Total No. of Printed Pages:1

SUBJECT CODE NO:- H-109
FACULTY OF SCINECE AND TECHNOLOGY
T.E. (Chemical)) Old (Sem-II)
Process Equipment Design & Drawing - I

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
1. Q .1 and Q.6 are compulsory
2. Solve any two   from remaining in section A and section B
3. Assume suitable data & mention it.

Section -A

Q.1   Answer the following   10
      1) Factor of safety in Equipment design
      2) Heating coils in equipment

Q.2   How is section of material of construction is done for a process equipment Do it for suitable   15
      batch process equipment.

Q.3   Derive equation for cylindrical vessel having inside pressure more than atm. & outside   15
      atmospheric to find thickness of plate

Q.4   Explain
      i)   Estimation of weight of equipment   08
      ii)   Fabrication techniques for vessels.   07

Q.5   What is flat head? Where it is used & derive the plate thickness of flat head.   15

Section – B

Q.6   Answer the following   10
      i)   Ovulation of storage tank
      ii)   Wind girders

Q.7   What is design procedure of bracket support to vessel?   15

Q.8   How the tank vessel is designed explain with necessary equations.   15

Q.9   Explain with suitable equation mechanical design of reaction vessel.   15

Q.10   Answer the following   15
      i)   Give the estimation procedure for nozzles C storage vessel
      ii)   What are different inlet & outlet nozzles of a storage tank with applications

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-129
FACULTY OF SCINECE AND TECHNOLOGY
T.E. (Chemical) (Sem-II)
Chemical Reaction Engineering –II
[OLD]

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
1. Questions No1 and Questions No.6 are compulsory
2. Solve any two questions from remaining of section
3. Assume suitable data if required & state it clearly.

SECTION – A

Q.1   Answer the following (any two)   10
   a) What do you mean by progressive conversion model?
   b) Determination of rate controlling step
   c) Examples of various liquid solid reaction

Q.2   a) Explain in details dispersion model for non- ideal flow & list its uses.   08
       b) Explain the multiple steady states in CSTR for isothermal condition.   07

Q.3   Explain the shrinking core model for spherical particle of unchanging size when reaction is   15
       controlled by diffusion through ash layer with chemical reaction Advantages of the model.

Q.4   Explain different models established for fluid – solid non catalytic reaction and give advantages   15
       & disadvantages of each

Q.5   Write note on   15

   a) Tank in series model
   b) optimum temperature progression
   c) Hydrodynamic flow model

Section – B

Q.6   Answer the following (Any two)   10
   1) Fixed bed reactors
   2) Promoters & Inhibitors
   3) Reactors used for study the catalyst deactivation

Q.7   What are different types of catalyst poisoning? Explain the mechanism of catalyst deactivation.   15
       List the method briefly to control deactivation

Q.8 What are method used to measure the catalyst surface area? Explain the BET method with merit 15 & demerit of it

Q.9 What is catalyst? Explain detail theories for catalysis with advantages, disadvantages for 15 different reactions

Q.10 Write note on 15
1) Resistances in slurry reaction
2) Tank in series model for ideal reactor
3) Thiete model

2

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-164
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (Sem-II)
Mass Transfer Operation - II
[Old]

[Time: Three Hours]   [Max.Marks: 80]

                    Please check whether you have got the right question paper.
N.B   1) Q. 1 & 6 are compulsory.
               2) Solve any two from remaining in each section.
               3) Assume suitable data wherever required.

Section – A

Q.1   Solve any FIVE.   10
       a. Azeotropes
       b. Equilibrium distillation
       c. Optimum reflux ratio
       d. Plate efficiency
       e. Yield of crystals
       f. MSMPR

Q.2   a. Describe VLE for ideal & non ideal binary system.   08
       b. Explain operation of differential distillation.   07

Q.3   a. Write down steps to find number of plate by using ponchan savarit method.   10
       b. Describe steam distillation.   05

Q.4   a. Write down Design Step of crystallizer.   08
       b. What are various types of crystallization explain any one.   07

Q.5   50 mol % , n-heptane (A), 50 mol % n- octane (B) were subjected to a differential distillation   15
       at atmospheric pressure with 60 mol % of liquid distilled. Compute composition of the
       composited distillate & residue.

x	0.50	0.46	0.42	0.38	0.34	0.32
y	0.689	0.648	0.608	0.567	0.523	0.497

Section - B

Q.6   Solve any five: 10
       i)   Extract
       ii)   Tie line
       iii)   Empulsion
       iv)   Cascade
       v)   Decoction
       vi)   Flocculation

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Q.7 a) Describe multistage counter current extraction operation. 08
b) Write down equilateral triangular coordinates. 07

Q.8 a. Explain construction working of packed tower for extraction. 08
b. Write down construction & working of mixer settlers. 07

Q.9 a. Describe various methods of unsteady state leaching operation. 10
b. Write neat sketch explain continuous counter current decantation. 05

Q.10 Sugar remaining in a bed of bone char used for decolonization is leached by flooding the bed 15
with water following which bed is drained of resulting sugar solution. The bed diameter is 1 m,
the depth 3 m, temperature is 65℃. The sugar solution which drains which has a density
1137 kg/m^3 and surface tension 0.066 N/m. The bulk density of char is 960 kg/m^3 and the
individual particle density 1762 kg/m^3. The particles have a specific external surface
16.4 m^2 / kg.
Estimate mass of solution still retained by the bed after dripping of the solution has
stopped. Express this also as mass solution mass dry bone char.

2

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-199
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (Sem-II)
Plant Design & Process Economics
[Old]

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
1. Q.no.1 and Q.no.6 are compulsory.
2. Attempt any two from the remaining of each section
3. State clearly any assumptions made
4. All variable have their usual meanings

Section A

Q.1   Answer the following: 10
a) Explain the term pilot plant.
b) Enlist various sources of literature survey.
c) Name the utilities in industry.
d) Explain the terms current ratio.
e) What is grouped plant layout?

