NEP- Fourth Semester B.Tech.(Chem.Engg.) Syllabi Details

4CH209PC/4CT209PC: **Fluid Flow Operation (**PCC**)**

Subject Code	Title	Credits-03		
4CH209PC/4CT209PC	Fluid Flow Operation	L	T	P
Semester: IV	Total Contact Hours: 3 Hrs / Week	3	0	0

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.)

4CH212PC/4CT212PC: FLUID FLOW OPERATION LAB. (PCC Lab.)

Subject Code	Title	Credits- 01		
4CH212PC/4CT212PC	Fluid Flow Operation Lab.	L	T	P
Semester: IV	Total Contact Hours: 2 Hrs / Week	0	0	2

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**

4CH210PC/4CT210PC: CHEMICAL ENGINEERING OPERATION-I (MECHANICAL OPERATION) (PCC)

Subject Code	Title	Credits- 03		
4CH210PC/4CT210PC	Chemical Engineering Operation-I (Mechanical Operation)	L	T	P
Semester: I V	Total contact hours: 3hrs/week	3	0	0

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.)

4CH213PC/4CT213PC: CHEMICAL ENGINEERING OPERATION-I LAB.
(MECHANICAL OPERATION LAB.) (PCC Lab.)

Subject Code	**Title**	**Credits- 01**		
4CH213PC/4CT213PC	Chemical Engineering Operation-I Lab. (Mechanical Operation Lab.)	L	T	P
Semester: I V	Total contact hours: 2 hrs / week	0	0	2

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 (Lab Record/Practical Work) : 20Marks
- ✓ Class Attendance : 05Marks
- **External University Practical Examination** : **25 Marks**

4CH211PC: Process Calculations (PCC)

Subject Code	**Title**	**Credits- 02**		
4CH211PC	Process Calculations	L	T	P
Semester: IV	Total contact hours: 2hrs/week	2	0	0

Course Objectives:

1. To introduce the fundamental concepts of unit operations, unit processes, and their relevance in chemical engineering calculations, including understanding of units, dimensions, and gas laws.
2. To develop skills for performing material balance calculations for physical processes without chemical reactions, including applications in distillation, absorption, crystallization, and drying.
3. To enable students to perform material balance calculations involving chemical reactions, incorporating concepts like stoichometry, percentage yield, selectivity, and unsteady-state systems.
4. To provide an understanding of energy balance principles in open and closed systems, focusing on enthalpy changes during phase transitions, evaporation, and mixing.
5. To teach the calculation of energy changes in chemical reactions, including standard heat of reaction, heat of formation, heat of combustion, and adiabatic flame temperatures.
6. To apply energy and material balance principles to combustion processes, including theoretical and excess air calculations, and evaluate the heating values of fuels.

Course Outcomes:

1. Students will be able to analyze unit operations and processes using fundamental concepts like units, dimensions, gas laws, and composition calculations.

2. Students will acquire proficiency in solving material balance problems for various unit operations, including distillation, extraction, evaporation, and drying.
3. Students will demonstrate the ability to perform material balance calculations for chemical processes, considering reaction stoichiometry, percentage conversion, and yield.
4. Students will be able to calculate energy balances for open and closed systems, incorporating enthalpy changes for phase transitions and mixing processes.
5. Students will apply thermodynamic principles to evaluate energy changes during chemical reactions and determine parameters like heat of reaction and adiabatic flame temperature.
6. Students will gain expertise in performing heat and material balance calculations for combustion processes and analyzing heating values and air requirements for fuels.

