

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-144
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Process Instrumentation & Analytical Tech.
(OLD)

[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 & draw neat sketches wherever required.

Section A

- | | | |
|-----|---|----------|
| Q.1 | Solve any five: | 10 |
| | <ol style="list-style-type: none"> 1) Measuring instrument 2) Recording type 3) Absolute zero temperature 4) Seebeck effect 5) Hook gauge 6) Transducer | |
| Q.2 | <ol style="list-style-type: none"> a) List various types of errors that lead to incorrect reading of instrument. b) Describe different type of transducers. | 08
07 |
| Q.3 | <ol style="list-style-type: none"> a) Describe construction & working of Radiation pyrometers. b) Describe principle, construction & working of thermocouple. | 08
07 |
| Q.4 | <ol style="list-style-type: none"> a) Describe Bourdon pressure gauge. b) Describe various point contact methods of level measurement. | 08
07 |
| Q.5 | Write short note: | 15 |
| | <ol style="list-style-type: none"> a) Static & dynamic error b) Sight & gauge level indicators c) Thermistor | |

Section B

- Q.6 Solve any five: 10
- 1) Application of TLC
 - 2) Injection port
 - 3) Galvanometer
 - 4) Primary coulometric analysis
 - 5) Molecular vibration
 - 6) Visible region
- Q.7
- a) Explain principle, construction & working of infrared spectroscopy. 08
 - b) What is potentiometry? Explain in detail. 07
- Q.8
- a) Explain coulometric technique & titration. 08
 - b) What is flame photometry? Explain in detail. 07
- Q.9
- a) What is technique of gas liquid chromatography? Explain in detail. 08
 - b) What are application of thin layer chromatography. 07
- Q.10 Write short note: 15
- a) Application of Karl Fischer Titrimetry
 - b) Half wave potential
 - c) Constant current coulometry

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-152
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Advanced Separation Processes
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
1. Q.No.1 from section A and Q.No.6 from section B are compulsory.
 2. Attempt any two questions from the remaining questions in each section
 3. Assume suitable data & draw neat sketches wherever required.

Section -A

- | | | |
|-----|--|----------|
| Q.1 | Solve any five. | 10 |
| | <ol style="list-style-type: none"> 1. Contact filtration 2. Blowdown 3. Retenate 4. Teflon 5. Regeneration column 6. drowing | |
| Q.2 | <ol style="list-style-type: none"> a) with neat sketch explain temperature swings adsorption b) Explain TLC & various terms related to it in detail. | 08
07 |
| Q.3 | <ol style="list-style-type: none"> a) Explain dialysis membrane separation process b) Write down concentration, polarization fouling. | 08
07 |
| Q.4 | <ol style="list-style-type: none"> a) With neat sketch explain reactive extraction b) Give detail classification of separation processes based on reversible chemical complex formation. | 08
07 |
| Q.5 | Write short note on. | 15 |
| | <ol style="list-style-type: none"> a) Characteristics of separation processes b) Micro filtration c) Ion exchange resin work. | |

Section -B

- Q.6 a) How electro osmosis is prevented in electrophoresis 03
 b) What is foam formation? 04
 c) Define streaming potential 03
- Q.7 Give design step for development of flotation equipment 15
- Q.8 a) What do you mean by adductive crystallization? Explain with sketch. 08
 b) Write down application of zone electrophoresis, zone refining. 07
- Q.9 Explain following equipment its working and construction in detail.
 a) Magnetic separation 08
 b) Recoil method. 07
- Q.10 Write short note. 15
 a) Modes of operation of foam.
 b) Zone refining
 c) Ultra centrifugation.

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-153
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Industrial Pollution and Control
(OLD)

[Time: Three Hours]

[Max.Marks: 100]

Please check whether you have got the right question paper.

- N.B
- i. Answer any three questions from each section.
 - ii. Draw neat sketches wherever required.
 - iii. Make the suitable assumption if required and state them clearly.

Section A

- Q.1 Explain the process of measurement of air pollutants and methods to identify air pollution. 16
- Q.2 Explain various type of plume behaviour for dispersion of air pollution. 16
- Q.3 Define an expression for calculation of collection efficiency of particulates in turbulent flow through gravity settling chamber. 16
- Q.4 With neat sketch explain any two equipment used to control air pollution and its operating problems. 16
- Q.5 Write notes on : 18
- a) Wind rose.
 - b) Venturi Scrubbers
 - c) ESP

Section B

- Q.6 What are different processes by which removal of chromium from effluents can be carried out explain the reduction precipitation process. 16
- Q.7 Calculate the size of high trickling filter for the effluent : 16
- a) Flow 4.5 million lts /day
 - b) Recirculation ratio 2:4
 - c) BOD of raw effluent 280 mg/l
 - d) BOD removal in primary settling 30%
 - e) BOD in final effluent 50 mg/l
- Q.8 Explain the phenosolvan extraction process used in the treatment of phenolic liquid effluents and compare it with other solvent extraction process. 16

Q.9 What are various sources of waste effluent for a dairy industry? With the help of a neat flow sheet give the ETP For this industry. 16

Q10 Write notes on : 18

- a) Ozonation
- b) Aerosol
- c) Zones of pollution in the stream.

Total No. of Printed Pages:02

SUBJECT CODE NO: H-129
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Chemical Reaction Engineering-II
(OLD)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

N.B

- 1) Q.NO.01 & Q.No.06 are compulsory.
- 2) Solve any two questions from remaining of each section.
- 3) Assume suitable data if required.

SECTION – A

- Q.1 a) Explain E, F and C curves with their relation. 04
- b) The data given below represent a continuous response to pulse input into a closed 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. 06

t, min	0	5	10	15	20	25	30	35
C_{pulse}, gm /l	0	3	5	5	4	2	1	0

- Q.2 a) What is film conversion parameter? State various criteria of it which is used in the study of fluid – fluid reactions. 07
- b) From time V/s tracer concentration data in the reactor effluent stream, calculate fractional concentration for a first order chemical reaction whose rate constant is $5 \times 10^{-2} \text{ sec}^{-1}$. 08

Time (sec)	0	20	40	60	80	100	120
Concentration(gm/lit)	0	0.3	0.7	0.6	0.1	0.04	0

- Q.3 a) Write short notes on Dispersion model for the non-Idea Reactors. 07
- b) Derive the rate equation for the following gas- liquid instantaneous reaction with low C_B , Include mass transfer and reaction terms in the rate equations. 08
- $A(g) + b B(1) \rightarrow \text{Product} (1)$.

- Q.4 a) List out characteristics of good tracer and explain step input experiment for finding F curve. 07
- b) Derive the rate equation for shrinking core model for spherical particles of unchanging size when reaction is controlled by diffusion through ash layer. 08

- Q.5 a) Compare various models established for the fluid – solid non – catalytic reactions and give your remarks. 07
- b) Find expression for conversion when reaction of micro fluid with second order kinetics $A \rightarrow R$ and $C_{A0} = C_{B0}$. 08

SECTION – B

- Q.6 Write short notes on any two of the following 10
- 1) Ideal and non ideal flow behaviour.
 - 2) Examples of various fluid – solid reactions.
 - 3) Various Resistances encountered in slurry reaction
 - 4) Tank in series model for the non Ideal Reactors.
- Q.7 a) Explain the different steps for the preparation of catalyst and discuss the function of promoters and inhibitors in it. 07
- b) Explain Mercury penetration method and Nitrogen desorption method to determine pore volume distribution of catalysts. 08
- Q.8 a) What are the different types of catalyst poisoning? Explain in detail the mechanism of catalyst deactivation. 07
- b) From BET plot for adsorption of nitrogen at -195.8°C it was found that $I = 1 \times 10^{-4} \text{ cm}^{-3}$ and $S = 13 \times 10^{-3} \text{ cm}^{-3}$ and 0.606 gm sample of Silica gel. Estimate the surface area per kg of silica gel. 08
- Q.9 a) Explain BET method to determine the surface area of the catalyst. 07
- b) Derive an expression of effectiveness factor from an isothermal first order irreversible chemical reaction $A \rightarrow \text{Product}$, in a straight cylindrical pore. 08
- Q.10 Write short notes on any three of the following. 15
- a) Different theories suggested for catalysis
 - b) Reactors used to study the catalyst deactivation
 - c) Promoters and inhibitors
 - d) Classification of catalyst
 - e) Fixed bed reactors

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-109
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Process Equipment Design & Drawing - I
(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 questions in each section.
 3. Assume suitable data & draw neat sketches wherever required.