Q.2   a) Describe the major steps considered in plant design.   10

b) What is the importance of pilot plant study?   05

Q.3   a) How a project report is prepared?   10

b) What conclusions can be made from a project report?   05

Q.4   Describe techniques for estimation of total cost of a plant.   15

Q.5   Write note on (any three):   15
a) Site selection for a process plant
b) Types of Insurance
c) Taxes
d) Rate of return

Section – B

Q.6   Explain the terms   10
a) Optimization
b) Physical plant life
c) Book value
d) Salvage value
e) Scrap value

Q.7   An equipment having initial cost of Rs.1,00,000 has an estimated service life of 8 years. Estimated   15
        salvage value at the end of services life is Rs.30,000 .The interest rate is 12% calculate the book
        value at the end of second and sixth year by straight line method , declining balance and sinking
        fund method.

Q.8   a) Compare linear & dynamic programming.   08

        b) State the importance of optimization in plant design.   07

Q.9   a) Describe the project evaluation & review techniques (PERT).   10

        b) Explain earliest start, earliest finish, latest start, latest finish terms used in PERT.   05

Q.10   Write short notes on (any three):   15
        a) Break even analysis
        b) Declining balance method for calculating depreciation
        c) Critical path method
        d) Causes of obsolescence

2

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-258
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical) (Sem-II)
Elective-II: Computer Aided design and Optimization
[Revised]

[Time: Three Hours] **[Max.Marks: 80]**

Please check whether you have got the right question paper.

N.B
1) Q.No.1 and Q.No.6 are compulsory.
2) Solve any two from remaining in each section.
3) Assume suitable data wherever required.

Section A

Q.1	Solve following	
	a) Vapor pressure	03
	b) Design of furnaces	04
	c) Process variables	03
Q.2	a) Write down thermodynamic properties of gases & binary mixtures.	08
	b) Describe vapor liquid equilibria.	07
Q.3	Write down design steps of following equipment's	15
	1) Absorption column	
	2) Evaporator	
Q.4	a) Describe process analysis.	07
	b) Write down method of equipment selection.	08
Q.5	Write short note	15
	1) Binary mixtures	
	2) Reactors	
	3) Process flow sheet	

Section B

Q.6	Solve following	
	a) Nature of optimization problems	04
	b) Constrained functions	03
	c) Fluid flow systems	03
Q.7	a) Write down organization of optimization problems.	08
	b) Write down formulation of objective functions.	07
Q.8	a) Write down basic concepts of optimization.	08
	b) Explain optimization of unconstrained.	07

1

Q.9   a) Write down dynamic programming in detail.   08

        b) Describe applications of optimizations in areas like heat transfer.   07

Q.10   Write short note   15

       1) Optimization problems

       2) Application of linear programming

       3) Discrete processes

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Total No. of Printed Pages:2

SUBJECT CODE NO:- H-299
FACULTY OF SCINECE AND TECHNOLOGY
T.E. (Chemical) (Sem-I)
Industrial Pollution & Control
[Old]

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
1. Q.no.1 and 06 are compulsory.
2. Answer any two questions from remaining of each section
3. Assume suitable data if required and draw neat sketches whenever needed.

Section   – A

Q.1   Explain following terms (any five):   10
   A) Erosion.
   B) Decibel.
   C) Chlorosis.
   D) Looping.
   E) Particle resistivity.
   F) Demerit of fabric filters.

Q.2   a) Explain pollution control aspects of waste water treatment.   07
        b) Describe Industrial gaseous Effluent analysis.   08

Q.3   a) Explain following terms a) Lapse rate   b) Adiabatic lapse rate and   c) Wind rose   08
        b) What are characteristics of particulate? Explain in detail.   07

Q.4   a) Explain with neat sketch principle, construction and working of ESP.   08
        b) A packed filter handing $1m^3$/s of std. air is packed with fibers of size $100\mu m$ in diam.   07
           Dust laden air passes through the filter with velocity of 1.5m/s and the packing density is
           0.1 the ave. diameter of the particles in the air is $1\mu m$ and the individual fiber efficiency.

Q.5   Write short note on: 15
   i)   Wind velocity and turbulence.
   ii)   Economic effect of Air pollution.
   iii)   High efficiency cyclones.

Section – B

Q.6   Explain following terms (any five):   10
   i)   TOC.
   ii)   Dilution factor.

1

iii)   Flocculent settling.
iv)   Protoplasm.
v)   Reduction precipitation.
vi)   Microstraining.

Q.7 a) $10m^3$/day of liquid effluent from food processing unit is to be treated by the activated   08
         sludge process at $30^o C$ from an initial $(BOD)_5$ days of 650mg/l to a final $(BOD)_5$ days of
         25mg/l. bench scale studies at 20^oC and mixed liquor biomass conc. of 3000mg/l gave
         BOD removal rate coefficient of 14 per days.
         Estimate the retention time and size of unit $\theta_1 = 1.02$

     b) Explain in detail oxygen sag curve.   07

Q.8 a) Determine the depth of a low rate trickling filter that has a diameter of 40m. The   08
         hydraulic loading is 0.15m³/s and influent and effluent BOD_5 are 250mg/l and 30 mg/l.
         The unit operates at 27^oC Assume the empirical constants m=n=1 and K_{25}=0.1 m/d the
         packing media are rocks which have a porosity of 0.5 and a sphericity of 0.8 the
         geometric mean size of the rocks is 80mm.

     b) Describe Activated sludge process with neat sketches.   07

Q.9 a) Explain pollution control in Pulp and paper industries.   08
     b) Describe removal of mercury from liquid streams.   07

Q.10 Write short note on: 15
      a) Waste stabilization ponds.
      b) Flotation.
      c) Comparison of tricking filter and activated sludge process.