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. Concepts of normality, molarity, and molality; PPM (Parts Per Million). Ideal Gas Law, Dalton's Law, partial pressure, Amagat's Law, average molecular weight, and density of gas mixtures. Raoult's Law, Henry's Law, vapor pressure, Cox chart, humidity and saturation, humidity chart, and their applications. (8Hrs)

Unit- II: Material balance without chemical reactions. Calculations for unit operations such as distillation, absorption, extraction, crystallization, drying, mixing, and evaporation. Recycle, purge, and bypass calculations. Introduction to unsteady-state material balance. (7Hrs)

Unit- III: Material balance involving chemical reactions. Principles of stoichiometry, simple oxidation reactions, multiple chemical reactions, percentage conversion, percentage yield, and selectivity. Recycle, purge, and bypass calculations. Unsteady-state material balance. (7Hrs)

SECTION-B

Unit- IV: Energy balance. Open and closed systems; heat capacity; calculations of enthalpy changes; enthalpy changes for phase transitions, evaporation, solution, and mixing. The Clausius-Clapeyron equation. (8Hrs)

Unit- V: Energy balance with chemical reactions. Calculation of standard heat of reaction, heat of formation, and heat of combustion. Hess's Law, the effect of temperature on the heat of reaction, and adiabatic flame temperature calculations. (8Hrs)

Unit- VI: Heating value of fuels. Calculations involving theoretical and excess air; heat and material balance of combustion processes. (7Hrs)

Text Books:

1. Bhatt, B. I., Vora, S. M., "Stoichiometry", Fourth Edition, Tata McGraw Hill Publishing Company Ltd,2004.
2. Narayanan K V and Lakshmikutty B, Stoichiometry and Process Calculations, Prentice Hall of India PvtLtd, New Delhi 2006.
3. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.
4. Himmelblau, D. M., Riggs, J. B. "Basic Principles and Calculations in ChemicalEngineering", Eighth Ed.,Pearson India Education Services, 2015.
5. Hougen. O. A, Watson K.M. and Ragatz R.A. "Chemical Process Principles, Part -I, Material and EnergyBalance".

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.)

4CH214M: Chemical Engineering in Air Pollution and Control (MDM– II)

Subject Code	**Title**	**Credits- 02**		
4CH214M	Chemical Engineering in Air Pollution and Control	L	T	P
Semester: IV	Total contact hours: 2 hrs / week	2	-	-

Course Objectives:

1. **Understanding the fundamentals of air pollution:**

   Defining air pollution and its key components (particulate matter, gaseous pollutants, etc.).
   Explaining the atmospheric processes influencing air pollution dispersion.
   Identifying major sources of air pollution (industrial emissions, vehicular exhaust, agricultural practices).
2. **Analyzing the impacts of air pollution:**
   Examining the health effects of air pollution on respiratory and cardiovascular systems.
   Discussing the environmental impacts of air pollution (acid rain, ozone depletion, climate change). Exploring the socio-economic impacts of air pollution on communities.
3. **Studying air pollution control technologies:**
   Examining different air pollution control devices (scrubbers, filters, electrostatic precipitators).
   Gaseous pollutant control by adsorption, absorption, condensation, combustion
4. **Air quality monitoring and assessment:**
   Evaluating the effectiveness of various pollution control strategies.
   Learning about air quality monitoring techniques and data analysis.
5. **Policy and regulatory frameworks:**
   Applying air quality modeling tools to predict pollution levels.
   Analyzing existing air pollution control policies and legislation at national and international levels.
6. **Interpreting air quality indices and standards.**
   Discussing challenges and opportunities in implementing air quality management plans.
   Exploring sustainable practices and mitigation strategies to reduce air pollution.

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

1. Understand the different types of air pollutants, their chemical properties, and sources of emission from various industries and activities.