Section A

- | | | |
|-----|--|----------|
| Q.1 | Solve <u>any five</u> : | 10 |
| | <ol style="list-style-type: none"> 1) Epoxy coating 2) Crevice corrosion 3) Rating of flange 4) Formed nozzle 5) Hoop stress 6) Formed Heads | |
| Q.2 | <ol style="list-style-type: none"> a) Describe material of construction for process equipment. b) Explain rubber & glass lining with its application. | 08
07 |
| Q.3 | <ol style="list-style-type: none"> a) What are various stresses induced in a pressure vessel subject to combined loading. b) Write down criteria for selection of economic head. | 08
07 |
| Q.4 | <ol style="list-style-type: none"> a) A vessel is designed for an internal pressure 100 kg/cm^2. A spiral wound metal, fibre stainless 10 steel gasket with inside diam 36cm & width 2 cm is used. Gasket factor is 3. While gasket seating stress is 675 kg/cm^2.
Permissible stress for bolt material at atmospheric & operating condition is 1300 kg/cm^2. Check the whether gasket width is sufficient to keep it away from crushing out. b) Describe reinforcement of nozzles. | 05 |
| Q.5 | Write short note. <ol style="list-style-type: none"> a) Inter granular corrosion b) Formed head c) Dimple jacket | 15 |

Section B

- Q.6 Solve any five: 10
- 1) Lug support
 - 2) Gusset plate
 - 3) Vapor lift
 - 4) Storage tank dike
 - 5) Cyclone
 - 6) Process Hazards
- Q.7 a) Design skirt support for vessel. 10
 b) How is skirt bearing plate thickness evaluated. 05
- Q.8 a) Write down mechanical design of a storage tank. 08
 b) With neat sketch explain types of floating roof. 07
- Q.9 a) Write down design of coupling & stuffing box & gland. 10
 b) Describe internal coil vessels & accessories. 05
- Q.10 Write short note. 15
- 1) Roof curb angles
 - 2) Conical roof
 - 3) Bolt chair

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-118
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Process Modeling and Simulation
(REVISED)

[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 remaining sections
 - 3) Assume relevant data where necessary with justification

Section A

- Q.1 Write notes on:-
- a) Compare design and simulation 03
 - b) Explain steady state model with suitable example. 03
 - c) Write continuity equation in spherical co-ordinate system. 04
- Q.2
- a) Explain uses of mathematical model. 07
 - b) Give classification of mathematical models with example. 08
- Q.3
- a) Draw neat labeled sketch of stage of vapor-liquid contactor, showing incoming and leaving stream gas and liquid phases in contact. 07
 - b) Draw a neat labeled sketch of stage in continuous staged liquid-liquid extractor. 08
- Q.4 For iso-propanol vapor at 200°C, the values of virial coefficient, $B = -388 \text{ cm}^3/\text{mol}$ and $C = -26000 \text{ cm}^6/\text{mol}^2$ By using truncated virial equation determine by using successive approximation method the molar volume at 200°C and 15 bar. 15
- Q.5 Write short notes on:-
- a) Chemical kinetics model 05
 - b) Euler method 05
 - c) Runge-Kutta method 05

Section B

- Q.6 Write notes on
- For a centrifugal compressor, list parameters and variables required for modeling and simulation. 03
 - Write and explain equations required to model continuous binary tray distillation column. 03
 - Model of pressure change equipment's. 04
- Q.7
- Develop dynamic mathematical model for single-effect evaporator for studying effect of changes in feed concentration on product concentration. Consider overall heat transfer coefficient to be constant. 08
 - Draw a neat labeled diagram for continuous staged distillation and model dynamics for binary distillation. 07
- Q.8 With neat sketch explain working of ideal binary tray distillation column and develop mathematical model using total continuity and component balance equations for feed plate, plate in rectifying & stripping section, condenser, reflux drum and reboiler. Also include appropriate equations for liquid holdup on plate. Make suitable assumption and mention them clearly. 15
- Q.9 It is desired to vaporize liquid feed of benzene to the vaporizer. Vaporizer is equipped with jacket for heating and control valve. The Volumetric flow rate of vapor through a valve is given by $V_c = K_c[P(P - P_0)]^{1/2}$ where P and P_0 are upstream and downstream of vapor w.r.t. valve. Develop dynamic mathematical model for the system. 15
- Q.10
- Draw neat labeled sketch of 1-1 S & THE and write an algorithm for simulation of 1-1 S & THE for predication of steady state outlet temperature of hot fluid with change in hot fluid flow rate. 08
 - Describe the functioning of trickle bed reactor with neat labeled sketch. Discuss fundamentals equations and laws required for modeling of trickle bed reactor. 07

Total No. of Printed Pages:2

SUBJECT CODE NO: H-199
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Plant Design & Process Economics
(OLD)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i) Q. No. 1 and Q. No.6 are compulsory.
 - ii) Attempt any two from the remaining of each section
 - iii) State any assumptions made
 - iv) All variables have their usual meanings.

Section A

- | | | |
|-----|---|----------|
| Q.1 | Define the following | 10 |
| | <ol style="list-style-type: none"> a) Salvage value b) Insulation c) Breakeven point d) Optimization e) Patent | |
| Q.2 | What are various sources of literature survey? Explain them | 15 |
| Q.3 | <ol style="list-style-type: none"> a) Draw a neat plant layout for a chemical industry (manu. of calcium) b) What are specific factors? | 10
05 |
| Q.4 | What are the factors to be considered for selection of material for equipment? Give examples and explain | 15 |
| Q.5 | Write notes on | 15 |
| | <ol style="list-style-type: none"> a) Site selection b) Pilot plant criteria c) Principle of similarity | |

Section B

- Q.6 Answer the following 10
- Define event w.r.t. PERT
 - Fire explosion hazards
 - Define obsolescence?
 - What is functional depreciation?
 - What is scrap value
- Q.7 a) With an example explain the following terms used in PERT 10
- Earliest Start
 - Earliest finish
 - Latest start
 - Latest finish
- b) Differentiate between CPM and PERT 05
- Q.8 a) Give the breakdown of indirect cost 05
- b) For installation of distillation column give the sequence of activities together with their predecessor and draw a network diagram for the same 10
- Q.9 How does linear programming help in solving optimization problem? Give examples and explain 15
- Q.10 Write notes on 15
- Methods for calculating depreciation
 - Total project cost
 - Patents

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-213
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Heat Transfer
(REVISED)

[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. Attempt any two questions from remaining question from each section
 3. Figure to right indicate full marks.
 4. Assume suitable data if necessary

Section A

- | | | |
|-----|---|---------------------|
| Q.1 | Answer the following question | 10 |
| | <ol style="list-style-type: none"> a) What is thermal diffusivity? Write its unit b) What is thermal boundary layer? c) Write Fourier's law of heat conduction d) What is forced convection? e) Define fouling factor. | |
| Q.2 | <ol style="list-style-type: none"> a) Explain in detail modes of Heat Transfer. b) Derive rate equation for heat transfer through a thick walled cylinder. | <p>08</p> <p>07</p> |
| Q.3 | <ol style="list-style-type: none"> a) Describe the concept of optimum thickness of insulation with neat diagram. b) Give the physical significance of Reynolds and Prandtl dimensionless number in heat transfer. | <p>08</p> <p>07</p> |
| Q.4 | <ol style="list-style-type: none"> a) Explain the term efficiency of fin and effectiveness of fin. b) A very long 20mm diameter copper rod ($k=380 \text{ W/m}^\circ\text{C}$. extends horizontally from plane heated wall at 100°C. The temperature of surrounding air is 20°C and convective heat transfer coefficient is $9 \text{ W/m}^2^\circ\text{C}$. determine the heat loss. | <p>07</p> <p>08</p> |
| Q.5 | Write note on | 15 |
| | <ol style="list-style-type: none"> a) Reynolds Analogy b) Resistance concept c) Transient heat flow | |

Section – B

- Q.6 Answer the following question 10
- List out the various types of heat exchangers
 - Define heat exchanger effectiveness
 - Explain the concept of log mean temperature difference
 - Explain the term absorptivity and reflectivity
 - Define 'evaporation'
- Q.7 a) State Stefan Boltzmann and Wien's laws of thermal radiation. 08
- b) With the help of a neat sketch, discuss the forward feed multiple effect evaporation system. 07
- Q.8 Explain the theory of laminar film condensation and derive necessary equation. 15
- Q.9 The flow rate of hot and water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficient on both sides are 650 W/m² °C, calculate area of the heat exchanger. 15
- Q.10 Write note on 15
- Concept of black body
 - Explain terms absorptivity, reflectivity, and transmissivity
 - Kirchhoff's law of radiation

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-214
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Mechanical Operations
(OLD)

[Time: Three Hours]

[Max.Marks: 80]

N.B Please check whether you have got the right question paper.