Total No. of Printed Pages:2
SUBJECT CODE NO:- H-320
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (Sem-I)
Chemical Reaction Engineering-I
[OLD]

[Time: Three Hours]   **[Max. Marks:80]**

Please check whether you have got the right question paper.
N.B   i) Q.No. 1& 6 are compulsory.
             ii) Solve any two question from remaining of section A & B.
             iii) State clearly any assumption made.

Section 'A'

Q.1   (a) Explain variable volume plug flow reactor.   05
         (b) Why was the order of reaction need not be an integer?   05

Q.2   Estimate the volume of two mixed flow reactors and into plug floor reactors for the reaction given   15
         data below which is for a gas mixture containing 50% A & 50% inert at 10 atm. The gas mixture
         enters the reactor with flow rate of 0.600m^3/sec at 144°C. The reaction is carried out in two mix
         flow reactors & two plug flow reactors separately in series with 40% conversion in first rector &
         overall conversion 85% of the reactant A compare the result obtained & suggest suitable
         alternative.

X	0.0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.85
-rA	0.0053	0.0052	0.0050	0.0045	0.0040	0.0033	0.0025	0.0018	0.00125	0.0010

Draw neat sketches for the reactor system indicating all inlet & outlet streams.

Q.3   The liquid phase reaction between trimethylamine (TMA) and n-propyl bromine (n.PB) is studied   15
         in a constant temperature bath at 137°C by immersing sealed glass tubes containing the reactants in
         the bath. Initial solutions of TMA, nPB in benzene, 02 molar are mixed and sealed in glass tube and
         placed in the constant temperature bath. After various intervals the tubes are cooled to stop the
         reaction and the contents analysed. Determine the order of reaction and specific reaction rate
         assuming the reaction is irreversible. Use both the differential method and integral method of
         analysis and compare the results obtained. Data available is

Run	Time (min)	Conversion
01	13.0	11.2
02	34.0	25.7
03	57.0	36.7
04	120.0	55.2

Q.4   (a) Detail out the qualitative discussion about product distribution for the decomposition of   08
                                                              K1   K2
             A by either of the below given two paths A $\xrightarrow{}$ R (derived product) A $\xrightarrow{}$ S (underlined
         products)

1

H-320

b) Acetic anhydride hydrolysis in mixed flow reactor (MFR). The concentration of acetic anhydride at the start of the reaction is 0.4 mol/lit The degree of conversion desired is 65%. The feed rate to the reactor is 28.0 lit/min., large excess of water is used. The reaction rate constant is 0.4 min^{-1}. Calculate   07
   i)   Reaction volume of a single MFR.
   ii) The reaction volume of a single PFR.
   iii) The number of stages of a MFR whose total volume is close to that of PFR.
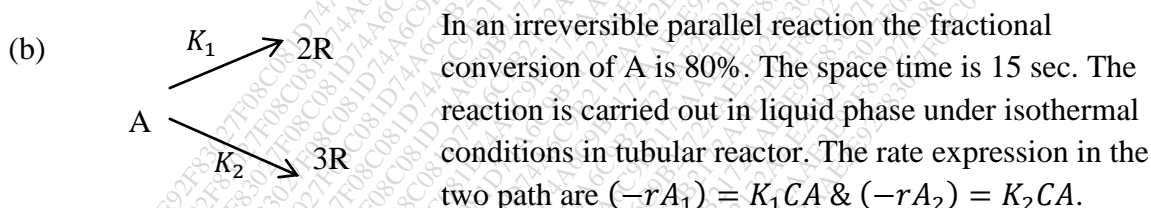
Q.5   (a) Explain in detail kinetics of series – parallel reaction.   08
         (b) How is the optimum recycle for a reactor found? Discuss in detail by specific example.   07

Section B

Q.6   (a) How is product distribution affected by temp.   05
         (b) What is the best arrangement of a set of ideal reactors and why?   05

Q.7   Detail out the quantitative treatment of product distribution and of reactor size for multiple reactions, If rate equation are known for the individual reactions.   15

Q8   (a) Write a detailed note on search for a rate equation and explain the need and use of the search.   08

         (b)

$$A \begin{array}{c} \nearrow^{K_1} 2R \\ \searrow_{K_2} 3R \end{array}$$

In an irreversible parallel reaction the fractional conversion of A is 80%. The space time is 15 sec. The reaction is carried out in liquid phase under isothermal conditions in tubular reactor. The rate expression in the two path are $(-rA_1) = K_1 CA$ & $(-rA_2) = K_2 CA$.

Calculate the values of specification reaction rate constant K_1 & K_2. If the moles of R produced per mole of 85 produced is 3.5.   07

Q.9   Develop the isothermal performance equation for the reaction A+B$\underset{K_2}{\overset{K_1}{\rightleftharpoons}}$R for the feed of A, B, R   15

and inerts is an isothermal plug flow reactors. Also show with the relevant chemical reaction example how to test this equation for an equation and feed of A&B.

Q.10   (a) Show that the reaction between CO & Cl2 to form phosgene follows the rate law   08
$$\frac{d(cocl2)}{dt} = K.(Co)(Cl2)^{3/2}$$

         (b) In vapor phase decomposition of hydrogen iodide (HI) the equilibrium value of fraction of   07
         HI decompose can be calculated as $X_{eq} = 0.138 + 7.2 \times 10^{-5}t + 2.6 \times 10^{-7}t^2$ where t is temperature ^{0}C.the initial concentration of HI is 0.024 gmole/Lit. The decomposition reaction is carried out at 321°C. Calculate the reaction rate constant for the forward and backward reaction HI decomposed was observed to be 0.83% after 23.5 min.

2

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-355
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (Sem-I)
Material Science & Technology
(Old)

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B   1. Q.No.1 & Q.No.6 are compulsory.
           2. Solve any two questions from remaining questions in each section.
           3. Draw neat sketches and assume suitable data wherever needed.

