SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH
3CT200PC & 3CT203PC CHEMICAL ENGINEERING THERMODYNAMICS

Subject Code: 3CT200PC	Chemical Engineering Thermodynamics	Credits = 0 4		
		L	T	P
Semester: III	Total contact hours: 5hrs/week	03	--	02

Course Objectives:

1. To introduce the basic principles and terminologies of thermodynamics; including systems, processes and energy classifications for understanding heat and work interactions.
2. To explain the laws of thermodynamics emphasizing; entropy, irreversibility, spontaneous processes and the limitations of energy transformations.
3. To analyze real and ideal gas behaviours using equations of state, critical properties and compressibility factors.
4. To apply thermodynamic principles to flow processes including; control volume analysis and evaluate the performance of devices like turbines, nozzles and compressors.
5. To understand solution thermodynamics including; phase equilibria, chemical potential, fugacity, Raoult's law and deviations in ideal and non-ideal systems.
6. To explore the concept of chemical equilibrium emphasizing; free energy changes, equilibrium constants and their dependence on temperature and pressure while analyzing factors affecting yield and conversion efficiency.

Course Outcomes: After successful completion of the course the students will be able:

1. Students will be able to classify thermodynamic systems and processes, calculate energy changes and apply the first law of thermodynamics to various systems.
2. Students will gain a thorough understanding of the second law of thermodynamics, entropy changes and the working principles of heat engines, pumps and refrigerators.
3. Students will be equipped to model real and ideal gases using equations of state, analyze deviations from ideal gas behaviour and study critical phenomena near phase transitions.
4. Students will demonstrate the ability to perform control volume analysis for flow processes and analyze the operation of flow devices such as nozzles, condensers and turbines.
5. Students will comprehend solution thermodynamics concepts including; vapour-liquid equilibrium, phase diagrams and the determination of molecular weights in ideal and non-ideal systems.
6. Students will evaluate chemical equilibrium systems, calculate free energy changes and apply Le Chatelier's principle to predict and optimize reaction outcomes under varying conditions.

SECTION- A

Unit- I: Basic Concepts and first law of thermodynamics: The terminologies of thermodynamics. Categorization of systems and processes. Energy classifications; point and path Function, heat and work, reversible and irreversible processes. First law of thermodynamics – heat and energy changes, enthalpy and heat capacity limitations of the first law, application of first law to different processes. (7Hrs)

Unit- II: Second law of thermodynamics: Introduction to the Second Law: Concepts of entropy, irreversibility, and spontaneous processes, Entropy changes in systems and surroundings, entropy change in mixing. Heat Engines and Efficiency: Carnot cycle, heat pumps, and refrigerators. The Third Law of Thermodynamics. (7Hrs)

Unit- III: Equation of State (EOS): Ideal gas law and real gas behavior. Van der Waals equation, Redlich-Kwong, and Peng-Robinson equations. Compressibility Factor (Z): Definition, significance, and deviations from ideal gas behavior. Z for Real Gases: Use of charts and equations of state for calculation.

Critical Properties: Definition of critical temperature, pressure, and volume. Behavior Near Critical Point: Phase transitions and compressibility factor. (8Hrs)

SECTION- B

Unit- IV: Basics of Flow Processes: Control volume analysis and the first law for flow systems flow of compressible fluids through ducts, compression processes. Applications of Flow Processes: Nozzles, condensers, compressors, and turbines. (7Hrs)

Unit- V: Solution thermodynamics: The Chemical Potential and Equilibrium, Partial Properties, Fugacity and Fugacity Coefficient of pure species and Species in Solution. Generalized Correlations for the Fugacity Coefficient . Vapour liquid equilibrium, phase rule , T-X-Y diagrams and X-Y diagram for ideal and non ideal system . Raoult's law and Henry's law, Deviations from Raoult's law. Comparison of ideal and non- ideal systems. Colligative properties, ebullioscopic constant. Determination of molecular weight of unknown chemical substances. (8Hrs)

Unit- VI: Chemical Equilibrium : Concept of equilibrium and dynamic nature of reversible reactions. Free energy change and its role in determining reaction spontaneity. Equilibrium Constant: Definition, expression, and its relation to reaction quotient. Le Chatelier's Principle. Temperature and Pressure Effects: Impact on equilibrium constant and equilibrium position. Relation Between Kp, Kc, and Kv Endothermic and Exothermic Reactions: Energy changes and their influence on equilibrium. Heterogeneous Equilibria Free Energy Change Calculations, Various methods to determine ΔG for reactions., Factors affecting yield and conversion efficiency. (8Hrs)

Text Books:

1. J.M. Smith and H.C. Van Ness, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, 1998.
2. K.V.Narayanan, ."A textbook of Chemical Engineering Thermodynamics", Prentice Hall of India Ltd., 2001.
3. An Introduction to Chemical Thermodynamics, R.P.Rastogi, R.R.Mishra. Vikas Publishing

Reference Books:

1. Sadler S. I., J, "Chemical and Engineering Thermodynamics" John Wiley and Sons, Inc. New York, 3rd Ed., 1999.
2. Elliot J. R. and Lira C.T., "Introductory Chemical Engineering Thermodynamics", Prentice Hall, 1999.
3. Eastop T. D. and McConkey A. "Applied Thermodynamics for Engineering Technologists", Addison Wesley Longman Ltd., England, 5th Ed., 1999.

Evaluation Scheme: Each Unit is Weighed 10 Marks

Internal Assessment : 40 Marks

- ✓ Class Test-I (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Class Test–II (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Teaching Evaluation Components : 10Marks
  (Viva Voce / Assignments / Report Writing etc.)
- ✓ Class Attendance : 10Marks
- **End-Semester Examination : 60 Marks**

(Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)

3CT203PC: Chemical Engineering Thermodynamics (PCC) (LAB)

List of experiments:

1. Determination of boiling point elevation by the Landsberger-Walker method.
2. Determination of the molecular weight of a substance and to identify the van't Hoff factor and equation.
3. Determination of freezing point depression of the sample
4. Critical solution temperature of the phenol water system.
5. Critical solution temperature of the phenol water system in the presence of impurities like NaCl.
6. Critical solution temperature of the phenol water system in the presence of impurities like succinic acid
7. To construct the (X-Y) equation curve
8. To study (X-Y) T equilibrium curve
9. To study the tertiary phase diagram of a three-component system
10. To study the distillation of benzoic acid
11. Study of boiling point diagram.

All the above experiments are to be arranged in the laboratory. The student must perform a minimum of 8 experiments to complete the term work.

Text Books:

1. J.M. Smith and H.C. Van Ness, “Introduction to Chemical Engineering Thermodynamics”, McGraw Hill, 1998.
2. K.V.Narayanan, .”A textbook of Chemical Engineering Thermodynamics”, Prentice Hall of India Ltd., 2001.
3. An Introduction to Chemical Thermodynamics, R.P.Rastogi, R.R.Mishra. Vikas Publishing

Reference Books:

1. Sadler S. I., J, “Chemical and Engineering Thermodynamics” John Wiley and Sons, Inc. New York, 3rd Ed., 1999.
2. Elliot J. R. and Lira C.T., “Introductory Chemical Engineering Thermodynamics”, Prentice Hall, 1999.
3. Eastop T. D. and McConkey A. “Applied Thermodynamics for Engineering Technologists”, Addison Wesley Longman Ltd., England, 5th Ed., 1999.

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH

3CT201PC PROCESS CALCULATION

Subject Code: 3CT201PC	Title: Process Calculation	Credits = 0 3		
		L	T	P
Semester: III	Total contact hours: 3hrs/week	03	--	--

COURSE OBJECTIVES:

- Students will learn the basic and fundamentals of chemical engineering operations and processes.
- Students will understand the material balance and energy balance of various unit operations and unit processes.
- Students will learn how to formulate and solve the problems related to material and energy balance with or without chemical reaction.