2. Analyze the effects of air pollution on human health, including respiratory diseases, cardiovascular issues, and other health concerns.
3. Evaluate the environmental effects of air pollution on ecosystems, vegetation, and climate change.
4. Apply mathematical models to predict the dispersion and concentration of air pollutants based on meteorological factors
5. Analyze and design various air pollution control devices like scrubbers, cyclones, electrostatic precipitators, and filters, considering their suitability for different pollutant types
6. Apply knowledge to analyze real-world air pollution scenarios and propose solutions based on engineering principles

SECTION-A

UNIT-I: Sources of air pollution: Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution–Source inventory.
Effects of air pollution: Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion. (9Hrs)

UNIT-II: Air Pollution Control: Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment
Gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries. (9Hrs)

UNIT-III: Air Quality Management: Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts– Zoning – Town planning regulation of new industries – Legislation and enforcement. (9Hrs)

Text Books:

- Anjaneyulu, D., "Air Pollution and Control Technologies", Allied Publishers, Mumbai, 2002
- Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi,1996

Reference Books:

- Rao M.N., and Rao H. V. N., Air Pollution Control, Tata-McGraw-Hill, New Delhi, 1996
- W.L.Heumann, Industrial Air Pollution Control Systems, McGraw- Hill, New Yark, 1997
- Mahajan S.P., Pollution Control in Process Industries, Tata McGraw- Hill Publishing Company, New Delhi, 1991
- Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, New Delhi, 1985
- Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi

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)

4CH215VS/4CT216VS: MACHINE DESIGN & DRAWING (VSEC-III)

Subject Code	Title	Credits- 02		
4CH215VS/4CT216VS	Machine Design & Drawing	L	T	P
Semester: IV	Total contact hours: 3 hrs / week	01	-	02

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.

SECTION-A

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 .

4CH215VS/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.)

4CH216OE: Water Treatment Technologies (OE-II**)**

SubjectCode	**Title**	**Credits-02**		
4CH216OE	Water Treatment Technologies	L	T	P
Semester: IV	Total contact hours: 2 hrs / week	2	0	0

Course Objectives:

1. To understand the water or hydrologic cycle and analyze the physical and chemical characteristics of water, including their impact on water quality and treatment processes.
2. To learn the capabilities and limitations of conventional water and wastewater treatment methods and recognize the need for advanced treatment techniques.
3. To explore advanced water treatment methods, including iron and manganese removal, reverse osmosis, ion exchange, and fluoride management, for improved water quality.
4. To examine advanced wastewater treatment techniques, focusing on nutrient removal, heavy metal removal, and treatment of refractory organics using biological and physical methods.

5. To investigate combined physico-chemical and biological treatment processes, including aerobic and anaerobic systems, activated carbon treatment, and pure oxygen systems.
6. To study recent advances in water treatment, filtration systems for high-quality effluents, and resource recovery methods for sustainable water management.

Course Outcomes:

1. Students will be able to identify and evaluate the physical and chemical characteristics of water and understand their significance in water treatment processes.
2. Students will acquire knowledge of conventional water and wastewater treatment methods and their limitations, enabling them to assess the need for advanced techniques.
3. Students will gain expertise in advanced water treatment methods such as reverse osmosis, electrodialysis, and activated carbon treatment for addressing specific water quality issues.
4. Students will demonstrate proficiency in advanced wastewater treatment techniques, including nutrient control, biological methods, and the removal of heavy metals and refractory organics.
5. Students will apply combined physico-chemical and biological processes to wastewater treatment systems and evaluate methods for achieving high-quality effluents.
6. Students will be equipped to analyze and implement recent advancements in water treatment technologies, multistage systems, and resource recovery approaches for sustainable water management.

SECTION-A

UNIT- I: Water or hydrologic cycle; Physical and chemical characteristics of water, such as color, turbidity, odor, pH, BOD, COD, DO, hardness, and nutrients. Conventional water and wastewater treatment methods: their capabilities and limitations. Need for advanced treatment of water and wastewater. (9Hrs)

UNIT- II: Advanced water treatment: iron and manganese removal; color and odor removal; activated carbon treatment; carbonate balance for corrosion control; ion exchange; electrodialysis; reverse osmosis and modern methods; and fluoride management. (9Hrs)

UNIT- III: Advanced wastewater treatment: nutrient control in effluents; nitrogen and phosphorus removal methods, including biological methods; methods for the removal of heavy metals, oil, and refractory organics. (9Hrs)

Text Books:

1. Introduction to Environmental Engineering, By P.A.Veslind, PWS Publishing Company, Boston, 1997.
2. Activated Sludge Process: Theory and Practices, By N.F.Grey, Oxford University Press, 1990.