Section A

Q.1   Define the following: 10
           a) Ionization potential
           b) Bond length
           c) Dipole bonding
           d) Ionic bonding
           e) Atomic number

Q.2   Explain the periodic table? Give its importance in the material science technology. Give examples.   15

Q.3   a) Explain the powder crystal method with neat sketch.   08
       b) Describe variation in bonding character and their properties.   07

Q.4   a) Explain covalent bounded structures and properties of covalent solids. 08
       b) Explain molecular by bonded structures and give their properties.   07

Q.5   Write notes on: 15
           a) Quantum states
           b) X-Ray diffraction method
           c) Plastic deformation of a single crystal

Section B

Q.6   Explain the following: 10
           a) Fatigue failure
           b) Corrosion
           c) Hysteresis
           d) Superconductors
           e) Non-metal

Q.7   With a example explain the changes in mechanical properties by heat treatment.   15

1

H-355

Q.8   What is creep? Explain the types of creep and creep curve and mechanism of creep failure? Draw   15
        neat sketches.

Q.9   a) What are different types of corrosion?   05

            b) What are the various methods used to prevent and control corrosion. Explain any one in   10
                detail.

Q.10   Write short notes on: 15
            a) Laws of magnetic force
            b) Electrical properties in selection of materials
            c) Steel

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-389
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (Sem-I)
Chemical Engineering Thermodynamics
[OLD]

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.
N.B   1) Question no. 1 and 6 are compulsory.
              2) Answer any two questions from the remaining of each Section.
              3) Assume suitable data, if required.

Section A

Q.1   Explain the following terms: 10
            a) Activity coefficient
            b) Entropy
            c) Fugacity coefficient
            d) Fugacity
            e) Enthalpy

Q.2   a) Discuss the Gibbs-Duhem equation and its various forms.   10
         b) Define Gibbs free energy, and show that at constant temperature the decrease in the Gibbs 05
            free energy measure the network available from a given change of state.

Q.3   a) The density of gaseous ammonia at 473 K and 50 bar is 24.3 kg/m^3. Estimate its fugacity. 07
         b) What do you mean by property change of mixing? Write volume change of mixing and   08
            Gibbs free energy change of mixing equations.

Q.4   a) Calculate the vapor pressure of water at 363 K, if the vapour pressure at 373 K is 101.3 07
            kPa. The mean heat of vaporization in this temperature range is 2275 kJ/kg.
         b) Give the classification of thermodynamic properties with example.   08

Q.5   Write short note on: 15
            a) Excess properties
            b) Determination of partial molar properties
            c) Ideal solution

Section B

Q.6   Explain following terms   10
            a) Reaction coordinates
            b) Bubble point temperature
            c) Dew point temperature
            d) Azeotropes
            e) Equilibrium constant

1

Q.7   a) A gas mixture containing 2 moles nitrogen, 7 moles hydrogen and 1 mole initially is   07
         undergoing following reaction.
         $N_2 + 3H_2 \rightarrow 2NH_3$
         Derive expression for the mole fraction of various components in the reaction mixture in
         terms of extent of reaction.
       b) Explain how the equilibrium constant for liquid phase reaction is evaluated.   08

Q.8   a) Mixture of n-heptane (A) and n-octane (B) are expected to behave ideally. The total   07
         pressure over the system is 101.3 kPa. Using vapor pressure data given below construct the
         boiling point diagram.

T K	371.4	378	383	388	393	398.6
P_A kPa	101.3	125.3	140	160	179.9	205.3
P_B kPa	44.4	55.6	64.5	74.8	86.6	101.3

       b) Liquid A and B forms azetropes containing 46.1 mole percentage A at 101.3 kPa and 345   08
         K. at 345 K, the vapour pressure of a is 84.8b kPa and of B is 78.2 kPa. Calculate the van
         Laar constant.

Q.9   Write down the equation for solving a general VLE problem. How does this equation get   15
       simplified for a) ideal gas phase, ideal liquid phase   b) low pressure equilibrium and
       c) High pressure equilibrium.

Q.10   Write short note on   15
       a) Vapor liquid equilibria at low pressures
       b) Wilson equation
       c) Feasibility of a reaction

Total No. of Printed Pages:3

SUBJECT CODE NO:- H-424
FACULTY OF SCINECE AND TECHNOLOGY
T.E. (Chemical) (Sem-I)
Mass Transfer Operations-I
[OLD]

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B   1. Q.1 & Q.6 are compulsory. Answer any two questions from remaining
                                of each section.

Q.1   Answer the following
        a) What is dumping in a distillation column?   02
        b) Explain the term dew point   02
        c) State examples of mass transfer operations where mass is transferred with simultarcous
            heat transfer.   02
        d) What is drying surface area?   02
        e) What is relative volatility?   02

Q.2   a) Write a note on : diffusion in porous solids.   05

        b) Oxygen (A) is diffusing through carbon monoxide (B) under steady state conditions with   10
            carbon monoxide non- diffusing. The total pressure is 1×10^5 N/m^2 and temperature
            0°C. The partial pressure of oxygen two planes 2.0 mm apart is respectively 13000 and
            6500N/m^2 the diffusivity of mixture is 1.87×10^{-5} m^2/s .Calculate the rate of diffusion of
            oxygen in Kmol/s through each square meter of the two planes .

