15/05/2025 BE CHEMICAL SEM-VIII C-SCHEME ESD QP CODE: 10085557

[3 Hours]

[Total Marks: 80]

N.B.: (1) Question No 1 is compulsory
   (2) Attempt any three questions out of remaining five questions
   (3) Assume suitable data if necessary and indicate it clearly.
   (4) Figures to the right indicate full marks.

Q.1. Solve the following (Any Four)   **20**
   (a) What is energy pricing & energy security?
   (b) List out the steps involved in energy audit methodology.
   (c) Explain any four techniques to make compressed air system energy efficient.
   (d) Describe concept of new & renewable energy sources.
   (e) What is cogeneration? Explain its benefits.
   (f) Explain the concept of Heat integration using Heat exchanger networking.

Q.2. (a) Consider a system where heat is being exchanged among hot & cold streams to   **10**
         meet MER target for which data is given below:

Stream No.	Ts (^{0}C)	Tt (^{0}C)	mCp (kW/^{0}C)
1	180	60	3
2	150	30	1
3	20	135	2
4	80	140	5

   If ΔT_{min}= 10^{0}C, find the minimum hot & cold utility requirements as well as the
   pinch temperature for this system. Also calculate minimum number of heat
   exchangers required for this system.

   (b) Explain energy conservation & its importance; also discuss Indian energy scenario   **10**
       in terms of major energy sources, energy consumption pattern, major problems in
       energy sector, energy intensive industries.

Q.3. (a) Estimate steam flow rate required to design a heat recovery steam generator. The **08**
         steam is to be used for power generation & is to be expanded in a 5000 RPM
         multistage condensing turbine to produce a maximum of 18500 kW. Steam inlet
         condition is 600 psig. Additional data is given below:
         PGC: 18500 kW
         Inlet steam: 600 psig
         Enthalpy, h_i: 1378.9 Btu/lb
         Enthalpy, h_o: 935.0 Btu/lb
         Turbine speed: 5000 RPM
         Turbine efficiency: 77%

   (b) With suitable diagram explain the following waste heat recovery equipments: **12**
       i) Heat Pump
       ii) Recuperator

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Q.4. (a) Design a feasible Heat Exchanger Network (HEN) to satisfy minimum energy **15** requirement for this system where heat is being exchanged among hot & cold streams for which data is given below. ΔT_{min} for this system is 30 °C, Hot pinch temperature is 90 °C and $Q_{H,min}$ and $Q_{C,min}$ are 160 kW and 190 kW respectively.

Data:

Stream No.	Ts (^{0}C)	Tt (^{0}C)	mCp (kW/^{0}C)
1	140	70	3
2	100	40	5
3	60	80	6
4	30	120	4

(b) What is Geothermal energy? Explain its various applications. **05**

Q.5. (a) Explain topping & bottoming cycle in cogeneration system. **10**
(b) What is energy audit? Explain different types of energy audit. **10**

Q.6. Write short notes on the following (Any four) **20**
(a) Vapour recompression in distillation column.
(b) Instruments used in energy audit.
(c) Basic equation & rules of heat exchanger networking introduced by Linnhoff
(d) Energy efficient practices in Lighting system
(e) Importance of waste heat recovery
(f) Working of Tidal Energy system

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Time: Three Hours   Marks:80

N.B.: 1   Question **ONE** is compulsory
       2   Attempt any **THREE** questions out of the remaining
       3   Figure to the right indicate full marks
       4   Illustrate answers with sketches wherever required and Diagram at appropriate
           places carries marks
       5   Assume suitable data if necessary and indicate it clearly.