COURSE OUTCOMES:

After successful completion of this course student will be able to

- Understand the concept of basic chemical calculations
- Understand the concept and application of theory of proportions
- Determine the humidity with/without using a psychrometric chart.
- Make the material balance over unit operations and processes.
- Make the energy balance over unit operations and processes.
- Solve the problem of fuels and combustion.

SECTION-A

UNIT I: Introduction to unit operations and unit processes, Units and dimensions, Atoms, moles and molecular weight, mole and mass fraction, Composition of solids, liquids and gases, Concept of Normality, Molarity and Molality, PPM (parts per million), Ideal gas law, Dalton's law, Partial pressure, Amagat's law, Average molecular weight, Density of gas mixture, Raoult's law, Henry's law, Vapour pressure, Cox chart. Humidity and saturation, Humidity chart and their application. (12hrs)

UNIT II: Material balance without chemical reaction stoichiometry and unit operations Distillation, Absorption, Extraction, Crystallization, Drying, Mixing, Evaporation. Recycle, purge and Bypass calculations. (10hrs)

UNIT III: Material balance involves chemical reaction, Principle of stoichiometry, simple oxidation reaction, multiple chemical reaction, percentage Conversion, percentage Yield, and selectivity, calculation involving combustion of gases, liquid and solid fuel. Recycle, purge and bypass calculations. Introduction to unsteady state material balance (11hrs)

SECTION-B

UNIT IV: Energy balance: open and closed system, heat capacity, calculations of enthalpy changes, enthalpy changes for phases transitions, evaporation, solution and mixing, clausius clapeyron equation. (10hrs)

UNIT V: Energy balance with chemical reaction, calculation of standard heat of reaction, heat of formation, heat of combustion, Hess law, Effect of temperature on heat of reaction; adiabatic flame temperature calculations. (9hrs)

UNIT VI: Heating value of fuels, calculations involving theoretical and excess air, heat and material balance of combustion processes. (8hrs)

Reference Books/Text Books:

- Bhatt, B. I., Vora, S. M., "Stoichiometry",4th Edition, Tata McGraw Hill Publishing Company Ltd, 2004.
- Narayanan K V and Lakshmikutty B, Stoichiometry and Process Calculations, Prentice Hall of India Pvt Ltd, New Delhi 2006.
- Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.
- Himmelblau, D. M., Riggs, J. B. "Basic Principles and Calculations in Chemical Engineering", 8th Pearson India Education Services, 2015.
- Hougen. O. A, Watson K.M. and Ragatz R.A. "Chemical Process Principles, Part -I, Material and Energy Balance".

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH

3CT202PC and 3CT204PC Chemical Engineering Analysis

Subject Code: 3CT202PC	Title: Chemical Engineering Analysis	Credits = 0 4		
		L	T	P
Semester: III	Total contact hours: 5 hrs/week	03	-	02

COURSE OBJECTIVES:

- To understand the electrical properties of fluid.
- To predict the high and low quantum yield photochemical reactions and to know about advanced spectroscopic analysis techniques.
- To know the basic concepts and industrial examples of catalysis and adsorption on surface.

COURSE OUTCOMES:

The course will enable the student to:

- Evaluate the specific rate, order and energy of activation of chemical reactions.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques and spectroscopic methods for identification of compounds.

SECTION-A

UNIT I: Surface, interfacial chemistry, and catalysis: Adsorption, types of adsorptions, Adsorption isotherms, Langmuir theory of adsorption, BET adsorption isotherm and its application for determination of surface area of fine powder. Homogeneous and Heterogeneous catalysis, Criteria of catalyst, Theory of heterogeneous catalysis, Homogeneous, Lewis acid-base catalysts, organometallic catalysts and industrially examples, Auto and enzyme catalysis. (12Hrs)

UNIT II: Electro analytical Methods

Introduction, Application of standard electrode potential, Application of Oxidation/Reduction potential, electrochemical cells, Types of electroanalytical methods; Potentiometry, pH metry, Conductometry (10Hrs)

UNIT III: Thermal Analysis techniques: Introduction, Principles, Thermal Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA) (8Hrs)

SECTION-B

UNIT IV: Kinetics and Separations:

Introduction, Rate of chemical reaction, Introduction to Chromatographic separations, Principles and application of Gas Chromatography (GC), High performance liquid chromatography (HPLC) (10 Hrs)

UNIT V: Photochemistry and Modern Analytical techniques: Photochemical Reaction, Lambert and Beer' Law, Laws of photochemical equivalence, quantum efficiency and its determination, low & high quantum yield reactions, Photosensitization (8Hrs)

UNIT VI: **Spectroscopic techniques and applications:** Principles and applications of UV-VIS spectroscopy and selection rules. Electronic spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules. Principle and applications of Infrared (IR), Nuclear Magnetic Resonance (NMR) Spectroscopy. (12 Hrs)

3CT204PC Chemical Engineering Analysis: - LAB.

List of Experiments: Minimum 8-10 Practical's Based on above syllabus

Text Books/ Reference Books Recommended:

- Principles of Instrumental Analysis, Skoog Douglas A, F James Holler, Stanley R , Cengage 7th Ed
- Fundamentals of Analytical Chemistry, Douglas A, Donald M, James F, Stanley R, Cengage 10th Ed
- Physical Chemistry, P.W. Atkins and J.D. Paula, Oxford University Press.
- Physical Chemistry , K.J. Laidler and J.M. Meiser, CBS Publisher
- Chemical kinetics and catalysis , R. J. Masel, John Wiley publications
- Handbook of conducting polymers, Skotheim, Elsenbaumer and Reynolds, Marce Dekker.
- Fundamentals of spectroscopy ,Banwell, Tata McGraw-Hill
- Physical chemistry of surfaces, Arthur W. Adamsons, Alice P. Gast, John Wiley
- publications
- Principle of Heterogeneous catalysis, J. M. Thomas, W.J. Thomas, John Wiley publications

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH

3CT205M MDM-1: AIR POLLUTION AND CONTROL

Subject Code: 3CT205M	Title: MDM-I: Air Pollution & Control	Credits =02		
		L	T	P
Semester: III	Total contact hours: 2hrs/week	2	-	-

UNIT-I: Introduction and Impacts of air pollution on human health, vegetation, animals, building materials, structures, and atmosphere, soil and water bodies. (11hrs)

UNIT-II: Sources, classification, and formation/transformation of air pollutants: Meteorology and Atmospheric Stability. Indoor air pollution: sources, types and health impacts. Sampling, assessment, and evaluation of Indoor air quality.

(10hrs)

UNIT-III: Air pollution emission standards, National and international policies, acts, rules and regulations. Emerging technologies and strategies to mitigate air pollution, Current challenges and way forward. (11hrs)

Books and references

- Wark, K., Warner, C.F., and Davis, W.T., "Air Pollution: Its Origin and Control", Addison-Wesley Longman. 1998.
- Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., "Fundamentals of Air Pollution", Academic Press. 2005.
- Seinfeld, J.H., Pandis, S.N., "Atmospheric Chemistry and Physics", John Wiley. 2006.
- Lodge, J.P. (Ed.), "Methods of Air Sampling and Analysis", CRC Press. 1988.
- Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), "Air Pollution: Health and Environmental Impacts", CRC Press. 2010.