Reference Books:

1. Wastewater Treatment and disposal, By S.J. Arceivalla, Marcel Dekker,1981.
2. Waste Water Treatment Plant Planning, Designand Operation, By S.R. Quasim, Holt, Rinehart &Winston N.Y.

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.)

4CH217EM/4CT218EM: INDUSTRIAL MANAGEMENT (HSSMC)

Subject Code	Title	Credits- 0 2		
4CH217EM/4CT218EM	Industrial Management	L	T	P
Semester: IV	Total contact hours: 2 hrs / week	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.)

B.Tech.(Chemical Engineering) Double Minor-I: Chemical Process Safety

4CH261DM1: **Fire Safety and Explosion Control (PCC)**

SubjectCode	Title	Credits-03		
4CH261DM1	Fire Safety and Explosion Control	L	T	P
Semester:IV	Total Contact Hours	3	0	0

Course Objectives: This course aims to:

1. Provide an in-depth understanding of the physics and chemistry of fire, including fire properties, combustion, and explosion phenomena.
2. Educate on fire prevention and protection measures, including ignition sources, fire classification, extinguishing methods, and firefighting equipment.
3. Explain industrial fire protection systems, such as sprinklers, hydrants, detection systems, and special suppression technologies.
4. Introduce the fundamentals of explosions, their types, characteristics, and the impact of blast waves.
5. Examine explosion protection systems, including containment, venting, suppression, and control measures for hazardous substances.
6. Analyze real-world case studies of industrial fires and explosions and review legal frameworks and technological advancements in fire safety.

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

1. Understand the principles of fire science, including fire spread, combustion, and explosion mechanisms.
2. Identify fire hazards and implement prevention measures using fire safety principles and protective systems.
3. Select and maintain industrial fire protection systems, including sprinklers, hydrants, and advanced suppression technologies.

4. Differentiate between deflagration and detonation, understand explosion parameters, and assess explosion risks.
5. Apply explosion protection techniques, such as containment, suppression, venting, and inert gas systems, in industrial settings.
6. Analyze past industrial fire and explosion incidents, evaluate fire safety regulations, and explore emerging fire protection technologies.

SECTION-A

Unit I: Physics and Chemistry of Fire (7Hrs)
Fire properties of solids, liquids, and gases. Fire spread. Toxicity of combustion products. Theory of combustion and explosion. Vapour clouds, flash fires, jet fires, pool fires, unconfined vapour cloud explosions, and shock waves. Auto-ignition. Boiling Liquid Expanding Vapour Explosion (BLEVE).

Unit II: Fire Prevention and Protection (8Hrs)
Sources of ignition. Fire triangle. Principles of fire extinguishing. Active and passive fire protection systems. Various classes of fires (A, B, C, D, E). Types of fire extinguishers. Fire stoppers, hydrant pipes, hoses, monitors, and fire watchers. Layout of standpipes, fire stations, fire alarms, and sirens. Maintenance of fire trucks. Foam generators. Escape from fire and rescue operations. Fire drills. Fire safety notices. First aid for burns.

Unit III: Industrial Fire Protection Systems (8Hrs)
Sprinklers, hydrants, standpipes. Special fire suppression systems such as deluge and emulsifier. Selection criteria for fire protection installations, reliability, maintenance, evaluation, and standards. Alarm and detection systems. Other suppression systems: CO_2 system, foam system, dry chemical powder (DCP) system, halon system, and the need for halon replacement. Smoke venting. Portable extinguishers. Fire protection for flammable liquids and tank farms. Indices of inflammability. Firefighting systems.

