magnetic coupling and losses occurred in magnetic circuit
Construction and working of single-phase transformers
Basic principle of electrical ac/dc machines with their construction, working principle and applications

**Course Outcome:**
On the successful completion of the course, students will be able to

| | |
|---|---|
| **CO1** | An exposure to common electrical components and their ratings. |
| **CO2** | Learning of electrical connections by wires of appropriate ratings. |
| **CO3** | Learning the usage of common electrical measuring instruments. |
| **CO4** | Understanding the basic characteristic of magnetic circuits and transformers |
| **CO5** | Understanding the basic characteristic of electrical machines. |

**CO-PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1O | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **3** | **2** | **2** | **2** | **2** | **2** | **2** | **1** | **1** | **1** | **2** |
| **CO2** | **3** | **3** | **1** | **1** | **2** | **2** | **1** | **1** | **2** | **2** | **1** | **1** |
| **CO3** | **3** | **3** | **2** | **2** | **2** | **2** | **1** | **2** | **2** | **2** | **1** | **1** |
| **CO4** | **3** | **3** | **2** | **2** | **2** | **2** | **1** | **2** | **2** | **2** | **1** | **2** |
| **CO5** | **3** | **3** | **2** | **2** | **2** | **2** | **1** | **2** | **2** | **2** | **1** | **2** |
| **Avg.** | **3** | **3** | **1.8** | **1.8** | **2** | **2** | **1.2** | **1.8** | **1.8** | **1.8** | **1** | **1.6** |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) ifthere is no correlation, put "-'

**Syllabus**

**Module I : DC Circuit Analysis and Network Theorems: (9 hours):**

Circuit Concepts: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R L and C as linear elements. Source Transformation.

Kirchhoff's Law; loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (Simple Numerical Problems)

**Module II: Steady – State Analysis of Single Phase AC Circuits: (8 hours):**

AC Fundamentals: Sinusoidal, Square and Triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits, Bandwidth and Quality Factor. (Simple Numerical Problems)

**Module III:**

**Three Phase AC Circuits: (3 hours)**

Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage / current relations, three phase power and its measurement. (Simple Numerical Problems)

**Measuring Instruments: (4 hours):**

Types of instruments: Construction and Working Principles of PMMC and Moving Iron type Voltmeter & Ammeters, Single Phase Dynamometer Wattmeter and Induction Type Energy Meter, use of Shunts and Multipliers. (Simple Numerical Problems on Energy Meter, Shunts and Multipliers)

**Module IV**

**Introduction To Power System: (2 hours):**

General layout of Electrical Power system and functions of its elements, standard transmission and distribution voltages, concept of grid.

**Magnetic Circuit: (3 hours):**

Magnetic circuit concepts, analogy between Electric & Magnetic circuits, Magnetic circuits with DC and AC excitations, Magnetic leakage. B-H curve, Hysteresis and Eddy Current looses, Magnetic circuit calculations mutual Coupling.

**Single Phase Transformer: (3 hours):**

Principle of Operation, Construction, e.m.f. equation, equivalent circuit, Power losses, efficiency, introduction to auto transformer. (Simple Numerical Problems)

**Module V (8 hours):**

**Electrical Machines:** Principles of electro mechanical energy conversion.

**DC Machines:**

Types of dc machines, e.m.f. equation of generator and torque equation of motor, characteristics and applications of dc motors. (Simple Numerical Problems)

**Three Phase Induction Motor:**
Types, Principle of Operation, Slip – torque Characteristics, applications. (Simple Numerical Problems)

**Single Phase Induction Motor:**
Principle of Operation and introduction to methods of starting, applications.

**Three Phase Synchronous Machines:**
Principle of Operation of alternator and synchronous motor and their applications.

**Text Books:**


1. V. Del Toro, " Principles of Electrical Engineering" Prentice Hall International
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
4. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
6. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.


**Reference Books:**


1. Edward Hughes, "Electrical Technology" Longman
2. T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press
3. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
4. W.H. Hayt & J.E. Kennely, "Engineering Circuit Analysis" Mc - Graw Hill


**Experiments list:**

1. Verification of Kirchhoff's laws.
2. Verification of (1) Superposition Theorem (2) Thevenin's Theorem (3) Maximum Power Transfer Theorem.
3. Measurement of power and power factor in a 1 – Ø ac series inductive circuit and study improvement of power factor using capacitor.
4. Study of phenomenon of resonance in RLC series circuit and obtain the resonant frequency.
5. Measurement of power in 3 – Ø circuit by Two Wattmeter method and determination of its power factor.
6. Determination of parameter of ac 1 – Ø series RLC Circuit.
7. Determination of (1) Voltage Ratio (2) Polarity and (3) Efficiency by load test of a 1 – Ø Transformer.

8. To Study speed control of dc shunt motor using (1) Armature Voltage Control (2) Field Flux Control.
9. Determination of Efficiency of a dc shunt motor by load test.
10. To study running and speed reversal of a 3 – Ø induction motor and record its speed in both direction.
11. To measure energy by a 1 – Ø energy meter and determine error.
12. Department may add any three experiments in the above list.

# EME-151/152: ENGINEERING MECHANICS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Sessional Marks: 50**
**End Semester Exam Marks: 50**

**Objective:** To provide the basic fundamentals of forces, moments, stresses and strains.

**Prerequisite: Class XII Mathematics & Physics**

**Course Outcomes (COs)**
At the end of this course students should be able to:

| | | |
|---|---|---|
| CO1 | Apply basic principal of mechanics and its application in engineering problems. | Understand,Apply |
| CO2 | Determine resultants and apply conditions of static equilibrium to plane force systems. | Apply |
| CO3 | Identify and evaluate all forces associated with a static framework. | Evaluate |
| CO4 | Analyze and sketch shear force and bending moment diagrams. | Analyze |
| CO5 | Derive and apply stress and strain relationships in single and compound members subject to axial force, bending moment and torsion. | Apply |
| CO6 | Stress analysis for two dimensional stress systems. | Analyze |

**Course Articulation Matrix (CO-PO Matrix of the selected Courses)**

| Course | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EME-101/ 102** | CO1 | 3 | 3 | 3 | | | 1 | 1 | 1 | 1 | 1 | | 1 | 3 | 3 |
| **EME-101/ 102** | CO2 | 3 | 3 | 3 | | | | | | | | | 1 | 3 | 3 |
| **EME-101/ 102** | CO3 | 3 | 3 | 3 | | | | | | | | | 1 | 3 | 3 |
| **EME-101/ 102** | CO4 | | 3 | 2 | 2 | | | | | | | | 1 | 3 | 3 |
| **EME-101/ 102** | CO5 | | 3 | 2 | 2 | | | | | | | | 1 | 3 | 3 |
| **EME-101/ 102** | CO6 | | 3 | 2 | 3 | | | | | | | | 1 | 3 | 3 |
| | | | | | | | | | | | | | | **3** | **3** |

**Course Content:**

**Unit-1:**

**Two Dimensional Force Systems:** Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two

dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

**Friction**: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Applications.

**Unit-2:**

**Beam**: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

**Trusses:** Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.

**Unit-3:**

**Centroid and Moment of Inertia:** Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

**Unit-4:**

**Simple Stress and Strain:** Introduction, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.

**Compound stress and strains:** Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle, Theories of Failure.

**Unit-5:**

**Pure Bending of Beams:** Introduction, Simple Bending Theory, Stress in beams of different cross sections.

**Torsion:** Introduction to Torsion of circular shaft, combined bending & torsion of solid & hollow shafts.

**Text and Reference Books:**


1. Engineering Mechanics by R.K.Bansal
2. Strength of Materials by R.K. Rajput
3. Engineering Mechanics by Irving H. Shames, Prentice-Hall
4. Mechanics of Materials by E. P. Popov, PHI
5. Strength of Materials by Ryder
6. Mechanics of Material by Gere & Timoshenko
7. Engineering Mechanics by A. Nelson
8. Engineering Mechanics by U.C. Jindal
9. Engineering Mechanics Statics by J. L. Meriam & L.G.Kraige

# HHS151/152 ENGLISH LANGUAGE AND COMPOSITION

| L T P C |
|---|
| 2 0 0 2 |

**Sessional Marks: 50**
**End Semester Exam: 50**

**Course Outcome:**

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

| | | |
|---|---|---|
| CO1 | Understand the various techniques of writing effectively and write professional statements & organizational communications. | Apply, Understand |
| CO2 | Develop writing skills by applying different strategies on organization system. | Understand and apply |
| CO3 | Will write articles, reports, projects and different organizational proposals differently and efficiently. | Apply, Create |
| CO4 | Write in concise with brevity and coherency all the messages of the organization. | Analyze and Create |

| **Course** | CO | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IHU 101/102** | CO1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | **1** | **2** |
| | CO2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 1 | 2 |
| | CO3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 1 | 2 |
| | CO4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 1 | 2 |
| Average | | | | | | | | | | 2 | 3 | | 1 | 1 | 2 |

**Syllabus**

**UNIT I Basic Applied Grammar and Usage:**
constituent of a sentence- noun, verb, adjective, preposition, etc.; use of articles, adjectival forms, prepositions, adverbs; verb forms; finite and non-finite verbs, gerund and participles, auxiliary verbs. Tense and mood, Subject- verb concord, pronoun concord

**UNIT II Sentence Structure-2**:
(i) adverb clause, adjective clause, noun-clause; (ii) negation and interrogation; (iii) passive; (iv) exclamatory; (v) transformations; (vi) tense forms; (vii) varieties of sentences; (viii) placement of modifiers

**UNIT III Paragraph Writing:**

Structure of Paragraph, Topic Sentence, Construction of Paragraph, Technique of Paragraph writing, Unity, Coherence, Emphasis

**UNIT IV Comprehension and Précis Writing**

Reading and listening comprehension, improving comprehension skills, précis writing

**UNIT V Short Essay Writing**

Dimension of essay writing- literary, Scientific, Comparison and Contrast, Narrative, Descriptive, Reflective, Expository, Argumentative and Imaginative

**References:**

**1.** Das, B K and A David, 'A Remedial Course in English for Colleges', (Book -1,2,3) Oxford University Press, New Delhi.
**2.** Sinha, R P, 'Current English Grammar and Usage with Composition', Oxford University Press, New Delhi.
**3.** Wren, P C & Martin, 'English Grammar and Composition', S Chand & Co Ltd. New Delhi.
**4.** A. S. Horne, Guide to Pattern and usage in English, Oxford University Press, N.D.
**5.** M.L. Tickoo& A. E. Subramanian, Intermediate Grammar, usage & composition, Orient Longman

# HHS 153/154, HHS-401: PROFESSIONAL COMMUNICATION

| Course: B. Tech & MCA | Branch: All | Year / Semester: Ist Year |
|---|---|---|
| Sessional Marks: | 50 | Credit: 3 |
| End Semester Exam: | 50 | LTPC: 3 0 2 3 |

**Course Outcome:**

On the successful competition of the course, students will be able to:

| | | |
|---|---|---|
| **CO1** | Understand the basics of technical communication | Apply, Understand |
| **CO2** | Developing the skills of variety of the words like synonyms and writing skills. | Understand |
| **CO3** | Draft a business letters and resume for to develop for industry. | Apply, Create |
| **CO4** | Explore the body language for perfect professional presentation. | Analyze and Create |
| **CO5** | To develop the humanistic & scientific approach towards life. | Create |
| **CO6** | Present themselves effectively and in a confident manner in the contemporary competitive market. | Apply |

CO-PO Matrix

| Course | CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HHS 103/104** | **CO1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | **1** | **2** |
| | **CO2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 2 | 1 |
| | **CO3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 2 | 1 |
| | **CO4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 2 | 1 |
| | **CO5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 2 | 2 |
| average | | | | | | | | | | 2 | 3 | | 1 | 1.8 | 1.4 |

**Syllabus**

**UNIT I Fundamentals of Technical Communication**:
Process of communication, language as a tool of communication, levels of communication , flow of communication, barriers to communication, communication across cultures; Technical Communication: meaning, significance, characteristics, difference between technical and general communication.

**UNIT II Elements of Written Communication**:
Words and phrases, word formation, synonyms and antonyms, homophones, one word substitution, sentence construction, paragraph construction,

**UNIT III Forms of Technical Communication**:

(A) business letters, job application letter and resume, business letters: sales & credit letters, letters of enquiry, letters of quotation, order, claim and adjustment letters, official letters: D.O. letters, government letters, letters to authorities, etc. ,

(B) Technical Reports: general format of a report, formal and informal reports, memo report, progress report, status report, survey report, trip report, complaint report, , Joining Report ,laboratory report, research papers, dissertations and theses. E-mail writing

Technical Proposals: purpose, characteristics, types, structure

**UNIT IV Presentation Strategies**:

Defining the subject, scope and purpose, analysing audience & locale, collecting materials, preparing outlines, organising the contents, visual aids, nuances of delivery, extemporaneous, manuscripts, impromptu, non- verbal strategies.

**UNIT V Value-based Text Reading**:

(A) Study of the following essays from the text book with emphasis on writing skills:

1. Man and Nature by J. Bronowski
2. The Language of Literature and Science by Aldous Huxley
3. The Aims of Science &The Humanities by Moody E Prior
4. Gods in this Godless Universe by Bertrand Russell
5. Science and Survival by Barry Commoner

(B) Readings of selected short stories:

1. The Renunciation by Rabindranath Tagore
2. The Lament by Anton P. Chekhov
3. The Barber's Trade Union by Mulk Raj Anand
4. The Eyes Are Not Here by Ruskin Bond

**Text Books:**

1. 'Improve Your Writing' ed. By V N Arora and Laxmi Chandra, Oxford University Press, New Delhi
2. 'An Anthology of English Short Stories', edited by R P Singh, Oxford University Press.
3. 'Technical Communication- Principles and Practices' by Meenakshi Raman &Sangeeta Sharma, Oxford University Press, New Delhi.

**Reference Books:**

1. Effective Technical Communication, by Barun K Mitra, Oxford University Press
2. Business Correspondence & Report Writing by R.C. Sharma & Krishna Mohan, Tata McGraw Hill, N.D.
3. Developing Communication Skills by Krishna Mohan & Meera Banerjee, Macmillan India
4. 'Technical Communication- Principles and Practices' by M R S Sharma, Oxford University Press, New Delhi

# Semester- 3

## BMA 251 MATHEMATICS-III

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

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

- Various mathematical tools likes Laplace/ Fourier transforms and their applications.
- Concepts and principle of complex analysis in solving various real life problems.
- Various statistical methods and tests for analyzing experimental data.

**Course Outcome**

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

| | | |
|---|---|---|
| CO1 | solve boundary value problems using Laplace transform and Fourier transform methods and solve difference equations and $BVP_S$ using z transform. | Apply, Evaluate |
| CO2 | construct conformal mapping between many kinds of domains. | Understand, Apply |
| CO3 | evaluate complex integrals, improper real integrals using various formulae/theorems.<br>find Taylor and Laurents series expansion of complex functions. | Apply, Evaluate |
| CO4 | estimate relationship between two variable using curve fitting, regression and its strength using correlation. | Understand, Apply |
| CO5 | various parametric and nonparametric tests parameter estimation, hypothesis testing and ANOVA. | Understand, Apply |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put"-"*

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | - | 1 | 3 | **2** | **2** |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | - | 1 | 3 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | - | 1 | 3 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| Average | 3 | 3 | 3 | 3 | 1.6 | 1.2 | 1.8 | 1 | 1 | .5 | .8 | 2.6 | 2 | 1.6 |

**Detailed Syllabus:**

**Unit – I: <u>Transform Methods:</u>**

Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Fourier transform pairs, existence conditions, operational properties. Applications of Laplace transform and Fourier transform to solve boundary value problems, Discrete and Fast Fourier transforms and its applications.

Development of difference equations as models, operator method, method of undetermined coefficients, Z-transform pairs, ROC. Operational properties, limiting- value theorems, its applications to solve difference equations and BVP, systems of difference equations.

**Unit- II: Functions of a Complex Variable and Conformal mapping:**

Limit, continuity, differentiability and analyticity, Cauchy-Riemann equations, harmonic functions, complex functions as mappings, liner transformation, inverse transformation, bilinear transformations, conformal mapping, applications.

**Unit- III: Integration of Complex Functions:**

Contour integrals and evaluations, Cauchy- integral theorem, Cauchy's integral formulae, Liouville's theorem, convergence of power series, Taylor series, Laurent series, zeros and singularities of a complex function, residues and residue theorem, Fundamental theorem of algebra Rouche's theorem, Argument Principle and maximum modules theorem, evaluation of definite and improper integrals.

**Unit- IV: Curve- Fitting, Correlation, Regression and Probability:**

Curve-fitting, method of least- squares, fitting of straight lines, polynomials, non-linear and exponential curves etc., correlation analysis, linear, non-linear and multi-regression analysis, probability, random variables and probability distributions, expectation, moments and transform methods, Binomial, Poisson and Normal distributions.

**Unit- V: Statistical Methods:**

Sampling theory (small and large), parameter estimation, confidence intervals, tests of hypotheses and significance; Overview of t-distribution, F-distributions and $3^2$-distribution. Z-, t-, F-, and $3^2$ tests, goodness of fit test- $3^2$ test, analysis of variance, non-parametric tests (Simple application). time series analysis, index numbers, quality control charts.

**Books Recommended:**


1. Dennis G, Zill & Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.
2. R.K. Jain & S.R.K. Iyengar; advanced Engineering Mathematics, Narosa Publishing House, 2002.
3 Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons 8th Edition.
4. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
5. J.N. Kapur and H.C. Saxena, Mathematical Statistics, S.Chand. & Co., 2001.
6. H.C. Saxena, Practical Mathematical Statistics, S. chand & Co., 2000.
7. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

# TOT-251 CHEMISTRY OF OILS & ALLIEDPRODUCTS

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

**Preamble**:

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

**Prerequisite:**

Students are required to have basic knowledge of Chemistry.