- N.B
- 1) Q. No. 1 and Q. No. 6 are compulsory.
 - 2) Answer any two questions from remaining of each section.
 - 3) Draw well labeled diagram if necessary.

Section A

- Q.1 Answer the following:- 10
- a) State kick's law
 - b) What is the ratio of actual mesh dimension in one screen to that of next smaller screen as per Tyler's standard scale?
 - c) What is classification?
 - d) What is blinding of a screen?
 - e) Define sphericity.
- Q.2 05
- a) What is critical speed of a ball mill? 05
 - b) Derive the efficiency of double deck vibrating screen. 05
 - c) Differentiate between jaw crusher and ball mill? 05
- Q.3 05
- a) What is mesh number? State its significance. 05
 - b) Compare ideal and actual screens. 05
 - c) Explain the terms capacity and effectiveness of a screen. 05
- Q.4 05
- a) What are bins? Give its design parameters. 05
 - b) Fine Barytes having bulk density 2000 kg/m^3 is to be conveyed by a 100 two roll ideal seat belt conveyor running at 4 m/s along an incline of 70. If the product has an angle of surcharge of 130, then determine the minimum belt width required to get mass through put of 40 kg/sec. Slope factor $k_s=0.855$. 05
 - c) Explain the term angle of repose. 05
- Q.5 Write short notes on:- 15
- a) Conveyer belt
 - b) Tumbling mill
 - c) Grizzly

Section B

- Q.6 Answer the following:- 10
- What is diamagnetic material?
 - What are desirable properties of filter medium?
 - What is a mixing index.
 - What is reverse osmosis?
 - What are industrial uses of cyclone separator?
- Q.7
- What is the necessity of separation in chemical engg.? 07
 - Explain construction & working of any two jigging equipment's. 08
- Q.8
- What is Principle of working of sedimentation? 03
 - What are filter aids? Give examples. 03
 - The collection efficiency of a cyclone is 45% over the size range 0-5 m, 80% over the size range 5-10 m, 96% for particles exceeding 10 m. Calculate efficiency of collection for the following dust Mass distribution 50% 0-5 m, 30% 5-10m and 20% above 10 m. 09
- Q.9
- What is purpose of mixing? 05
 - Derive an expression for calculating power consumption in agitating Newtonian fluid by 10 dimensional analysis.
- Q.10 Write short notes on:- 15
- Constant pressure filtration
 - Banbury mixer
 - Magnetic drum separator

Total No. of Printed Pages:2

SUBJECT CODE NO: H-164
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Mass Transfer Operations-II
(OLD)

[Time: Three Hours]

[Max.Marks:80]

- N.B Please check whether you have got the right question paper.
- i) Q.No.1 and Q.6 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 |
| | <ol style="list-style-type: none"> a) Reflux ratio b) Relative volatility c) Bubble point temperature d) Dew point temperature e) Partial pressure | |
| Q.2 | <ol style="list-style-type: none"> a) Write down the equation for solving a general VLE problems. How does this equation get simplified for a) ideal gas phase, ideal liquid phase and b) low pressure equilibrium? b) What do you mean by Azeotropes. | 12
03 |
| Q.3 | <ol style="list-style-type: none"> a) Derive Rayleigh's equation for differential distillation. b) Explain, with necessary equations, the McCabe-Thiele method of determining the number of ideal plates in a fractionating column. | 07
08 |
| Q.4 | Explain the following method. <ol style="list-style-type: none"> a) Fenske's method b) Ponchan Savarit | 07
08 |
| Q.5 | Write short note on <ol style="list-style-type: none"> a) Concept of MSMR b) Crystal formation and crystal growth c) Extractive distillation | 05
05
05 |

Section B

- Q.6 Explain following terms 10
- Lixiviation
 - Heap leaching
 - Extraction
 - Leaching
 - Decoction
- Q.7 Write in short the procedure to determine the number of theoretical stages for counter-current multistage extraction. 15
- Q.8 Explain the graphical method of determining the number of theoretical stages in a multistage counter-current leaching. 15
- Q.9 A solution of 500kg of Na_2SO_4 in 2500 kg water is cooled from 333k to 283k in an agitated vessel of mass 750kg. At 283k the solubility of anhydrous salt is 8.9kg/100kg water & the stable crystalline phase is $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$. At 291k the heat of solution is -78.5 mj/kmol & the specific heat capacity of solution and mild steel are 3.6 & 0.5 KJ/kg K respectively. If during cooling 2 percent of the water initially percent is lost by evaporation estimate the heat which must be removed. 15
- Q.10 Write short note on 08
- Concept of HTU and HETP
 - Analysis on solvent free basis
- 07

Total No. of Printed Pages:02

SUBJECT CODE NO: H-309
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Process Dynamics and Control
(REVISED)

[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 remaining sections.
- 3) Assume relevant data where necessary with justification

SECTION – A

- Q.1 Explain following 10
- a) Cross over frequency
 - b) Stable control system
 - c) Breakaway point
 - d) Gain margin
 - e) Routh stability test
- Q.2 a) A first order system is given in impulse change a magnitude 10. The time constant for it is 6 second. Sketch the response and comment on it. 08
- b) Derive transfer function for U- tube manometer. 07
- Q.3 a) Explain the mechanism of PI controller in detail with the help of flapper and nozzle arrangement. State the application of different controllers. 08
- b) Derive transfer function for two tank non-interacting system. 07
- Q.4 a) Explain concept of mathematical model used for chemical processes and its significance. 05
- b) The transfer function of second order system is given as $G(S) = 5/(2S^2 + 1.63S + 5)$. A step 10 change of magnitude 5 is given to input variables of system. Determine overshoot, rise time and maximum value of response.
- Q.5 Write note on 15
- a) Pure capacitive system
 - b) Concept of linearization
 - c) Stem response of under damped second order system

SECTION – B

- Q.6 Answer following 10
- a) Open loop pole & open loop Zero
 - b) Servo control problem
 - c) Off set value
 - d) Block diagram reduction
 - e) Break in point
- Q.7 Draw root locus diagram for control system whose open loop transfer function is 15
 $G(s) = (S + 1)(S - 0.25)/(S(S + 0.5)(S + 2)(S + 3)(S + 4))$
- Q.8 Sketch bode diagram for non-interacting system whose time constants are 0.1 and 10 sec respectively. 15
- Q.9 08
- a) Explain in details mechanism of cascade control system with the help of an example.
 - b) Explain in detail the Routh Hurwitz's stability criteria 07
- Q.10 Write note on 15
- a) Ratio control
 - b) Gain margin & phase margin
 - c) Distributed control system

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-310
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Chemical Reaction Engg. -II
(OLD)

[Time: Three Hours]

[Max.Marks:100]

Please check whether you have got the right question paper.

- N.B
- 1) Answer any three questions from each section.
 - 2) Assume suitable data, if required and draw neat sketches wherever needed.

SECTION – A

- Q.1 a) Explain multiple steady states in CSTR for non- isothermal conditions. 08
- b) For diffusion through Gas layer controlling derive expression of relation, for time required and conversion, assuming unreacted core model for spherical particles of unchanging size. Also find time required for complete conversion. 08
- Q.2 a) Explain in detail the tank in series model for non-ideal flow. 08
- b) Draw neat sketches for contacting pattern for fluid particle reaction. 08
- Q.3 a) Explain the Shrinking core model for spherical particles of unchanging size when reaction is controlled by diffusion through ash layer and chemical reaction. 08
- b) Write short notes on Optimum temperature progression. 08
- Q.4 a) Explain the steps determination of rate controlling in fluid particle reaction. 08
- b) Explain the Arrhenius law for temperature dependency of reaction rate. 08
- Q.5 Write short notes any three of the following. 18
- i) Stimulus response technique to find RTD in reactor.
 - ii) Earliness and lateness of mixing
 - iii) Ideal and non-ideal flow behaviour
 - iv) Applications of mean and variance function.