Q.3   a) Discuss the concept of reflux ratio.   05

        b) Derive Rayleight equation.   10

Q.4   a) What is critical moisture?   05

        b) Classify various driers.   10

Q.5   Write short notes on
        a) Boiling point diagram   05
        b) Surface renewal theory   05
        c) Flick's law of diffusion   05

Section –B

Q.6   Answer the following
      a) Name various adsorbents   02
      b) State the application of chromatography   02
      c) Explain the term: HETP   02
      d) Define : Relative humidity   02
      e) What is chemisorption?   02

Q.7   a) Enlist various solvents used in absorption columns. Comment on their properties.   05

      b) Discuss important equation and steps used for designing absorption column.   10

Q.8   a) Describe freundlich adsorption isotherm.   05

      b) Spherical particles of 15 nm diameter and density 2290kg/m³ are pressed together to form   10
          a pellet. The following equilibrium data were obtained for the sorption of nitrogen at
          77K. Obtain estimates of the surface area of pellet from adsorption isotherm. Compare
          the estimates with geometric surface. The density of liquid nitrogen at 77K is 808 kg/m³.

P/P^0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
M^3Liq N_2 x 10^6/kg solid	66.7	75.2	83.9	93.4	108.4	130	150.2	202.0	348.0

Where P is pressure of sorbate & P^0 is vapor pressure at 77K
Data:
Density of liquid nitrogen = 808 kg /m³
Area occupied by one adsorbed molecule of nitrogen = 0.162nm²
Avogardo number = 6.02×10^{26} molecules /kmol

Q9   a) Compare humidification and dehumidification .   05

      b) In a vessel at 101.3KN/m² and 300K, the percentage relative humidity of water vapour in   10
          air is 25. If the partial pressure of water vapour when air is saturated with vapour at 300K
          is 3.6 KN/m² calculate|:
          a) The partial pressure of water vapour in the vessel
          b) The specific volumes of air and water vapour
          c) The humidity of air and humid volume and
          d) Percentage humidity

Q.10   Write short notes on
    a) Design of cooling tower   05
    b) BET isotherm   05
    c) Molecular sieve   05

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Total No. of Printed Pages:02

SUBJECT CODE NO:- H-526
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (CGPA) (Sem-I)
Mass Transfer Operations-I
(Revised)

[Time: Three Hours]   **[Max.Marks:80]**

Please check whether you have got the right question paper.

N.B   1) Q.1 & 6 are compulsory.
             2) Solve any two from remaining in each section.
             3) Assume suitable data wherever required.

Section A

Q.1   Solve any five: 10

             1) Eddy diffusion
             2) Mass transfer coefficients
             3) Down spout
             4) Coning
             5) Equilibrium moisture
             6) Freeze drying

Q.2   a) Write down various theories of mass transfer. Explain any one.   08

             b) With neat sketch explain steady state co current processes.   07

Q.3   a) Write down various steps of designity of sparged vessels.   10

             b) With neat sketch. Explain various types of packing.   05

Q.4   a) A wet solid is dried from 25 to 10% moisture under constant drying conditions in   10
                15 ks. If the critical & equilibrium moisture contents are 15 & 5% resp. how long
                will it take to dry the solid from 30 to 8% moisture under the same conditions.

             b) Explain rate of drying curve.   05

Q.5   Write short note   15
             1) Unsaturated surface drying
             2) Mechanically agitated vessels
             3) Diffusion in solids.

Section B

Q.6   Solve any five: 10
    1) Non ideal liquid
    2) Desorption
    3) Activated adsorption
    4) Adsorbent
    5) % RH
    6) Enthalpy

Q.7   a) Write down expression for counter current multistage operation in absorption.   10

       b) Describe equilibrium solubility of gases in liquids.   05

Q.8   a) Describe term nature of adsorption.   08

       b) Discuss adsorption from dilute and concentrated solutions.   07

Q.9   a) The overall liquid transfer coefficient K_La. For the absorption of SO_2 in water in a   10
          column is 0.003 $kmol/sm^3$. By assuming an expression for the absorption of NH_3
          in water at the same liquor rate & varying gas rates derive an exp. For the overall
          liquid film coefficient K_La for the absorption of NH_3 in water in this equipment at
          the same rate though with varying gas rates. The diffusivities of SO_2 & NH_3 in air at
          273 k are 0.103 and 0.170 cm^2/s. SO_2 dissolves in water & Henry's constant is equal
          to 50 $(kN/m^2)/(kmol/m^3)$. All data are for the same temp. K_Ga is proportional to
          (diffusivity)$^{0.56}$.

       b) Explain performance evaluation of cooling tower.   05

Q.10   Write short note: 15

       1) Cooling tower arrangement
       2) Stripping factor
       3) Rate calculation in ion exchange

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-533
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (CGPA) (Sem-I)
Industrial Pollution And Control
(Revised)

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
i) Q.1 &6 are compulsory.
ii) Solve any two from remaining in each section.
iii) Assume suitable data wherever required.

Section A

Q.1   Solve <u>any five</u>.   10
1) Particulate matter
2) dBa
3) Adibatic lapse rate
4) Photochemical smog
5) Collection efficiency
6) Terminal settling velocity

Q.2   a) Describe types of pollution in detail.   08
        b) Discuss water preservation & control of pollution in detail.   07

Q.3   a) What are various sources & effect of Air pollutant?   08
        b) Explain plume behavior and estimator.   07

Q.4   a) A multi tray settling chamber having 8 trays, including the bottom surface handles $6m^3$ is   10
           of air at 20^0c. The trays are spaced 0.25m apart & chamber is to 1m wide & 4m long. What
           is the minimum particle size of density $2000kg/m^3$ that can be collected with 100.1
           efficiency what will be efficiency of the settling chamber? If $50\mu m$ particles are to be
           removed? Laminar flow condition within the chamber & presence of no dust on trays may
           be assumed.
        b) Write down construction & working of ESP.   05

Q.5   Write short note.   15
1) Cyclone separator
2) Stability
3) Pollution control aspects

1

H-533

Section B

Q.6	Solve <u>any five</u>.	10

1) Pretreatment
2) Flotation
3) Trace elements
4) Lagooning
5) Reserve osmosis
6) Application of lead

Q.7	a)	What are various types of water quality standards as per CPCB Norms?	08
	b)	Write down COD analysis procedure.	07

Q.8	a)	Write down detail process of Trickling filters.	08
	b)	Explain advanced waste water treatment method any one.	07

Q.9	a)	Write down detail process of Removal of mercury.	08
	b)	Explain pollution control in pulp & paper industries.	07

Q.10	Write short note.	15

1) Mercury losses in chlor alkali industries
2) Ion exchange
3) Adsorption on activated carbon

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-540
FACULTY OF SCINECE AND TECHNOLOGY
T.E. (Chemical) (Sem-I)
Chemical Reaction Engineering-I
[Revised]

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
1. Q. No. 1 & 6 are compulsory.
2. Answer any two questions from remaining of each section.
3. Assume suitable data if required.