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

1. Classification of Oils & Fats.
2. Fatty acids compositions of Oils & Fats.

3. Production and consumption pattern of various Oils & Fats.

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus:**

**Module-I**

History and general introduction

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

**Module –II**

Non–glyceride components, important minor constituents and contaminants

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

**Module– III**

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

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

**Module–IV**

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

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

**Module–V**

Brief introduction to chemical reactions of fats and fatty acids

Esterification, interesterification, saponification, hydrolysis: reactions involving the carboxyl groups e.g., formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc.: alkoxylation, pyrolysis: reactions in the fatty acid chain; hydrogenation, dehydrogenation, halogenation, addition of sulphur, phenols, cresols, hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds, Rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants

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

**Reference Books and suggested readings:**


1. Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams 4th ed., Chapman and Hall (1964)
2. Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
3. Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, Allied publishers (2003)
4. Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)
5. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)
6. Fatty Acid by K. S. Markely, Interscience publishers (1968)
7. Treatise on fats , fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
8. Natural fatty acids and their sources by E. H. Pryde
9. BIS specifications; IS- 548, part I, II


**Course Objective:**

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

**Course Outcome:**

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

**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **History and general introduction** | |
| 1.1 | Oils, fats, waxes, mineral oils, essential oils, their sources | 4 |
| 1.2 | Composition and structures of Oils, fats, waxes, mineral oils, essential oils. | 4 |
| 1.3 | Constituents of natural fats Glycerides and fatty acids, their nomenclature, classification and principle sources. | 4 |
| 1.4 | Theories of glyceride structure. | 2 |
| 1.5 | Production and consumption pattern of various Oils & Fats in the Country vis-à-vis world. | 2 |
| **2.** | **Non–glyceride components, important minor constituents and contaminants** | |
| 2.1 | Phosphatides, sterols, gossypol, carotenoids, hydrocarbons | 4 |
| 2.2 | Coloring matter, natural pigments, vitamins, antioxidants, Fatty Alcohols | 2 |
| 2.3 | Sterols, Tocopherols, Tocotrinols, Oryzanols, Triterpine Alcohols Waxes etc. Gossypol, Sesamol and Sesamoline, Flavoring compounds | 4 |
| 2.4 | Some minor important constituents of oilseeds: ricin, sinigrin, linamarine, saponin, allylisothiocyanate, gossypol, sesamol and sesamoline; environmental contaminants. | 4 |
| | **Total** | **30** |

# TOT-253 CHEMISTRY OF OILS & ALLIED PRODUCTS LAB

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

**OBJECTIVE: The objective of this course is t**o enable the students

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

**Course Outcome**

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

| | | |
|---|---|---|
| **CO1** | Apply laboratory methods of analysis for estimation of purity of oil | Apply |
| **CO2** | Apply laboratory techniques for determination of physical properties of oils, fats & oilseeds | Apply |
| **CO3** | Apply analytical methods for identification of oil | Apply |
| **CO4** | To identify different adulteration & to analyzed the quality of oils & fats & to apply understanding of chemistry of oils & fats & to ensure quality. | Analyze |

| **COs** | **POs** | | | | | | | | | | | | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** |
| **CO1** | M | M | L | M | L | M | L | M | M | M | M | M | M | S |
| **CO2** | L | L | L | L | L | M | M | L | L | L | M | L | M | S |
| **CO3** | S | S | S | S | M | M | L | M | M | M | M | M | L | M |
| **CO4** | M | M | L | L | L | M | M | L | L | L | M | L | M | M |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

- Determination of physical characteristics of oils and fats as per BIS-
  - Specific gravity,
  - Refractive Index,
  - Color,
  - Viscosity by Ford cup and Ostwald Viscometer,
- Titre Determination of chemical characteristics of oils and fats as per BIS-
  - Acid value,
  - Saponification value,
  - Iodine Value,
  - Hydroxyl and acetyl Value,
  - Peroxide value

**Course contents and Lecture schedule:**

| **Module No.** | **Topic** | **No. of Lectures** |
|---|---|---|
| **1.** | **Physico-chemical characteristics of natural oils, fats and fatty acids** | |
| 1.1 | BIS methods for testing of oils and fats | 1 |
| 1.2 | Oiliness and viscosity, cloud point, titre, density and coefficient of expansion | 1 |
| 1.3 | Melting point, plasticity of fats & plastic range, smoke, flash and fire | 1 |

| | | |
|---|---|---|
| | points, Boiling point | |
| 1.4 | Solubility and miscibility, refractive index | 1 |
| 1.5 | Acid value, saponification value, Iodine value, unsaponifiable matter. | 2 |
| 1.6 | Thiocyanogen value, diene value, acetyl and hydroxyl value Riechert Miessel and Polensky values, and Kirshner value. | 2 |
| 1.7 | Peroxide Value, Anisidine Value, Oxirane Value, TBA value, Totox value. | 1 |
| **2.** | **Adulteration tests for vegetable and animal fats and oils and their chemistry** | |
| 2.1 | Boudiens Test, Holde Test, Halphens test. | 1 |
| 2.2 | Hexa Bromide Test, Ammonium Molybdate test, Belliers Turbidity Test | 2 |
| 2.3 | Test for the presence of Argemone, Sal Neem Kusum, Karanja, Animal fat, Allylisothiocyanate test. | 3 |
| 2.4 | Detection of ricebran oil in other oils and other relevant test. | 1 |
| **3.** | **Brief introduction to chemical reactions of fats and fatty acids** | |
| 3.1 | Esterification, interesterification, saponification, hydrolysis: reactions involving the carboxyl groups. | 2 |
| 3.2 | formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc. | 1 |
| 3.3 | alkoxylation, pyrolysis. | 1 |
| 3.4 | hydrogenation, dehydrogenation, halogenation. | 1 |
| 3.5 | addition of sulphur, phenols, cresols, hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds. | 2 |
| 3.6 | Rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants | 2 |
| | **Total** | **25** |

**Reference Books and suggested readings:**


1. Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams 4th ed., Chapman and Hall (1964)
2. Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
3. Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, Allied publishers (2003)
4. Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)
5. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)
6. Fatty Acid by K. S. Markely, Interscience publishers (1968)
7. Treatise on fats , fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
8. Natural fatty acids and their sources by E. H. Pryde
9. BIS specifications; IS- 548, part I, II

# TOT 255 FLUID MECHANICS & MECHANICAL OPERATIONS

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 2 | 5 |

**Assessment:**

Sessional: 50 marks

End Semester: 50 marks

**Course Objective:**

To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.

**Course outcomes:**

| | | |
|---|---|---|
| CO 1 | Understand the need of fluid mechanics for chemical engineers | Understand |
| CO 2 | Understand the basic terms and their concepts of fluid flow | Understand |
| CO 3 | Apply the knowledge to develop a dimensional number for the fluid flow | Apply, Create |
| CO 4 | Understand the fundamentals in characterization and classification of solids | Apply, Analyze |
| CO 5 | Understand the sieving performances using different sieve size | Analyze, Evaluate |
| CO 6 | Calculate the crushing efficiency of different size reduction equipment using crushing laws | Analyze, Evaluate |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 1 | - | - | 2 | - | - | 1 | - | 2 | **3** | **2** |
| CO2 | 3 | 3 | 3 | - | - | 1 | 1 | - | - | 1 | - | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | - | - | 1 | - | 2 | 3 | 2 |
| CO4 | 3 | 2 | 1 | - | - | 2 | 2 | - | - | 1 | - | 2 | 3 | 3 |
| CO5 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | - | - | 1 | - | 3 | 3 | 2 |
| CO6 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | - | 3 | 1 | - | 3 | 3 | 3 |
| Avg. | 3.00 | 2.67 | 1.83 | 1.50 | 0.67 | 1.33 | 1.33 | - | 0.5 | 1 | - | 2.33 | 3 | 2.5 |

**Syllabus**

**Module I (8 hours)**

Introduction to process fluid mechanics; Fundamental concepts: Definition of a fluid; Continuum hypothesis; Velocity field; Stress field; Newtonian and non-Newtonian fluids, Fluid statics: pressure variation in a static fluid, hydrostatic forces on submerged surfaces, buoyancy, Manometers. Dimensional analysis and similitude: Buckingham Pi theorem and applications

**Module II (8 hours)**

Macroscopic Balances: derivation of integral balances for mass, energy and momentum; Derivation of engineering Bernoulli equation with losses, Application of macroscopic balances: Losses in expansion, Force on a reducing bend, Diameter of a free jet; Jet ejector. Flow measurement: Orifice meter, venturi meter, Pitot tube, and Rota meter.

**Module III (8 hours)**

Differential balances of fluid flow: derivation of continuity and momentum (Navier-Stokes) equations for a Newtonian fluid, Boundary layer theory, Pipe flows and fittings: laminar and turbulent flows; friction factor charts, losses in fittings, Fluid transportation: Valves and Pumps and Compressors.

**Module IV (8 hours)**

Flow through packed and fluidized beds: Flow through beds of solids, motion of particles through the fluid, Particle settling, Fluidization, minimum fluidization velocity, Mixing and Agitation- power consumption, mixing times, scale up

**Module V (8 hours)**

Filtration: Governing equations, constant pressure operation, constant flow operation, cycle time, types of filters. Centrifuges and Cyclones: Gravity settling, centrifugal separation, cyclone separations, separation efficiency, pressure loss,

**Reference:**

1. McCabe and Smith, Unit Operations of Chemical Engineering: McGraw Hill

2. Coulson & Richardson, Chemical Engineering Vol. I: Pergamon, (1979) McGraw hill

3. Gupta, Vijay and S. K. Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi (1984).

4. W.L.Badger and J.T.Banchero, Introduction to Chemical Engineering, TMH (1979)

# TOT 257 MATERIALS & ENERGY BALANCE

**Assessment:**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

Sessional: 50 marks

End Semester: 50 marks

**Course Objective:**

To understand and apply the basics of calculations related to material and energy flow in the processes.

**Course Outcome**

| | | |
|---|---|---|
| CO1 | Demonstrate comprehensive understanding of material and energy balance equations for open and closed systems. | Understand, Apply, Remember |
| CO2 | Select appropriate basis and conduct degree of freedom analysis before solving material and energy balance problems. | Apply, Evaluate |
| CO3 | Make elementary flow-sheets and perform material and energy balance calculations without and with chemical reactions, and involving concepts like recycle, bypass and purge. | Analyse, Evaluate |
| CO4 | Perform process calculations utilizing psychometric charts and steam tables. | Understand, Apply, Evaluate |
| CO5 | Apply simultaneous material and energy balance calculations for steady state continuous flow systems and unsteady state systems | Understand, Apply, Evaluate |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | 1 | 1 | **1** | **3** |
| CO2 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 1 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | 1 | 1 | 1 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | 3 |
| CO5 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | 1 | 1 | 2 | 3 |
| Avg | 3 | 3 | 2.4 | 1.8 | 0.6 | 0.4 | 0.2 | - | - | 0.4 | 0.8 | 1 | 1.6 | 3 |

**Syllabus**

**Module 1 (9 hours)**

Dimensions, system of units and their conversions, Mass and volume relations, Basic stoichiometric principles, limiting and excess reactants, Degree of completion, Conversion, selectivity, yield. Ideal gas law, Dalton's Law, Amagat's Law, Introduction to degrees of freedom analysis.

**Module 2 (7 hours)**

Vapor pressure of liquids and solids, Vapor pressure plot (Cox chart), Vapor pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law. Humidity and saturation use of humidity charts for engineering calculations.

**Module 3 (8 hours)**

Material balance without chemical reactions and its application to unit operations like distillation, absorption etc. Material balance with chemical reaction Recycle, bypass and purging.

**Module 4 (8 hours)**

Heat capacity of gases, liquids and solutions Heat of fusion and vaporization. Steady state energy balance for systems with and without chemical reactions. Calculations and application of heat of reaction combustion, formation, neutralization and solution. Enthalpy-concentration charts. Orsat analysis Calculation of theoretical and actual flame temperatures

**Module 5 (8 hours)**

Simultaneous material and energy balance. Introduction to Unsteady state material and energy balance.

**Suggested Text books**


1. Hougen, O.A., Watson, K.M and Ragatz, R.A., "Chemical Process Principles Part-I", John Wiley and Asia Publishing, 1970.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", sixth Edition, Prentice Hall Inc., 1996.
3. Felder, R.M. & Rousseau, R.W. "Elementary Principles of Chemical Processes ", 3rd edition. JohnWiley. (1999)
4. Bhatt, B.L., VORA, S.M., "Stoichiomentry ", Tata McGraw-Hill, 1976.


**Suggested Reference Books**


1. Venkataramani, V., Anantharaman, N., Begum, K. M. MeeraSheriffa, "Process Calculations", Second Edition, Prentice Hall of India.
2. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.

# HHS 253/254 ORGANIZATIONAL BEHAVIOR

| **Course: IIIrd B. Tech** | **Branch: CS/IT** | **Year / Semester: IIIrd Year** |
|---|---|---|
| **Sessional Marks:** | **50** | **Credit: 3** |
| **End Semester Exam:** | **50** | **LTPC: 3 0 0 3** |

**Objective:**

- To identify organizational objectives, components and models for better results in attaining organizational goals;
- To understand individual behavior dimensions and interpersonal behavior;
- To analyze group, group behaviour, team and team building with its key role in organization;

**Course Outcomes (COs)**

At the end of this course students should be able to:

| | | |
|---|---|---|
| CO1 | Understand organisation, features, key elements, components, types and OB Models | Understand |
| CO2 | Demonstrate individual behavioural dimensions, learning theories, perceptual process, values & ethics with motivational techniques in stressed situations. | Understand and apply |
| CO3 | Identify mechanism for conducive survival of individual in an organization with interpersonal understanding. | Analyze and apply |
| CO4 | Ascertain group, group behaviour, team building with its key role in organization | Analyze, evaluate and apply |
| CO5 | Demonstrate organisational structure, organisational change, organisational development for achieving higher productivity and accomplishing goals of organisation | Analyze and evaluate |

| CO | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 3 | **3** | **3** |
| CO2 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| CO3 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO5 | 0 | 0 | 0 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | | | | 1.4 | | 1.4 | 1.4 | 2.4 | 2.6 | 2.6 | 1.6 | 3 | 3 | 3 |

**CO-PO Matrix**

**Syllabus**

**Unit 1: Introduction to organizations**

What is an organization, components of organization, nature and variety of organizations (in terms of objectives, structure etc.), models of analyzing organizational phenomena, organizational and business variables, organizations in the Indian context, institutions and structures,

**Unit 2: Dimensions of Individual Behavior**

Individual Behavior, Dimensions of individual behavior: Perceptions, Learning, Motivation, Personality, Commitment, Attitudes, Values & Ethics, Stress Management

**Unit 3: Dimensions of Interpersonal Behavior**

Transactional Analysis, Interpersonal communication, Listening, Feedback, Counseling,

**Unit 4: Group Behavior**

Leadership, Communication, Group: Formal Vs Informal Groups, Group Decision making, Team: Team building, team problem solving.

**Unit 5: Organizational Dimensions**

Organizational Structure: Elements of Organizational Structure, Dimensions of Organizational Structure, Organizational change, Organizational Development, Power, Authority, Politics

**Test Books:**

1. Luthans Fred., "Organizational Behavior", McGraw Hill, 1998
2. Pareek, Udai, "Understanding Organizational Behavior, Oxford university press

**Additional Reference Books:**

1. Robbins (4th ed.), "Essentials of organizational behavior", Prentice Hall of India Pv1. Ltd., New Delhi, 1995
2. Keith Davis, "Organisational Behaviour,
3. Hersey and Blanchard (6th ed.). "Management of organizational behavior L utilising human resources", Prentice Hall of India Pv1. Ltd., New Delhi, 1996.
4. Nancy J. Adler, “International Organisational behavior’, Cengage Learning
5. Nelson Quick, ‘Organizational Behaviour Function Learning’ Fifth Edition

# ECS 255: CYBER SECURITY

| L | T | P | C |
|---|---|---|---|
| 0 | 2 | 0 | 0 |

**Course Outcomes:**

1. Understand information, information systems, information security, Cyber Security and Security Risk Analysis. (Understand)
2. Understand and apply application security, data security, security technology, security threats from malicious software. (Understand, Apply)
3. Understand the concepts of security threats to e-commerce applications such as electronic payment system, e-Cash, Credit/Debit Cards etc. (Understand)
4. Understand and apply Information Security Governance & Risk Management, Security of IT Assets and Intrusion Detection Systems. (Understand, Apply)
5. Understand various types of Security Policies, Cyber Ethics, IT Act, IPR and Cyber Laws in India. (Understand).

**Syllabus**

**Unit-1:**

Introduction to information systems, Types of information systems, Development of Information systems, Introduction to information security, Need for Information security, Threats of Information Systems, Information Assurance, Cyber Security and Security Risk Analysis.

**Unit-2**

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology- Firewall and VPNs, Intrusion Detection, Access Control, Security Threats- Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce – Electronic Payment System, e-Cash, Credit/Debit Cards, Digital Signature, public Key Cryptography.

**Unit-3**

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design, Security Issues in Hardware, Data Storage & Downloadable devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

**Unit-4**

Security Policies, why Policies should be developed, WWW Policies, Email Security Policies, Policy Review Process- Corporate policies- Sample Security Policies, Publishing and Notification requirement of the Policies. Information Security Standards- ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India: IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Pattern Law.