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH

3CT206OE OE-I: EXPLORATION AND PRODUCTION OF PETROLEUM

Subject Code: 3CT206OE	Title: Exploration & Production of petroleum	Credits = 03		
		L	T	P
Semester: III	Total contact hours: 3 hrs/week	3	-	-

SECTION-A

UNIT-I: Origin, Occurrence, and Formation of crude petroleum. History of Indian Petroleum and Refining Industry and future trends. (10hrs)

UNIT-II: Crude Oil and Natural Gas Production and Consumption in India. Petroleum refineries in India, their location, year of commissioning, and organizations, Refining Capacity & throughput. (10hrs)

UNIT-III: Production & Consumption of Petroleum Products. Advantages and disadvantages of petroleum. (10hrs)

SECTION-B

UNIT-IV: Exploration and prospecting for petroleum and gas field, Structure of earth and of the earth crust, formation of Sedimentary rocks, Geological, Geophysical, Geochemical prospecting methods, geophysical borehole logging methods. (10hrs)

UNIT-V: Development of an oil or gas field. Drilling for Petroleum, Drilling operation, Cable tool method, Rotary drilling, Turbo drilling, types of drill bits, mud fluids, casing off formations, Deviation of holes, Directional drilling, Offshore drilling rigs, Well control systems. (12hrs)

UNIT-VI: Hydrocarbon resources in India, history. World Petroleum Scenario, world Petroleum Reserves and Deposits. (8hrs)

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH

3CT207EM: ENGINEEING ECONOMICS

Subject Code: 3CT207EM	Title: Engineering Economics	Credits = 02		
		L	T	P
Semester: III	Total contact hours: 2 hrs/week	2	-	-

Course Objectives:

1. **Understanding economics concepts**: Learning the basics of economics, like demand and supply, costing factors, and market structures
2. **Evaluating problems**: Using economic theories to analyze problems
3. **Analyzing costs and benefits**: Using time value of money concepts to evaluate the costs and benefits of engineering projects over time
4. **Formulating economic outcomes**: Estimating and evaluating the economic outcomes of different alternatives
5. **Applying cost analysis methods**: Learning how to use cost analysis methods like equivalence, value measurement, and interest relationships
6. **Using problem-solving methods**: Learning how to use problem-solving methods to make decisions in the face of Privatization and Globalization.

Course Outcomes:

1. **Economic analysis**: Students can perform economic analysis to evaluate the impact of financial factors on projects.
2. **Investment planning**: Students can analyze investment planning and cost controls.
3. **Cost-benefit analysis**: Students can perform cost-benefit analysis to evaluate the economic outcomes of engineering alternatives.
4. **Time value of money**: Students can account for the time value of money in economic analyses.
5. **Economic decision-making**: Students can make economic decisions using present worth, annual worth, future worth, and capitalized cost.
6. **Scope of Indian Economy in Privatization & Globalization**: Students can make decisions to evaluate the scope of business in global scenario.

SECTION A

UNIT-I: Nature and scope of economics, Demand and Supply, Demand: concepts, specification, types of demand. Demand Analysis: significance of demand analysis, law of diminishing utility, consumer surplus. Demand Forecasting: concept of forecasting, types of forecast, steps in demand forecasting, techniques of demand forecasting. (9Hrs)

UNIT-II: Market: Meaning, types of market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition. Inflation: Causes, measurement, effects, controlling of inflation. (9Hrs)

UNIT-III: Nature and characteristics of Indian economy, Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Concepts of VAT, WTO. Banking, Foreign exchange. (9Hrs)

BOOKS RECOMMENDED:

- Managerial Economics :K. K. Seo, RichardD. Irwin Inc.
- Engineering Economics : J. L. Riggs, McGraw Hill, New York, Latest Edition.

Managerial Economics :Adhikary M.,Khosla Pub.House, New Delhi.

Internal Assessment : **20 Marks** Class Test-I (MCQ/ Subjective/ Objective) : 05Marks

Class Test–II (MCQ/ Subjective/ Objective) : 05Marks

Teaching Evaluation Components : 05Marks

Class Attendance : 05Marks

End-Semester Examination : **30 Marks**

Small Business Management Fundamentals: Dan Strenhoff and J.F.Burgess, McGraw Hill Book Company.

Evaluation Scheme: Each Unit is Weighed 10 Marks

(Viva Voce / Assignments / Report Writing etc.)

(Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: THIRD B. TECH

3CT208VE : ENVIRONMENTAL STUDIES (VEC- ENVIRONMENTAL SCIENCE)

Subject Code: 3CT208VE	Title: Environmental Studies	Credits = 02		
		L	T	P
Semester: III	Total contact hours: 2 hrs/week	2	-	-

Course Objectives:

1.To introduce & understand the concepts of climate changes in environment

2.To examine the significance of environmental degradation.

3. To analyse the economic and environmental impacts on natural recourses.

4. To explore advancements in environment protection.

5.To Study Renewable and Non Renewable Energy Alternatives.

6.To Evaluate the Economic and Environmental Implications on living beings.

Course Outcomes: Upon successful completion, students will be able to:

1.Explain the fundamentals of climate change and its importance in global sustainability.

2. Apply Energy Efficiency and Process Optimization Strategies in environmental protection Technologies.

3. Analyse and Select Appropriate Technologies for environment protection in general.

4. Design & Evaluate strategies for implementing bio-diversity in ecosystem.

5. Explore Renewable Energy Solutions.

6. Assess & Analyse the techno-economic feasibility and Environmental Impact Assessments of ecosystem, biodiversity and it's conversation methods.

SECTION-A

UNIT-I:

(a) The Multidisciplinary nature of environmental studies: (9Hrs)

Definition, Principles, Scope and importance, Need for public awareness.

(b) Natural Resources: Renewable and non-renewable resources:

- Availability, uses, over exploitation and associated environmental problems related to following Natural resources:
- Mineral Resources: Use and Over exploitation, environmental effects of extraction.
- Food Resources: Use and Over exploitation, deforestation, case study.
- Energy Resources: Growing energy needs, renewable and nonrenewable energy sources, case study.
- Role of individual in conservation of natural resources.

UNIT-II: Ecosystems: (9Hrs)

▪ Concept and components of an ecosystem.

▪ Types of ecosystems.

▪ Structure and function of forest and pond ecosystem.

▪ Energy flow in the ecosystems.

▪ Food chains, food webs and ecological pyramids.

▪ Ecological succession: General mechanism.

UNIT-III: Biodiversity and its Conservation: (9Hrs)

▪ Introduction, definition, and types of biodiversity.

▪ Bio-geographical classification of India.

▪ India as a mega-diversity nation.

▪ Hot-spots of biodiversity.

▪ Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.

▪ Endangered and endemic species of India.

▪ Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Reference Books:

▪Text Book of Environmental studies, Erach Bharucha, UGC.

▪Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd.

▪ Ecology and Environment, P. D. Sharma.

▪ Ecology, M. P. Arora, Himalaya Publishing House.

Evaluation Scheme: Each Unit is Weighed 10 Marks

Internal Assessment : 20 Marks

✓ Class Test-I (MCQ/ Subjective/ Objective) : 05Marks

✓ Class Test–II (MCQ/ Subjective/ Objective) : 05Marks

✓ Teaching Evaluation Components : 05Marks

(Viva Voce / Assignments / Report Writing etc.)

✓ Class Attendance : 05Marks

• End-Semester Examination : 30 Marks

(**Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)**

B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CT209PC & 4CT212PC: FLUID FLOW OPERATION

Level 5 (UG-Diploma)

Subject Code: 4CT209PC	Fluid Flow Operation	Credits = 04		
		L	T	P
Semester: IV	Total contact hours: 5hrs/week	3	-	02

Description of relevance of this course in Chem. Eng. Program:
This course is an industrially relevant course which help students to understand various components of fluid transport systems used in industry such as pipes, fittings, valves, pumps, blowers, compressors, vacuum pumps etc. The industrial operations involve heating, cooling of the reactors and other mixing/separation equipment which is provided by steam boilers, thermic fluid heaters, chillers, cooling towers etc. Many reactions and separation equipment also require understanding of fluid flow at design, operation and troubleshooting stage.

Course Objectives:

1. Understand Properties of fluids and their classification. Acquire knowledge of Fluid statics. and analyze Euler's equation.
2. Elaborate Kinematics of flow, Explore Equations of Continuity and Motion and its applications in various engineering problems. Evaluate Dimensional analysis in fluid flow operation.
3. Understand and apply Dynamics of flow, Bernoulli's Equation and its engineering applications, Correlate Pressure drop in Piping systems.
4. Apply and recommend flow measuring devices for process industries.
5. Apply and classify fluid moving machinery in various process industries.
6. Understand and apply flow past immersed bodies and Particle Dynamics, Compare flow through packed bed and fluidized Bed.