Section -A

Q.1   Answer the following terms: 10
   i)   Rate constant of reaction.
   ii)   Auto catalytic reaction.
   iii)   Free radical reaction mechanism.
   iv)   Molecularity of reaction.
   v)   Order of reaction.

Q.2   a) Explain with relevant equation. The temperature dependency of rate constant using   07
          Arrhenius law, give comparison of collision theory with Arrhenius law.

       b) A first order reaction is to be treated in series of two mixed reactors – show that the   08
          volume of two reactors is minimum when reactors are of equal size.

Q.3   a) Explain the integral method of analysis for rate equation. State the difference between   08
          differential & integral method of analysis.

       b) After 8 minute of reaction in batch reactor reactant is 80% converted, after 18 minute the 07
          conversion is 90% find the rate expression to represent this reaction.

Q.4   a) Derive an equation for second order reversible reaction in terms of equilibrium   07
          conversion.

       b) 100 lit/hr of radioactive fluid having half-life period of 20 hr is to be treated by passing if 08
          through two ideal mixed reactors in series of volume 40,000lit each. In passing through
          system. How much has the activity decayed?

Q.5   Write note on: 15
   i)   Reaction of shifting order.
   ii)   Molecularity and free radical reaction mechanism.
   iii)   Search for reaction rate mechanism.

1

H-540

Section B

Q.6 Answer the following terms: 10
- i) Non adiabatic operations.
- ii) Equilibrium constant.
- iii) Product distribution of reaction.
- iv) Recycle reactor.
- v) Size comparison of reactors.

Q.7 a) Explain the reaction kinetics of first order reaction followed by zero order reaction. 08

b) How to construct the rate. Conversion temperature chart from kinetic data. 07

Q.8 a) What is effect of temperature on equilibrium conversion? 07

b) Derive the performance equation of steady state plug flow reactors. Show the graphical representation. 08

Q.9 a) Give the detail kinetics of auto catalytic reaction. 07

b) A gaseous reactant A decomposes as 08
$$A \rightarrow 3R$$
$-rA = (0.6 \text{ min}^{-1})\ CA$
Find conversion of A in a 50% inert feed
$$V_O = 180\ lit/min, C_{AO} = 300\frac{mol}{lit}$$
To a $1m^3$ mixed flow reactor.

Q.10 Write note on : 10
- i) Optimum temperature progression.
- ii) Product distribution in series reaction.
- iii) Auto catalytic reaction.

2

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-547
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (CGPA) (Sem-I)
Material Science &Technology
(Revised)

[Time : Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B   1. Q.No.1 & 6 are compulsory.
             2. Solve any two questions from remaining in each section.
             3. Assume suitable data if required.
             4. Draw neat sketches wherever required.

Section A

Q.1   Explain the following   10
             a) Unit cell
             b) Electron negativity
             c) Curie point
             d) Crystalline state
             e) Atom

Q.2   a) Explain the quantum state.   05

       b) What is the importance of periodic table for selecting new materials for equipment give   10
           example?

Q.3   Explain variation in bonding characteristics and give its properties. Give a example.   15

Q.4   a) Explain Bragg's law of X-ray diffraction?   08
       b) Describe the crystal powder method with neat sketch.   07

Q.5   Write short notes   15
             a) Schrodinger wave equation
             b) Role of material science in process industries
             c) Bohr's atomic

Section B

Q.6   Explain the following   10
             a) Magnetic potential
             b) Ferromagnetism
             c) Fracture of material
             d) Hysteresis
             e) Flux density

1

| Q.7 | a) | What are different heat treatment? | 08 |
| | b) | Differentiate between metals and non-metals. | 07 |

| Q.8 | a) | Explain the mechanism of creep | 05 |
| | b) | How electrical and magnetic properties of materials is important in selection of material. | 10 |

| Q.9 | a) | Describe the term superconductivity and give its types. | 08 |
| | b) | What are different types of corrosion | 07 |

Q.10   Write short notes on: 15
     a) Griffith crack theory
   b) Critical transition temperature
     c) Graphite

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Total No. of Printed Pages:2

SUBJECT CODE NO:- H-562
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (CGPA)(Sem-I)
Chemical Engineering Thermodynamics
**(Revised)**

[Time: Three Hours] **[Max.Marks:80]**

Please check whether you have got the right question paper.
N.B
    i) Question no.1 and 6 are compulsory.
    ii) Answer any two questions from the remaining of each section.
    iii) Assume suitable data, if required.

Section A

Q.1   a)   Explain terms i) Gibbs free energy ii) Helmholtz free energy   04
      b)   Define fugacity and show that the fugacity and pressure are identical for ideal gases.   04
      c)   Define chemical potential. What is its physical significance?   02

Q.2   a)   What are the characteristics of an ideal solutions? What is Lewis-Randall rule?   07
      b)   "All property change of mixing are zero for ideal solution". Do you agree? Explain.   08

Q.3   a)   How would you state criterion of equilibrium in terms of the entropy, the work function and Gibbs free energy?   08
      b)   The fugacity of component 1 in binary liquid mixture of component 1 and 2 at 298 K and 20 bar is given by $\overline{f}_1 = 50x_1 - 80x_1^2 + 40x_1^3$ 07

Where $\overline{f}_1$ is in bar and x_1 is mole fraction of component 1. Determine
   i.   The fugacity of pure component 1.
   ii.   Fugacity coefficient Henry's law constant of component 1.