**Text and Reference Books:**

1. Charles, P., and Shari Lawrence P fleeger, “Analyzing Computer Security”. Pearson Education India.
2. V.K. Pachghare, “Cryptography and information security”, PHI Learning Pvt. Ltd., Delhi India.
3. Dr Surya Prakash Tripathi, RitendraGoyal, and Praveen Kumar Shukla, "Introduction to Information Security and Cyber Law", Willey Dream tech Press.
4. Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill.
5. Chander Harish, “Cyber Laws and their Protection”, PHI Learning Private Limited, Delhi, India.

## Semester- 4

# BCY 252 MODERN ANALYTICAL TECHNIQUES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**OBJECTIVE:**
The objective of this course is to make the students aware of the modern instrumental techniques, the principles underlying them and their applications in the characterization of materials.

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

| | | |
|---|---|---|
| CO1 | Interpret Raman and IR–Spectra for characterization of materials. | Understand, Apply, Analyze |
| CO2 | Interpret NMR, Mass and ESR–Spectra for characterization of materials. | Understand, Apply, Analyze |
| CO3 | To analyze the conductivity to determine the concentration of solution and i-E characteristics of the samples. | Understand, Apply |
| CO4 | Analytical separation carried out by Chromatography in a multi-component system. | Remember, Apply, Analyze |
| CO5 | Elucidation of the Thermal Stability of different molecules and their Characterization on the basis of their thermal stability and Glass Transition Temperature of Polymers. Determine the specific heat, heat of reaction, Melting point & boiling point. Check the purity of drugs, crystallization and fusion of polymeric materials. | Understand, Apply, Evaluate, Create |
| CO6 | To develop experimental skills to perform, monitor and manipulate the reactions. | Understand, Evaluate, Analyze |

| **Chemistry** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BCY101/ 102** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | 3 | 3 | 2 | 3 | 2 | - | 1 | - | - | - | - | 3 |
| CO2 | 3 | 3 | 2 | 3 | 2 | - | 1 | - | - | - | - | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | - | 1 | - | - | - | - | 3 |
| CO4 | 3 | 3 | 2 | 3 | 2 | - | 1 | - | - | - | - | 3 |
| CO5 | 3 | 3 | 2 | 3 | 2 | - | 1 | - | - | - | - | 3 |
| CO6 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | - | 3 |
| Average | 3 | 3 | 2.17 | 3 | 2 | 0.33 | 1.17 | 0.33 | 0.17 | 0.33 | - | 3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

**Syllabus**

**Module I**

**(i) Infrared Spectroscopy:** Introduction, Principle, Instrumentation, mechanics of measurements, Selection rules, fundamental vibration modes, Factors influencing the Band Position and intensities, some characteristics frequencies and co-relation of IR spectra with molecular structures, effect of Hydrogen Bonding on vibrational frequencies.

(Lectures: 6-7)

**(ii) Raman Spectroscopy:** Introduction theory of Raman Spectroscopy, Mechanism of Raman and Rayleigh scattering, Rule of Mutual Exclusion, correlation with the molecular structure, difference between Raman and IR spectra, Resonance Raman effect, Application of Raman Spectroscopy.

(Lectures: 4-5)

**Module II**

**(i) Nuclear Magnetic Resonance Spectroscopy:** Introduction, basic principles, mechanics of measurements, chemical shift, band multiplets, spin-spin splitting, shielding and deshielding effect, spin-spin coupling and coupling constant (J), some characteristics of NMR positions, Application in elucidation of molecular structure, , Elementary idea of NOE, DEPT NMR, $C^{13}$ NMR, $P^{31}$NMR, $F^{19}$NMR. (Lectures: 4-5)

**(ii) Mass Spectroscopy:** Introduction, basic principles, instrumentation, fragmentation patterns, nitrogen rule, Mc Lafferty Rearrangement, interpretation of mass spectra and applications.

(Lectures: 3-4)

**(iii) ESR (Electron Spin Resonance) -** Basic Principles and Magnetic Interactions, Instrumentation and Applications. (Lectures: 2-3)

**Module III**

**(i) Potentiometry and Conductometry:** General principles, reference and indicator electrodes, potentiometric and conductometric titrations (Lectures: 3-4)

**Polarography:** Basic principle, dropping mercury electrode (DME), half wave potential, polarographic currents and applications. (Lectures: 3-4)

**Module IV**

**(i) Chromatographic methods**: Introduction to Chromatographic methods: TLC, Column and Gas chromatography, Principles, Instrumentation, GC column, Detectors and stationary phases and applications, hyphenated techniques (GC-MS). (Lectures: 4-5)

Liquid Chromatography LC/HPLC, Column efficiency in LC, Detectors, Instrumentation, Partition/Adsorption/Ion Exchange Chromatography (Lectures: 4-5)

**Module V**

**(i) Thermal Methods of Analysis:** Thermogravimetric analysis, differential thermal analysis and differential scanning calorimetry and applications. (Lectures: 4-5)

## CHEMISTRY LAB

### List of Experiments:

1. Estimation of vitamin C in commercial soft drink / Glucon D.
2. Determine the strength of oxalic acid conductometrically using sodium hydroxide solution.
3. Separation of amino acids by thin layer chromatography.
4. Determination of Rf value of Methyl Orange and Phenolphthalein using paper/ thin layer chromatography.
5. Separation of metal ions by paper/thin layer chromatography.

6. Determine the adsorption isotherm of oxalic acid/acetic acid on activated charcoal and verify the Freundlich adsorption isotherm.
7. Determine the rate constant (K) of hydrolysis of ethyl acetate catalyzed by HCL.
8. Prepare p-nitro acetanilide from acetanilide and find its percentage yield.
9. Determine the viscosity and percentage composition of the given liquid using Ostwald's viscometer.
10. Determine the strength of given glucose solution by titration against Fehling's solution.
11. Evaluation of Dissociation Constant k for a weak acid using conductometry.
12. Elution of chemicals by Column Chromatography.
13. Elution of genomic DNA from plants suspension.
14. Estimation of Phosphoric acid from coca cola.

**Reference Books:**


1. Instrumental Analysis, Douglas A. Skoog, F. James Holler & Stanley R. Crouch.
2. Instrumental Methods of Analysis, Willard, Merit and Dean.
3. Handbook of Instrumental Techniques for Analytical Chemistry Ronald A. Hites, Indian University, School of Public and Environmental Affairs and Department of Chemistry.
4. Applications of absorption spectroscopy of organic compounds, John R. Dyer.
5. Instrumental Methods Analysis, B. K. Sharma.
6. Text book of Quantitative Inorganic Analysis, A. I. Vogel.
7. Spectroscopy of Organic Compounds by P.S. Kalsi, Y.R. Sharma, Robert M. Silverstein & Francis X. Webster.

# BMA 252 COMPUTER ORIENTED NUMERICAL METHODS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 2 | 4 |

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

- various numerical methods for solving linear and non linear equations.
- various numerical techniques of interpolation, integration and differentiation with their applications.
- various numerical methods to solve $IVP_S$ and $BVP_S$.
- developing computer programs of numerical methods using $C/C^{++}$ language.

**Course Outcome**

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

| | | |
|---|---|---|
| CO1 | find roots of nonlinear equations and solve systems of algebraic equations. | Apply, Evaluate |
| CO2 | use interpolation techniques and to find numerical differentiation/ integration of data function. | Apply, Evaluate |
| CO3 | use numerical methods for finding solutions of ordinary differential equations, simultaneous and higher order equations. | Apply, Evaluate |
| CO4 | learn numerical methods for finding solution of initial and boundary value problems, partial differential equations. | Apply, Evaluate |
| CO5 | learn basic concepts of some Finite element methods. | Apply, Evaluate |
| CO6 | developing computer programs of numerical methods using $C/C^{++}$ language. | Apply, Evaluate, Create |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | - | - | - | - | 3 |
| CO2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | - | - | - | - | 3 |
| CO3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | - | - | - | - | 3 |
| CO4 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | - | - | - | - | 3 |
| CO5 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | - | - | - | - | 3 |
| CO6 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 |
| Average | 3 | 2 | 2.83 | 2.83 | 1.33 | 1.16 | 1 | .33 | .33 | .33 | .33 | 3 |

1: Slight (Low) 2: Moderate (Medium) 3:Substantial (High) *If there is no correlation, put "-"*

**Syllabus:**

**UNIT I: Nonlinear Equations and Simultaneous Linear Equations**

Roots of nonlinear equation, Methods of solution, Order of convergence of iterative methods, Simple roots: Bisection, False position, secant, Newton-Raphson, Chebyshev, Iteration and multi point iteration methods, Multiple roots: Newton-Raphson and Chebyshev, Complex roots: Newton-Raphson and Muller's method, a system of nonlinear equations: Newton-Raphson and Iteration methods, Polynomial equations: Bairstow's method, convergence analysis of above methods.

Linear systems: Introduction, Direct methods, Operation count, Pivoting, III conditioned linear systems & condition number, Iteration methods: Jacobi, Gauss-Seidel, SOR methods, convergence

conditions. Special system of equations: Thomas algorithm. Eigen value problems: Given's and Power methods.

**UNIT II: Interpolation, Differentiation and Integration**

Curve fitting: Polynomial interpolation, error, Existence and Uniqueness, Truncation error bounds, difference operators, Newton forward and backward difference interpolations, Lagrange, Newton divided difference and Iterated interpolations, stirling and Bessel's interpolations, Spline interpolation, Least squares and Chebyshev approximations. Numerical Differentiation: Methods based on interpolation, Error analysis. Numerical Integration: Methods based on interpolations (Trapezoidal, Simpson's 1/3, simpson's 3/8 rule), Gauss quadrature methods, Romberg integration, Error bounds and estimates.

**UNIT III: Numerical Solution of Ordinary Differential Equations**

Initial-value problems, Single step methods: Taylor's, Picard's, Euler's, Modified Euler's method and Runge-Kutta method (fourth Order), Error estimates, Multi-step methods: Adam's-Bashforth and Milne's methods, convergence and stability analysis, Simultaneous and Higher order equations: RK Fourth order method.

**UNIT IV: Initial & Boundary Value Problems and Iterative Solvers**

BVP: Shooting method and Finite difference methods for Ordinary Differential Equations, Solution of Partial differential equation; solution of Laplace, Poisson equations: Standard 5- point and diagonal 5- point formulae, Jacobi method, Gauss Seidel method (Liebmann's iterative method) Relaxation method. Solution of heat equation: Crank – Nicolson method, Solution of wave equation.

**UNIT V: Finite Element Method**

Basic concepts, variational formulation and functional, base functions, approximations weighted residual methods: Ritz method, Galerkin method, Least squares method, collocation method, Finite element and solution of simple problems and time dependent problems.

**NT Lab**

Develop Programs of the following techniques in C/C++ Language:

1. To implement iterative methods to solve a nonlinear equation.
2. To implement iterative methods to solve a system of linear equations.
3. To implement Forward, Backward and Central difference interpolation formulae.
4. To implement Newton's divided difference and Lagrange's interpolation formulae.
5. To implement Numerical differentiation.
6. To implement Numerical integration using Trapezoidal, Simpson 1/3 and Simpson 3/8 rules.
7. To implement single step methods to solve initial value problems.
8. To implement multi step methods to solve initial value problems.
9. Solution of Heat equations (Parabolic equations) by finite difference method.
10. Solution of Laplace equations (elliptic equations) by finite difference method.
11. Solution of wave equations (Hyperbolic equations) by finite difference method.

**Books Recommended:**

1. M.K.Jain, S.R.K. Iyengar & R.K.Jain, Numerical methods for Scientific and Engineering Computation, N age International Publication.
2. S.S Sastry, Intoductory Methods of Numerical Analysis, Eastern Economy Edition.
3. S. Rajasekaran, Numerical Method in Science and Engineering, Wheeler Publishing House.
4. B.S. Grewal, Numerical Method in Engineering & Science, Khanna Publishers.

# TOT-252 Sources, Composition, Characterization of Oils, Fats and Waxes

**L : T: P:C**
**3 : 1: 2:5**

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

Composition characteristics and use:

1. Natural waxes
2. Synthetic waxes.

**Syllabus:**

**Module-I**

**Natural sources of oils and fats**

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

**Module-II**

**Handling and Storage of Oils and oilseeds**

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

**Module–III**

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

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

**Module-IV**

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

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

**Module-V**

**Natural and synthetic waxes characteristics, composition and utilization**

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

**Module- VI**

**Laboratory work**

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

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

**Reference Book**


1. Bailey's Industrial Oil and Fat Products, Volume 5, Sixth Edition Edible Oil and Fat
2. Products: Processing Technologies Edited by Fereidoon Shahidi, A Wiley-Interscience Publication, JOHN WILEY & SONS, New York. Oils & fats Technology Edited by E. Bernardini
3. Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams 4th ed., Chapman and Hall (1964)
4. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)
5. Fatty Acid by K. S. Markely, Interscience publishers (1968)
6. Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)


**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Natural sources of oils and fats** | |
| 1.1 | Global and national production of oil seeds and oil | 2 |
| 1.2 | Demand and supply scenario of oils and oil seed | 2 |
| 1.3 | Import and export of oils | 1 |
| 1.4 | Import and export of oil seeds | 1 |
| 1.5 | Import and export of cake | 1 |
| 1.6 | Fast trends and future projections in fluctuation of production and price and their reasons | 2 |
| **2.** | **Handling and Storage of Oils and oilseeds** | |
| 2.1 | Handling of oil seeds and oil bearing material and crude oils | 2 |
| 2.2 | Storage of oil seeds | 1 |
| 2.3 | Grading and evaluation of oil seed and oil bearing material as per BIS/Codex | 1 |
| 2.4 | Drying of oil seeds | 2 |
| **3.** | **Commercial oils, oilseeds, cultivation, characteristics, composition and utilization from plant sources** | |
| 3.1 | Coco nut, palm, kernel | 1 |
| 3.2 | Olive, Cocoa butter, sun flower | 1 |
| 3.3 | Safflower, sesame, ground nut | 1 |
| 3.4 | Mustard rape-seeds canola, niger seed | 1 |
| 3.5 | Soybean, linseed, castor | 1 |
| 3.6 | Rice bran cotton seed, corn, tung, | 1 |
| 3.7 | Oiticica, neem, mahua, kusum | 1 |
| 3.8 | Karanja, Sal, Mango kernel, tobacco | 1 |
| 3.9 | Shea fat, watermelon, wheat germ | 1 |
| 3.10 | Alage oils, Chiaseed oil, jatropha | 1 |
| 3.11 | Genetically modify oil seeds | 1 |
| **4.** | **Production, characteristics, composition and utilization of oils from animal sources** | |
| 4.1 | Milk fats and butter | 1 |
| 4.2 | Animal fats, lard tallow | 1 |
| 4.3 | Emu oil and greases | 1 |
| 4.4 | Fish and marine oils: halibut, herring, shark | 1 |
| 4.5 | Menhaden, whale | 1 |
| 4.6 | Sardine oil, fish lever oils, krill oil | 1 |
| 4.7 | Different methods of rendering | 1 |
| **5.** | **Natural and synthetic waxes characteristics, composition and utilization** | |

| | | |
|---|---|---|
| 5.1 | Natural waxes such as bees wax, shellac wax | 1 |
| 5.2 | Carnauba wax, sugar cane wax | 1 |
| 5.3 | Montana wax, Jojoba wax | 1 |
| 5.4 | Sperm oil, rice bran | 1 |
| 5.5 | Sunflower and spermaceti | 1 |
| 5.6 | Synthetic waxes their occurrence and classifications | 2 |
| 5.7 | General properties and uses of synthetic waxes | 1 |
| | **Total** | **41** |

# TOT 254 HEAT TRANSFER OPERATIONS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Assessment:**

Sessional: 50 marks

End Semester: 50 marks

**Course Objective:**To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

**Course outcomes:**

| | | |
|---|---|---|
| CO 1. | Understand different modes of heat transfer. | Understand |
| CO 2 | Apply the concepts of one-dimensional and multi-dimensional; steady and unsteady state conduction heat transfer, and relevant boundary and initial conditions in problem solving. | Apply, Analyze ,Evaluate |
| CO 3. | Apply the knowledge of analytical and graphical (temperature charts) techniques in solving specific transient heat conduction problems, including lumped and one-dimensional systems | Apply, Evaluate |
| CO 4 | Understand the concept of temperature-dependent buoyancy which causes natural free convection, and apply the dimensionless Grashof number used in correlations for free convective heat transfer calculations | Understand, Analyze, Evaluate |
| CO 5. | Understand phase-change phenomena and latent heat of vaporization, including free convective, nucleate and film boiling, as well as dropwise and film condensation | Understand, Analyze |

| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | 2 | 1 | 1 | - | - | 2 | - | - | 1 | - | 1 | **1** | **2** |
| CO2 | | 3 | 3 | 3 | 3 | 2 | 1 | 1 | - | - | 1 | - | 1 | 2 | 2 |
| CO3 | | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | 1 | 1 | 1 | 1 | 2 |
| CO4 | | 3 | 2 | 3 | 3 | 3 | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 2 |
| CO5 | | 3 | 3 | 3 | 3 | 1 | 2 | 1 | - | - | 1 | 1 | 1 | 1 | 2 |
| Avg. | | 3 | 2.6 | 2.6 | 2.6 | 1.8 | 1.2 | 1.4 | - | - | 1 | 0.6 | 1 | 1.4 | 2 |

**Syllabus**

**Module 1 (6 hours)**

Introduction ot heat transfer and general concepts of heat transfer by conduction, convection and radiation, Conduction: Basic concepts of conduction in solids, liquids, gases, steady state temperature fields and one dimensional conduction without heat generation e. g. through plain walls, cylindrical

and spherical surfaces, composite layers, Insulation materials, critical and optimal, insulation thickness, Extended surfaces, fins and their applications, Introduction to unsteady state heat transfer.