Course Outcomes: Students will be able to

1. Predict the velocity profile and flow behavior in various types of systems.
2. Calculate pressure loss in different types of flow systems.
3. Calculate power requirement for fluid transport.
4. Compare and select appropriate types of fluid moving machineries for fluid transport.
5. Justify the use of specific fluid moving machineries.
6. Calculate flow regimes and pressure drop different situations in multiphase systems such as two-phase pipe flow, fixed and fluidized beds etc.

SECTION- A

Unit- I: Definition, basic concepts of fluid, Properties of fluids and their classification. Fluid statics: Forces on fluids, pressure depth relationship for compressible and incompressible fluids. Forces on submerged bodies. Rigid body motion, pressure measurements, Euler's equation. (7Hrs)
Unit- II: Kinematics of flow, Description of velocity field, Stream functions, Angular velocity, Fluids in circulation, Fluid flow: Laminar and turbulent flows, Equations of Continuity and Motion in laminar flows and its applications for the calculation of velocity profiles, shear stresses, power, etc. in various engineering applications. Dimensional analysis; Buckingham's Pi Theorem ; Dimensionless numbers and their physical significance; Vortex flow (9Hrs)

Unit- III: Dynamics of flow , Bernoulli's Equation and engineering applications, Conservation of mass, momentum and energy balance , Navier-Stokes equations, Basics of Turbulent flows, motion for turbulent flows: Prandtl mixing length theory,. Turbulent pipe flow, basis of Universal velocity profile and its use. Boundary layer theory. (9Hrs)

SECTION B

Unit- IV: Flow measuring devices for chemical plants: Orifice meter, Venturi meters, Rotameter, Pitot tube and rectangular & V-Notches. (6Hrs)
Unit- V: Transportation and metering of fluids, friction , major & minor losses , Pressure drop in Pipe fitting and valves, Construction, working and characteristic features of various types of pumps, compressors, blowers and fans (7Hrs)
Unit- VI: Flow past immersed bodies: Drag, Drag coefficients, Flow through beds of solids, Particle motion, Terminal velocity, Hindered settling, Settling and rise of bubbles and drops Particle Dynamics, flow through packed bed and fluidized Bed. Introduction to computational

fluid dynamics. (7Hrs)

Books Recommended:

1. *W. L. McCabe, J. C. Smith, P. Harriott P.,* Unit Operations of Chemical Engineering", 7 th Ed., McGraw-Hill, New York, 2017.
2. *R. B. Bird, W. E. Stewart, E. N. Lightfoot,* Transport Phenomena, 2nd ed., John Wiley & Sons,
3. *Coulson J. M. and Richardson J. F.* Chemical Engineering, Vol. 1sixth edition Elsevier publication.
4. *Dr. R.K.Bansal* ,Fluid Mechanics and Hydraulic Machines ; 9th edition, Laxmi publications.
5. *F. M. White,* Fluid Mechanics, 9 th Ed., McGraw Hill, 2022
6. *G. K. Batchelor,* An Introduction to Fluid Dynamics, 2 nd Ed., Cambridge Univ Press, 2000.

Evaluation Scheme: Each Unit is Weighed 10 Marks

- **Internal Assessment** : **40 Marks**
- ✓ Class Test-I (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Class Test–II (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Teaching Evaluation Components : 10Marks
  (Viva Voce / Assignments / Report Writing etc.)
- ✓ Class Attendance : 10Marks
- **End-Semester Examination** : **60 Marks**

(Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)

4CT212PC: FLUID FLOW OPERATION

List of experiments:

1. Experiment on equivalent length of pipe fittings.
2. Experiment on Reynolds number.
3. Experiment on viscosity by Stokes' law.
4. Experiment on Bernoulli's theorem.
5. Experiment on Venturimeter.
6. Experiment on Rotameter.
7. Experiment on Orifice meter.
8. Experiment on characteristics of the Centrifugal pump.
9. Experiment on flow through 'V' notch.
10. Experiment on flow through rectangular notch.
11. Experiment on cativation.
12. Virtual Lab experiment.

All above experiments are to be arranged in the laboratory. Minimum 8 experiments are required to be performed by the student to complete the term work.

Evaluation Scheme:

- **Internal Assessment** : **25 Marks**
- ✓ Teaching Evaluation Components : 20Marks
- ✓ Class Attendance : 05Marks

External University Practical Examination : **25 Marks**

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CT210PC & 4CT213PC: MECHANICAL OPERATION

Level 5 (UG-Diploma)

Subject Code: 4CT210PC	Fluid Flow Operation	Credits = 04		
		L	T	P
Semester: IV	Total contact hours: 5hrs/week	3	-	02

Course Objectives:

1. **Understanding particle properties:** To analyze the physical characteristics of particles like size, shape, and density, and how these properties affect mechanical operations.
2. **Size reduction methods:** To study the principles behind different size reduction techniques like crushing, grinding, and milling, including the selection of appropriate equipment based on material properties and desired particle size distribution.
3. **Screening and separation:** To understand the mechanisms of particle separation using sieves and other screening devices, as well as other separation techniques like sedimentation, centrifugation, and flotation.
4. **Filtration:** To analyze the principles of filtration, including the selection of filter media and design considerations for various types of filters.
5. **Equipment design and operation:** To gain knowledge about the construction and operation of key mechanical operation equipment like crushers, grinders, screens, centrifuges, and filters, including factors affecting their performance and efficiency.
6. **Application to industries:** To demonstrate the application of mechanical operations in various industries like pharmaceuticals, food processing, mining and chemical manufacturing etc.

Course Outcomes: After successful completion of this course student will be able to:

1. Perform the size reduction and screening operation in industry.
2. Understand the principle, construction and working of various classifier and thickeners used for solid separation.
3. Select the suitable transportation system for different types of solids.
4. Understand the principle construction and working of various filtration equipments for solid separation form liquid.
5. Understand the principle of centrifuges and cyclones.
6. Understand the adsorption mechanism and application of adsorption.

SECTION- A

UNIT- I: Relevance of mechanical operations in industry.

1. Size reduction, stages of reduction, Equipments operating variables, laws of energies, energy requirements.
2. Screening: Screen analysis, Particle size distribution
3. Unit operation design, basis concepts. (7Hrs)

UNIT- II:

1. Classification: Equal falling particles, equipments, jigging, tabling.
2. Gravity settling, drag force, terminal settling velocity.
3. Sedimentation: Continuous thickeners. (7Hrs)

UNIT III:

1. Storage and handling of solids, transportation
2. Mixing principle, mixers, agitation, types of agitators, 3D design of equipment's.(8Hrs)

SECTION-B

UNIT IV:

1. Filtration: Theory, operation, types, flotation agents, flotation cells.
2. Filter Calculations, filtration equation for compressible and non-compressible cakes,
3. Specific cake resistance.
4. Filtration - Constant pressure and constant rate and their equipment's. (8Hrs)

UNIT V:

1. Centrifuges: Theory, Equipment's, types and calculations.
2. Cyclones: Hydro cyclones, liquid scrubbers and electrostatic precipitators. (7Hrs)

UNIT VI:

- Adsorption, theory, type and application, nature of adsorbents, industrial adsorbents.
- Adsorption in fixed bed, fluidized beds, adsorption equilibria calculations for vapor, gas and liquid adsorption. Adsorption, operation such as single stage, multi stage, cross current & multistage counter current operation &equipment's.
- Recent developments in mechanical operation equipment's, animation. (8Hrs)

Text Books/ Reference Books:

- Momentum Transfer Operation: S .K. Gupta, TMC, Latest edition.
- Unit Operations of Chemical Engineering : McCabe and Smith,TMC
- ChemicalEngineeringVol. I: Coulson & Richardson,Pergamon, Latest edition.
- Principles of Unit Operations: A. S. Foust *et al*.
- Unit Operations: C. G. Brown.
- Introduction to Chemical Engg. : Badger & Banchero.
- Mass Transfer Operations : R.E. Treybal.
- Mechanical Operations Vol.-I: R. S. Hiremath & A. P .Kulkarni.