SECTION – B

- Q.6 a) Explain in detail Thiele modules and effectiveness factor for porous catalysts. 08
- b) What are the different methods used for the measurement of catalyst surface area? Explain in detail the BET method. 08
- Q.7 a) Explain Mercury penetration method and Nitrogen desorption method to determine pore volume distribution of catalysts. 08
- b) From BET plot for adsorption of nitrogen at -195.8°C it was found that $I = 1 \times 10^{-4}\text{cm}^{-3}$ and $S = 13 \times 10^{-3}\text{cm}^{-3}$ for 0.606 gm sample of Silica gel. Estimate the surface area per kg of silica gel. 08
- Q.8 Write short notes on
- a) Kinetics regions in fluid-fluid reaction 08
- b) Trickle bed reactor 08
- Q.9 a) Explain in details about the steps for preparation of catalyst. 08
- b) Explain the term film conversion parameter. 08
- Q.10 Explain the following terms (any three) 18
1. Types of catalyst poisons
 2. Pore size distribution
 3. Accelerator
 4. Surface are of the catalyst
 5. Promoters and Inhibitor

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-320
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Chemical Reaction Engineering-I
(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 of each section.
- 3) Assume suitable data if required.

Section A

- | | | |
|-----|--|----|
| Q.1 | Answer the following terms:- | 10 |
| | <ol style="list-style-type: none"> a) Rate of reaction b) Autocatalytic reaction c) Molecularity of reaction d) Rate Constant e) Order of reaction. | |
| Q.2 | <ol style="list-style-type: none"> a) Define elementary and non elementary reaction. Explain temperature dependency of rate of reaction with Arrhenius law. | 07 |
| | <ol style="list-style-type: none"> b) The activation of energy of a bimolecular reaction is about 9150 cal/mole. How much faster is this reaction takes place at 500 K then at 400 K. | 08 |
| Q.3 | <ol style="list-style-type: none"> a) Explain the integral method of analysis for rate equation. State major differences between differential & integral method of analysis. | 07 |
| | <ol style="list-style-type: none"> b) After 8 minutes in a batch reactor a reactant is 80% converted, after 18 min the conversion is 90%. Find a rate expression to represent this reaction. | 08 |
| Q.4 | <ol style="list-style-type: none"> a) Explain the temperature dependency term in rate equation using thermodynamics and collision theory. | 07 |
| | <ol style="list-style-type: none"> b) Derive the rate expression for first order reversible reaction. | 08 |
| Q.5 | <ol style="list-style-type: none"> a) Derive the performance equation of steady state plug flow reactor for the first order reaction with change in density case. | 07 |
| | <ol style="list-style-type: none"> b) A gaseous feed with $C_{A0} = 100$, $C_{B0} = 200$ and $C_{i0} = 100$ enters a steady flow reactor in which the isothermal gas phase reaction $A + 3B \rightarrow 6R$ takes place. Determine C_B, X_B, X_A at the exit of the reactor if C_A at exit is 40. | 08 |

Section B

- Q.6 Answer the following terms:- 10
- Parallel reactions
 - Adiabatic operations
 - Size comparison of reactors
 - Successive irreversible reactions
 - Optimum temperature progression
- Q.7 a) What are the different ideal reactors used to carry out homogeneous reaction? Derive performance equation of Batch reactor. 07
- b) Assuming a stoichiometry $A \rightarrow R$ for a first order gas phase reaction, the size of a plug flow reactor for 99% conversion of pure A is calculated to be 32 litres. In fact, however, the stoichiometry of the reaction is $A \rightarrow 3R$. For this corrected stoichiometry, find the required volume of a reactor. 08
- Q.8 a) Derive the equation of space time for N equal size mixed flow reactors connected in series. 07
- b) Define rate of equation. Give the classification of the reactions with examples. 08
- Q.9 a) Compare the performance of single mixed and plug flow reactors for the nth order reaction. 07
- b) Show that total volume required is minimum when two equal sizes CSTR is connected in series. 08
- Q.10 a) Derive an expression to find kinetics of 1st order reaction taking place in a variable volume batch reactor. 07
- b) Presently 90% of reactant A is converted into product by a second order reaction in a single mixed flow reactor. We propose to place a second reactor similar to the one being used in series with it. For the same treatment rate as that used presently, how will this addition of reactor affect the conversion of reactant? 08

Total No. of Printed Pages:02

SUBJECT CODE NO: H-299
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
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 Q.no 6 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
- I. Decibel
 - II. Erosion.
 - III. Adiabatic Lapse rate.
 - IV. Aerosols
 - V. Application of settling chambers
 - VI. Involute Inlet
- Q.2 a) Explain in detail Water Act 1974. 07
- b) What are various types of Air quality monitoring instruments explain with parameters. Range, accuracy and principles. 08
- Q.3 a) Write down various types of Air pollutant explain in detail. 08
- b) Describe Meteorological factors influencing air pollution. 07
- Q.4 a) Explain with neat sketch principle, construction and working of settling chambers. 08
- b) A plate type ESP for use in cement plant for removing dust particles consists of 10 equal channels. The spacing between the plates is 0.15m and the plates are 2m high and 2m long. The unit handles $10000m^3/hr$ of gas. What is efficiency if other conditions are the same? Particle migration velocity = 0.10 and $\eta = 0.99$. 07
- Q.5 Write short Note on. 15
- a) Venturi scrubbers.
 - b) Wind velocity and turbulence.
 - c) Environment legislation

SECTION – B

- Q.6 Explain following terms. (Any five) 10
- Sediments
 - TDS
 - Pretreatment.
 - Sloughing.
 - Reduction precipitation
 - Microstraining
- Q.7 a) What are various water pollutant Explain in detail. 07
- b) Describe BOD analysis method in detail. 08
- Q.8 a) Determine the depth of a low rate trickling filter that has a diameter of 40 m. The hydraulic loading is $0.15 \text{ m}^3/\text{s}$ and influent and effluent BOD_5 are 250 mg/l and 30 mg/l . The unit operates at 27°C . Assume the empirical constants $m = n = 1$ and $K_{25} = 0.1 \text{ m/d}$. 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 80 mm. 08
- b) Describe Activated sludge process with neat sketches. 07
- Q.9 a) Write down various Chromium control methods. Explain any one with neat sketch. 08
- b) Explain removal of mercury from gaseous stream. 07
- Q.10 Write short Note on. 15
- Waste stabilization ponds.
 - Water quality standards.
 - Pollution control in Petrochemical Industries.

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-286
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Heat Transfer
(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. Attempt any two questions from remaining question from each section.
 3. Figure to right indicate full marks.
 4. Assume suitable data, if necessary.

Section A

- Q.1 Answer the following question.
- | | | |
|-----|---|----|
| | a) What is the importance of dimensionless number? | 04 |
| | b) State and explain Fourier's law of heat conduction. | 04 |
| | c) What is forced convection? | 02 |
| Q.2 | a) Explain in detail modes of Heat Transfer. | 08 |
| | b) Derive rate equation for heat transfer through a thick walled cylinder. | 07 |
| Q.3 | a) Describe the concept of optimum thickness of insulation with neat diagram. | 08 |
| | b) Give the physical significance of Reynolds and Prandtl dimensionless numbers in heat transfer. | 07 |
| Q.4 | a) Explain the term efficiency of fin and effectiveness of fin. | 07 |
| | b) Derive the Dittus- Boltzer equation. | 08 |
| Q.5 | Write note on | 15 |
| | a) Colburn equation | |
| | b) Transient heat flow | |
| | c) Coefficient of scale deposit. | |

Section B

- Q.6 Answer the following question.
- | | | |
|-----|---|----|
| | a) Define heat exchanger effectiveness. | 03 |
| | b) Explain the concept of log mean temperature difference. | 03 |
| | c) Explain the term absorptivity and reflectivity. | 04 |
| Q.7 | a) Explain in detail drop wise film wise condensation. | 08 |
| | b) With the help of a neat sketch, discuss the forward feed multiple effect evaporation system. | 07 |

- Q.8 What do you mean by fouling of plate heat exchanger? Explain in detail. 15
- Q.9 The flow rate of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficient on both sides are 650W/m² °C, calculate area of the heat exchanger. 15
- Q.10 Write note on 15
- Concept of black body
 - Plate type heat exchanger
 - Kirchhoff's law of radiation.

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-256
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Elective-II: Food Technology
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i) Q.1 and Q.6. Are compulsory.
 - ii) Solve any two from remaining each section.
 - iii) Draw neat sketches wherever required.

Section A

- Q.1 Define the following:- 10
- a) Additives
 - b) Rendering
 - c) Immersion freezing
 - d) Pasteurization
 - e) Aseptic packaging
- Q.2 What are the factors which influence deterioration of food? State their control methods. 15
- Q.3 Give the structure & composition of meat muscle. Explain the changes that occur after slaughtering of animal. 15
- Q.4 What are vitamins? Explain each with their sources. 15
- Q.5 Write notes on 15
- a) Hedonic scale
 - b) Fish processing
 - c) Shelf life of good.