**MODULE 2 (6 hours)**

Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside tubes, Dimensional analysis, determination of individual and overall heat transfer coefficients, heat transfer in molten metals.

**MODULE 3(6 hours)**

Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchoff's law, solar radiations, combined heat transfer coefficients by convection and radiation.

**MODULE 4(6 hours)**

Heat Transfer by phase change: Condensation of pure vapours, film wise and drop wise condensation, eat transfer in boiling liquids, boiling heat transfer coefficients, Evaporation: Elementary principles, types of evaporators, Single and multiple effect evaporators.

**MODULE 5(6 hours)**

Heat exchangers: Types of heat exchangers, Principal components of a concentric tube & shell-and-tube heat exchangers, baffles, tube and tube distribution, tubes to tube sheet joint, heat exchanger with multiple shell and tube passes, log-mean temperature difference, overall heat transfer coefficient, fouling factors, design of double pipe and shell and tube heat exchangers.

BOOKS:

1. "Heat Transfer principles and applications" Dutta, B. K., PHI
2. "Heat Transfer" Holman J. P, 9th Ed. McGraw Hill.
3. "Process Heat Transfer". Kern D. Q. McGraw Hill Book
4.Heat and Mass Transfer Fundamentals and Applications, Cengel Y. A. and Ghajar A. J., McGraw Hill,5th edition, 2016.

# TOT 256 CHEMICAL ENGINEERING THERMODYNAMICS

**Assessment:**
Sessional: 50 marks

End Semester: 50 marks

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Course Objective:**

To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria.

**Course outcomes:**

| | | |
|---|---|---|
| CO 1 | Understand the basic of thermodynamics and the terminology associated with engineering thermodynamics | Understand |
| CO 2 | Understand the knowledge of contemporary issues related to chemical engineering thermodynamics | Understand |
| CO 3 | Understand and apply the knowledge of phase equilibria in two-component and multi-component systems | Understand, Apply |
| CO 4 | Analyse the thermodynamic properties of substances in gas or liquid state of ideal and real mixture | Apply |
| CO 5 | Understand intermolecular potential and excess property behaviour of multi-component systems | Understand |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | - | - | 1 | - | - | 1 | - | 1 | **1** | **2** |
| CO2 | 3 | 1 | 1 | 1 | - | 3 | 3 | - | - | 1 | - | 1 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | 1 | - | 1 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | - | - | 1 | - | 1 | 2 | 2 |
| CO5 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | - | - | 1 | - | 1 | 2 | 2 |
| Avg. | 3 | 2.2 | 1.8 | 1.8 | 1.6 | 1 | 1.2 | - | - | 1 | - | 1 | 1.6 | 2 |

**Syllabus**

**Module 1 (8 hours)**

Basic Concepts & First Law of Thermodynamics: Scope of thermodynamics, System & Surroundings, Properties -Force, Temperature & pressure, Equilibrium, Processes- Reversible & Irreversible, Work, Heat, Energy ,Phase rule, Joule's Experiment, Internal energy, Enthalpy, Heat capacities, Application of first law to closed & open systems.Volumetric properties of pure fluids: PVT behavior of pure substances, Virial equation of state and its application ,ideal gas and cubic equation of state, Generalized correlations for gases and liquids.

**Module 2 (6 hours)**

Second Law of Thermodynamics: Heat engine and its efficiency, Heat pump, Refrigerator, COP, Second law of Thermodynamics, Kelvin–Planck statement &Clausius Statement, Carnot's cycle and Carnot theorems, Clausius inequality, Entropy balance for open systems, ideal work and lost work, Principle of entropy.

**Module 3 (6 hours)**

Residual properties, two phase systems: Clapeyron equation, Estimation of thermodynamic properties by using graphs and tables.Solution thermodynamics Theory: Fundamental property relation, Chemical potential and phase equilibria ,Partial properties ,Ideal gas mixture model.

**Module 4 (6 hours)**F

ugacity and fugacity coefficient for pure species and in solution, Ideal solution model and excess properties.Solution thermodynamics Application: Liquid phase properties from VLE data, Models for the excess Gibbs energy, Property changes of mixing.

**Module 5 (4 hours)**

Phase Equilibria: Nature of equilibrium, phase rule, VLE qualitative behavior, Simple Models for VLE, VLE by Modified Raoultslaw and VLE from K-value charts.

**Reference**

1. "Introduction to Chemical Engineering Thermodynamics" by J.M. Smith and H.C. Van Ness, McGraw Hill International Ltd, 2005.

2. "Chemical Engineering Thermodynamics" by Y.V.C. Rao, Universities Press (India) Ltd. Hyderabad.

3. "Chemical and Process Thermodynamics", Kyle B.G., 3rd ed., Prentice Hall. 1999

4. "Chemical Engineering Thermodynamics", by Narayanan, K.V., Prentice Hall. 2007

# HHS 251/252 ENGINEERING ECONOMICS AND MANAGEMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Course: B. Tech.** | **Branch:** All Branches | **Year: 2nd Year** |
| **Sessional Marks:** | **50** | **Credit: 3** |
| **End Semester Exam:** | **50** | **LTP: 3 0 0** |

**Objective:**

- ✓ To provide useful knowledge to engineering students in their professional career particularly in corporate and manufacturing sector.
- ✓ To understand essential economic principles for solving economic problems with suitable policy alternatives.
- ✓ To study and analyze the contemporary market situations, market strategy to manage the business and industry.
- ✓ To understand fundamental of business management and apply management techniques for the benefit of business and society.

**Course Outcome (COs)**

At the end of this course students should be able to:

| | | |
|---|---|---|
| CO1 | Understand essential economic principles for solving economic problems with suitable policy alternatives | Understand |
| CO2 | Understand and evaluate the production system with different type of cost. | Understand, evaluate |
| CO3 | Study and analyse the market, structure, types and characteristics | Analyze and apply |
| CO4 | Understand fundamentals of management principles and functions | Understand and apply |
| CO5 | Know various forms of business ownership, formation and their relevance | Analyze, evaluate and apply |

| Course | CO | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HHS-201/202 | CO1 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 3 | 1 | 3 | 3 | 3 | **1** | **2** |
| | CO2 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| | CO3 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 1 | 2 |
| | CO4 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| | CO5 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| average | | 0.2 | 0 | 0 | 0.4 | 0 | 2 | 1.8 | 3 | 2.4 | 2.8 | 3 | 3 | 1.6 | 1.8 |

**CO-PO Matrix**

**Syllabus**

**UNIT I Introduction to Economics**:

Overview: production possibility curve, choices-what, how and for whom, micro- and macro economics, inflation, unemployment, GDP and business cycle; demand and supply, elasticity of demand, consumer surplus and its applications, utility theory.

**UNIT II Production and Cost**:

Factors of production, production function, law of variable proportion, isoquant analysis, return to scale, economies of scale;

Types of costs: direct and indirect costs, explicit and implicit costs, opportunity cost, economic cost, fixed cost and variable costs, average and marginal costs, short-run and long-run costs, optimal combination of factor-inputs.

**UNIT III Market Structure:**

Perfectly Competitive Market, Imperfect market: Monopoly, Oligopoly, Monopolistic Market

**UNIT IV Fundamentals of Management**:

Development of Management Thoughts, Objectives, Functions of Management: Planning, Organising, Directing, Controlling and Coordination.

**UNIT V Business Enterprises**-

Business Ownership: Sole Proprietorship, Partnership, Company: Promotion, Formation & Development, Cooperative Firms.

**Text Books:**

1. **Koutsoyiannis, A**., 'Modern Microeconomics', English Language Book Society, Macmillan.
2. **Joseph, L Massod,** "Essential of Management", Prentice Hall, India.

**Additional Reference Books**:

1. **Armstrong, Michel**, "A Handbook of Management Techniques", Kogan Page Limited
2. **Babcock, D L and Lucy C Morse**, "Managing Engineering and Technology", third edition, Pearson Education, 2006
3. **Pindyck, R S, Rubinfeld, D L &Mehta** , 'Microeconomics', 6th Edition, Pearson Education India.
4. **Barthwal, R R , Microeconomic Analysis**
5. **Samuelson, Paul A** , 'Economics', 5th edition, McGraw Hill New York.
6. **Henderson, J M and Quadnt, R E** , 'Microeconomic Theory: A Mathematical Approach.', Tata MacGraw Hill, New Delhi,2003
7. **H. Varian,** 'Intermediate Micro Economics'
8. **G. Mankiw,''**Principles of Micro Economics

# HHS-256: INDIAN CONSTITUTION

| L | T | P | C |
|---|---|---|---|
| 0 | 2 | 0 | 0 |

**Course Objectives (COs) at the end of this course students should be able to:**

1. Configure the preambles & fundamental rights.
2. Actuate the governance & functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system & its role in governance.
5. Develop a democratic process through electoral mechanism into system.

**Syllabus**

**UNIT – I**
Indian Constitution Sources and Features, Preamble, Fundamental Rights, Fundamental Duties and Directive Principles of State Policy

**UNIT-II**
Union Executive President, Vice President, Prime Minister, Council of Ministers, State Executives- Governor, Chief Minister and Council of Ministers

**UNIT- III**
Union Legislature Parliament- Composition and Functions, Speaker of Lok Sabha, Amendment Process, State Legislature- Vidhaan Sabha, Panchaayati Raj, Institutions- History, Basic Features and 73rd Amendment

**UNIT- IV**
Judiciary Supreme Court, High Courts, Judicial Review and Judicial Activism UNIT-V- Election Commission Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the Welfare of SC/ST/OBC and Women.

**Reference Books:**

1. Indian Constitution : D.D Basu
2. Indian Administration: Avasthi and Avasti

**Additional Reference Books:**

1. The Indian Constitution: Corner Stone of a Nation, G. Austin, Oxford University Press.

2. Indian Politics: Contemporary Issues and Concerns, M. P. Singh and RekhaSaxena, Prentice Hall of India, Delhi

# SEMESTER- 5

## TOT-351 TECHNOLOGY OF SOAPS & FAT SPLITTING

**L : T: P:C**
**3 : 1: 2:5**

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

| | | |
|---|---|---|
| (CO1) | Have basic knowledge of various surface active agents, their effectiveness and applications. | Understand |
| (CO2) | Select raw materials on the basis of their properties on the requirement of finished products & testing of the raw materials. | Apply |
| (CO3) | Select method of Soap Manufacture, builders, fillers and additives & knowledge of the plant & machinery & maintenance of the same. | Apply |
| (CO4) | Evaluate quality of raw materials and finished products | Evaluate |
| (CO5) | Prepration of laundry & tiolet soap in pilot project or in laboratory Assess process for saponification and develop formulation, to make it cost effective, knowledge of pollutant produced in the industry & their process. | Create |

Mapping with Program Outcomes

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

Assessment Pattern:

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus:**

**Module-I**

**Fundamentals of soaps:**

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

**Module-II**

**Manufacture of household soaps:**

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

**Module-III**

**Continuous processes of soap manufacture:**

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

**Module-IV**

**Manufacture of specialty soaps:**

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

**Module-V**

**Fat splitting and fatty acid distillation:**

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

**Module -VI**

**Laboratory work**

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

**Reference Books and suggested readings**


1. M.M Chakrabarty. Chemistry and Technology of Oils and Fats. Allied Publishers Pvt. Ltd. New Delhi.
2. NIIR Board. The Complete Technology Book on Soaps (2nd Revised Edition)
3. Parasuram K. S. (2002) Soaps and Detergents. Tata Macgraw Hill. (ISBN 007-462324-9)
3. Spitz, L. (2016). Soap Manufacturing Technology: Second Edition.


**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Fundamentals of soaps** | |
| 1.1 | History and background of soaps, chemistry of cleaning action | 1 |
| 1.2 | General principles of soap-making | 1 |
| 1.3 | Raw material for soaps and their selection | 3 |
| 1.4 | Quality specifications and soap making properties of oils and fats | 1 |
| 1.5 | Selection and functions of builders, fillers and other auxiliary raw materials | 2 |
| 1.6 | Upgradation of raw materials including fractionation | 1 |
| **2.** | **Manufacture of household soaps** | |
| 2.1 | Machinery employed for soap manufacture | 2 |
| 2.2 | Quality specifications for toilet & laundry soaps | 1 |
| 2.3 | Machinery for milling and plodding | 1 |
| 2.4 | Production of soap base by traditional methods in single vessel | 1 |
| 2.5 | Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes | 2 |

| | | |
|---|---|---|
| 2.6 | Manufacture of soaps from fatty acids & methyl esters | 1 |
| **3.** | **Continuous processes of soap manufacture** | |
| 3.1 | Production of extruded soaps-solidification | 1 |
| 3.2 | High shear reaction system | 1 |
| 3.3 | Modern process and plant for the production of household and toilet soaps | 3 |
| 3.4 | Cascade, mazzoni processes for the production of household and toilet soaps | 2 |
| 3.5 | Specifications of soaps and fatty acids as per BIS standards | 1 |
| **4.** | **Manufacture of specialty soaps** | |
| 4.1 | Soft soaps, liquid soaps | 1 |
| 4.2 | Transparent and translucent soaps | 1 |
| 4.3 | Super fatted soaps, medicated soaps | 2 |
| 4.4 | Floating soaps, multi coloured soaps | 1 |
| 4.5 | Soap powders like spray-chilled and spray-dried powders | 2 |
| **5.** | **Fat splitting and fatty acid distillation** | |
| 5.1 | Hydrolysis of oils and fats | 1 |
| 5.2 | Effect of temperature, pressure, catalyst and ratio of reactants in hydrolysis of fats | 1 |
| 5.3 | Plants and processes employed for fat splitting | 2 |
| 5.4 | Twitchell process | 1 |
| 5.5 | Enzymatic fat splitting, low, medium and high pressure autoclave processes | 1 |
| 5.6 | Semi-continuous and continuous processes of fat splitting | 2 |
| 5.7 | Fatty acid distillation, crystallization, fractionation, high purity fatty acid products blends distillation | 2 |
| 5.8 | Specifications of fatty acids and glycerin as per BIS, Recovery of glycerin from spent soap lye & sweet water | 1 |
| | **Total** | **43** |

# TOT-353 EXPRESSION AND EXTRACTION TECHNIQUES OF OIL BEARING MATERIALS

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

**Preamble**:

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

**Prerequisite:**

Knowledge of various oil bearing materials oil seeds cakes etc.

**Course Outcome:**

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

| | | |
|---|---|---|
| (CO1) | Acquire the knowledge of various oil bearing materials, oil seeds, cakes and their processing for oil extraction the need of analytical methods for better oil contents quality. | Understand |
| (CO2) | Select processes for seed preparation. | Apply |
| (CO3) | Select methods of recovery of oil from oil bearing material, their performances. Machines & plants used, their maintenances | Apply |
| (CO4) | Assess quantity and quality of extracted oil& de-oiled cake, adoption of green technologies & their impact on environment. | Analyze |
| (CO5) | Evaluate quality of end products viz extracted oils, de-oiled cake adopting different process and cost effectiveness. | Evaluate |

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus:**

**Module-I**

**Pre-treatments of oil bearing materials:**

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

**Module-II**

**Production of Oil by mechanical expression:**

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

**Module-III**

**Production of Oil by solvent extraction:**

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

**Module-IV**

**De-solventization of meals & miscella:**

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

**Module-V**

**Alternative extraction processes:**

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

**Reference Book and suggested readings:**


1. Bailey's Industrial Oil and Fat, Edition 6 Vol-5 ( 2005), Edited by Feireidoon Shahidi, Wiley Interscience publication
2. Seader J. D. and Henley E. J. "Separation Process Principles", 2nd Ed. (2006), Wiley-India.
3. King C. J., "Separation Processes", Tata McGraw Hill (1982).
4. Basmadjian D., "Mass Transfer and Separation Processes: Principles and Applications", 2nd Ed. (2007), CRC.
5. Khoury F. M., "Multistage Separation Processes", 3rd Ed. (2004), CRC
6. Wankat P. C., "Separation Process Engineering", 2nd Ed. (2006), Prentice Hall.
7. Official methods of AOCS
8. Handbook of FSSAI


**Course contents and Lecture schedule:**

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

| | | |
|---|---|---|
| **5.** | **Alternative extraction processes** | |
| 5.1 | Alternative solvents for extraction | 1 |
| 5.2 | Comparison with conventional solvents | 1 |
| 5.3 | Super critical extraction | 2 |
| 5.4 | Oleo stearine preparations | 1 |
| 5.5 | Aqueous extraction | 1 |
| 5.6 | Enzymatic extraction | 1 |
| | **Total hours** | **40** |

# TOT-355: BIOTECHNOLOGY OF OILS AND OILSEED

**L : T: P:C**
**2 : 0: 0:2**

**Preamble**:

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

**Prerequisite:**

Basic science and engineering and oil technology

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

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

**Course Outcome 2(CO2)**

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

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

## Syllabus:

**Module-I Introduction to GM crops**

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

**Module-II Enzymes and their Technology**

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

**Module –III Bio processing of Oils & Fats**

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

**Module –IV Specialty fats & Oils**

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

**Module –V GM Oilseeds**

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

**Course contents and Lecture schedule:**

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

**Reference Book**


1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman & Company, 2004.
2. Lubert Stryer, Biochemistry, 4th Edition, W.H.Freeman and Company, 1995
3. Biotechnology for the Oils & fats industry (1983) Edited by Colin Ratledge, Peter Dawson and James Rattray
4. Bailey J.E and Ollis D.F., "Biochemical Engineering Fundamentals", 2nd 1987 Ed., McGraw Hill.
5. Doble M. and Gummadi S.N., "Biochemical Engineering", Prentice Hall 2007.
6. Schuler M. L. and Kargi F., "Bio Process Engineering", 2nd Ed., 2002 Prentice Hall.