Evaluation Scheme: Each Unit is Weighed 10 Marks

- **Internal Assessment** : **40 Marks**
- ✓ Class Test-I (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Class Test–II (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Teaching Evaluation Components : 10Marks
  (Viva Voce / Assignments / Report Writing etc.)
- ✓ Class Attendance : 10Marks
- **End-Semester Examination** : **60 Marks**

(Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)

4CT213PC: MECHANICAL OPERATION

List of experiments:

1. To study the performance of Ball Mill and find out it's crushing efficiency.
2. To study the performance of Jaw Crusher and find out it's crushing efficiency.
3. To study the performance of Crushing Rolls and find out it's crushing efficiency.
4. To study the settling characteristics (Free & Hindered settling) of a given suspension of particles.
5. To study the filtration characteristics of rotary vacuum filter.
6. To study the filtration characteristics of Plate and frame filter press.
7. To study the filtration characteristics of Leaf and sparkle filter.
8. To carry out differential and cumulative screen analysis of given sample of solid particles.
9. To determine energy consumption and crushing law constants for jaw crusher.
10. To determine Critical speed of Ball mill & Average particle size of the product obtained in ball mill.
11. To determine area of batch thickener by conducting batch sedimentation test.
12. To determine efficiency of Cyclone separator.
13. To Determine Variation of size reduction in ball Mill by changing the residence time, size of grinding medium and material of grinding medium.

All above experiments are to be arranged in the laboratory. Minimum 8 experiments are required to be performed by the student to complete the term work.

Evaluation Scheme:

- **Internal Assessment** : **25 Marks**
- ✓ Teaching Evaluation Components : 20Marks
  (Lab Record/Practical Work)
- ✓ Class Attendance : 05Marks

- **External University Practical Examination** : **25 Marks**

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4FT211PC & 4FT214PC FOOD TECHNOLOGY Sp. Tech-I

Level 5.0 (UG-Certificate)

Subject Code: 4FT211PC	Title: Food Technology Sp. Tech-I	Credits = 0 4		
		L	T	P
Semester: IV	Total contact hours: 5 hrs/week	03	-	02

COURSE OBJECTIVES:

The main objectives of this course is for students to differentiate chemical interactions and reactions of food components and their effect on sensory, nutritional, and functional properties of foods, and how processing influences these properties.

COURSE OUTCOMES:

By learning this course students will develop

- Ability to understand the concept and properties of food chemistry, structure and composition of carbohydrates and its metabolism.
- Ability to demonstrate the structure, composition, physical and chemical properties of different types of fats.
- Ability to recognize the function of the proteins understands their practical implications.
- Ability to describe the importance of water, colloidal systems and effect of water activity on shelf life of food products.
- Ability to understand the importance of micro nutrients in food products and able to find the energy value of different foods.
- Ability to understand different micronutrients.

SECTION-A

UNIT-I: History of food chemistry

History of food chemistry, Importance of food chemistry in food Science and Technology, Functions of foods. Physical and chemical properties of food, Colloidal properties of food. Sensory perception of tastes, flavor, aroma and texture. Sensory analysis of food. (11hrs)

UNIT-II: Chemistry of Carbohydrates

Classification, composition / structure, physical and chemical properties of carbohydrates, pectic substances, gums and other polysaccharides. Role of carbohydrates in different food product. Functions of carbohydrate. Digestion of carbohydrate-based food and its metabolism. (12hrs)

UNIT-III: Chemistry of Lipids:

Definition and classification of lipids, chemistry of fatty acids and glycerides, physical and chemical characteristics. Chemistry of processing of fats and oils, hydrogenated fats, shortening agents and confectionery fat etc. Rancidity of fats and oils, its prevention and antioxidants. Functional properties of lipids in foods. Metabolism of lipids. (11hrs)

SECTION-B

UNIT-IV: Chemistry of Protein and enzyme:

Importance of proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides and proteins Sources and distribution of proteins. Isolation identification and purity of

proteins, denaturation, Functional properties of proteins in food. Metabolism of proteins, Introduction classification and nomenclature of enzymes, specificity. Industrial applications of Enzymes, kinetics, Techniques of immobilization of enzymes. (14hrs)

UNIT V: Water and Ice

Importance of water in foods. Structure of water and ice. Water Activity and its influence on shelf life of foods. Concept of bound and free water and their implication. (6hrs)

UNIT VI: **Micronutrients of food**

Vitamins – Classification, sources, functions and deficiency symptoms, assay of vitamins. Minerals – Micro & Macro Minerals, pigments and flavors. (6hrs)

Books Recommended:

1. The Chemical Analysis of Foods, Sixth Edition by David Perason, J.O.A. Churbcill, 104 Gloucester place London. 70
2. Manual of Analysis of Fruits and vegetable products: S. Ranganna, Ph.D. Central Food Technological. Research Institute, Mysore, Publisher, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Food Analysis by A.G. Woodman, 4th Edition, Publishers, Mc.Graw Hill Book Company, INC, New York and London, Latest Edition.
4. Modem Food Analysis by F. Leslie Hart A.N. and Hary John Stone Fishes. Ph.D. Publishers, Springer - Verlag. Berlin Heidelberg, New York, Latest Edition.
5. Food Analysis by R Lees, Published by Leonard Hill Books, London.
6. Food Chemistry: L H Meyer, Van Nostrand Reinhold Co New York 1960
7. Principles of Food Science, Ed. Owen R Fennema Part I, Food Chemistry, Marcel Dekker Inc New York
8. The Chemical analysis of foods and food products : Morris B Jacob, 3rd Edition, Vam Nostrand Co, Princeston, New Jersey
9. Instrumental Methods of Analysis: Peksock and Shield

4FT214PC: FOOD TECHNOLOGY Sp. Tech-I- LAB.

Course Objectives:

- To provide an opportunity to the students in developing the concept and to learn various methods of estimation of macro nutrients.
- Learn the various methods of estimation of micro nutrients like minerals and vitamins.
- Able to identify methods and instruments that can be used to study of food chemistry
- To focus on the development of skills to control the quality of food.

List of Experiments:

1. To determine the moisture content in food samples by Oven drying or Karl Fischer titration method.
2. To determine total ash and acid insoluble ash from food product
3. Determination of free fatty acid in oils/fats
4. Determination of Fat rancidity by using peroxide value (fats/oils)
5. Determination of gluten in wheat flour
6. To isolate the starch from potato
7. Analysis of Proteins by Flowrin Lowry Method or Biuret Method
8. Quality evaluation of water (pH, Hardness, Turbidity of water, TDS)
9. To determine the sugar content (e.g., glucose, fructose, sucrose) in food samples by refractometry or titration methods (e.g., Fehling's solution, Benedict's solution).
10. To measure the acidity or alkalinity of food products by pH meter or pH Indicator papers.
11. Estimation of ascorbic acid (vitamin c) by titration method
12. Estimation of iron
13. Estimation of Phosphorus
14. Estimation Of Calcium (Based on above Minimum 13 Performances expected

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4PT211PC & 4PT214PC PULP & PAPER TECHNOLOGY Sp. Tech-I

Level 5.0 (UG-Certificate)

Subject Code: 4PT211PC	Title: Pulp & Paper Technology Sp. Tech- I	Credits = 0 4		
		L	T	P
Semester: IV	Total contact hours: 5hrs/week	03	-	02

Course Objective: After completion of course students would be able to identify different raw materials used as paper making raw material, understand their chemical composition and suitability for paper making.