SECTION-B

Unit IV: Introduction to Explosions (7Hrs)
Definition and types of explosions (physical, chemical, nuclear). Deflagration vs. detonation. Blast waves and pressure effects. Explosion parameters. Factors influencing explosion severity.

Unit V: Explosion Protection Systems (8Hrs)
Principles of explosion, detonation, and blast waves. Explosion parameters. Explosion protection methods: containment, flame arrestors, isolation, suppression, and venting. Explosion relief for large enclosures. Explosion venting using inert gases. Plant for the generation of inert gases. Rupture discs in process vessels and pipelines. Explosion suppression systems based on carbon dioxide (CO_2) and halons. Hazards in handling LPG, ammonia (NH_3), sulfur dioxide (SO_2), and chlorine (Cl_2).

Unit VI: Case Studies (7Hrs)
Case studies and analysis of recent major industrial fires and explosions. Various rules and legislation on fire safety. Recent advances in fire safety.

Text Books:

1) Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay1977.

Reference Books:

1) Derek, James, Fire Prevention Hand Book, Butterworths and Company, London, 1986.
2) Daniel E. Della-Giustina, Fire Safety Management Handbook, Third Edition, CRC Press, Taylor & Francis Group, 2014

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

2. (Viva Voce / Assignments / Report Writing/ Field Work 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.)

B.Tech.(Chemical Engineering) Double Minor-II: Biofuels Technology

4CH265DM2: **Biogas-Production Process Engineering (PCC)**

Subject Code	**Title**	**Credits- 03**		
4CH265DM2	Biogas- Production Process Engineering	L	T	P
Semester: IV	Total Contact Hours: 3 Hrs / Week	3	0	0

Course Objectives:

1. To provide the knowledge about properties, composition, features of biogas and uses of biogas.
2. To provide the students a substantial knowledge of biogas production technologies.
3. To provide knowledge about the process of biogas production and methods of production of biogas.
4. To provide knowledge about feedstock characterization.
5. To provide knowledge about biogas applications.
6. To explore the concept of Biogas and their environmental impacts.

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

1. Describe the functional principle of biogas in small and large scale.
2. Describe the main steps and components in biogas production.
3. Participate actively in teamwork and work with case related problem solving.
4. Work with professional problem solving in an industrial environment.
5. Work in other fields of engineering.
6. Will create the awareness of environmental protection among society.

SECTION- A

Unit- I: Introduction to Biogas and Renewable Energy: (7Hrs)

- Types of Biomass: Exploring various types of biomass resources suitable for biogas production including agricultural residues, animal waste, and food processing byproducts.
- **Anaerobic Digestion:** The fundamental process of anaerobic digestion including the microorganisms involved and the different stages of biogas production.

Unit- II: Biogas Production Fundamentals: (7Hrs)

- Factors affecting biogas production (temperature, pH, etc.) Optimization of the digestion process.
- **Feedstock Characterization:** Analyzing the properties of different biomass feedstocks and their mpact on biogas production.

Unit- III: Biogas Plant Design and Engineering: (8Hrs)

- Principles of biogas plant design, including digester types, sizing, and material selection.
- **Digester Design and Construction:** Different types of biogas digesters (fixed dome, floating dome, etc.) and their construction methods.

SECTION- B

Unit- IV: Biogas Utilization and Applications: (7Hrs)

- **Biogas Cleaning and Upgrading:** Techniques for removing impurities from biogas (e.g., carbon dioxide, hydrogen sulfide) and upgrading it to biomethane.
- **Biogas Applications:** Exploring various applications of biogas, including cooking, heating, electricity generation, and transportation fuel.

Unit- V: Biogas Storage and Distribution: (8Hrs)

- Methods for storing and distributing biogas including pipelines and storage tanks.
- **Digestate Management:** Understanding the composition and utilization of digestate (the solid and liquid residue from biogas production) as a fertilizer or soil amendment.

