

PRINCIPLES OF CHEMICAL ENGINEERING

(Qualitative Treatment Only)

I Year B. Tech. I Semester

(CHEMICAL)

Course Code: 26CH1101

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3	0	2	4

THEORY:

Course Outcomes:

On successful completion of the course, the student should be able to

CO 1 Write about the importance of Chemical Engineering

CO 2 Describe the importance of material balances, types of fluids, fluid flow and fluid moving machinery.

CO 3 Describe the importance of heat transfer and the related equipment.

CO 4 Describe the importance of mass transfer operations and the equipment of mass transfer operations.

CO 5 Identify the materials for construction and the economics and profitability of the process.

UNIT-I

(8 Lectures)

What is Chemical Engineering: What is Chemical Engineering, The Impact of Chemical Engineering, The role of Chemical Processing: What is a Chemical Process, Representing Chemical Processes Using Process Diagrams.

Learning outcomes: After the completion of the Unit I, the student will be able to

1. Explain the basics of Chemical Engineering and chemical processes. (L1)
2. Identify and represent chemical processes using process diagrams. (L2)

UNIT-II

(8 Lectures)

Chemical Engineering in daily life: Oil Refineries, Sugar, Fertilizer, Soaps, Polymers, Bio-Polymers, Pesticides, Paint, Electro-chemical, Pharmaceutical, Bio-medical, Water treatment, Electronic chip industry, Food industry.

Major **effluents and emissions** generated from chemical and allied industries; their impact on **air, water, and soil**;

Learning outcomes: After the completion of the Unit II, the student will be able to

1. Describe the applications of Chemical Engineering in different industries. (L2)
2. Identify industrial pollutants and explain methods for their control. (L2)

UNIT-III

(12 Lectures)

MATERIAL BALANCES:

Conservation of Total Mass, Material Balances for Multiple Species, Material Balances with No Formation/Consumption.

FLUID FLOW:

Concepts of pressure, viscosity, shear stress, principles of fluid flow, Bernoulli equation, effect of fluid friction, pumps and turbines.

Learning outcomes: After the completion of the Unit III, the student will be able to

1. Apply material balance principles to simple chemical engineering problems. (L3)
2. Explain the basic principles of fluid flow, pumps, and turbines. (L2)

UNIT-IV

(10 Lectures)

HEAT TRANSFER:

Energy balance for steady state open systems. Rate of heat transfer for conduction, convection and radiation. Application of steady state energy balance.

HEAT EXCHANGE DEVICES:

Co-current and counter current flow, 1-1 shell and tube heat exchanger.

Learning outcomes: After the completion of the Unit IV, the student will be able to

1. Explain the basic modes of heat transfer and apply energy balances.(L2)
2. Describe the working of co-current, counter-current, and shell-and-tube heat exchangers.(L2)

UNIT-V

(10 Lectures)

MASS TRANSFER:

Molecular diffusion, Liquid-liquid extraction, Gas-liquid Absorption, Distillation, liquid-solid extraction.

CHEMICAL REACTION ENGINEERING:

Describing reaction rates, concepts of batch, CSTR and PFR.

Learning outcomes: After the completion of the Unit V, the student will be able to

1. Explain the basic principles of mass transfer and separation processes. (L2)
2. Describe reaction rates and the working of batch, CSTR, and PFR reactors.(L2)

TEXT BOOK:

Kenneth A Solen & John.N.Harb, “*Introduction to Chemical Engineering*”, 5th Edition, John Wiley, 2011.

REFERENCE BOOK:

Ghoshal S.K., Sanyal S.K and Dutta S, “*Introduction to Chemical Engineering*” Tata McGraw Hill Publication New Delhi 1993.

LAB:

Course Outcomes: At the end of the laboratory course, the student should be able to

CO1: Assess drinking water quality and pollution using standard chemical tests. (L3)

CO2: Analyze edible oils and detect common food adulterants using suitable methods. (L4)

CO3: Assess soil quality through pH, electrical conductivity, and nutrient analysis. (L3)

CO4: Apply fluid-flow and heat-transfer principles to determine frictional losses, pressure drop, and heat transfer in single and composite systems. (L3)

CO5: Apply diffusion and reaction-kinetic principles to estimate vapor diffusivity and determine batch reactor performance considering the effects of activation energy and temperature.(L3)

List of Experiments:

Water Analysis

1. Determination of total hardness of water sample
2. Determination of Alkalinity of water sample
3. Determination of Dissolved Oxygen in Water sample
4. Determination of Chemical Oxygen demand of water sample
5. Determination of Biological Oxygen demand of water sample
6. Determination of fluoride in given water sample
7. Determination of heavy metal (Pb^{+2}) in water sample

Food Analysis

8. Determination of acid value of an edible oil.
9. Determination of peroxide value of an edible oil
10. Determination of total polar compounds (TPC) in edible reused oil
11. Detection of Food adulterants (milk, chilli powder, turmeric powder, etc.)

Soil analysis:

12. Soil pH, Electrical Conductivity (EC)
13. Macronutrients: Nitrogen (N), Phosphorus (P), Potassium (K)

Mass Transfer:

14. Estimation of vapor diffusivity using diffusivity equipment.

Virtual Lab Experiments on the following:

Fluid Mechanics:

15. Understanding the effect of pipe length on friction losses
16. Effect of inlet velocity and pipe length on pressure drop

Heat Transfer:

17. Qualitative understanding of conductivity, area of the heat transfer and thickness of the slab on conductive heat flux
18. Effect of metal conductivity on heat transfer in composite slabs

Reaction Engineering:

19. Understanding the Effect of activation energy, temperature of operation in the batch reactor.