Section B

- Q.6 Define the following. 10
- a) Nip
 - b) Aseptic system
 - c) Stabilizers
 - d) Fermentation
 - e) Dehydration
- Q.7 What are various unit operations carried out in food industry. Explain in detail any three. 15
- Q.8 With neat flow explain the following 07
- a) Manufacture of chocolate
 - b) Butter 08

- Q.9 What are various packaging methods in food industry Explain any two. 15
- Q.10 Write notes 15
- a) Preservation of food
 - b) Dairy products
 - c) Blanching

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-257
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Elective-II: Polymer Technology
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

- N.B Please check whether you have got the right question paper.
- i) Q.1 & 6 are compulsory.
 - ii) Answer any two questions from remaining of each section.
 - iii) Draw neat sketches whenever required.

Section A

- | | | | |
|-----|---|--|----|
| Q.1 | Answer the followings:- | | |
| | a) Properties of polymer | | 04 |
| | b) Copolymerisation | | 03 |
| | c) Chief transfer agents | | 03 |
| Q.2 | a) Explain classification of polymers. | | 08 |
| | b) What is basic concept of polymer chemistry? | | 07 |
| Q.3 | a) Explain transition in polymers. | | 08 |
| | b) What are polymer solubility parameters? Explain in detail. | | 07 |
| Q.4 | a) Describe Emulsion, & suspension polymerization. | | 08 |
| | b) Explain Homogenous polymerization in detail. | | 07 |
| Q.5 | Write short note | | 15 |
| | a) Cross linked polymers | | |
| | b) Solution polymerization | | |
| | c) Polymer degradation | | |

Section B

- Q.6 Solve following
- a) Compression moulding 04
 - b) Kinetics of copolymerization 03
 - c) ABC polymers 03
- Q.7
- a) Write down manufacturing process of poly propylene. 08
 - b) What are polymers based on Isocyanate reactions & silicones? 07
- Q.8
- a) Explain casting molding method in detail. 08
 - b) Describe coating methods & its importance. 07
- Q.9
- a) Explain kinetics of step growth polymerization. 08
 - b) Kinetics of coordination polymerization. 07
- Q.10 Write short note 15
- a) Polyamides
 - b) Compounding
 - c) polyether's

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-258
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
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

- i) Q.No.1 and Q.No.6 are compulsory.
- ii) Solve any two questions from the remaining of each section.
- iii) Assume suitable data if required.

Section A

- Q.1 a) How will you connect the physical properties of various compounds from data bank? 05
 b) What is process model? Explain the different models with at least one example of each. 05
- Q.2 a) Draw and explain the flow diagram for BUBLE T calculation of a ternary mixture with liquid non-ideal and vapour ideal. 07
 b) What is simple column? Explain in detail the column sequencing. 08
- Q.3 Give the step by step procedure of design of absorption column by CAD? 15
- Q.4 a) Obtain a model equation for stirred tank heater in which flow rate and temperature can vary. Assume that the tank is perfectly insulated. 07
 b) Following reaction is carried out in a CSTR, Which is having a by-product and stagnant region problem. The stoichiometry is $A + B \rightarrow C + D$, $k = 0.32 \text{ m}^3 / \text{kmol.min}$,
 $V = 1 \text{ m}^3$, $v_0 = 0.1 \text{ m}^3 / \text{min}$, $C_{A0} = C_{B0} = 2 \text{ kmol/m}^3$, $\alpha = 0.92$, $\beta = 0.202$
 Calculate the conversion for ideal reactor. 08
- Q.5 Write short notes on any three of the following. 15
 a) "Minimum spanning Tree" method
 b) Steps for optimization of shell and tube heat exchanger.
 c) Importance of CAD in chemical engineering.
 d) Model equation of absorption column.

Section B

- Q.6 Discuss in detail the concept of optimization with the considering the example of optimum insulation thickness on pipes. 10
- Q.7 a) Why engineers are interested in optimization? Three points are selected a distance h apart. $(x_0, x_0 + h, x_0 + 2h)$. With corresponding values f_0, f_1 and f_2 . Find the maximum or minimum attained by a quadratic function passing through all three points. 07
- b) Carryout four stage of the simples methods to minimize the function $f(x) = x_1^2 + 3x_2^2$ starting at $X = [1,1.5]$. Using $X = [1,2]$ for another corner. Show each stage on a graph. 08
- Q.8 In planning & scheduling of a project how optimization is used explain with example. 15
- Q.9 a) Explain the general procedure for solving the optimization problem 07
- b) A box with a square base and open top is to hold 1000 cm^3 . Find the dimension that requires the least material to construct the box. 08
- Q.10 Write short notes on any three of the following. 15
- Golden section search method.
 - Linear and non-linear programming
 - Newton's and Quasi-Newton's method
 - Lagrangian multiplier technique
 - Region elimination methods.

Total No. of Printed Pages:2

SUBJECT CODE NO: H-259
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Elective-III: Catalysis
(OLD)

[Time: Three Hours]

[Max. Marks: 100]

Please check whether you have got the right question paper.

- N.B
- i) Answer any three questions in full from each sections
 - ii) All variables carry their usual meaning and state clearly any assumption made
 - iii) Assume relevant data where necessary with justification

Section A

- Q.1
- a) Explain how homogeneous and heterogeneous catalysis is industrially useful? 08
 - b) Discuss the role of supports in heterogeneous catalysis. 08
- Q.2
- a) Explain concept of Thiele modulus and its application in catalysis. 08
 - b) Discuss various engineering problems associated with heterogeneous catalysis. 08
- Q.3
- a) Explain the mechanism of solid catalyzed reactions with suitable examples. 08
 - b) Give experimental method to determine the rate of solid catalyzed reactions. 08
- Q.4
- a) State various adsorption isotherms and explain their significance. 08
 - b) Compare and contrast alumina and silica as catalyst support or carrier. 08
- Q.5
- Calculate the amount of catalyst needed in packed bed reactor to achieve 80 % conversion of 1000 m³/hr of pure gaseous A ($C_{A0} = 100 \text{ mol/m}^3$) for: 18
- a) $A \rightarrow R, -r'_A = (50 C_A) / (1 + 0.02 C_A) \text{ mol/hr. kg Cat}$
 - b) $A \rightarrow R, -r'_A = 50 C_A^2 \text{ mol/hr. kg Cat}$

Section B

- Q.6 Write short notes
- a) Mechanism of liquid-liquid catalysis 06
 - b) Phase transfer catalysis 06
 - c) Mass transfer in catalysis 06
- Q.7 Explain catalyst cracking and application with different catalytic cracking processes. 16

- Q.8 a) Explain the major steps involved in preparation of catalyst and its formation. 08
 b) Explain in details ZSM-5. 08
- Q.9 a) Derive the M-M kinetics equations of the reaction using an enzyme as a catalyst. 08
 b) Explain inhibition in biocatalyst. 08
- Q.10 A sucrose is hydrolyzed at ambient temperature by enzyme sucrose as: Sucrose $\xrightarrow{\text{sucrose}}$ product starting with sucrose concentration $C_{A0} = 1 \text{ mol/m}^3$ and sucrose (enzyme) concentration $C_{E0} = 0.01 \text{ mol/m}^3$
 The following data are obtained in a batch reactor:

t, hr	2	6	10
$C_A \text{ mol/m}^3$	0.68	0.16	0.006

 Find a rate equation to represent the kinetics of this hydrolysis reaction 16

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-271
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Chemical Process Industries
(OLD)

[Time: Three Hours]

[Max.Marks:80]

- N.B Please check whether you have got the right question paper.
- (1) Q.1 & 6 are compulsory.
 - (2) Solve any two questions from remaining in each section.
 - (3) Draw neat sketches wherever required.