Q.4   Discuss the Gibbs Duhem equation and its various forms. What are the major fields of application of the Gibbs Duhem equation?   15

Q.5   Write short note on
      a)   Phase rule for non reactiong systems   05
      b)   Phase equilibria in single component system   05
      c)   Effect of pressure and temperature on activity   05

Section B

Q.6   a)   What is pointing correction?   02
      b)   Distinguish between bubble point and due point temperature.   04
      c)   What do you mean by the 'extent of reaction'?   04

Q.7   a)   What is the criterion of chemical reaction equilibrium? Explain it.   07

b) The standard heat of formation and standard free energy of formation of ammonia at 298 K   08
are -46100 J/mol and -16500 J/mol respectively. Calculate equilibrium constant for the
reaction.

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$
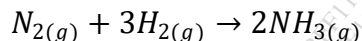
At 500 K assuming that standard heat of reaction is constant in the temperature rang 298 to
500 K.

Q.8   a) A gas mixture containing 2 moles nitrogen, 7 moles hydrogen and 1 mole initially is   08
undergoing following reaction

$$N_2 + 3H_2 \rightarrow 2NH_3$$
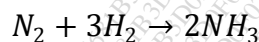
Derive expression for the mole fraction of various components in the reaction mixture in
terms of extent of reaction.

b) Explain how the equilibrium constant for liquid phase reaction is evaluated.   07

Q.9   a) What do you mean by positive and negative deviation from ideality? Explain.   08
b) What is mean by tie line? How does the tie line help in determining the amount of liquid and 07
vapor in equilibrium?

Q.10   Write short note on   15
a) Vapor liquid equilibria at low pressures
b) Wilson equation
c) Feasibility of a reaction

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-568
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (Sem-II)
Mass Transfer Operations-II
[Rev]

[Time: Three Hours] **[Max. Marks: 80]**

Please check whether you have got the right question paper.

N.B   i. Q.No.01 and 06 are compulsory.
          ii. Answer any two questions from remaining of each section.
          iii. Assume suitable data if required and draw neat sketches whenever needed.

Section A

Q.1   Define and explain   10
          a) reflux ratio
          b) relative volatility
          c) bubble point temperature
          d) dew point temperature
          e) Vapour pressure

Q.2   a) Explain, with necessary equations, the McCabe-Thiele method of determining the number of
          ideal plates in a fractionating column.   10
          b) What do you mean by Azeotropes? Distinguish between minimum and maximum boiling
          azerotrops.   05

Q.3   a) Explain with neat sketch construction and working of Swenson-walker crystalliser.   07
          b) A liquid mixture containing 50 mole % n-heptane (A) and 50 mole % n-octane (B) at 30°C
          were subjected to a differential distillation at 1 std atmospheric pressure. With 60 mole % of
          the liquid distilled. Compute the composition of the composited distillate and residue.
          Equilibrium data:

Temperature °C	98.4	105	110	115	120	125.6
Vap.pr.of n-heptane, mmHg	760	940	1050	1200	1350	1540
Vap.pr.of n-octane, mmHg	333	417	484	561	650	760

                                                                                                                  08

Q.4   a) A hot solution containing 5000 Kg of Na_2CO_3 and water with a contracton of 25% by
          weight. Na_2CO_3 is cooled to 293 K and crystals of Na_2CO_3. $10H_2O$ are precipitated. At 293
          K the solubility is 21.5 kg anhydrous Na_2CO_3 per 100 kg of total water. Calculate the yield
          of Na_2CO_3 crystal obtained if 5% of original water in the system evaporates on cooling.   08

          b) The vapour pressures of n-heptane and toluene at 373 K are 106 and 73.7 kN/m^2
          respectively. What are the mole fractions of n-heptane in the vapour and in the liquid phase
          at 373 K if the total pressure is 101.3 kN/m^2?   07

1

H-568

Q.5   Write short note on
        a) Azeotropic distillation   05
        b) Crystal formation and crystal growth   05
        c) Extractive distillation   05

Section-B

Q.6   Explain following terms   10
        a) Lixiviation
        b) Heap leaching
        c) Extraction
        d) Leaching
        e) Decoction

Q.7   Write in short the procedure to determine the number of theoretical stages for counter- current
        multistage extraction.   15

Q.8   Nicotine in water solution containing 1% nicotine is to be extracted with kerosene at 20°C.
        Kerosene and water are insoluble. Determine the percentage of extraction if 100 milligram of feed
        solution is extracted once with 150 milligram of solvent. What will be the extraction if three ideal
        stages are used with 50 kg solvent in each stage?
        Equilibrium data:

X'	0	0.00101	0.00246	0.00502	0.00751	0.00998	0.0204
Y'	0	0.00081	0.001962	0.00456	0.00686	0.00913	0.0197

        Where X' is kg nicotine / kg water and Y' is kg nicotine / kg kerosene.   15

Q.9   a) Explain, with necessary equations, the single stage leaching.   08

        b) How success of leaching dependent upon prior treatment which may be given the solid? 07

Q.10.   Write short note on
        a) ternary phase diagram   08
        b) analysis on solvent free basis   07

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Total No. of Printed Pages:02

SUBJECT CODE NO:- H-575
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (CGPA) (Sem-II)
Process Equipment Design And Drawing-I
[Revised]

[Time: Three Hours] **[Max.Marks:80]**

Please check whether you have got the right question paper.
N.B   1) Q. No. 1 & 6 are compulsory.
             2) Solve any two questions from remaining questions in each Section.
             3) Assume suitable data & Draw neat sketches whenever necessary.