# TOT 357 MASS TRANSFER OPERATION

**LTPC**
**3 1 0 4**

**Assessment:**

Sessional: 50 marks

End Semester: 50 marks

**Course Objectives:** The purpose of this course is to introduce the undergraduate students with the most important separation equipments in the process industry, and provide proper understanding of unit operations.

**Course outcomes:**

| | | |
|---|---|---|
| CO 1 | Understand the principles of molecular diffusion and basic laws of mass transfer. | Understand, |
| CO 2 | Ability to determine mass transfer rates using Fick's Law | Apply |
| CO 3 | Estimate diffusion coefficients and apply to practical problems | Apply |
| CO 4 | Ability to determine convective mass transfer rates | Apply |
| CO 5 | Analyze the Similarity of mass, heat and momentum transfer – Analogy and understand the humidification processes and use of psychometric chart | Analyze |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 1 | **1** | **2** |
| CO2 | 3 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 1 | 2 | 1 |
| CO3 | 3 | 2 | 3 | 2 | 3 | - | - | - | - | 1 | 1 | 1 | 1 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | 1 | 1 | 1 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | 1 | 1 | 1 | 3 | 2 |
| Avg | 3 | 2.4 | 2.2 | 1.8 | 1.6 | - | - | - | - | 1 | 1 | 1 | 1.6 | 1.8 |

**Syllabus**

**Module I (8 hours)**

Mass Transfer and Diffusion: Steady-state ordinary molecular diffusion: Fick's law of diffusion; Velocities in mass transfer, Equimolar counter diffusion; unimolecular diffusion, Diffusion coefficients: Diffusivity in gas mixtures, diffusivity in liquid mixtures, Diffusivity in solids, One-dimensional, steady-state, molecular diffusion through stationary media, Mass transfer in turbulent flow: Reynolds analogy; Chilton-Colburn analogy; Other analogies, Models for mass transfer at a fluid-fluid interface: Film theory; Penetration theory; surface-renewal theory; film-penetration theory, Two-film theory and overall mass transfer coefficients. Introduction to absorption.

**Module II (8 hours)**

Distillation: Pressure-composition, Temperature-composition, Enthalpy-composition diagrams for ideal and non-ideal solutions; Raoult's law and its application; Maximum and minimum boiling mixtures; Concept of relative volatility; Single Stage Distillation-Differential distillation, Flash vaporization; Vacuum, molecular and steam distillations.

**Module III (8 hours)**

Liquid-Liquid Extraction: Applications; Ternary liquid-liquid equilibria; Triangular graphical representation; Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation.

**Module IV (8 hours)**

Solid-Liquid Extraction: Applications; Solid-liquid equilibrium; Equipment used in solidliquid extraction; Single and multistage crosscurrent contact and countercurrent operations; Overall stage efficiency; Determination of number of stages. Introduction to Humidification and drying.

**Module V (8 hours)**

Adsorption: Description of adsorption processes and their application, Types of adsorption, Nature of adsorbents; Adsorption isotherms and adsorption hysteresis; Stagewise and continuous contact adsorption operations, Determination of number of stages, Equipments; Ion exchange, Equilibrium relationship; Principle of ion-exchange, techniques and applications. Introduction to Crystallization theory.

BOOKS:

1. Treybal, R.E. "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).

2. Seader, J.D. and Henley, E.J., "Separation Process Principles", 2nd ed., Wiley India Pvt. Ltd., New Delhi (2013).

3. Sherwood, T. K., Pigford, R. L. and Wilke, C.R. "Mass Transfer" McGraw Hill (1975).

4. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th ed., PHI Learning Private Limited, New Delhi (2012).

# TOT 359 CHEMICAL REACTION ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Assessment:**

Sessional: 50 marks
End Semester: 50 marks

**Course Objective:** To apply knowledge from calculus, differential equations, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems, To examine reaction rate data to determine rate laws, and to use them to design chemical reactors, To simulate several types of reactors in order to choose the most appropriate reactor for a given need, To design chemical reactors with associated cooling/heating equipment.

**Course Outcomes:**

| | | |
|---|---|---|
| CO 1 | Able to develop an understanding of the basic concepts involved in using reaction rate equations and kinetic constants | Understand, Apply |
| CO 2 | Perform derivations of rate equations for non-elementary reactions both in homogenous and in heterogeneous reacting systems | Apply |
| CO 3 | Able to understand the role of temperature and concentration in the rate equation | Understand |
| CO 4 | Perform constant volume batch reactor calculations | Apply |
| CO 5 | Develop calculations using the integral method and applying differential method of analysis using reactions with different orders | Understand, Apply |

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | **PSO s** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | - | - | - | - | - | - | 1 | - | 1 | **1** | **2** |
| CO2 | 3 | 3 | 3 | 1 | - | 1 | - | - | - | 1 | - | 1 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | - | 2 | - | - | - | 1 | - | 1 | 1 | 2 |
| CO4 | 3 | 3 | 1 | - | 2 | 1 | - | - | - | 1 | - | 1 | 1 | 2 |
| CO5 | 3 | 3 | 2 | 2 | 2 | 1 | - | - | 2 | 1 | - | 3 | 3 | 2 |
| Avg. | 3 | 2.8 | 2.4 | 1 | 0.8 | 1 | - | - | 0.2 | 1 | - | 1.4 | 1.6 | 1.8 |

**Syllabus**

**Module I (8 hours)**

Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, temperature dependency from thermodynamics, collision and

activated complex theories. Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.

**Module II (8 hours)**

Interpretation of variable volume batch reactions for zero, first and second order reactions, Space-time and state-velocity, design equation for ideal batch, steady-state continuous stirred tank, steady-state plug flow reactors for isothermal reaction.

**Module III (8 hours)**

Design for single reactions, Size comparison of single reactors, Multiple reactor systems, plug flow/mixed flow reactors in series and parallel, reactors of different types in series, optimum reactor size, recycle reactor, autocatalytic reactions.

**Module IV (8 hours)**

Introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size, selectivity, the side entry reactor, irreversible first-order reactions in series, Quantitative treatment: plug flow or batch reactor, Quantitative treatment: mixed flow reactor, Successive irreversible reactions of different orders, reversible reactions, irreversible series-parallel reactions, the Denbigh reactions and their special cases, Heat of reaction from thermodynamics, equilibrium constants from thermodynamics, General graphical design procedure for non-isothermal reactors, Optimum temperature progression, Heat effects: Adiabatic operations and non-adiabatic operations, Exothermic reactions in mixed flow reactors.

**Module V (8 hours)**

Residence time distribution of fluids in vessels, State of aggregation of the flowing systems, Earliness of mixing, Role of RTD, State of Aggregation and earliness of mixing in determining reactor behavior, E, F and C curves, Conversion in Non-ideal flow reactors.

**Reference Books:**


1. Levenspiel, O., “Chemical Reaction Engineering”, 3rd edition, John Wiley (1998).
2. Fogler H.S., “Elements of Chemical Reaction Engg.”, 4th Ed., Prentice Hall of India (2005).
3. Doraiswamy, L.K. and Uner, D., “Chemical Reaction Engineering: Beyond the Fundamentals”, CRC Press (2013).

# HHS 341/342 ENTREPRENEURSHIP DEVELOPMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Sessional Marks: 50**
**End Semester Exam: 50**

**Course Outcome (COs)**

At the end of this course students should be able to:

| | | |
|---|---|---|
| CO 1 | Describe what it takes an Entrepreneur; describe multiple ways to become an entrepreneur; including, intrapreneur, and manager, woman entrepreneur rural & urban: highlights motives to become entrepreneur | Understand |
| CO2 | Apply the beginner concept, ownership and various forms with focus on small scale enterprises | Understand, Analyse, Apply |
| CO3 | Identify opportunities using identification; project conceptualisation, formulation & evaluation | Analyse, Apply, Evaluate |
| CO4 | Identify potential contribution of human resources, marketing, financial and strategic management with fund, opportunities | Analyse, Create |
| CO5 | Decipher the role of Institution support and policy framework of Government for enterprises in India | Analyse, Apply |

**CO-PO Matrix**

| Course | CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HHS 341/342** | **CO1** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 3 | 2 | **2** | **2** |
| | **CO2** | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 3 | 2 | 2 | 2 |
| | **CO3** | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 2 | 1 |
| | **CO4** | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 2 | 2 | 2 |
| | **CO5** | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 1 |
| average | | 0.4 | 0.6 | 1 | 0.2 | 0.6 | 1 | 1 | 1.2 | 0.6 | 0.4 | 2.8 | 1.8 | 2 | 1.6 |

**Syllabus**

**UNIT I Entrepreneurship**:
Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.
**Entrepreneurial Motivation:** motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.

**UNIT II Business Enterprises and Ownership Structure**:

Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

**UNIT III Project Management**:
Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

**UNIT IV Management of Enterprises**:
Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

**UNIT V Institutional Support and Policies**:
Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

**References:**


1. **Khanka, S S**. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
2. **Desai, Vasant**, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.


**Additional Reference Books**


1. **Gupta and Srinivasan**, 'Entrepreneurial Development', S Chand & Sons, New Delhi.
2. **Ram Chandran**, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
3. **Saini, J. S**. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd
4. **Holt, Davis, '**Entrepreneurship : New Venture Creations, PHI

# SEMESTER- 6

## TOT-352 HYDROGENATION AND MODIFICATION OF OILS

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

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

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

**Course Outcome 2(CO2)**

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

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus:**

**Module-I**

**Hydrogenation of oils:**

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

**Module-II**

**Hydrogenation catalysts and hydrogen production:**

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

**Module-III**

**Commercial plants and processes for hydrogenation of oils:**

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

**Module-IV**

**High-pressure hydrogenation:**

Production of fatty alcohols, Hydrogenation of fatty acids: importance of operating variable and feed stock purity, commercial fatty alcohols and their industrial applications, working principles of nitrogen based filtration systems.

**Module-V**

**Modification of oils and their applications:**

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

**Module VI**

**Laboratory work**

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

**Reference Book**


1. Bailey's Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi A Wiley- Interscience Publication, John Wiley & Sons, New York.
2. Hydrogenation of Oil & Fat Edited by H.B.W. Patterson Applied Science publishers (1983)
3. Gupta, M. K., Practical guide to vegetable oil processing. AOCS Press, 2008 Urbana, Illinois.
4. M.M Chakrabarty. Chemistry and Technology of Oils and Fats. Allied Publishers Pvt. Ltd. New Delhi.
5. Fats and oils, Formulating and Processing for Applications, 3rd Edition,2009, Richard D.O. Brien.
6. Fats and Oils Handbook, Michael Bockisch, 1st Edition, 1998, AOCS Press
7. BIS 10633


**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Hydrogenation of oils**: | |
| 1.1 | Principle of hydrogenation | 1 |
| 1.2 | Importance of hydrogenation & its kinetics | 1 |
| 1.3 | Parameters And their effects on rate of hydrogenation | 1 |
| 1.4 | Selectivity an isomer formation | 1 |
| 1.5 | Trans-fat and its effect on products | 1 |
| 1.6 | World wide trends and regulations in hydrogenation | 1 |
| **2.** | **Hydrogenation catalysts and hydrogen production:** | |
| 2.1 | Catalyst structure, poisons and promoters | 2 |
| 2.2 | Theory of catalysis | 1 |
| 2.3 | Properties of catalysts | 1 |
| 2.4 | Types of catalysts employed forhydrogenation of oils and fats | 1 |
| 2.5 | Methods of catalyst manufacture & regeneration | 1 |
| 2.6 | Manufacture of hydrogen gas | 1 |
| 2.7 | Hydrogen distribution through manifold & direct gasification | 1 |
| 2.8 | Estimation of purity of hydrogen and oxygen gas | 1 |
| 2.9 | Hydrogen gas requirements for hydrogenation of different oils | 1 |
| **3.** | **Commercial plants and processes for hydrogenation of oils:** | |

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

# TOT-356 TECHNOLOGY OF SURFACTANTS & SYNTHETIC DETERGENTS

**L : T: P:C**
**2 : 1: 0:3**

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

1. Chemistry and route of synthesis of anionic surfactants and their applications

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus**

**Module-I**

**Surface active agents:**

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

**Module –II**

**Classification, synthesis and applications of surfactants:**

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

**Module –III**

**Plants and manufacturing processes of surfactants:**

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

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

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

**Module –V**

**Evaluation of detergent products:**

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

**Reference Books**


1. The Handbook Of Soap Manufacture, Simmons ,W. H. and Appleton ,H. A. Kindle Books, USA.
2. Soap, Detergent & Perfume Industry,Srivastava S.B ,Small Industry Research Institute,New Delhi.
3. Sulphonation Technology In The Detergent Industry, Herman W. and De Groot, Springer-Verlag New York.
4. Surface Active Agents , Goliath Company,The Gale Group, USA
5. Powdered Detergents , Showell, M. The Procter & Gamble Company, Cincinnati, Ohio, USA.
6. Synthetic Detergents,. Davidson, A.,and Mılwidsky, B.M.,John Willey Sons,New York.
7. The manufacture of glycerol,by Martin, G. Technical Press, London
8. Handbook Of Detergents, Waldhoff, H.,and Henkel K.CRC Press, USA.
9. Soap-Chemistry and Technology, Kane,J. G.,
10. The Manufacture of Soaps, Other Detergents, and Glycerine,Woollatt, Edgar, Mountainview Books, PA, U.S.A.
11. Detergent Of Speciality Surfactants,Ed, Fredil,F.E.,Marcel Dekker, Inc.New York.
12. The Handbook of Soap Manufacture, by W. H. Simmons and H. A. Appleton,
13. Handbook of Detergents,Edited by Uri Zoller,CRC Press,London.
14. BIS – IS: 4955-1978; Specification for Synthetic Detergent Powders for household use
15. Gemini Surfactants: Synthesis interfacial and Application
16. Handbook of Detergent; Part A, B, C, D


**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Surface active agents** | |
| 1.1 | Theory of surface action; effect and behavior of surface active agents on the interfaces; solid- liquid, gas-liquid, liquid-liquid | 2 |
| 1.2 | Bulk properties of surfactant solutions and methods of their measurements: micelle properties, foaming, wetting, emulsification, dispersion | 2 |
| 1.3 | Measurement of critical micelle concentration, foaming power and foam stability | 2 |
| 1.4 | Measurement of wetting power, emulsifying power, stability of dispersion and detergency | 2 |
| **2.** | **Classification, synthesis and applications of surfactants** | |
| 2.1 | Anionic surfactants: sulfated and sulfonated surfactants e.g. sulfated oils, alkyl sulfates, alkyl ether sulfates, sulfated mono-glycerides, alkyl glyceryl ether sulfonates, sulfated derivatives alkanolamides, ester and amide sulfonates, sulfonated poly-carboxylic acid surfactants, alkyl aryl sulfonates, olefin sulfonates, methyl ester sulfonates, mahogany and petroleum sulfonates and other miscellaneous anionic surfactants. | 3 |
| 2.2 | Cationic surfactants: Non-quaternary nitrogen bases e.g. amines, nitriles and their: quaternary nitrogen bases and miscellaneous cationic surfactants | 2 |
| 2.3 | Nonionic surfactants: Poly-ethoxy ethers and esters and poly-hydroxy nonionic surfactants | 2 |
| 2.4 | Amphoteric surfactants, | 1 |

| | | |
|---|---|---|
| 2.5 | Bio surfactants and Novel surfactants | 2 |
| **3.** | **Plants and manufacturing processes of surfactants** | |
| 3.1 | Plants and manufacturing processes of anionic surfactants viz. alcohol sulfates, alkyl aryl sulfonates, alpha olefin sulfonates, sulfated and sulfonated oils, methyl esters sulfonatesetc | 3 |
| 3.2 | Plants and manufacturing processes of nonionic surfactants viz. Poly-ethoxy ethers and esters, poly-hydroxy surfactants etc | 2 |
| 3.3 | Plants and manufacturing processes of cationic surfactant e.g. quaternary ammonium compounds | 2 |
| **4.** | **Builders, fillers and auxillary materials, production of detergent products** | |
| 4.1 | Inorganic and organic builders and fillers used in the manufacture of synthetic detergents and their functions | 2 |
| 4.2 | Polymers, optical brighteners, enzymes and other performance additives used in the manufacture of synthetic detergents and their functions | 2 |
| 4.3 | Various physical forms of synthetic detergents: Solid, liquid, and non/liquid forms | 1 |
| 4.4 | Plants and processes employed for manufacture of powder, liquid, cake and other forms | 2 |
| **5.** | **Evaluation of detergent products** | |
| 5.1 | Analytical techniques employed for analysis of synthetic detergents as per BIS Methods | 2 |
| 5.2 | Analytical techniques employed for analysis of surfactants as per BIS Methods | 2 |
| 5.3 | Environmental impact and toxicity of surfactants | 2 |
| 5.4 | Methods for determination of efficacy of surfactants | 2 |
| | **Total** | **40** |

# TOT-356 REFINING OF OILS

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

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus:**

**Module-I**

**Pretreatment of oils:**

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

**Module-II**

**De-acidification of oils and fats:**

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

**Module-III**

**Bleaching of oils and fats:**

Theory of adsorption bleaching; components responsible for oil color; chemical and physical characteristics of various bleaching agents; activated bleaching earth and activated carbon and their methods of manufacture, extraction of oils from spent earth, determination of bleach ability and bleaching efficiency of adsorbents, batch and continuous methods of bleaching by adsorption; DOBI value, filtration techniques for removal of spent bleaching agents from bleached oils viz. Plate &

frame filter, polish filter, pressure leaf filter, use of hydro gel & silica gel, chemical bleaching; color fixation in oils and fats.