Course Outcomes

- Knowing the different raw materials used in the manufacture of paper, understanding the source of cellulose and availability.
- Understand the anatomy of different fibrous raw material. Study the various morphological properties relevant to paper manufacture.
- Identify the chemical composition of wood which gives an idea of cellulose, hemicelluloses, lignin and extractives present in the wood.
- Study the chemistry of cellulose and hemicelluloses. Understanding the role played by each wood component, reactions of cellulose and hemicelluloses with chemicals.
- Understanding the relevance of lignin, reactions of lignin with different chemicals and their effect, qualitative and quantitative analysis of lignin, utilization of lignin as different polymeric products

SECTION-A

UNIT-I: CHEMISTRY OF WOOD AND PULP OF PAPER MATERIALS:

Species, anatomy and physical properties of Wood:-

Species used as papermaking raw material

Classification of woods, plants used in pulp and paper, gross structure of trunk, structure elements of wood, fiber dimensions, water conducting system, food conducting system, reactions of wood, bark and its structural elements. (11 hrs)

UNIT-II: Fiber morphology: Cell formation and growth, fiber structure, chemical composition of wood, non-wood fibers used in pulping bast, fruits, grass, leaf, animal, mineral and synthetic fibers, proximate analysis of fibrous raw material, physical properties of fiber, decay of wood, physical properties of wood, extractives and it's chemical composition. (11 hrs)

UNIT-III: Cellulose: Chemistry and location in the cell, isolation molecular constitution, microfibrils, crystalline and amorphoupus Pulp of Paper biogenesis of the cell wall, Polysacchrides, sorption, swelling and solution of cellulose, degradation reactions of pulp of paper. (8hrs)

SECTION-B

UNIT-IV: Identification and formation of hemicelluloses and extractives Hemicelluloses it's structure and characteristics in wood, chemistry of xylan, galactoglucomannans, glucomannan, arabinogalactan, isolation of hemicelluloses. Types of extractives, Terpenoids and Steroids chemistry and analysis, Fats and Waxes chemistry and availability, Phenolic Constituents present in wood. (12hrs)

UNIT-V: Lignin: Structure and location of lignin in wood, laboratory isolation methods, lignin heterogeneity, lignin carbohydrate bonds, biochemical formation of lignin, dehydrogenative polymerization of lignin. (10hrs)

UNIT VI :

Various commercial separation methods, qualitative analysis of lignin, quantitative analysis of lignin, structural analysis and utilization of lignin, low molecular weight products, polymeric products from lignin. (8hrs)

Books Recommended:

- "The Chemistry of Cellulose" by Emil Hauser, John Wiley & Sons, New York.
- "The Methods of Cellulose Chern" Charles Dorce, Chapman & Hall, L.
- High Polymers Vol V (Part-I to V) edited by Emil Ott & Others, Interscience Publishers.
- Publishing Processes by S.A.Rydholm, John Wiley & Sons, Inc., New York.
- Pulp & Paper : Chemistry & Chemical Technology by James P. Cascy.

4PT214PC: PULP & PAPER TECHNOLOGY Sp. Tech-I- LAB.

List of Experiments:

Determination of various components of wood such as moisture content. Ash content, Water Solubility, alkali, solubility extractives, lignin Cellulose; hemicellulose, holo cellulose pentosans etc. Microscopic observations of fibrous materials.

(Based on above minimum 13 Performances expected)

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4OT2011PC & 4OT214PC OIL AND PAINT TECHNOLOGY Sp. Tech-I

Level 5.0 (UG-Certificate)

Subject Code: 4OT211PC	Title: Oil & Paint Technology Sp. Tech I	Credits = 0 4		
		L	T	P
Semester: IV	Total contact hours: 5hrs/week	03	-	02

COURSE OBJECTIVES:

The main objectives of this course are to know about oil & Paint Technology. The structure of Oils & their uses for human as industrial applications. The importances of paints in living as well as industrial applications are to be studies.

COURSE OUTCOMES:

By learning this course students will develop

- The ability to understand about edible oils as well as nonedible oils, their importance for metabolism oil industrial applications.
- They understand about the knowhow and importune of resins & paints.
- Ability to describe the importance of edible oils as essential fatty acids for growth of body
- Ability to know the adulteration in oils & fats which are dangerous for human life
- Ability to know the recent developments in oils & Paints Technology

SECTION-A

UNIT I: Natural Fats : Their Sources, classification and composition Constituents of natural fats : Glycerides, Phospholipids, Fatty acids, non-glycerides constituents, toxic constituents and detoxication, Nutritional functions of Fats. (10hrs)

UNIT-II: **Glycerides and fatty acids:** Nomenclature, Structure, occurrence in fats. Physical properties of fats and fatty acids. Elementary ideas on their liquid properties, solution properties and spectral properties. (8 hrs)

UNIT-III: Chemical reaction of fats and their fatty acids. Chemistry of hydrogenation, hydrogenolysis, autoxidation, polymerisation dehydration, pyrolysis, halogenation, sulpation and sulphonation , esterification , interesterification and hydrolysis. Chemical Oxidation of fatty acids, Significance and importance of these reactions. Rancidity of Oils & Fats, Oils antioxidant and synergists. (12hrs)

SECTION-B

UNIT-IV: Physical and Chemical characteristics: Indian standards for oils and fats - ISI Specifications of Oilseeds, Oils, DOC, Vegetable Ghee. Identification of fats. Detection of adulteration in fats and Indian standards for oils and fats. (12hrs)

UNIT-V: Introduction of Paints, Types of Paints, Basic Ingredients of paint system, Industrial applications of Paints. (10hrs)

UNIT-VI: Recent development in the field of Oils & Paints. (8hrs)

Books Recommended:

- Industrial Oil and Fat Products Ed.: A. E. Bailey. Interscience & Sons New York, London, Sydney 5th Edn.
- An Introduction of the Chemistry and Biochemistry of Fatty Acids : Gumstone.
- Progress in the Chemistry of Fats and other liquids (Vols. 1 to 11) T. R. Holmann, Pergamon Press.
- Fatty Acids : K. S. Markley, Inter Sc. Publishers, 2nd edition, New York.
- Industrial Chemistry of Fats and Waxes : T. Hilditch Balliere Tindall and Cox, London 2nd Edition.
- Rancidity of Edible Fats : C. H. Lea, His Majesty's Stationary Office, London, Latest Edition.
- Analysis of Fats and Oils : V. V. Mellen Bacher, Garrard Press Publishers, Illinois, Latest Edition.
- Outline of Paint Tech. - H. Hea
- Introduction of paints by Morgan.

4OT214PC: OIL AND PAINT TECHNOLOGY Sp. Tech-I- LAB.

- Preparations & Standardization of Solutions,
- Determination of various physical and chemical characteristics of oils, fats and waxes, colour, solubility and thermal test for purity.
- Analysis of oilseeds and cakes,
- Estimation of rancidity.
- Analysis of nickel catalysts and acid oils determination,
- Physical and chemical characteristics of vanaspati, margarine and ghee.
- Detection of adulteration in oils & fats
- Testing of readymade Paints & Raw materials of paints systems like pigments, Solvents, additives, Resins.

  (Based on above minimum 13 performances expected)

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH(CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOUTH B. TECH
4PC211PC & 4PC214PC PETROCHEMICAL TECHNOLOGY Sp.Tech-I
Level 5.0 (UG-Certificate)

Subject Code:4PC211PC	Title: Petrochemical Tech Sp.Tech- I	Credits=04		
		L	T	P
Semester: IV	Total contact hours:05hrs/week	03	-	02

COURSE OBJECTIVES:

- Basic Concepts of Chemistry of Hydrocarbons
- Introduction to Basic Refinery Processes
- Formation Theories of Petroleum
- Exploration and prospecting for petroleum and gas field, Drilling, Transportation, Storage of Petroleum & Products and future Energy Sources.

COURSE OUTCOMES:

- Students will be able to understand
- The chemistry and composition of petroleum.
- Importance petroleum as a source of energy and petrochemicals
- Technology involved in exploration and prospecting for petroleum and gas field, as well as drilling for petroleum.