Section -A

Q.1	Solve the followings:	10
	i) Elliptical head	
	ii) Dye penetration test	
	iii) Metallic coating	
	iv) Types of corrosion	
	v) Gasket width	

Q.2   a) What are the formed heads? How is their selection made for the vessel?   08
       b) What are common non-ferrous alloys used for fabrication of process equipment?   07

Q.3   Calculate the plate thickness of hemispherical head, elliptical head & torispherical head for a   15
       pressure vessel having design pressure 7 kg/cm^2 diameter of vessel 1.5 m and permissible
       stress of 1250 kg/cm^2 Weld joint efficiency is 0.80.

Q.4   Derive necessary equation for design of heating & cooling coils for different two applications.   15

Q.5   Write note on: 15
       i)   Nozzle Reinforcement
       ii) Selection of economic head
       iii) Design of stuffing box

Section -B

Q.6   Solve the following: 10
       i)   Floating roof
       ii) Clamp coupling
       iii) Baffles
       iv) Stress due to wind load
       v)   Gland

Q.7   Design a lug support for pressure vessel. Draw neat diagram discuss the precaution to be taken   15
       while designing.

1

Q.8   Describe with suitable equation design of spherical storage tank for petroleum product. Add a   15
       note on losses & its prevention.

Q.9   a) Explain the agitation & mixing with specific application in process industry.   08
       b) Explain in detail cyclone separator with limitation of separation of fluids.   07

Q.10   Write note on:-   15
       i)   Skirt support.
       ii)   Internal & external coils for heating
       iii)   Safety devices on storage tank of hazardous chemical

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-582
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical) (CGPA) (Sem-II)
Chemical Reaction Engineering-II
[Revised]

[Time: Three Hours] **[Max.Marks: 80]**

Please check whether you have got the right question paper.
N.B   1) Q.No.1 & Q. No. 6 are compulsory.
        2) Solve any two questions from remaining of Section A&B.
        3) Assume suitable data whenever required.

Section A

Q.1	Solve the following:	10
	i) RTD & rate of reaction	
	ii) Slow reaction with example.	

Q.2   a) Explain the shrinking core model for spherical particles of unchanging size when   15
reaction is controlled by diffusion through ash layer with example and necessary
equations.

Q.3   a) The data given below represent a continuous response to pulse input into a closed   08
vessel which is to be used as chemical reaction. Calculate the mean residence time of
fluid in the vessel and tabulate and construct E curve.

t,min	0	5	10	15	20	25	30	35
Cpulse,gm/lit	0	3	5	5	4	2	1	0

        b) Explain multiple steady states in CSTR for non-isothermal conditions.   07

Q.4   a) Derive rate equation for slow reaction.   08
        b) State mass transfer with chemical reaction with example.   07

Q.5   Write note on: 15
        i)   Film conversion parameter
        ii)   Self mixing of single fluid
        iii)   Slurry reaction kinetics.

Section B

Q.6   Solve the following: 10
        i)   Effectiveness factor
        ii) N_2 desorption method

Q.7   a) List the resistances observed in slurry reaction.   08
        b) Explain construction and working of adiabatic moving bed reactor.   07

1

Q.8   a) What are different types of catalyst poisoning? Explain the regeneration of catalyst.   08

            b) Explain the selection criteria of a catalyst for a typical reaction with type of reactor.   07

Q.9   a) What are different methods used to measure the catalyst surface area.   08

            b) Explain N_2 desorption method to determine pore volume distribution of catalyst.   07

Q.10   Write notes on:-   15
        i)   Heat effect during reactron
        ii)   Resistances in solid-liquid reactron.
        iii)   Tank in series model for ideal reactor.

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-589
FACULTY OF SCINECE AND TECHNOLOGY
T.E. Chemical (CGPA) (Sem-II)
Plant Design & Process Economics
[Revised]

[Time: Three Hours]   **[Max.Marks:80]**

Please check whether you have got the right question paper.

N.B
1. Q. No. 1 & Q. No.6 are compulsory.
2. Attempt any two from remaining of each section.
3. State any assumption made.
4. All variables have their usual meaning.

SECTION -A

Q.1	Define the following:	10
	a) Liquid asset	
	b) Income tax	
	c) GST	
	d) Pilot plant	
	e) Pipe Codes	
Q.2	Draw a neat plant layout for a oxalic acid chemical industry.	15
Q.3	a) Which factors are considered for site selection?	07
	b) Explain various sources used to carry out a literature survey.	08
Q.4	What is the selection criterion of a size reduction equipment. Explain with a neat data sheet.	15
Q.5	Write notes on:	15
	a) Principle of similarity	
	b) Mechanical hazards	
	c) Types of insurance	

SECTION - B

Q.6	Answer the following	10
	a. Define optimization	
	b. Explain market value of equipment	
	c. Salvage value	
	d. Activity in PBRT	
	e. Plant overhead cost	
Q.7	What are causes of depreciation? Give various methods for calculating depreciation.	15

1

Q.8   Draw a project network from the data given in table. Also mark the C. P. M.   15

Activity	Activity description	Immediate Predecessor	Estimate Duration (2 weeks)
A	EXCAVATE	-	2 weeks
B	Lay foundation	A	4
C	Put up wall	B	10
D	Put up roof	C	6
E	Install exterior plumbing	C	4
F	Install interior plumbing	E	5
G	Put up exterior accessories	D	7
H	Exterior painting	E,G	9
I	Electrical work	C	7
J	Wall board / panel	F,I	8
K	Flooring	J	4
L	Interior painting	J	5
M	Exterior fixtures	H	2
N	Interior fixtures	K,L	6

Q.9   a) What is the importance of network analysis technique,   07
       b) Giving example explain linear programming.   08

Q.10   Write notes on   15
       a. Breakdown of indirect cost
       b. Breakeven analysis
       c. Project scheduling

2