Section A

- | | | |
|-----|--|----------|
| Q.1 | Solve any Five.
(1) Prilling process
(2) Soda ash
(3) Oleum
(4) Producer gas
(5) Electrolytic process.
(6) DAP | 10 |
| Q.2 | (a) What are challenge faced by chemical Industries in India.
(b) Write down development of chemical process Industries in India. | 08
07 |
| Q.3 | With Neat sketch Explain manufacturing process of following chemical in Detail.
(1) Ammonium Nitrates
(2) Hydrochloric acid | 08
07 |
| Q.4 | Write down production process of following chemical in Detail.
(a) Oxygen
(b) Sodium Bicarbonate. | 08
07 |
| Q.5 | Write Short Note
(a) Synthesis of Ammonia
(b) Bleaching powder
(c) Frasch process | 15 |

Section B

- Q.6 Solve any Five
 (1) Hydrogenation
 (2) Thinner
 (3) Sucrose
 (4) Pulp
 (5) PVC
 (6) Nitro benzene 10
- Q.7 Explain production process of following chemical in Detail
 (a) Vinyl Chloride 08
 (b) Starch 07
- Q.8 Write down manufacturing process of following chemical in Detail
 (a) Polyethylene 08
 (b) Soap & Detergents 07
- Q.9 (a) Write down various properties of Natural & Synthetic rubber 07
 (b) Explain production process of silicon oils in Detail. 08
- Q.10 Write Short Note 15
 (a) Vinegars
 (b) Varnishes
 (c) Chloro benzene

Total No. of Printed Pages:3

SUBJECT CODE NO:- H-179
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Strength of Materials
(OLD)

[Time: Three Hours]

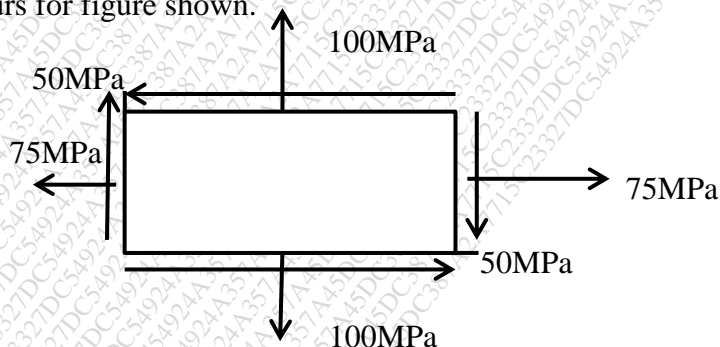
[Max.Marks: 80]

Please check whether you have got the right question paper.

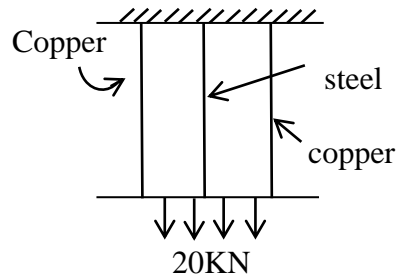
- N.B
1. Q.1 & Q.6 are compulsory. Attempt any two questions from remaining in each section.
 2. Assume suitable data if required & state it clearly.

Section A

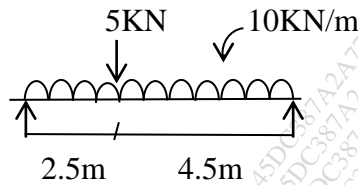
- Q.1 Attempt any five 10
- a) Enlist the properties of material, define any two.
 - b) Define modulus of rigidity.
 - c) Define linear stress & strain.
 - d) Define neutral axis.
 - e) Define SF & BM at a section.
 - f) Draw loading diagram for pure bending.
 - g) What is section modulus?
 - h) Explain principle stresses.
 - i) Enlist different types of beam. With sketch.
 - j) Write down shear stress formula state the terms.
- Q.2 a) Find the value of maximum shearing stresses & the direction of the planes on which they occurs for figure shown. 12



- b) Define major principal plane & stress. 03
- Q.3 Find the stresses in the wires of the system as shown in figure below. The cross sectional area of the wires is 60 mm^2 & the temperature of system rises by 20°
- $E_s = 210 \text{ GPa}$
 $\alpha_s = 12 \times 10^{-6} / ^\circ\text{C}$
 $E_c = 110 \text{ GPa}$
 $\alpha_c = 16 \times 10^{-6} / ^\circ\text{C}$



- Q.4 a) Derive the flexural formula for pure bending. 05
 b) Draw SFD & BMD. 10



- Q.5 a) Draw shear stress distribution diagram with τ_{max} & τ_{avg} . For circular, I section, T section & triangular section. 05
 b) Derive $q = \frac{S A \bar{y}}{I b}$ 07
 c) Derive relationship between shear force, bending moment & load intensity. 03

Section B

- Q.6 Attempt any five. 10
 a) State Lamé's theory.
 b) Differentiate in thin & thick cylinder.
 c) Define combined stresses.
 d) Write down torsional formula state the terms included.
 e) Define long column & short column.
 f) What is maximum value of eccentricity for a rectangular section for no tension condition? If bending is takes place @ Y axis
 g) Explain middle third rule.
 h) Define proof resilience & resilience
 i) What is slenderness ratio?
 j) What is radius of gyration?

- Q.7 a) Derive torsional formula. 08
 b) Derive the load carrying capacity formula of column by Euler's theory. 07

- Q.8 A shell 4 metres long 1 metre in diameter is subjected to an internal pressure of 2N/mm^2 . If thickness of shaft is 15mm. find maximum & minimum tensile stresses induced. Also find change in volume, change in length change in dimension. Change in area. Take $E = 200\text{ GPa}$ & $\mu = 0.33$ 15
- Q.9 a) Derive Rankine's formula for column load carrying capacity 08
- b) A hollow shaft is to have an outside diameter 'd' and an inside diameter $d/2$. Calculate the minimum value of d if it is to transmit 375kw at 105 rpm with working stress of 40 N/mm^2 . Determine the twist in length equal to 10 times the external diameter. Take $G = 80\text{ GPa}$ 07
- Q.10 Solve any three
- a) Determine the limiting value of eccentricity for no tension condition. 05
- b) Calculate strain energy stored in a bar 2m long, 50mm wide & 40mm thick. When it is subjected to gradual tensile load of 60KN. Take $E = 200\text{ GPa}$ 05
- c) Define column & axially loaded column 05
- d) Limitation of Euler's theory for mild steel 05

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-189
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Petrochemical Engineering
(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 from remaining in each section.
 - (3) Draw neat sketches wherever required.

Section A

- | | | |
|-----|--|----------|
| Q.1 | Solve any five | 10 |
| | <ol style="list-style-type: none"> (1) Unsaturation (2) Octane Number (3) H.F. Alkylation (4) LPG (5) BTX (6) Direct Pyrolysis | |
| Q.2 | <ol style="list-style-type: none"> (a) Write down various Basic raw material for petrochemical synthesis. (b) Describe origin, formation and composition of petroleum & Natural gas. | 08
07 |
| Q.3 | <ol style="list-style-type: none"> (a) Explain Isomerization technique to produce petrochemicals. (b) What are polymer of olefins & plastics. | 08
07 |
| Q.4 | Write down production process of following chemicals in Details | |
| | <ol style="list-style-type: none"> (a) Carbon-di-sulfide. (b) Ethanol. | 08
07 |
| Q.5 | Write Short Note | 15 |
| | <ol style="list-style-type: none"> (a) Propylene (b) Derivatives of higher paraffins. (c) Production process of Methyl ethyl ketons. | |

Section B

- | | | |
|-----|---|----|
| Q.6 | Solve any five | 10 |
| | <ol style="list-style-type: none"> (1) Naphthalene (2) Maleic anhydride (3) Thermoplastic polymer (4) Cross linked polymers (5) LNG (6) Neutralization. | |

- Q.7 Write down production process of following chemical in detail.
(a) Pthalic anhydride 08
(b) BHC 07
- Q.8 Write down manufacturing process of following chemical in detail.
(a) Polyethylene 08
(b) Explain preparation methods for polymers in detail. 07
- Q.9 (a) What are safety aspect in petrochemical industry 08
(b) Write down Energy crisis & Petrochemical industry. 07
- Q.10 Write short Note 15
(a) Hexamethylene diamine
(b) Pollution control Norms
(c) Homopolymerization

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-355
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Material Science & Technology
(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.
- 2) Solve any two from remaining in each section.
- 3) State clearly any assumptions made.
- 4) Draw neat sketches wherever required.