Unit- VI: Environmental and Economic Considerations: (8Hrs)

- **Environmental Impacts of Biogas Production:** Assessing the environmental benefits and potential drawbacks of biogas production including greenhouse gas emissions and nutrient cycling.
- **Biogas Technology for Rural Development:** Exploring the role of biogas in promoting sustainable rural development.

Text Books:

1. Biogas Production, Upgradation and Slurry Management, Author- V.K. Vijay, ISBN-13: 9788184871364
2. Biogas Production Management And Utilisation, by A.N.Mathur (Author), Publisher: Himanshu Publications (1 January 1992), ISBN-13 : 978-8185167602
3. EMERGING TRENDS IN BIOGAS TECHNOLOGY: Unlocking the Power of Biogas, by Dr. A. Sajidas (Author), Kindle Edition, ASIN: B0CW1FTKK1, Amzon.in

Reference Books:

1. Handbook on Biogas and Its Applications (from Waste & Renewable Resources with Engineering & Design Concepts) (2nd Revised Edition), Author: NIIR Board of Consultants & Engineers, Publisher: NIIR PROJECT CONSULTANCY SERVICES. ISBN-13: 978-9381039779

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/ Field Work 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.)

B.Tech.(Chemical Engineering) Double Minor-III: Petrochemical Technology

4CH269DM3: Natural Gas Engineering (PCC)

Subject Code	**Title**	**Credits- 03**		
4CH269DM3	Natural Gas Engineering	L	T	P
Semester: III	Total Contact Hours: 3 Hrs / Week	3	0	0

Course Objectives:

1. To enable the students to understand production and processing of natural gas.
2. To enable the students to get acquainted with Gas-liquid separation.
3. To enable the students to understand various gravity separators, theory behind gravity separation, and types of gravity separation method such as vertical, horizontal gravity separator and coalescer
4. To enable the students to understand various gas purification steps such as acid gas treatment, gas dehydration and gas cleaning.
5. To provide knowledge about Gas hydrates and coal bed methane.
6. To provide knowledge about various aspects of the transportation and storage of natural gases.

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

1. Equipped to handle various operating units in an industrial gas processing units.
2. Well equipped for trouble-shooting in the above units.
3. Knowledgeable about pipeline maintenance and flow assurance.
4. Able to analyze and compare various natural gas separation operations and associated equipments.
5. Able to design new acid gas treatment units and mange existing acid gas treatment units in the plants.
6. Able to design aspects of the transportation and storage of natural gases.

SECTION- A

Unit- I: Introduction to Gas Processing and Their Properties: (7Hrs)

Origin, Composition, Natural gas properties, Phase behavior, Characterization of reservoir based on phase behavior

Unit- II: Phase Separation: (8Hrs)

Phase separation, Sizing of two, three phase separators, skimmers.

Unit- III: Gas Hydrates: (7Hrs)

Origin, Thermodynamics of formation and decomposition, Properties, Methods of extraction.

SECTION- B

Unit- IV: Gas Dehydration: (8Hrs)

Water-hydrocarbon system, Gas dehydration, Physical and Chemical, solid, liquid, Sizing of dehydration units

Unit- V: Treatment Process: (8Hrs)

Acid gas treating, Design of treatment plants, Chemistry behind acid gas separation

Unit- VI: LNG processing and Storage: (7Hrs)

Liquefaction of Natural Gas, Thermodynamics of LNG processing, refrigerant processes and Storage of Natural gas

Text Books:

1. Natural Gas Peoduction Engineering, C. U. Ikoku (Gas dehydration)
2. Advanced Natural Gas Engineering, X. Wang & M. Economides (three phase separation)
3. Natural Gas Hydrates J. Caroll (Gas hydrates)
4. Petroleum and Gas field processing, H. K. Abdel Aal, M. Aggour, M. A. Fahim (two phase separation)
5. Handbook of Natural Gas Transmission and Processing by Saeid Mokhatab, William A. Poe, James G. Speight (Acid gas treatment)
6. Natural Gas Processing Principles and Technology-Part I and II, A. H. Younger, P. Eng

Evaluation Scheme: Each Unit is Weighed 10 Marks

a. Internal Assessment : **40 Marks**

i. Class Test-I (MCQ/ Subjective/ Objective) : 10Marks

ii. Class Test–II (MCQ/ Subjective/ Objective) : 10Marks

iii. Teaching Evaluation Components : 10Marks
(Viva Voce / Assignments / Report Writing/ Field Work etc.)

iv. Class Attendance : 10Marks

b. 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.)