**Module-IV**

**Deodorization of oils and utilities:**

Components responsible for odor, flavor reversion, principle of deodorization, batch and continuous methods of deodorization; effect of operating variables; deodorization losses, commercial deodorizer design, thin film deodorization, Thermic fluid heater, thermo-syphoning, vacuum systems and their applications, steam generation, cooling tower. Concept of 3-MCPDE (3-Mono Chloro Propane Diol Esters) & GE (Glycidyl esters)

**Module-V**

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

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

**Module–VI**

**Laboratory work**

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

**Reference Books and suggested readings:**

1. Bailey's Industrial Oil and Fat Products, Volume 5, Sixth Edition Edible Oil and Fat Products: Processing Technologies Edited by Fereidoon Shahidi, A Wiley- Interscience Publication, JOHN WILEY & SONS, New York.
2. Gupta, M. K. 2008. Practical guide to vegetable oil processing. AOCS Press, Urbana, Illinois.
3. M.M Chakrabarty. Chemistry and Technology of Oils and Fats. Allied Publishers Pvt. Ltd. New Delhi.
4. List, G. 2009. Bleaching and Purifying Fats and Oils Theory and Practice. AOCS Press.
5. W. Hamm, R. J. Hamilton, G. Calliauw 2013. Edible Oil Processing, Second edition, John Wiley & Sons, Ltd, UK
6. Dijkstra, A. J. (2017). About water degumming and the hydration of non-hydratable phosphatides. *European journal of lipid science and technology*, *119*(9), 1600496.
7. Pandey, R. A., Sanyal, P. B., Chattopadhyay, N., & Kaul, S. N. (2003). Treatment and reuse of wastes of a vegetable oil refinery. *Resources, Conservation and Recycling*, *37*(2), 101-117.
8. Dumont, M. J., & Narine, S. S. (2007). Soapstock and deodorizer distillates from North American vegetable oils: Review on their characterization, extraction and utilization. *Food Research International*, *40*(8), 957-974.
9. Bhosle, B. M., & Subramanian, R. (2005). New approaches in deacidification of edible oils—a review. *Journal of Food Engineering*, *69*(4), 481-494.
10. de Morais Coutinho, C., Chiu, M. C., Basso, R. C., Ribeiro, A. P. B., Gonçalves, L. A. G., & Viotto, L. A. (2009). State of art of the application of membrane technology to vegetable oils: A review. *Food Research International*, *42*(5-6), 536-550.
11. Gunawan, S., & Ju, Y. H. (2009). Vegetable oil deodorizer distillate: characterization, utilization and analysis. *Separation & Purification Reviews*, *38*(3), 207-241.

**Course contents and Lecture schedule:**

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

# TOT 358 Quality Assurance of Oils and Allied Products

**L : T: P:C**
**2: 1: 0:3**

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

1. Quality control and quality assurance in oils and allied industries.

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

**Course Outcome 2(CO2)**

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

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus**

**Module -I**

**Quality control and Quality Assurance:**

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

**Module–II**

**Chromatographic Techniques:**

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

**Module –III**

**Spectroscopic Techniques;**

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

**Module –IV**

**Special quality control methods:**

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

**Module –V**

**Hyphenated techniques:**

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

**Reference Books and suggested readings:**


1. Manual of Methods of Analysis of Foods, Oils and Fats. Food Safety and Standards Authority of India, 2015
2. Laboratory Handbook for Oil and Fat Analysts. L. V. Cocks and C. Van Rede
3. Standard Methods for the Analysis of Oils, Fats and Derivatives. C. Paquot, Pergammon Press, 6th Edition, 2013
4. Chemistry and Technology of Oils and Fats. M.M Chakrabarty, Allied Publishers Pvt. Ltd. New Delhi
5. Fats and Oils Formulating and Processing for Applications, 3rd Edition Richard
6. D.O. Brien, 2009Principles of Instrumentation analysis, Edition- III (1985) Edited by Douglas A. Skog
7. Standard methods of analysis CODEX, BIS, AOCS, ISO, FSSAI.


**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Quality control and Quality Assurance** | |
| 1.1 | Concept of quality assurance and quality control in relation to oil industry | 2 |
| 1.2 | Quality management systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP) | 4 |
| 1.3 | Role of international organizations such as ISO; IDF; CAC; AOAC; WTO and national organizations like BIS; and Agmark; FSSAI and APEDA (Agricultural and Processed Foods Export Development Authority) in oil industry | 4 |
| 1.4 | Guidelines for setting up quality control laboratory. Legislation on oils and allied products | 4 |
| **2.** | **Chromatographic Techniques** | |
| 2.1 | Theoretical developments of various chromatographic techniques | 4 |
| 2.2 | Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of thin layer chromatography | 2 |
| 2.3 | Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of column chromatography | 2 |
| 2.4 | Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of gas-liquid chromatography | 4 |
| 2.5 | Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of HPLC | 4 |
| 2.6 | Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of Super critical Chromatography | 4 |
| | **Total hours** | **34** |

# TOT-360: ENVIRONMENTAL ASPECTS OF OILS AND ALLIED INDUSTRIES

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

**Preamble**:

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

**Prerequisite:**

Knowledge of engineering and oil processing.

**Course Outcome:**

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

| | | |
|---|---|---|
| (CO1) | Understand the various pollutants and their effects on global scenario as well as effects on the processing of oils and allied products. | Understand |
| (CO2) | Analyze various characteristics of effluent streams. | Analyze |
| (CO3) | Apply the best treatment option available among the various pollution control methods. | Apply |
| (CO4) | Apply various waste minimization options available for reduction, recovery, reuse & recycle principles. | Apply |
| (CO5) | Apply Pollution prevention and environment management system. Audit, different regulations & acts for air, water & solid pollution control. Procedure of lisoning work & cost of processing for the treatment of the effluents produce in the oil & allied industries. | Apply |

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

3. Study of by-product utilization.

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus:**

**Module-I**

**Industrial pollution and its impact**

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

**Module-II**

**Environmental Management Policy and Regulations**

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

**Module-III**

**Waste Management**

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

**Module-IV**

**Liquid Effluent Treatment Technology**

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

**Module-V**

**Solid & Gas Effluent treatment**

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

**Text Books:**

**1.** Air Pollution Engineering, S.K.Garg, Khanna Publishers(2016), DariyaGanj, New Delhi.

2. Waste Water Engineering, Metcalf Eddy, Tata McGraw-Hill publishing Company Ltd. (1990) 2nd edition, New Delhi.

**Reference Book:**

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

**Course contents and Lecture schedule:**

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

# TOT 362 INSTRUMENTATION & PROCESS CONTROL

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Assessment:**

Sessional: 50 marks

End Semester: 50 marks

**Course Objectives:**

To gain the knowledge of different process instruments and various control processes for closed loop and open loop systems..

**Course outcomes:**

| | | |
|---|---|---|
| CO1 | Understand and interpret control diagrams | Understand |
| CO2 | .Design and tuning of controllers for specific applications | Apply |
| CO3 | Calculate the dynamic response of closed loop systems | Analyze |
| CO4 | Understand the principles involved in measurements, Attain knowledge on different measurement methods employed in industrial processing and manufacturing. | Understand |
| CO5 | Understand and Analyze the different temperature measurement devices in Chemical industries. | Understand and Analyze |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | 1 | 1 | 2 | **2** | **2** |
| CO2 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 2 | 2 |
| CO4 | 3 | 1 | 1 | - | - | - | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| CO6 | 3 | 3 | 3 | 2 | 2 | - | - | - | 3 | 2 | 1 | 2 | 2 | 2 |
| Avg | 3 | 2.5 | 2.16 | 1.83 | 1.83 | - | - | - | 0.5 | 0.83 | 0.66 | 2 | **3** | **2** |

**Module 1 (8 hours)**

Introduction to Process control systems, Use of Laplace & Inverse Laplace Transformation in study of Process Dynamics & Control. Characteristics of measurement system, classification of measuring instruments.

**Module 2 (8 hours)**

Dynamic Modeling of a Process, Dynamic behavior of First order system, First order systems in series & second & higher order systems for various kind of inputs, Linearization of nonlinear systems, Transportation & Transfer Lag.

**Module 3 (8 hours)**

Classification of control systems, Regulator & Servo control, Feed Forward & Feed backward control, Negative & Positive Feedback Control, Modes of control action, Controllers & Final control Elements, Reduction of Block & Signal Flow Diagrams.

**Module 4 (8 hours)**

Principles of measurements and classification of process control instruments, Functional elements of an instrument, Static & Dynamic Characteristics of instruments, Transducers, Error analysis, Measurement of temperature: expansion thermometers, Resistance Thermometers, thermocouples, Thermistors, Pyrometers.

**Module 5 (8 hours)**

Flow measurement: Inferential flow measurements, Quantity flow meters, Mass flow meters. Flow measurement, head types-area flow meters, mass flow meters, positive displacement type flow meters, electrical type flow meters and solid flow measurement.

**Suggested Text Books**

1. Coughnour and Koppel, " Process Systems Analysis and Control ", McGraw-Hill, New York, 1986.
2. George Stephanopolous, " Chemical Process Control ", Prentice-Hall of India Pvt-Ltd., New Delhi, 1990.
3. Singh, S. K. , Industrial Instrumentation and Control , Prentice Hall of India, 2016

4 .Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., New York, 1990

# BMA 342 OPERATIONS RESEARCH

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVE: The objective of this course is to educate the students about:**

- Mathematical formulation and solution of Linear programming problems by various method.
- Transportation problems and assignment problems and their solutions.
- Advanced LPP and Travelling salesman Problem and their solutions.
- Fundamentals of Network problems and their solutions by CPM and PERT Methods.
- Dynamic programming problem and genetic algorithm.

**Course Outcome**

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

| | | |
|---|---|---|
| CO1 | understand and solve linear programming problems. | Apply, Evaluate |
| CO2 | formulate and solve Transportations models, Assignment models and integer linear programming problems. | Apply, Evaluate, Create |
| CO3 | formulate and solve sequencing and scheduling models. | Apply, Evaluate, Create |
| CO4 | formulate and solve Replacement and inventory models. | Apply, Evaluate, Create |
| CO5 | learn and use Dynamic programming and Genetic Algorithms. | Apply, Evaluate |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | - | 3 | 3 | **1** | **2** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | - | 3 | - | 3 | 3 | 3 | 3 |

**Detailed Syllabus:**

**UNIT I: Linear Programming Problems (LPP)**

OR model, Formulation of LPP. model, Graphical LPP solution and sensitivity analysis, simplex method, M-method, Two-phase method, Special cases in simplex method application, Duality theory, Dual simplex method, Revised simplex method, Degeneracy, Sensitivity analysis, Various industrial application of LP.

**UNIT II: Transportation Models, Assignment Models and Integer Programming:**

Formulation and Optimal solution of transportation models, Assignment models, Transshipment models, Degeneracy in TP model, Industrial application, Formulation and Solution of integer linear programming problems; Cutting-plane algorithm, Branch and Bound algorithm, 0-1 ILPP, applications, Knapsack problem, facility-location problem.

**UNIT III: Sequencing and Scheduling Model:**

Sequencing problems- Travelling salesman problem, Machine-scheduling problem (Job shop), Network based planning models, Objectives of CPM and PERT, Characteristics of CPM/PERT

projects, Network diagram, Terminology, Critical path, Project duration, PERT Network, Activity time, Probabilities of project completion, Optimal crashing of project activities.

**UNIT IV: Replacement and Inventory models:**

**Replacement Problems:** Optimal age of equipment replacement, capital equipment discounting cost, Replacement of items that fail, Individual and group replacement policies.

**Inventory Models:** Deterministic inventory models, Classic EOQ model, EOQ with price breaks, Multiterm, stochastic inventory models under probabilistic demand and lead times.

**UNIT V: Dynamic Programming and Genetic Algorithms:**

**Dynamic programming:** Bellman's principle of optimality, computations in DP, Forward and Backward recursions, Dynamic Programming formulations, Investment problem, General allocation problem, Storage coach problem, Production scheduling.

**Genetic Algorithms:** Working principles, similarities and differences between Gas and Traditional methods, Gas for constrained optimization, Applications of Gas to solve simple problems.

**Text Books Recommended:**

**1.** S.S. Rao, "Optimization: Theory and Applications" Willey Eastern Limited.

**2.** H.A. Taha, " Operations Research- AN Introduction", Macmillan.

**3.** Hiller, F.S., G.J. Lieberman, "Introduction to Operations Research", Hoiden-Day.

**4.** Kalyanmoy Deb, "Optimizaton for Engineering Design: Algorithms & Examples " Prentice- Hall of India.

**5.** B.E. Gillet, Introduction Operations Research- A Computer Oriented Algorithmic Approach, McGraw Hill 1989.

## SEMESTER- 7

# TOT-451: QUALITY ASSURANCE OF OILS AND ALLIED PRODUCTS LAB

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

**OBJECTIVE: The objective of this course is t**o enable the students

- Awareness of instruments used for quality testing of oils & fats & their properties.
- Utilization of Instruments & testing methods.
- Use of modern instrument for determination of purity of oils & fats & detecting the adulteration.
- Determination of DOBI value for palm oil,
- Preparation of methyl esters from crude oils,
- Determination of fatty acid composition and detection of adulteration by Chromatographic techniques,
- Determination of mono, di and tri glyceride,
- Determination of di-ene and tri-ene content by UV-Visible,
- Analysis of oils and fats using GC, GC-MS etc..

**Course Outcome**

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

| | | |
|---|---|---|
| **CO1** | Study of spectroscopic techniques, FTIR, NIR, NMR, Mass spectrography, role of TLC-FID/FPD, GC-MS, SFC-GC, LC-MS & ICP-MS. | Understanding |
| **CO2** | The utilization of above instruments for testing of the oil samples for their nature & purity. | Apply |
| **CO3** | Analyze the properties of Oil & Oleochemicals. | Analyze |
| **CO4** | Search for advance oleochemicals having similar properties. Searching ecofriendly oleochemicals. | Create |

| **COs** | **POs** | | | | | | | | | | | | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** |
| **CO1** | M | M | L | M | L | M | L | M | M | M | M | M | M | S |
| **CO2** | L | L | L | L | L | M | M | L | L | L | M | L | M | S |
| **CO3** | S | S | S | S | M | M | L | M | M | M | M | M | L | M |
| **CO4** | M | M | L | L | L | M | M | L | L | L | M | L | M | M |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course contents and Lecture schedule:**

| **Module No.** | **Topic** | **No. of Lectures** |
|---|---|---|
| 1. | Determination of DOBI value for palm oil | 3 |
| 2. | Preparation of methyl esters from crude oils, | 3 |
| 3. | Determination of fatty acid composition and detection of adulteration by Chromatographic techniques, | 3 |

| | | |
|---|---|---|
| 4. | Determination of mono, di and tri glyceride, | 3 |
| 5. | Determination of di-ene and tri-ene content by UV-Visible | 6 |
| 6. | Analysis of oils and fats using GC, GC-MS etc.. | 6 |
| | **Total** | **24** |

**Reference Books and suggested readings:**


1. Manual of Methods of Analysis of Foods, Oils and Fats. Food Safety and Standards Authority of India, 2015
2. Laboratory Handbook for Oil and Fat Analysts. L. V. Cocks and C. Van Rede
3. Standard Methods for the Analysis of Oils, Fats and Derivatives. C. Paquot, Pergammon Press, 6th Edition, 2013
4. Chemistry and Technology of Oils and Fats. M.M Chakrabarty, Allied Publishers Pvt. Ltd. New Delhi
5. Fats and Oils Formulating and Processing for Applications, 3rd Edition Richard
6. D.O. Brien, 2009Fatty acids; Their chemistry, properties, production and uses Part – III Edited by K.S. Markley
7. Principles of Instrumentation analysis, Edition- III (1985) Edited by Douglas A. Skog
8. Standard methods of analysis CODEX, BIS, AOCS, ISO, FSSAI.

# TOT-453: ESSENTIAL OILS & COSMETICS

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

**Preamble**:

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

**Prerequisite:**

Knowledge of basic sciences organic chemistry, oils & fats.

**Course Outcome:**

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

| | | |
|---|---|---|
| (CO1) | Understand various essential oils,their sources & grades. | Understand |
| (CO2) | Characterize various essential oils in various applications as per their physico-chemical properties | Analyze |
| (CO3) | Isolate various active components of essential oils and their recovery by different suitable process. | Apply |
| (CO4) | Synthesize and formulate various perfumery materials for different applications. | Create |
| (CO5) | Formulate various cosmetic products for different applications. | Create |

Mapping with Program Outcomes

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

Assessment Pattern:

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

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

**Course Outcome 2(CO2)**

1 Physical, Chemical and optical characteristics.

2. The modern analytical methods such as GC, GC-MS.

3.Tools for finding adulteration..