Section A

- | | | |
|-----|--|----|
| Q.1 | Explain the following | 10 |
| | (a) Space lattice | |
| | (b) Pauli Exclusion principle | |
| | (c) Ionic bond | |
| | (d) Thermal conductivity | |
| | (e) Anelasticity | |
| Q.2 | (a) Explain the Bragg law of X-ray diffraction. | 07 |
| | (b) What is metallic bonding? Explain with example. | 08 |
| Q.3 | (a) With neat diagram explain the powder method. | 07 |
| | (b) What is Schrodinger-wave equation? | 08 |
| Q.4 | (a) Describe covalent bonded structures and the properties of covalent solids. | 07 |
| | (b) Describe ionically bonded structures and the properties of ionic solids. | 08 |
| Q.5 | Write short notes on | 15 |
| | (a) Quantum states | |
| | (b) Crystals | |
| | (c) Elastic deformation | |

Section B

- | | | |
|-----|--------------------------|----|
| Q.6 | Explain the following | 10 |
| | (a) Ductile fracture | |
| | (b) Hysteresis | |
| | (c) Free Electron theory | |
| | (d) Superconductivity | |
| | (e) Eutectic point | |

- Q.7 Explain with a phase diagram transformation of steel to Austenite and Pearlite. 15
- Q.8 Define corrosion? How many types are there? Explain any two with neat diagram corrosion mechanism. 15
- Q.9 (a) What are the factors determining the choice of material. 07
(b) Explain the Griffith crack theory. 08
- Q.10 Write notes on 15
(a) Types of Superconductors
(b) Creep mechanism
(c) Soft magnets

Total No. of Printed Pages:02

SUBJECT CODE NO: H-403
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Physical Chemistry & Thermodynamics
(OLD)

[Time: Three Hours]

[Max.Marks:80]

- N.B Please check whether you have got the right question paper.
- i) Q.No.1 & Q.No.6 are compulsory.
 - ii) Solve any two questions from the remaining questions.
 - iii) Draw a well labelled diagram & Assume suitable data wherever necessary.

SECTION – A

- | | | |
|-----|--|----|
| Q.1 | Explain the following terms (<u>any five</u>) | 10 |
| | <ol style="list-style-type: none"> i) Photochemical Reactions ii) Foams iii) Viscosity iv) Conductivity v) Dipole moments vi) Heat of adsorption vii) Adsorption isobar | |
| Q.2 | a) Explain in detail verification of BET equation. | 07 |
| | b) Explain how molecular structure affects. Dipole moments. | 08 |
| Q.3 | a) Explain the term surface tension and parachor value and discuss in detail the determination of surface tension by liquid drop method. | 08 |
| | b) Explain in detail radiation chemistry and ionization by radiation. (with suitable examples). | 07 |
| Q.4 | a) Discuss in detail the various properties of colloidal systems in various fields with diagram. | 08 |
| | b) Discuss in detail Langmuir's theory of adsorption. Derive an expression of Langmuir's Unimolecular adsorption isotherm (with diagram). | 07 |
| Q.5 | Write short notes on | 15 |
| | <ol style="list-style-type: none"> a) Photochemical reaction for decomposition of Hydrogen Iodide. b) Viscosity & viscosity Index. c) Gells & its applications. | |

SECTION – B

- Q.6 Define the following: 10
- Enthalpy
 - Internal energy
 - Degree of freedom
 - Accentric factor
 - Third law of thermodynamics.
- Q.7 Heat is transferred to 10 Kg of air which is initially at 100 kPa & 300K until its temp reaches 600 K. Determine the change in internal energy, the change in enthalpy, the heat supplied & the work done in the following processes: 15
- Constant volume process
 - Constant pressure process
- Assume that air is an ideal gas for which the P-V-T relationship is $PV = nRT$ where n is the number of moles of the gas and R is the ideal constant $R = 8.314 \text{ KJ} / \text{Kmol} \cdot \text{K}$.
Take $C_p = 29.099 \text{ KJ/Kmol K}$, $C_v = 20.785 \text{ KJ/Kmol/K}$ molecular weight of air =29.
- Q.8 Calculate the volume of one mole liquid *n - octane* at 427.85 K and 0.215 MPa. The vander waals constants are $a = 3.789 \text{ m}^3/\text{mol}^2$, $b = 2.37 \times 10^{-4} \text{ m}^3/\text{mol}$. 15
- Q.9 a) What is a phase rule? Explain with a example. 07
- b) The block of 10 Kg of ice at 0°C is dumped in an insulated tank containing 100 Kg water at 30°C . Calculate the change in entropy of the mixture the entropy generated. The heat capacity of water is 4.23 KJ/kg K and the latent heat of melting of ice is 333.44 KJ/kg . 08
- Q.10 Write notes on: 15
- State functions
 - PVT behaviour
 - Heat engines

Total No. of Printed Pages:02

SUBJECT CODE NO: H-404
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Mechanical Operation
(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 questions from remaining of each section.
- 3) Draw well labelled diagram if necessary.

SECTION – A

- Q.1 Answer the following:
- a) Define Mesh number 02
 - b) Define bulk density 03
 - c) What is a paramagnetic material. 03
 - d) Define reverse osmosis 02
- Q.2
- a) What is working principle of electrostatic separation processes? Draw a neat sketch. 07
 - b) What is a cyclone separator? How it works? What are its industrial application? 08
- Q.3 Explain the following: 15
- a) Cone classifiers
 - b) Rake classifier
- Q.4 Differentiate between 15
- a) Pressure filtration and vacuum filtration.
 - b) Agitator and impellers
 - c) Hindered and free settling
- Q.5 Write short notes: 15
- a) Filter Media properties
 - b) Jigging
 - c) Ribbon blender

SECTION – B

- Q.6 Answer the following:
- State kicks law? 02
 - What are the principles of size reduction. 03
 - What is closed circuit grinding 03
 - Define work index. 02
- Q.7
- Derive the mathematical expression for calculating overall effectiveness of screen. 08
 - What are various motions used in screening. Draw neat diagram. 07
- Q.8
- How are solids stored? Draw neat sketches and explain. 08
 - What are the problems associated with handling of solids. 07
- Q.9 Explain the construction, working and sketch of
- Screw conveyor 15
 - Ball Mill
- Q.10 Write notes on: 15
- Toothed roll crusher
 - Belt conveyor
 - Importance of angle of repose

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-441
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Chemical Process Calculations
(OLD)

[Time: Three Hours]

[Max.Marks:80]

Please check whether you have got the right question paper.

- N.B
- i. Q.No.1 from section A and Q.No.6 from section B are compulsory.
 - ii. Attempt any two questions from the remaining questions in each section.
 - iii. Assume suitable data if required.

Section A

- Q.1 Answer the following:(any five) 10
- a) molarity
 - b) Recycling operation
 - c) Distillation
 - d) Latent heat of vaporization
 - e) Excess reactant
 - f) Limiting reactant
- Q.2 In a process of manufacturing of chlorine a dry mixture of HCL gas and air is passed over heated catalyst. Acid is used 30% excess of that theoretical requirement. Calculate weight of air supplied per kg of acid. Air contains 23.2% O_2 by wt. 15
- Q.3 Ethylene oxide is produced by oxidation of ethylene 101 kmol of ethylene are fed to a reactor and the product is found to contain 81 kmol ethylene oxide and 10 kmol CO_2 calculate : 15
- a) % conversion of ethylene
 - b) % yield of ethylene oxide.
- Q.4 a) An aqueous solution of acetic acid of 35% concentration by weight has density of 1.04kg/wt.08 at 25°C Find the molarity, normality & molality. 07
- b) Write a note on van der Waal's equation of state & how to calculate it's constant.
- Q.5 Write note on: 15
- a) General steps require for material balance with chemical reaction.
 - b) Explain the absorption operation.
 - c) Explain the drying operation.

Section B

Q.6 answer the following:(any five)

10

- 1) Heat of formation.
- 2) Why excess air is supplied for burning fuel.
- 3) Close system.
- 4) Standard heat of reaction.
- 5) Net calorific value of fuel.
- 6) Use of enthalpy –concentration chart.

Q.7 a) Crude analysis found to contain 87% carbon 12.5% H_2 & 0.5% sulphur by wt. calculates the net calorific value of crude oil at 298 K $GCV = 45071 \text{ KJ/kg}$. Latent heat of water vap. at 298 k is 2442 KJ/kg
 b) Explain drying mass balancing.

05

Q.8 a) Calculate the standard heat of formation of n-propanol liquid using following data :
 Standard heat of formation of CO_2 gas is -393.51 KJ/mol
 Standard heat of formation of H_2O liquid is -285.83KJ/mol
 Standard heat of combustion of n-propanol is- 2028.19 KJ/mol

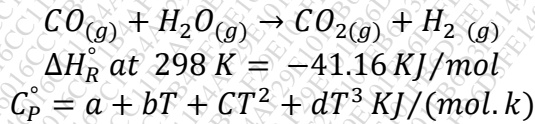
08

b) Explain Hess law of heat summation.

07

Q.9 Obtain an empirical equation for heat of reaction of any temperature T(K) for the following reaction

15



Component	a	$b \times 10^3$	$c \times 10^6$	$d \times 10^9$
H_2	28.6105	1.0194	-0.1476	0.769
CO_2	21.3655	64.2841	-41.0506	9.7999
H_2O	32.4931	0.0796	13.3107	-4.5474
CO	29.0277	-2.8165	11.6437	-4.7063

Q.10 Write note on :

15

- a) Relationship between CP & CV of ideal gas.
- b) Explain the extraction & leaching.
- c) Explain psychometric chart.