B.Tech.(Chemical Engineering) Double Minor-IV: Polymer Technology

4CH273DM4: Thermoplastics Polymer Technology (PCC)

Subject Code	**Title**	**Credits- 03**		
4CH273DM4	Thermoplastics Polymer Technology	L	T	P
Semester: IV	Total contact hours: 3hrs/week	3	0	0

Course Objectives:

1. Understand the fundamentals of thermoplastic polymers
2. Explore the thermoplastics material Properties:
3. Develop Practical Skills on processing of thermoplastic materials:
4. Apply the knowledge of thermoplastic Polymer Science in Industry:
5. Promote for Sustainable Practices using thermoplastic polymers :
6. Foster Innovation in Thermoplastic Polymers:

Course Outcomes:

1. The Students will able to study industrial manufacturing process advantages disadvantages, process parameters of the thermoplastics polymers and environmental concerns of their products.
2. To give understanding of properties like physical mechanical thermal rheological etc
3. To make aware of practical applications of thermoplastics in real world and structure properties and relationship.
4. To study basic processing methods related to of the thermoplastics polymers.
5. To make aware of different grades of commodity and engineering plastics manufacturer suppliers of them in the market.
6. Students will gain expertise in the area of thermoplastic polymer technology.

SECTION- A

Unit- I: Industrial Manufacturing processes, properties and applications processing environmental concerns of various types of polymers polyolefin like LDPE HDPE etc. (8Hrs)

Unit- II: Polypropylene and copolymer of PP, polyolefin like EVA LLDPE etc. (7 Hrs)

Unit-III : Polystyrene, HIPS, SAN, Saturated Polyesters such as PET, PBT. (7 Hrs)

SECTION-B

Unit- IV: ABS ,important copolymers of styrene maleic anhydride and styrene acrylics copolymers, toughening mechanism of impact modified plastics. (8Hrs)

Unit- V: Polyvinyl chloride & its copolymers Compounding of PVC. Polyamides- Nylon 6, Nylon 66, Nylon. (7 Hrs)

Unit-VI: Thermoplastic PU, Poly vinyl acetate, Polyvinyl alcohol, cellulose acetates, etc. (7 Hrs)

Text Books:

1. Plastics Materials, 7th Edition by John Brydson, Elsevier 1999.
2. Text book of polymer Science by Billmeyer, John Wiley and Sons 1984.
3. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House2002.
4. Polymer Science by Gowarikar, John Wiley and Sons 1986

Reference Book:

1) Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc1965.

2. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc1988.

3. Handbook of Thermoplastics, Second Edition Olagoke Olabisi by CRC Press 2015.

4. Thermoplastic Materials by Ibeh, Christopher C, Taylor Francis Inc 2013.

5. Introduction to Polymer Science and Technology by H. S. Kaufman and J. J.Falcetta,

Wiley – Interscience Publication, 1977.

6. Handbook of Polyethylene, A. J. Peacock, Marcel Dakker Inc, 2000 .

Evaluation Scheme: Each Unit is Weighed 10 Marks

a. Internal Assessment : **40 Marks**

i. Class Test-I (MCQ/ Subjective/ Objective) : 10Marks

ii. Class Test–II (MCQ/ Subjective/ Objective) : 10Marks

iii. Teaching Evaluation Components : 10Marks
(Viva Voce / Assignments / Report Writing/ Field Work etc.)

iv. Class Attendance : 10Marks

b. 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.)