Time: 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.

Q1.Solve any four questions   20

    (a) Explain codes and standards for equipment design

    (b) Explain classification of heat exchangers.

    (c) Explain weld joint efficiency and corrosion allowance.

    (d) Explain various ferrous and nonferrous materials of construction

    (e) Explain ultrasonic nondestructive testing method.

Q2. (a) Write a design procedure with relevant equations for evaporator.   10

  (b) Explain shrink fit and auto-frettage construction of high pressure vessel.   10

Q3. (a) Design a fixed tube sheet heat exchanger having the following data   10
     Shell design pressure= 0.5 N/mm^2
     Permissible stress for shell material=95 N/mm^2
     Corrosion allowance for shell material = 1.5mm
     Tube design pressure = 1.5 N/mm^2
     Tube outside diameter=20mm
     Tube pitch= square
     Tube length=2500mm
     Number of tubes = 40
     Number of passes on tube side = 2 $\beta = 0.7$
     Shell flange:
     Raised facing Gasket used is flat metal jacketed asbestos filled
     Design seating stress= 53.4 N/mm^2
     Gasket Factor = 3.75
     Allowable stress for bolt material= 138 N/mm^2
     Design should include
     i)   Shell
     ii)   Shell Flange

  (b) Explain different types of supports used in process industries.   10

Q4 (a) A tall vertical column 2.5 m in outer diameter and 42 m in height is to be installed. The available specifications are: **10**

Operating temperature and pressure – 160°C and 4 kg/cm^2

Skirt height – 3.0 m.

Tray spacing – 0.6 m.

Top space disengagement – 1.2 m.

Weir height – 60 mm.

Bottom space separation – 1.8 m

Tray loading with liquid – 110 kg/m^2

Tray support ring – 45 mm x 45mm x 11 mm angles

Corrosion allowance – 1.5 mm

Wind force acting over vent – 110 kg/m^2

Design pressure – 4 × 1.2 = 4.8 kg/cm^2

Insulation thickness – 120 mm.

Permissible material stress of shell – 780 kg/m^2.

Welded joint efficiency – 0.80

Density of shell material. – 7600 kg/m^3.

Density of insulation – 500 kg/m$^{3.}$

Overhead vapor pressure line – 2280 mm

Weight of ladder – 30 kg/m.

Weight of 280 mm outer diameter pipe – 60 kg/m

(b) Explain different column internals for packed and tray column with neat and labelled diagram **10**

Q 5 (a) List out types of NDT methods. Explain Radiography in detail with neat diagram **10**

(b) Which are the different losses while storing the volatile liquids? Explain different types of storage vessels used for storing volatile liquids. **10**

Q6. (a) Write a design of agitation system .Design should include **12**

    i.   Design of shaft

    ii.   Design of stuffing box and glands

(b) Explain different types of jackets used for reaction vessels. **08**

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[Time: 03 hrs]   [Marks:80]

N. B.: (1)   Question No. **1** is **Compulsory**.
      (2)   Attempt any **THREE** questions out of remaining **FIVE** questions.
      (3)   Figures to the **right** indicate **full** marks.
      (4)   While explaining the Flow sheets mention Operating Parameters, I/P, O/P etc clearly.

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1.   Answer the following questions: [20]
    (a)   Origin theory of petroleum.
    (b)   Explain Cloude point and smoke point.
    (c)   Explain Sweet and Sour crude.
    (d)   Write a short note on Biofuel.

2.   (a)   Explain HF alkylation process in detail and compare it with sulfuric acid alkylation
        Process.   [10]
    (b)   Explain different types of Asphalt and explain air blowing of bitumen process   [10]

3.   (a)   Discuss in brief the process of furfural extraction for lubricating oil. What
        are the advantages of using furfural over phenol as a solvent?   [10]
    (b)   What the different type of Coking methods. Explain Flexi Coking in detail with a
        flow diagram.   [10]

4.   (a)   Explain Merox Sweetening process for Gasoline.   [10]
    (b)   Explain different tower arrangement used for crude distillation unit with a
        suitable diagram.   [10]

5.   (a)   Explain Propane dewaxing process with neat flow diagram   [10]

    (b)   Describe the fluidized catalytic cracking (FCC) process with its importance in
        Refinery.   [10]
6.   (a)   Discuss LPG manufacture in detail with suitable flow diagram.   [10]
    (b)   Give different testing methods to test quality of gasoline. Explain anyone method
   in short with a suitable diagram   [10]

02/06/2025 BE CHEMICAL SEM-VII C-SCHEME IPDC QP CODE: 10082828

(3 hour) **[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

Q.1) a) Write controller equation and derive transfer function for PID controller (5)
  b) Explain Phase Margin and Gain Margin (5)
  c) Determine the stability of a system that has the characteristic equation (5)
  $s^4+5s^3+3s^2+1=0$
  d) Write short note on classification of variables in process control (5)

Q.2) a) A liquid surge tank has the following transfer function of $\dfrac{H(s)}{Q(s)} = \dfrac{10}{50s+1}$ (10)

  The system is operating at the steady state with $q_{is}=0.4 m^3/s$, and $h_s=4m$ when the inlet flow rate fluctuates as a sine wave with an amplitude of $0.1 m^3/s$ and a cyclic frequency of 0.002 cycles/s. What is the maximum and minimum value of the level after 10 min?

  b) Explain continuous cyclic tuning method with the help of Zeigler Nichols (10) controller tuning relations

Q.3) a) Derive transfer function for mercury in glass thermometer system with necessary (10) assumptions
  b) A simple surge tank with a valve on the exit line is illustrated in Figure. (10)
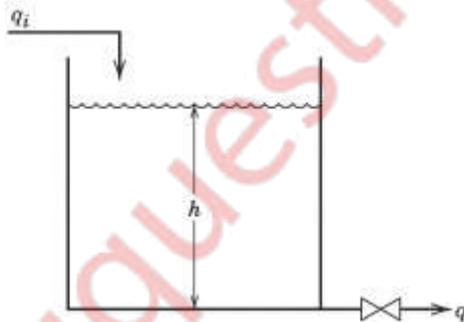
If the exit flow rate is proportional to the square root of the liquid level, an unsteady-state model for the level in the tank is given by

$$A\frac{dh}{dt} = q_i - C_v h^{1/2}$$

By assuming that the process initially is at steady state, Find the transfer function $H'(s)/Q_i(s)$. Put the transfer function in standard gain/time constant form.

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Q.4) a) Draw a standard block diagram for a feedback control system. Derive closed loop transfer function for set point changes and disturbance changes (10)

b) For a system with $G(s)H(s) = \dfrac{K(1+s)^2}{s^3}$ find range of 'K' for system to be stable (10)

Q.5) a) For the unity feedback control system, (15)

$$G(s) = \frac{80}{s(s+2)(s+20)}$$

Draw the bode plot. Determine GM, PM, ω_{gc}, ω_{pc} Comment on stability.

b) Explain gain cross over frequency and phase cross over frequency (5)

Q.6) a) Write short note on turbine flow transmitter with neat sketch (10)

b) Write short note on Bourdon gauge for pressure measurement (10)

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