1   Write short notes
   (a)   Explain applications of nanotechnology in water treatment.   (05)
   (b)   Define- surface diameter, volume diameter, drag diameter, specific surface   (05)
           diameter and aerodynamic diameter for a particle.
   (c)   Explain Electric Arc synthesis of fullerenes.   (05)
   (d)   Explain principle of atomic lithography.   (05)

2 (a)   With suitable diagram, explain steps involved in Super critical   (10)
           agglomeration.
   (b)   Compare top down and bottom up technologies for nanomaterial.   (10)

3 a   With suitable diagram explain the principle involved in Microwave   (05)
           spectroscopy.
   b   Explain principle of Sol Gel Processing.   (05)
   c   With suitable diagram explain condensed phase synthesis of nanoparticles.   (10)

4 a   Explain electro deposition as a nanostructuring method.   (10)
   b   With suitable diagram explain the method used for semiconductor   (05)
           compounds and thermoelectric components on Nanoscale.
   c   What is role of gold nanoparticles in drug delivery systems.   (05)

5 (a)   What is role of protein nanoparticles in drug delivery systems?   (10)
   (c)   Describe different Types of Inorganic materials used for the synthesis of   (10)
           Hybrid Nano-bio assemblies.

6 (a)   Calculate the area and volume of following shaped particles (a) Sphere of   (12)
           radius R (b) Cube of side A (c) Rectangular paralleled pipe of sides A and
           B (d) Cylinder of radius R and height H
   (b)   Explain four steps involved in collection process for a particulates in fluid.   (08)

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21/05/2025 BE CHEMICAL SEM-VIII C-SCHEME EM QP CODE: 10086721

[Time: 3 Hours]   [Marks:80]

1. **Questions No. 1 is Compulsory.**
2. **Attempt any three out of remaining Questions.**
3. **Figures to the right Indicate full marks.**

Q.1   Attempt any Four.   **20**
   a) Explain any five Salient features of the Environment Protection Act, 1986.
   b) Describe the current energy scenario in India. What challenges does India face in meeting its energy demands?
   c) What is a food chain? How does it differ from a food web?
   d) What are atomic and biomedical hazards?.
   f) Explain the role of the government as a planning and regulatory agency.

Q.2 a) Discuss major environmental problems in India and their implications for public
   health and natural resources.   **10**
   b) Explain Ozone layer depletion? What are the Causes, effects and preventive measures of Ozone depletion?   **10**

Q.3 a) Define ecosystem. Classify different types of Ecosystems? What   **10**
   are the biotic and abiotic components of an ecosystem?
   b) Discuss the role of Central Pollution Control Board (CPCB) in pollution
   monitoring.   **10**

Q.4 a) What is ISO 14000? Explain its significance in environmental management and
   how it helps organizations reduce their environmental impact.   **10**
   b) What is Corporate Environmental Responsibility (CER)? Explain its importance and mention any three ways in which companies can practice CER to promote environmental sustainability.   **10**

Q.5 a) Compare natural and human-made sources of greenhouse gases. Which ones have the
   greatest impact on global warming and why? Support your answer with examples   **10**
   b) What is Environmental Quality Management (EQM)? Explain its objectives in
   detail.   **10**

Q.6 a) With reference to EMS, explain PDCA cycle with neat diagram.   **10**
   b) Critically evaluate the concept of sustainable development as a multidimensional approach. How does it reconcile the conflicting goals of economic growth, environmental conservation, and social equity?   **10**


(3 hours)   **[Total marks: 80]**

N.B.: 1. Question-1 is compulsory. Answer any three questions from remaining
     2. Assume data if necessary and specify the assumptions clearly
     3. Draw neat sketches wherever required
     4. Answer to the sub-questions of an individual question should be grouped and
       written together i.e. one below the other

Q1.a)	Discuss advantages and disadvantages of ANN	**5**
Q1.b)	Explain classification of mathematical models.	**5**
Q1.c)	List out the various methods of optimization and explain in brief.	**5**
Q1.d)	Explain sequential based approach for solving flowsheet	**5**