SECTION-A

UNIT-I: Origin, Occurrence, and Formation of crude petroleum. History of Indian Petroleum and Refining Industry and future trends. Hydrocarbon resources in India, history. World Petroleum Scenario, world Petroleum Reserves and Deposits. Crude Oil and Natural Gas Production and Consumption in India. Petroleum refineries in India, their location, year of commissioning, and organizations, Refining Capacity& throughput, Production& Consumption of Petroleum Products.Advantages and disadvantages of petroleum. (10hrs)

UNIT-II: Composition, Chemistry, Classification of Petroleum Hydrocarbon composition of petroleum and petroleum products (liquid and gas).Non-hydrocarbon compounds in petroleum. Properties of hydrocarbons and non-hydrocarbons. Classification and description of crude oils and petroleum gases. (10hrs)

UNIT-III: Refining Processes and Operations Various refining processes, operations and chemistry involved. Principle involved in dehydration, desalting and conditioning of crude oil. Thermodynamics, kinetics and reaction mechanism, principle involved in thermal and catalytic processes such as thermal and catalytic cracking, hydro cracking, reforming, isomerisation, polymerization, alkylation. (10hrs)

SECTION-B

UNIT-IV: Exploration and prospecting for petroleum and gas field Structure of earth and of the earth crust, formation of Sedimentary rocks, Exploration and prospecting for petroleum and gas field, Geological, Geophysical, Geochemical prospecting methods, geophysical borehole logging methods. Migration of petroleum and gas deposits and commercial petroleum accumulations. Petroleum traps and their classifications. Development of an oil or gas field. (10hrs)

UNIT -V: Drilling for Petroleum Drilling operation, Cable tool method, Rotary drilling, Turbo drilling, types of drill bits, mud fluids, casing off formations, Deviation of holes, Directional drilling, Offshore drilling rigs, Well control systems. (10hrs)

UNIT-VI: Other Sources of Hydrocarbons, Transportation& Storage of Petroleum Sources of hydrocarbons other than crude oil, future automotive fuel resources, new and future energy sources. Transportation and storage of crude oil, petroleum gases, and petroleum products. Shipping tankers, Pipelines: Materials and Corrosion, Onshore and offshore pipeline construction. Pipeline network in India. (10hrs)

Reference Books:

- Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri
- Modern Petroleum Technology Volume-I Upstream Edited by Richard A. Dawe
- Geology of Petroleum Vol. 5, Edited by Heinz Beckmann

Text Books:

- Modern Petroleum Refining Processes by B. K. Bhaskara Rao, Latest Edition.
- Petroleum Refining Technology by Dr. Ram Prasad
- Chemistry of Petrochemical Processes by Sami Matar, Lewis F. Hatch
- The Chemistry and Technology of Petroleum by James G. Speight
- Handbook of Petroleum Product Analysis byJames G. Speight

4PC214PC: PETROCHEMICAL TECHNOLOGY SP. TECH-I - LAB.

List of Experiments:

- Determination of Flash point of given petroleum sample by Abel's method.
- Determination of Flash point of given petroleum sample by Pensky Marten's method.
- Determination of Flash and fire point of given petroleum sample by Clevland's Open Cup method.
- Determination of Smoke Point of given petroleum sample.
- Determination of Cloud & pour Point of given petroleum sample.
- Determination of Aniline point of given petroleum sample.
- Determination of Copper Strip corrosion test.
- Determination of API gravity of given petroleum sample.
- Determination of Needle penetration of grease sample and cone penetration index of bitumen sample.
- Determination of melting point of wax by cooling curve method.
- Determination of drop melting point of wax.
- Determination of congealing point of wax.

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CT215M MDM-2: SOLID WASTE MANAGEMENT

Level 5 (UG-Diploma)

Subject Code: 4CT215M	Solid Waste Management	Credits =02		
		L	T	P
Semester: IV	Total contact hours: 2hrs/week	2	-	-

UNIT I: Fundamental of solid waste Management

Introduction, sources of solid waste, Physical & Chemical characteristics of municipal solid waste factor affecting solid waste generation (10hrs)

UNIT II: Storage, collection, and Transportation of Municipal solid waste

Storage of solid waste, Collection Methods, Transportation of Municipal waste (10hrs)

UNIT III: Disposal of Municipal Solid Waste

Concept of composting of waste, Methods of composting. Variety of industrial waste, collection and disposal of industrial waste, control measures for industrial waste, recycling (10hrs)

Reference Books/Text Books:

- Solid waste : T. George, K. Frank, McGraw Hill New Delhi
- Environmental studies : D.C. Manjunath, Pearson Education Pub. New Delhi
- Solid waste Management : K. Sasikumar, PHI, New Delhi
- Environmental pollution : S. M. Khopkar, New Age Int. Ltd. New Delhi

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CT216VS VSEC-III Machine Design & Drawing

Level 5 (UG-Diploma)

Subject Code: 4CT216VS	Machine Design & Drawing	Credits =02		
		L	T	P
Semester: IV	Total contact hours: 2hrs/week	1	-	2

This course seeks to introduce the design of machine elements commonly encountered in engineering practice.

Course Objectives:

1. To understand background in mechanics of materials-based failure criteria underpinning the safety-critical design of machine components.
2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations.
3. An overview of standards and design guidelines for different elements.
4. Overview of the design methodologies employed for the design of various machine components.
5. To analyze the principles of designing the pressure vessels.
6. To demonstrate the application of pressure vessels in chemical industries.

Course Outcomes: After successful completion of this course student will be able to:

1. Introduce design and drawing as a process and as a final product.
2. Introduce to the design assignment, their aims and objectives, scope, special emphasis, and limitation.
3. Application of design standards for the proposed design safety.
4. Planning and design data collection, design analysis, and design synthesis.
5. Major designs and drafting of the parts or modification in the existing part for better result and efficiency.
6. To select suitable material and dimensions of equipment parts.

UNIT- I: (1) Engineering Materials: Mechanical Properties of materials, I.S. designation of materials, and selection of materials. Selective assembly and Interchangeability.

(2) Traditional design methods, Design process, Design analysis, Design synthesis. Design consideration: Limits, Fits and tolerances. (5Hrs)

UNIT- II: (1) Design for Static and Fluctuating Loads: Ductile and Brittle Materials, Theories of Failure, Factor of safety, Stress concentration and notch sensitivity in materials, Fluctuating stresses, Endurance limit, Stress-Strain diagram, Soderberg diagrams.

(2) Design of Riveted & Welded joints: Failures, strength, and efficiency of riveted joints. Eccentric loaded riveted joint. Symbolic representation, strength of transverse and parallel fillet welded section. Circular fillet welded section. (5Hrs)

UNIT- III: Pressure Vessels: Thick and Thin Pressure Vessels, Design of Cylindrical and Spherical Pressure Vessels, Design of Pipelines, Introduction to design of unfired pressure vessels. (5Hrs)

Reference Books:

- Machine Design by Dr. P. C. Sharma & Dr. D. K. Agrawal, Katsons Books publication
- Design of Machine elements by C. S. Sharma, Kamlesh Purohit, PHI publication
- Design of Machine elements by V. B. Bhandari, Tata McGraw Hill Publication
- Machine Design, Jindal, Pearson publications
- Design Data Book by- P.S.G. Coimbatore
- Design Data Book by Mahadevan.

(Use of any data book from the above will be permitted during the examination).

Text Books:

- Machine Drawing by N. D. Bhatt, Charator Publication
- Machine Design by R. S. Khurmi and J. K. Gupta , S. Chand Publication .

4CT216VS: MACHINE DESIGN & DRAWING (VSEC-III) Practical

Minimum 8 Free hand drawing sheets based on the Syllabus 4CH215VS: MACHINE DESIGN & DRAWING thereof should be submitted by each student.