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus:**

**Module –I**

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

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

**Module -II**

**Physico-chemical characteristics of essential oils**

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

**Module -III**

**Production, properties and composition of important Indian essential oils**

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

**Module -IV**

**Important isolates, synthetic perfumery materials and fixatives**

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

**Module -V**

**Production of cosmetic products**

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

**Module -VI**

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

**Reference Book**

1. Soap, Detergent & Perfume Industry, S.B Srivastava, Small Industry Research Institute,New Delhi. 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. Gylcerin Edited Vol -11 (1991)by Eric Jungermann & Norman O.V. Sonntag
7. Soaps: Their chemistry & Technology by J.G. Kane
8. Soaps & detergent by K.S. Parasuram

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

**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Sources, classification and chemistry of essential oil bearing materials** | |
| 1.1 | Sources from different parts of natural essential oil plants, availability, timing, etc. | 3 |
| 1.2 | Different methods of manufacturing essential oils from various parts and according to the characteristics of flowers etc. | 4 |
| 1.3 | Grading and standardization of essential oils | 1 |
| **2.** | **Physico-chemical characteristics of essential oils** | |
| 2.1 | Specific gravity, refractive index, optical rotation, solubility, acid value, ester Value | 2 |
| 2.2 | Analysis of essential oils e.g. free alcohol, total alcohol, aldehyde and ketone Content | 2 |
| 2.3 | Phenol content, common adulterants and their detection | 3 |
| **3.** | **Production, properties and composition of important Indian essential oils** | |
| 3.1 | Rose, jasmine, khus, sandal wood, keora | 3 |
| 3.2 | Palmarosa, lemon-grass, peppermint, lemon | 2 |
| 3.3 | spices oils, clove oil | 3 |
| 3.4 | orange oil, eucalyptus oil , natural fats and bi additives compounds etc | 2 |
| **4.** | **Important isolates, synthetic perfumery materials and fixatives** | |
| 4.1 | Menthol, camphor, thymol, geraniol, citral | 2 |
| 4.2 | eugenol, terpeniol, vanillin, coumarins, musk:Natural | 2 |
| 4.3 | Synthetic & Artificial, benzyl acetate, benzyl benzoate etc | 2 |
| 4.4 | Synthesis;Esters of geraniol, citraniol & terpenols, ionones, Hydroxy citronellol etc. | 2 |
| 4.5 | Castor oil based perfumery chemicals, blending of perfumes | 2 |
| **5.** | **Production of cosmetic products** | |
| 5.1 | Face creams(cold and vanishing creams), Face powders, Talcum powders, Hair oil, Hair cream & dyes | 3 |
| 5.2 | Shampoos, Tooth pastes & powders, Shaving creams, body gels | 2 |
| 5.3 | Lipsticks, Nail polishes Depilatories, aroma therapeutic products and herbal products etc. | 2 |
| 5.4 | Related plant and machinery for cosmetics & improvement design of essential oils and isolates manufacturing plants. | 3 |
| **Total** | | **45** |

# TOT-455 ADVANCE OIL CHEMISTRY AND OLEO CHEMICALS

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

**Preamble**:

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

**Prerequisite:**

Knowledge of oil chemistry.

**Course Outcome:**

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

| | | |
|---|---|---|
| (CO1) | Understand glyceride structure by different method of testing synthesis of fatty acids and glycerides. | Understand |
| (CO2) | Apply knowledge for derivation of oleo chemicals . | Apply |
| (CO3) | Find applications of various oleo-chemicals in different industries. | Apply |
| (CO4) | Apply knowledge of oil modification and its utilization in paint & polymer industries. | Apply |
| (CO5) | Synthesis bio fuels and eco-friendly surfactants. Comparioson of costing with chemical process of products with bioprocess. | Create |

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

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

**Course Outcome 2(CO2)**

1. Mechanism of important chemical & bio-chemical reactions of fats & fatty acids.
2. Polymorphism of fats & their utilization in making industrial fat products.

3. Oleo-chemicals from various oils.
4. Utilization of by-products.

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

## Syllabus:

### Module-1

**Glyceride structure :**

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

### Module-2

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

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

### Module-3

**Oil derivatives and their applications:**

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

### Module-4

**Chemistry and applications of drying oils:**

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

### Module-5

**Production and applications of methyl ester:**

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

## Reference Book

1. Richard D. O'Brien "Fats and Oils: Formulating and Processing for Applications" 3rd Edition (2008) CRC Press
2. Moghis Ahmad "Fatty Acids: Chemistry, Synthesis, and Applications" 1st Edition Academic Press and AOCS Press.
3. Robert Selby Morrell, H. R. Wood "The Chemistry of Drying Oils" E. Benn limited.

4. Ian P. Freeman, Sergey M. Melnikov (2015) “Margarines”
https://doi.org/10.1002/14356007.a16_145.pub2
5. International Castor Oil Association (1992) “The Chemistry of Castor Oil and Its Derivatives and Their Applications”

**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Glyceride structure** | |
| 1.1 | Advanced theories of glyceride structure | 2 |
| 1.2 | Determination of glyceride structure | 3 |
| 1.3 | Synthesis of fatty acid and their derivatives | 1 |
| 1.4 | Estimation of mono – diglycerides | 1 |
| 1.5 | Polymorphism of fats and fatty acid, glycerides synthesis, reaction mechanism, oleo-chemicals, bye-products utilization | 2 |
| **2.** | **Mechanism of important chemical and biochemical reaction of fats and fatty acids** | |
| 2.1 | Mechanism of designing, inter-esterification, isomerisation | 1 |
| 2.2 | Oxidation, saponification, important oleo-chemicals. | 2 |
| 2.3 | Inter-esterification | 2 |
| 2.4 | Polymorphism | 1 |
| 2.5 | Oleo-chemicals | 3 |
| 2.6 | Bye-products Utilization | 2 |
| **3.** | **Oil derivatives and their applications** | |
| 3.1 | Production and utilizations of fatty nitriles | 2 |
| 3.2 | Production and utilization of fatty amine | 2 |
| 3.3 | Sulphated and sulphurised oils | 1 |
| 3.4 | Textile chemicals, leather chemicals | 1 |
| 3.5 | Polymer additives, paint additives, lubricants additives, | 2 |
| **4.** | **Chemistry and applications of drying oils** | |
| 4.1 | Modification of oils for surface coating industries, thermal and chemical modification method | 2 |
| 4.2 | Properties of modified oils ,changes by heat bodying and oxidative polymerization | 1 |
| 4.3 | Process of maleinised, epoxidized oils | 1 |
| 4.4 | Process of boiled oils, stand oils, blown oil | 1 |
| 4.5 | Ureathane oils, alkyds | 1 |
| 4.6 | Evaluation of surface coating materials | 1 |
| **5.** | **Production and applications of methyl ester** | |
| 5.1 | Various methods of production | 2 |
| 5.2 | Specifications as per STM, BIS & determination thereof | 1 |
| 5.3 | Sulphated & sulphonated methyl ester & their application | 2 |
| | **Total** | **40** |

# TOT-457 PETROLEUM PRODUCTS AND PETROCHEMICALS

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

**Preamble**:

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

**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

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

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

**Course Outcome 2(CO2)**

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

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus:**

**Module I**

**Introduction to mineral oils**:

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

**Module II**

**Processing of petroleum**;

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

**Module III**

**Petroleum refining processes and operation**s:

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

**Module IV**

**Auxiliary processes**:

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

**Module V**

**Petrochemicals**;

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

**Reference Book**


1. Nelson W. L., "Petroleum Refinery Engineering" 4th Ed.., McGraw Hill 1987
2. Wauquier J. P., "Petroleum Refining 2 Separation Processes", Vol:1-5, IFP, Technip Ed. 1998
3. Meyers R. A., "Hand book of Petroleum Refining Processes", 3rd Ed., The McGraw-Hill Publication Data 2004
4. Dawe R. A., "Modern Petroleum Technology- Part I", by Institute of Petroleum (IP), John Wiley 2002
5. Prakash Surinder " Refining Processes Hand book" Elsevier 2003
6. Hobson,G.D." Modern Petroleum technology Volume I & II" Wiley 1984

7. Bhaskar rao, B.K. "Modern Oetroleum refining processes" Oxford &IBH Publishing Co Pvt.Ltd. 2005

**Course contents and Lecture schedule:**

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

# TOT-459: COMMERCE, PROCESS ECONOMICS, AND SAFETY MANAGEMENT IN OIL INDUSTRIES

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

**Preamble**:

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

**Prerequisite:**

Knowledge of engineering operations, commerce & process economics of oil processing industry.

**Course Outcome:**

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

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

Mapping with Program Outcomes

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

Assessment Pattern:

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

1. Different mechanism involved in procurements of oil seeds and oil.
2. Knowledge of Taxes and import-export duties on oil seeds and oil.

3. Practices of sale of bulk/packaged oils with supply chain management.

**Course Outcome 2(CO2)**

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

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus:**

**Module- I**

**Procurement process for oilseeds and oils taxes & duties:**

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

**Module II**

**Components of Costing, project appraisal and Human resource development:**

Capital cost of project for establishing oil mills, solvent extraction plant, oil refinery plant, & other plant related to oil industries, technical appraisal, commercial appraisal & marketing, financial appraisal, management appraisal & economic appraisal-social cost benefits. Human resource Planning: Importance and processes, Job analysis and Engagements, Training need analysis, Management Information System (MIS).

**Module- III**

**Utilities & Production planning:**

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

**Module-IV**

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

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

**Module- V**

**Safety management:**

Segregation of deodorizer distillate and isolation of value added products by conventional and molecular distillation and other plants and machinery involved. Classification of effluents of oil and allied industries, Safety considerations in storage of hazardous and inflammable raw materials. Fire Protection and safety: Sources, types, Fire & explosion index, safety measures for protection. Health and Hazards: Resources, competence & regulations, systems & tools, HAZOP guidelines.

**Reference Books and suggested readings:**

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

**Course contents and Lecture schedule:**

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

| | | |
|---|---|---|
| 3.3 | Energy conservation in oil processing industry | 1 |
| 3.4 | Financial analysis i.e. break-even point and rate of return | 1 |
| 3.5 | Financial analysis i.e. pay-back period and depreciation | 1 |
| 3.6 | Factory layout of solvent extraction and oil refinery | 1 |
| 3.7 | Machine layout in solvent extraction and oil refinery | 1 |
| 3.8 | Instrumentation and automation in oil refinery | 1 |
| **4.** | **By- products of oil and oilseed processing industry and their utilization** | |
| 4.1 | Phospholipids, production of industrial and edible grade Lecithin gums | 2 |
| 4.2 | Manufacture of cattle and poultry feed | 1 |
| 4.3 | Production protein concentrates and isolates | 1 |
| 4.4 | Re-esterification of fatty acid with glycerin | 1 |
| 4.5 | Trans-esterification for production of bio-diesel | 2 |
| 4.6 | Utilization of deteriorated deep fried oil for industrial utilization | 1 |
| **5.** | **Safety measures, Effluents and their treatment** | |
| 5.1 | Segregation of deodorizer distillate and isolation of value added product by conventional and molecular distillation | 2 |
| 5.2 | Classification of effluents of oil and allied industry | 2 |
| 5.3 | Safety consideration in storage of hazardous and inflammable raw materials | 1 |
| 5.4 | Fire protection and safety | 1 |
| 5.5 | Health and hazard regulations | 1 |
| 5.6 | HAZOP guidelines | 1 |
| 5.7 | Environment eco-friendly, waste minimization and waste disposal | 1 |
| 5.8 | Effluent treatment plants, system efficiency etc. | 1 |
| 5.9 | GOI specification of effluents, eco-friendly processes and green technology | 2 |
| | **Total** | **43** |

# TOT 461 LIPID BIOTECHNOLOGY

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

**Preamble**:
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 biotechnological industries will also be discussed.

**Prerequisite:**
Advance science and engineering and oil technology

**Course Outcome:**
On the successful completion of the course, students will be able to.

| | | |
|---|---|---|
| (CO1) | Acquire the fundamental knowledge of scholarly discourse in lipid synthesis, recognize the biological roles vitamins and examine the toxicology of lipid components. | Understand |
| (CO2) | Combine the theories and concepts of microbial lipase in industrial applications. | Understand |
| (CO3) | Illustrate the critical skills in solving the reaction kinetics and optimizing the enzymatic process. | Apply |
| (CO4) | Differentiate between structured and genetically modified lipids, and identify ethical issues in environmental bioremediation. | Analyze |
| (CO5) | Evaluate synthesis and inter conversion of fatty acid and determination of glycerides structure of fats by enzymatic methods | Evaluate |

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

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

**Course Outcome 2(CO2)**

1. Single cell lipids their production and applications
2. Genetically modified oils their properties

3. Genetically modified oil's applications & ethical values

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus:**

**MODULE-1**

Biosynthesis of fatty acids and phospholipids; Mechanism of chain elongation and desaturation of acyl chains; Regulation of lipid metabolism; Biological role of fat in human nutrition; Atherosclerosis.

**MODULE-2**

EFA, MUFA, PUFA –Sources and biological activities in human health; Biochemical aspects of vitamins in nutrition; Toxic constituents in oilseeds and oils: Sources, structures, toxicological effects and methods of detoxification.

**MODULE-3**

Microbial production of fats and other lipids; Biotransformation of fats and lipids using whole microbial cells; General aspects of Microbial Lipases: Sources, isolation and purification and industrial applications

**MODULE-4**

Enzymatic Interesterification: Chemistry, reaction in (aqueous/organic) solvent systems, immobilization of enzymes, factors affecting enzyme activity, enzyme kinetics, reactor design.

**MODULE-5**

Structured lipids: Synthesis, analysis and applications Genetically modified lipids: Physical, chemical and nutritional functionality modifications. Environmental biotechnology concept: Principles in bioremediation and biological water & waste treatment.

**Reference Books:**


1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman & Company, 2004.
2. Lubert Stryer, Biochemistry, 4th Edition, W.H.Freeman and Company, 1995
3. Outline of Biochemistry by Eric.E. Conn and P.K. Stumpf, 5thedition, Wiley India.
4. Lipids: Biochemistry, Biotechnology and Health, 6th Edition by Michael I. Gurr, John L. Harwood, Keith N. Frayn, Denis J. Murphy, Robert H. Michell, WileyBlackwell
5. Fatty Acids in Fish Oğuz Taşbozan and Mahmut Ali Gökçe http://dx.doi.org/10.5772/68048
6. Food Lipids Chemistry, Nutrition, and Biotechnology, Fourth Edition Edited Casimir C. Akoh Taylor & Francis Group


**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Plant lipid sources** | |
| 1.1 | Animal lipid sources | 2 |
| 1.2 | Lipids in human nutrition | 3 |
| 1.3 | The lipid soluble vitamins | 3 |
| **2.** | **Biochemical Organization** | |

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

# Open Elective
# OOT- 491: TECHNOLOGY OF OILS, OLEO CHEMICALS AND SURFACTANTS

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

**Preamble**:

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

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**Prerequisite:**

Basic concept of chemistry.

**Course Outcome:**

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

| | | |
|---|---|---|
| (CO1) | Understand fundamental chemistry of oils, oleo chemicals and allied products. | Understand |
| (CO2) | Understand industrial importance of chemicals derived from oils and fats. | Understand |
| (CO3) | Understand expression and extraction techniques of oil from oil bearing materials. | Understand |
| (CO4) | Understand the process of refining of crude oils and its importance from health point of view. | Understand |
| (CO5) | Understand the role and importance of various ingredients in manufacturing soaps and detergents. | Understand |

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

1. Basics of oil seeds, oils, processing technology, various reaction and assessment of raw oil quality to be processed.

2. Selection of optimum technology to be adopted.
3. Knowledge of plant and machinery, their design, preventive and break down maintenance as per process requirement .

**Course Outcome 2(CO2)**

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

**Course Outcome 3(CO3)**

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

**Course Outcome 4(CO4)**

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

**Course Outcome 5(CO5)**

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

**Syllabus:**

**Module-I**

**Introduction to oils & fats**

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

**Module-II**

**Chemical reactions of oils & fats**

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

**Module-III**

**Post harvest technology of oilseeds**

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

**Module-IV**

**Refining of oils**

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

**Module-V**

**Introduction to surface active agent**

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

**Reference Books**

1. Richard D. O'Brien "Fats and Oils: Formulating and Processing for Applications" 3rd Edition (2008) CRC Press

2. Moghis Ahmad “Fatty Acids: Chemistry, Synthesis, and Applications” 1st Edition Academic Press and AOCS Press.
3. Robert Selby Morrell, H. R. Wood “The Chemistry of Drying Oils” E. Benn limited.
4. Ian P. Freeman, Sergey M. Melnikov (2015) “Margarines” **https://doi.org/10.1002/14356007.a16_145.pub2**
5. International Castor Oil Association (1992) “The Chemistry of Castor Oil and Its Derivatives and Their Applications”
6. NIIR Board. The Complete Technology Book on Soaps (2nd Revised Edition)
7. Parasuram K. S. (2002) Soaps and Detergents. Tata Macgraw Hill. (ISBN 007-462324-9)
8. Spitz, L. (2016). Soap Manufacturing Technology: Second Edition.

**Course contents and Lecture schedule:**

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

# TOT- 493 INDUSTRIAL TRAINING

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

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

1. To aware with the industrial environment, movement of raw materials upto finished products, human behavior, industrial relation, manpower management & efficient management of the manpower.
2. To have a proper knowledge of the manufacturing process of different products, their quality control procedure, utilities, and various techniques of quality control in terms of raw material, in process parameters and finished products as per norms of BIS, FSSAI and other statutory bodies.
3. To gain knowledge of water treatment, effluent treatment and air pollution control devices. Proper analysis of fuel and other utilities.
4. Students are allotted to work on project assign in that particular industries for controlling the losses, utilities consumption & other inputs for reducing cost of production.
5. To understand proper maintenance of the equipment's in the plants, i. e. regular, preventive and other schedule maintenance.
6. To understand the stores activities of procurement, storage & issue of spare-parts, packaging materials and various consumables & raw materials get conversant with FIFO system.
7. To understand the industrial drawings like layout, P&ID, line diagrams, electrical & instrumentation, civil drawings.
8. The students must understand the costing of various inputs on different section basis so as to have a knowledge of total cost of production.
9. To understand the R&D activities being carried out by the industries or intent to carry by the company & share their knowledge.
10. They should also aware the applicable the tax structure.