Q2.a)   An isothermal, irreversible reaction takes place $A \xrightarrow{k} B$ in the liquid phase in a   **10**
constant volume reactor. The mixing is not perfect. Observation of flow patterns
indicates that a two-tank system with back mixing, as shown in figure below, should
approximate the imperfect mixing. Assuming F and F_R are constant. Write equations
that can describe the system
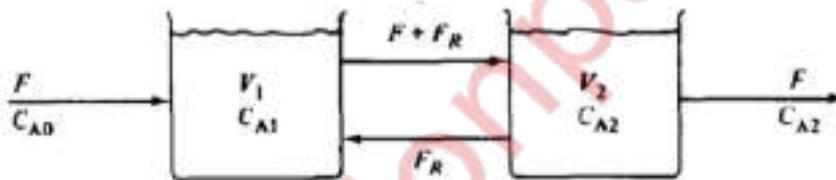
Q2.b)   Write the component continuity equations for a perfectly mixed batch reactor of   **10**
constant volume with first order isothermal reactions:
    a) Consecutive: $A \xrightarrow{k1} B \xrightarrow{k2} C$
    b) Simultaneous: $A \xrightarrow{k1} B, A \xrightarrow{k2} C$

Q3.a)   A fluid of constant density ρ is pumped into a cone-shaped tank of total volume   **10**
$H\pi R^2/3$. The flow out of the bottom of the tank is proportional to the square root of
the height h of liquid in the tank. Derive the equations describing the system.
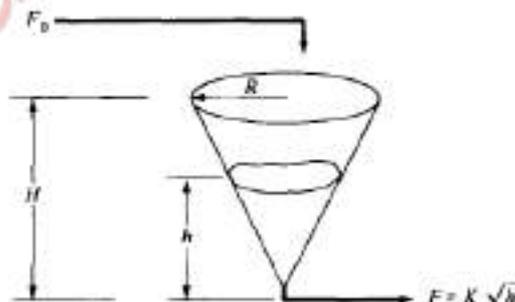
Q3.b) Solve the fixed point problem given by   10
$$x_1 = 1 - 0.5 \exp(0.7(1 - x_2))$$
$$x_2 = 2 - 0.3 \exp(0.5(x_1 + x_2))$$
Using direct substitution method starting from $x_1 = 0.8$ and $x_2 = 0.8$

Q4.a) Consider a reaction $A \xrightarrow{k} B$, carried out in a constant volume batch reactor. The   10
differential equation of the species A is $\frac{dC_A}{dt} = -kC_A$. The initial condition is: at t=0,
C_A=1 mol/m^3. The rate constant of the reaction is $0.1 s^{-1}$. Using the Runge-Kutta fourth
order method, determine the concentration of A at 10s. Take the step size in time as
5 s

Q4.b) Maximize $8x-3x^2+x^3-2x^4-x^6$ start with range (0, 1.2) using one dimensional search   10
method. Also find the optimal solution with $\epsilon=0.01$

Q5.a) Write mathematical model of ANN? How an artificial neuron model can be compared   10
with biological neuron model with neat diagram

Q5 b) Determine solution for the following equation using Armijo line search method take α   10
has 1and initial guess has x=[2, 1] ?
$$f_1 = 2x_1^2 + x_2^2 - 6 = 0$$
$$f_2 = x_1 + 2x_2 - 3.5 = 0$$

Q6.a) Feed stream with pure species A and B are mixed with recycle stream enter CSTR,   15
where following reactions take place
$$A + B \rightarrow C$$
$$C + B \rightarrow P + E$$
$$P + C \rightarrow G$$
$$k_1 = 5.9755 \times 10^9 \exp\left(-12000 \Big/ T\right)$$
$$k_2 = 2.5962 \times 10^{12} \exp\left(-15000 \Big/ T\right)$$
$$k_3 = 9.6283 \times 10^{15} \exp\left(-20000 \Big/ T\right)$$

Here, C is an intermediate, P is main product, E is by product and G is oily waste. The
plant consist of reactor, a heat exchanger to cool reactor effluent, a decanter to
separate waste product G from reactants and other products and a distillation column
to separate product P. Due to formation of an azeotrope some of product (equivalent
to 10 wt% of mass flow rate of component E) is retained in the column bottom. Most
of the bottom product is recycled to reactor and rest is purged. Construct a Williams-
Otto flowsheet and develop the process equations.

Q6.b) Explain partitioning, precedence ordering and tearing in flow sheet simulation   5