Evaluation Scheme:

Internal Assessment : 50 Marks

- ✓ Class Test-I (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Class Test–II (MCQ/ Subjective/ Objective) : 10Marks
- ✓ Teaching Evaluation Components (Lab Record/Practical Work) : 10Marks
- ✓ Class Attendance : 10Marks
- ✓ Viva Voce (Oral Examination) : 10 Marks

(Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CT217OE-II: PETROLEUM REFINING

Level 5 (UG-Diploma)

Subject Code: 4CT217OE	Petroleum refining	Credits =02		
		L	T	P
Semester: IV	Total contact hours: 2hrs/week	2	-	2

COURSE OBJECTIVES: After completion of this course, the students are expected to learn about:

- Objective of Refining of Crude Oil
- Product Pattern and fractions for specific applications
- Integration of refining operations and processes

COURSE OUTCOMES: After successful completion of this course student will be able to:

- Understand the importance & necessity of integration of refining operations
- Treatments required for producing quality products as well as role of Primary Conversion and Upgrading Processes
- Understand the complexity of refinery operations as well as the importance of crude oil quality and its effect on refining operations.

SECTION-A

UNIT I: Introduction to petroleum refining. Basic refinery processes-operations. Product pattern. Classification of refining processes. Important properties of crude oil: Specific gravity, Sulfur content, TAN number. Improving distillate yields and production of high value products. Classifying Refineries by Configuration and Complexity, Nelson's complexity and its determination. Petroleum refining industry in India, Vision of refining industries in India.

UNIT II: Integrated Refinery. Refinery Classes and Characteristic Yield Patterns. Descriptive account of atmospheric and vacuum distillations. Features of Primary Conversion Processes. Features of Primary Upgrading Processes. Separation Processes, Utilities and Support Operations, Product Blending.

SECTION-B

UNIT III: Types of impurities, Sulphur, nitrogen and oxygen in petroleum, purposes for desulfurization, order of difficulty of sulfur removal. Hydrotreating Processes. Treatment techniques (process description, process variables, typical operating conditions). Introduction to upgrading processes (Reforming, isomerization, alkylation etc.).

UNIT IV: Thermal and Catalytic cracking processes (process description, process variables, reactions involved, and typical operating conditions). Mechanism of thermal and catalytic cracking. Most probable thermal and catalytic reactions for various types of hydrocarbon compounds.

Text Books/ Reference Books:

Reference Book:

1) Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri
2) Modern Petroleum Technology Volume-I Upstream Edited by Richard A. Dawe
3) Fundamentals of Petroleum Refining by Mohamed A. Fah Im, Taher A. Alsahhaf, Amal Elkilani
4) Handbook of Petroleum Processing Edited by David S. J. "Stan" Jones And Peter R. Pujad´O
5) Petroleum Refining Technology and Economics by James H. Gary and Glenn E. Handwerk

Text Books:

1) Modern Petroleum Refining Processes by B. K. Bhaskara Rao, Latest Edition.
2) Petroleum Refining Technology by Dr. Ram Prasad
3) Chemistry of Petrochemical Processes by Sami Matar, Lewis F. Hatch
4) The Chemistry and Technology of Petroleum by James G. Speight

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CT218EM : INDUSTRIAL MANAGEMENT (HSSMC)

Level 5 (UG-Diploma)

Subject Code: 4CT218EM	Industrial Management	Credits =02		
		L	T	P
Semester: IV	Total contact hours: 2hrs/week	2	-	2

Course Objectives:

1. Explaining the relationship between planning, organizing, staffing, directing, and controlling.
2. Identifying different organizational structures and their implications.
3. Analyzing production processes and identifying materials management.
4. Applying techniques of marketing research to optimize costs.
5. Understanding the advertizing ethics and its effective implementation.
6. Awareness about business and finances of chemical industry.

Course Outcomes: Upon successful completion of the course, students will be able to:

1. Understand the fundamental concepts of Management and planning function.
2. Describe the functions of Managers, and Entrepreneurs.
3. Understand the concepts of entrepreneur and entrepreneurship.
4. Describe the concept of the small-scale industries.
5. Explain the support system and funding opportunities for an entrepreneur to start an industry.
6. Describe feasibility study to choose a project, project preparation and conduction.

UNIT- I: Basic concepts and functions of Management, Personal Management. Production Management: Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Concepts of material management, inventory control; its importance and various methods. (9Hrs)

UNIT- II: Marketing Management: Definition of marketing, marketing concept, objectives and functions of marketing. Marketing Research – Meaning; Definition; Objectives; Importance; Limitations; Process.

Advertising – meaning of advertising, objectives, functions, criticism. (9Hrs)

UNIT- III: Financial Management: Introduction, Objectives of Financial Management, Functions and Importance of Financial Management. Concept of capital structure and various sources of finance. (9Hrs)

BOOKS RECOMMENDED:

- Small Business Management Fundamentals: Dan Strenhoff and J.F.Burgess, McGrawHill Book Company.
- Effective Small Business Management: Richard M. Hodgills, Academic Press Incorporated, Harcourt, Brace Jovanovich.
- Marketing Management: Analysis, Planning, Implementation and Control: Kotler, Phillip, Prentice Hall of India Pvt.Ltd., Latest Edition.
- International Economy, Liberalization Process : V.K. Bhalla Anmol, New Delhi
- Marketing Management for Small Units: Jain Vijay K.,Management Publishing Co., Latest Edition.
- Management: Koonts H and Wechrich H, Mc Graw Hill.
- Production and Operations Management: Cherry S.N.,Tata McGraw Hill.

Evaluation Scheme: Each Unit is Weighed 10 Marks

- **Internal Assessment** : **20 Marks**
- ✓ Class Test-I (MCQ/ Subjective/ Objective) : 05Marks
- ✓ Class Test–II (MCQ/ Subjective/ Objective) : 05Marks
- ✓ Teaching Evaluation Components : 05Marks
  (Viva Voce / Assignments / Report Writing etc.)
- ✓ Class Attendance : 05Marks
- **End-Semester Examination** : **30 Marks**

(Records of Internal Assessment must be kept with the department / institute at least till 5 years from the admission academic year of the student.)

SYLLABI PRESCRIBED FOR FOUR YEAR DEGREE COURSE
B. TECH (CHEMICAL TECHNOLOGY)
(FOOD, PULP & PAPER, OIL & PAINT AND PETROCHEMICAL TECH.,)
SEMESTER PATTERN (NEP-2020)
SEMESTER: FOURTH B. TECH

4CH219 VE: VALUE EDUCATION COURSE: Environmental Sciences

Level 5 (UG-Diploma)

Subject Code: 4CH219VE	Title: Environmental Sciences	Credits =02		
		L	T	P
Semester: IV	Total contact hours: 2hrs/week	2	-	-

SECTION-A

UNIT I:

Social issues and the Environment:

- Unsustainable to sustainable development
- Urban problems related to energy
- Water conservation: rain water harvesting, water shed management
- Environmental ethics: issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion and nuclear accidents

(8hrs)

Unit II:

Environmental Legislation:

Environment protection Act (1986); Air (prevention and control of pollution) Act (1981-82); Water (prevention and control of pollution) Act (1974); Wildlife protection act (1972); Forest conservation act (1980), Issues involved in enforcement of environmental legislation

(10hrs)

SECTION-B

Unit III: Human population and the environment:

- Population growth and variation among nations
- Population explosion- family welfare program
- Environment and human health
- Human rights
- HIV / AIDS
- Women and child welfare
- Role of information technology in environment and human health (6hrs)

Unit IV: Field work: Project report / Survey

- Visit to a local area to document environmental assets - river / forest / grassland / hill / mountain.
- Visit to a local polluted site - urban / rural / industrial / agricultural.
- Study of local plants, insects, birds.
- Study of local ecosystems - pond, lake, river, forest, etc.

Reference Books:

- Text Book of Environmental studies, Erach Bharucha, UGC.
- Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd.
- Ecology and Environment, P. D. Sharma.
- Ecology, M. P. Arora, Himalaya Publishing House.