# TOT-495 SEMINAR

L : T: P:C

0 : 0 : 4:2

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

**OUT COMES**

1. This training provides a basic backbone for students for future industrial working environment.

2. Students after training gain a lot for appearing in campus placement activities.

3. Presentation enhances communication skill of the student.

# TOT-497 PROJECT

**L : T: P:C**
**0 : 0: 8:4**

**Objectives**

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

**Outcomes**

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

## Semester 8
# TOT-452 PACKAGING OF OILS, FATS AND ALLIED PRODUCTS

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

**Preamble**:

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

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**Prerequisite:**

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

**Course Outcome:**

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

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

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

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

Course Outcome 2(CO2)

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

Course Outcome 3(CO3)

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

Course Outcome 4(CO4)

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

Course Outcome 5(CO5)

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

**Syllabus:**

**Module I Introduction to Packaging**

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

**Module II Criteria and selection of packing material**

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

**Module III Forms of packaging**:

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

**Module IV Printing of packaging surfaces**

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

**Module V Packaging of various products**

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

**Reference Books and suggested readings**

1. Handbook of food packaging by F. A Paine and H.Y paine., Publisher: Blackis and Son Ltd London (1983)

2. Food Packaging Principles and Practice: Gordon L. Robertson
3. Modern processing and distribution system for food edited by F. A Paine
4. Food and packaging interaction by Risch. S. H., Publisher: American chemical Society, Washington (1991)
5. Packaging materials and containers by Paine F. A., Publisher: Blackis and sons Ltd, London (1983)
6. Mathlouthi, M. Food Packaging and Preservation. Gaithersburg: Aspen, 1999
7. Paine F. A . Packaging media Publisher: Blackis and son Ltd; Bishop Briggs (1977)
8. Bureau, G., and J. L. Multon. Food Packaging Technology. New York, n.d. (1996)
9. Chemistry of Food Packaging by Swalam C.M., American Chemical Society, Washington D. C. 1974.
10. Packaging. Rockport, MA: Rockport Publishers, 1995.

**Course contents and Lecture schedule:**

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

| | | |
|---|---|---|
| 5.5 | Packaging of lubricating oils and grease | 1 |
| 5.6 | Packaging of bye-product and allied industries | 1 |
| 5.7 | Limitation of solid waste management practices. | 1 |
| 5.8 | Types of packaging material and environmental issues, advantages and disadvantages. | 1 |
| 5.9 | Minimizing environmental impact. | 1 |
| 5.10 | Physical & chemical tests of packing materials. | 1 |
| | **Total** | **41** |

# TOT -454 FUELS AND GREEN LUBRICANTS

L:T: P:C

**3 : 1: 0:4**

**Preamble**:

The subject deals with the study of different types of fuels and lubricants used in the industries. The basis of selection of fuels and lubricants along with the role of various additives is also discussed. The subject also include information related to the quality parameters and method of production of lubricating oils and greases.

**Prerequisite:**

Fundamental knowledge of lubricating principles, oils & fats

**Course Outcome:**

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

| | | |
|---|---|---|
| CO1 | Gain knowledge related to the fuels used in the industries | Understand |
| CO2 | Understand the role & properties of lubricants and role of additives in the performance of lubricants | Understand |
| CO3 | Perform analytical tests for assuring the quality of fuel | Analyze |
| CO4 | Select the type of lubricant based on different applications | Apply |
| CO5 | Develop formulations for natural & synthetic lubricating greases | Create |

**Mapping with Program Outcomes**

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

**Assessment Pattern:**

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

**Course Level Assessment Questions:**

Course Outcome 1(CO1)

1. Different fuels used in the industry
2. Properties and industrial uses of different fuels.

Course Outcome 2(CO2)

1. Classification of lubricants
2. Additives and their role in lubricating oils.

Course Outcome 3(CO3)

1.Thermo chemistry of fuels

2.Test methods of fuels

Course Outcome 4(CO4)

1. Principle of lubrication.
2. Properties of lubricating oils.

Course Outcome 5(CO5)

1. Properties and types of lubricating greases
2. Additives used in lubricating greases.
3. BIS test methods of greases.

**Syllabus**

**Module-I**

**Handling and storage of fuels**

Fuels used in industry such as LDO, furnace Oil ,HSD, Gas, thermic fluid, coal, husk, briquets.

**Module-II**

**Introduction to lubricants**

Liquid, Solid and gas lubricants and their applications, Lubricating oils Synthetic lubricants. Physical properties, manufacture of lubricating oils.Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, classification of lubricating oils such as thermic fluids, gear oils, hydraulic oils etc, viscosity index improver.

**Module-III**

**Properties of Fuels**

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, distillation, vapour pressure, flash point, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point etc.

**Module-IV**

**Lubricants**

General aspects of lubrication, lubricant characteristics and types ,selection principle ,Lubrication in metal cutting, conditions of use for cutting fluids, coolants, gear oils.

**Module-V**

**Lubricating Greases**

Properties, types, ingredients, additives, analysis of lubricating oils and greases as per BIS test methods. Manufacture of lubricating Greases-Processes and equipments.

**Reference Books:**

1. Internal Combustion Engineering Edited by V. Ganesan. 2003
2. Lubrication and Lubricants, Edited by Eric R. Braithwaite ( 1967)
3. Lubricating Greases by C.J.Boner
4. Lubricating Oils by C.J.Boner

**Course contents and Lecture schedule:**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Handling and storage of fuels** | |

| | | |
|---|---|---|
| 1.1 | Handling and storage of LDO and HSD | 2 |
| 1.2 | Handling and storage of furnace Oil and thermic fluid | 2 |
| 1.3 | Handling and storage of Gas, coal, husk and briquets | 2 |
| **2.** | **Introduction to lubricants** | |
| 2.1 | Liquid, Solid and gas lubricants and their applications | 2 |
| 2.2 | Lubricating oils Synthetic lubricants | 1 |
| 2.3 | Physical properties and manufacturing of lubricating oils | 1 |
| 2.4 | Specific requirements for automotive lubricants | 1 |
| 2.5 | Oxidation deterioration and degradation of lubricants | 2 |
| 2.6 | Additives and additive mechanism such as viscosity index improver, pour point depresants | 2 |
| 2.7 | Classification of lubricating oils such as thermic fluids, gear oils, hydraulic oils etc | 2 |
| **3.** | **Properties of Fuels** | |
| 3.1 | Thermo-chemistry of fuels | 1 |
| 3.2 | Properties and testing of fuels | 1 |
| 3.3 | Test methods for relative density, calorific value, distillation, vapour pressure | 2 |
| 3.4 | Test methods for flash point, spontaneous ignition temperature, viscosity, pour point | 2 |
| 3.5 | Test methods for flammability, ignitability, diesel index, API gravity, aniline point | 3 |
| **4.** | **Lubricants** | |
| 4.1 | General aspects of lubrication | 1 |
| 4.2 | Lubricant characteristics and types | 2 |
| 4.3 | Selection principle of lubricants | 1 |
| 4.4 | Lubrication in metal cutting, conditions of use for cutting fluids, coolants, gear oils | 2 |
| **5.** | **Lubricating Greases** | |
| 5.1 | Properties of lubricating greases | 1 |
| 5.2 | Types of lubricating greases | 1 |
| 5.3 | Ingredients and additives of lubricating greases | 2 |
| 5.4 | Manufacture of lubricating Greases-Processes and equipments. | 2 |
| 5.5 | Analysis of lubricating oils and greases as per BIS test methods. | 2 |
| | **Total** | **40** |

# TOT 456 PROCESS MODELING AND SIMULATION

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

**Assessment:**
Sessional: 50 marks
End Semester: 50 marks

**Course Objectives:**
This course explores the basic concepts and steady state equations of simple systems in chemical process industries. It deals with the techniques for derivation of system model equations, data analysis and visualization. The course aims to present the basic idea and concept on process model with detailed analysis and solution of model equations for steady operation.

**Course Outcomes:**
Students completing the course will be able to

| | | |
|---|---|---|
| CO 1 | Model deterministic systems and differentiate between nonlinear and linear models | Remember, Apply, Analyze |
| CO 2 | Numerically simulate linear and non linear ordinary differential equations for deterministic systems | Apply, Analyze, Evaluate |
| CO 3 | Estimate and validate a model based upon input and output data. | Apply, Analyze, Evaluate |
| CO 4 | Create a model prediction based upon new input and validate the output data | Understand, Apply, Analyze, Evaluate, Create |
| CO 5 | Develop steady state models for flash vessels, equilibrium staged processes, distillation columns, absorbers, strippers, CSTR, heat exchangers and packed bed reactors. | Remember, Apply, Analyze, Evaluate |

| | **POs** | | | | | | | | | | | | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | 3 | 3 | 2 | - | - | 1 | - | 1 | 1 | 2 | **1** | **1** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | - | 1 | - | 1 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | - | 1 | - | 1 | 1 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | - | 1 | - | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | - | 1 | 2 | 3 | 3 | 3 |
| Avg. | 3 | 3 | 3 | 2.6 | 2.6 | 0.8 | 0.2 | 1 | - | 1 | 1.2 | 2.2 | 3 | 3 |

**Module1 (6 hours)**

Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs. Non linear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODE-BVP.

**Module2 (6 hours)**

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.

**Module3 (6 hours)**

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, - steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

**Module4 (6 hours)**

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.

**Module5 (6 hours)**

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries.

**Suggested Text Books**


1. Luyben W.L., "Process Modeling, Simulation, and Control for Chemical Engineering", Mc Graw Hill.
2. D. F. Rudd and C. C. Watson, " Strategy of Process Engineering", Wiley international.
3. M.M. Denn, "Process Modelling", Wiley, New York, (1990).


**Suggested Reference Books**


1. A. K. Jana, "Chemical Process Modelling and Computer Simulation", PHI,(2011)
2. C.D. Holland, "Fundamentals of Modelling Separation Processes", Prentice Hall, (1975)
3. Hussain Asghar, "Chemical Process Simulation", Wiley Eastern Ltd., New Delhi, (1986)

# PROGRAMME ELECTIVE COURSE I V

## TOT 458 COMPUTER AIDED EQUIPMENT DESIGN

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Assessment:**
Sessional: 50 marks
End Semester: 50 marks

**Course Objectives:**

The objective of this course is to acquire basic understanding of design parameters, complete knowledge of design procedures for commonly used process equipment and their attachments (e.g. internal and external pressure vessels, tall vessels, high pressure vessels, supports etc.), and different types of equipment testing methods.

**Course outcomes:** Students completing the course will be able to

| | | |
|---|---|---|
| CO1 | Understand the basics of process equipment design and important parameters of equipment design | Understand |
| CO2 | Understand the basics of process equipment design and important parameters of equipment design | Understand |
| CO3 | Design special vessels such as tall vessels, self supporting vessels, and skirt (and other support for vertical vessels). | Apply |
| CO4 | Design liquid and gas storage tanks with and without floating roof | Apply |
| CO5 | Select standard piping, flanges, gaskets and bolts associated with the vessels and storage tanks. | Analyze |

**Syllabus**

**Module 1 (6 hours)**

Introduction: Classification of engineering materials, properties of Ferrous metals, Non ferrous metals, alloys & Ceramic materials Structure-Property relationship in materials. Deformation of Materials Fracture: Elastic deformation, Plastic deformation, Creep, Visco-elastic deformation, Different types of fracture, Corrosion And Prevention: Direct Corrosion, electro-chemical corrosion, Galvanic cells, High temperature corrosion, Passivity, factor influencing corrosion rate, Control and of corrosion-modification of corrosive environment, Inhibitors, Cathodic protection, protective coatings. Corrosion charts, Metal forming techniques (bending, Rolling, Forming) & Metal joining techniques, welding – such as Butt, Lap, fillet, corner. Inspection and testing of process vessel.

**Module 2 (6 hours)**

Pressure Vessels: Type of pressure vessels, Thin cylinder theory for internal pressure. Code & standard for pressure vessels (IS:2825: 1969), Design considerations, classification of pressure vessels as per codes, design of cylindrical and spherical shells under internal and external pressure, selection

and design of closures and heads such as Flat, hemispherical, tori-spherical, elliptical & conical.; Introduction to compensation for opening such as nozzles & manholes etc.

**Module 3 (6 hours)**

Flanges: Selection of gaskets, selection of standard flanges, optimum selection of bolts for flanges, design of flanges. Inspection and testing of vessels, heads and flanges as per code specifications. Piping: Pipe thickness calculation under internal and external pressure, introduction to flexibility analysis of piping system.

**Module 4 (6 hours)**

Tall Tower Design: Design of shell, skirt, bearing plate and anchor bolts for tall tower used at high wind and seismic conditions. Supports: Design of lug support and saddle support including bearing plates and anchor bolts.

**Module 5 (6 hours)**

Storage Tanks: Introduction to Indian standards, filling and breathing losses; classification of storage tanks; Design of liquid and gas storage tanks with and without floating roof. High-pressure vessels, Fundamental equations, Compound vessels, Liquid storage tanks, Mechanical design of centrifuges, Centrifugal pressure, Bowl and spindle motion: critical speed.

**Suggested Text Books**


1. Brownell L. E. and Young H. E., "Process Equipment Design", John Wiley and Sons. 2009.
2. Bhattacharya B. C., "Introduction of Chemical Equipment Design", 1st Edition, CBS Publisher. 2008.
3. I.S.:2825-1969, "Code for Unfired Pressure Vessels", Bureau of Indian Standards.1969.
4. I.S.:803-1962, "Code of Practice for Design, Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks", Bureau of Indian Standards.1962.


**Suggested Reference Books**


1. Moss D. R., "Pressure Vessel Design Manual", 3rd Edition, Gulf Publishers, 2004.
2. Annartone D., "Pressure Vessel Design", 3rd Edition, Springer 2007.
3. Joshi M.V., and Mahajani, V.V., "Process Equipment Design", 3rd Edition, Macmillan India, 2000.
4. Coulson, J.M., Richardson, J.F., and Sinnott, R.H., "Chemical Engineering Volume 6, 3rd revised Edition, Butterworth-Heinemann Ltd., 1999.

# OPEN ELECTIVE COURSE IV

# TCH 492 TRANSPORT PHENOMENA

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Assessment:**
Sessional: 50 marks
End Semester: 50 marks

**Course Objectives:**
This course will highlight coupling between three transport phenomena with applications in various disciplines in engineering and science, and will demonstrate to the students the common mathematical structure of transport problems. The course will deal with flow problems involving Newtonian and non-Newtonian fluids, solid-state heat conduction, forced and free convection, binary diffusion with or without chemical reaction.

**Course Outcomes:**

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| | | |
|---|---|---|
| CO1 | Perform basic vector and tensor analysis | Understand, Apply, |
| CO2 | Solve transport problems using shell balances | Apply, Evaluate |
| CO3 | Formulate and solve one-dimensional transport problems by using the conservation equations | Analyse, Evaluate |
| CO4 | Formulate simple multi-dimensional transport problems | Apply, Evaluate, Create |
| CO5 | Understand and apply the shell balance and boundary conditions on various types of system | Understand, Evaluate |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | 1 | **1** | **2** |
| CO2 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 | 1 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 | 1 | 3 | 3 |
| CO4 | 3 | 3 | 1 | 2 | 2 | 1 | - | - | - | 1 | 1 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 1 | 2 | 2 | 1 | - | - | - | 1 | 1 | 1 | 3 | 3 |
| Avg | 3 | 2.8 | 2 | 2 | 1.8 | 0.8 | - | - | - | 0.8 | 0.8 | 1 | 3 | 3 |
| | | | | | | | | | | | | | **3** | **3** |

**Syllabus**

**Module1 (7 hours)**
Introduction to Newton's law of viscosity, non –Newtonian fluids, pressure & temperature dependence of viscosity, estimation of viscosity from critical properties. Shell momentum balances, boundary conditions, flow of a falling film, flow through a circular tube, flow through annular, creeping flow along a solid sphere.

**Module2 (7 hours)**
The equation of continuity, the equation of motion, use of the equations of change to set up steady flow problems and applications.

**Module3 (4 hours)**
Flow near a wall suddenly set in motion, Boundary layer theory and applications.

**Module4 (6 hours)**
Shell energy balances, temperature profiles, average temperature, energy fluxes at surfaces, Equations of change, equation of motion for forced and free convection and applications.

**Module5 (6 hours)**
Definitions of concentrations, velocities & mass fluxes, Fick's law of diffusion, Temperature & pressure dependence of mass diffusivity, Maxwell's law of diffusion. shell mass balance, boundary conditions, diffusion through a stagnant gas film and applications.

**Suggested Text books**
1. Bird, R. B., Stewart, W. E. and Lightfoot, E. N., "Transport Phenomena", 2nd edition John Wiley (1960).
2. Bannet, C. O. and Myers J. E., "Momentum Heat and Mass Transfer" Tata McGraw Hill, (1973).

**Suggested Reference Books**
RS Brodkey and HC Hersey, "Transport Phenomena: AUnified approach", McGraw-Hill Book,(1988).

**TOT-498 PROJECT (DTEFR)** **L : T: P:C**

**0 : 0: 20:10**

## Objectives

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

## Outcomes

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