Total No. of Printed Pages:3

SUBJECT CODE NO:- H-442
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Chemical Process Calculations
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i. Q.No.1 from section A and Q.No.6 from section B are compulsory.
 - ii. Attempt any two questions from the remaining questions in each section.
 - iii. Assume suitable data if required.

Section A

- Q.1 Solve any five: 10
- 1) Define with example:
 - i) Atomic weight.
 - ii) Molecular weight.
 - 2) Define :
 - i) Molarity.
 - ii) Molality.
 - 3) Define:
 - i) Boyle's law.
 - ii) Charles's law.
 - 4) Explain density of gas mixture.
 - 5) Explain the material balance of distillation.
 - 6) Explain material balance of absorption.
- Q.2
- a) A mixture of phenol & water forms two separate liquid phases. One rich in phenol & other rich in water composition of layer is 70% & 9% by weight phenol respectively. If 500 kg of phenol & 700kg water are mixed & layers allowed to separate what will be weight of each layer. 07
 - b) 2000kg of wet solids containing 70% solids by wt. are fed to tray dryer where it is dried by hot air. The product finally obtained is found to contain 01% moisture by wt. calculate- 08
 - i) Kg of water removed from wet solid.
 - ii) Kg of product obtained.
- Q.3 15
- The producer gas made from the coke has the following composition by volume.
 $CO = 28\%$, $CO_2 = 3.5\%$, $O_2 = 0.5\%$, $N_2 = 68\%$
 The gas is burned with such quantity of air that the oxygen from air is 20% excess of net oxygen required for complete combustion. It the combustion is 98% complete. Calculate the weight of gaseous product formed per 100 kg of gas burned.

Q.4 Water gas is produced by passing steam over a hot bed of coke at 1273k 15
 $C + H_2O \rightarrow CO + H_2$
 $CO + H_2O \rightarrow CO_2 + H_2O$

calculate the consumption of coke and steam for the production of $1000m^3$ (NTP) of water gas containing 55.4% H_2 , 44% CO & 0.6% CO_2 by volume .coke contains 90% C by weight & yield is 90%

Q.5 4500 kg/hr of the solution containing 33.3% K_2CrO_4 by weight is joined by a recycle stream 15
 containing 36.36% K_2CrO_4 and the combined stream is fed to the evaporator. The concentrated stream that leaves the evaporators containing 49.4% K_2CrO_4 this stream is fed into a crystallizer in which it is cooled & then filtered. The filter cake consist of K_2CrO_4 crystals and a solution that contains 36.36% K_2CrO_4 by wt. The crystal account for 95% of total weight of filter cake the solution that passes through the filters also 36.36% K_2CrO_4 is the recycle stream
 Calculate the weight of water removed in evaporator the rate of production of crystalline K_2CrO_4 the ratio and the feed rate that the evaporator & crystallizer must be designed to handle.

Section B

Q.6 Solve any five 10
 1) Define
 a) Heat.
 b) Work.
 2) Explain mean molal heat capacities of gases.
 3) Heat of reaction.
 4) Adiabatic flame temperature.
 5) Latent heat of vaporization.
 6) Absolute saturation.

Q.7 The gas having the following composition is at temp of 775K 15
 $SO_2 = 7.09\%$, $O_2 = 10.55\%$, $SO_3 = 0.45\%$, $N_2 = 81.91\%$
 Calculate the neat content of 1Kmol gas mixture over 298K using the heat capacity data given below.

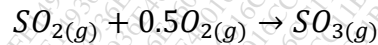
$$C_p^\circ = a + bT + cT^2 + dT^3 \text{ KJ}/(\text{kmol} \cdot \text{k})$$

Gas	a	$b \times 10^3$	$c \times 10^6$	$d \times 10^9$
SO_2	24.7706	62.9481	-44.2582	11.22
O_2	26.0257	11.7551	-2.3426	-0.5623
N_2	29.5909	-5.141	13.1829	-4.968
SO_3	22.0376	121.624	-91.8673	24.3691

Q.8 A mixture of benzene vapor and nitrogen gas at 297K and 100Kpa has a relative humidity of 60% 15
 it is desire to recover 80% of benzene by cooling a mixture to 283K and compressing to a suitable
 pressure. Find out the pressure required for above duty.
 Vap. pressure of benzene at 297K = 12.2Kpa
 Vap. Pressure of benzene at 283K =6Kpa

Q.9 The purge gas obtained from ammonia synthesis loop has the following molar composition 15
 $H_2 = 69\%$, $N_2 = 23\%$, $Ar = 2.7\%$ & $CH_4 = 5.3\%$
 It is burnt with 20% excess air. Calculate the theoretical air required and molar composition of the
 dry flue gases.

Q.10 obtain the empirical expression relating the heat of reaction and temperature of the reaction for the 15
 following reaction



Calculate the heat of reaction at 773K

$$SO_3, \Delta H_f^\circ = -395720$$

$$SO_2, \Delta H_f^\circ = -296810$$

$$C_p^\circ = a + bT + cT^2 + dT^3 \text{ KJ}/(\text{kmol} \cdot \text{k})$$

Component	a	$b \times 10^3$	$c \times 10^6$	$d \times 10^9$
SO_3	22.036	121.624	-91.867	24.369
SO_2	24.771	62.948	-44.258	11.122
O_2	26.026	11.755	-2.343	-0.562

Total No. of Printed Pages:2

SUBJECT CODE NO: H-412
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Industrial Safety and Management
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i) Q.No.1 and Q.No.6 are compulsory.
 - ii) Answer any two questions from the remaining in each section

Section A

- Q.1 Explain the following
- a) Workmen compensation act 03
 - b) Auto ignition 02
 - c) Flammability limits 03
 - d) Fault tree 02
- Q.2 Explain the clause of factories rule about safety measures for pressure plant and vessel operated under pressure over atmospheric pressure 15
- Q.3 What is a PPE? What is its need? With neat sketch explain different PPE for different operation 15
- Q.4 Describe the following 15
- a) HAZOP
 - b) Risk assessment
- Q.5 Write notes on: 15
- a) Safety review
 - b) Fire triangle
 - c) SMPV Rules

Section B

- Q.6 Explain the following
- a) Maslow theory 03
 - b) Resource flexibility 04
 - c) Capital intensity 03
- Q.7 What are contribution of Elton mayo and skinner to behavioral sciences? 15

- Q.8 a) What are procedure and methods of job evaluation and merit rating 07
b) Explain goal oriented behavior 08
- Q.9 Define process management? What are various process decisions? Explain any two. 15
- Q.10 Write notes on 15
 - a) Organizational goals
 - b) Understanding past behavior
 - c) Process improvement

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-335
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Fluid Mechanics
(REVISED)

[Time: Three Hours]

[Max. Marks: 80]

- N.B Please check whether you have got the right question paper.
- 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
a) Fluid
b) Viscosity
c) The shear stress field
d) Momentum
e) Pressure | 10 |
| Q.2 | a) A plate, 0.025 mm distant from a fixed plate, moves at 50 cm/s and requires a force of 1.471 N/m ² to maintain this speed. Determine the fluid viscosity between plates in the poise.

b) What is effect of temperature and pressure on viscosity of gases and liquid? | 07

08 |
| Q.3 | A horizontal cylindrical continuous decanter is to separate 9.93m ³ /h of liquid petroleum fraction from an equal volume of wash acid. The oil is the continuous phase and at operating temperature has a viscosity of 1.1 cP and density of 865 kg/m ³ . The density of acid is 1153 kg/m ³ . compute
a) the size of vessel and b) the height of overflow above the vessel floor. | 15 |
| Q.4 | a) State and explain hydrostatic law

b) Derive an expression for hydrostatic equilibrium in a centrifugal field. | 07

08 |
| Q.5 | Write short note on:
a) Application of basic equations of fluid flow
b) Boundary layer formation in straight pipes
c) Ideal gas equation. | 05

05

05 |

Section B

- Q.6 Explain the following terms. 10
- a) Streamline
 - b) Local velocity
 - c) Mach Number
 - d) Stream tube
 - e) Uniform flow
- Q.7 a) Derive the expression for velocity variation for a laminar incompressible flow in a circular pipe. 10
- b) What is orifice meter? Derive an expression for discharge through a orifice meter 05
- Q.8 a) With neat sketch explain construction and working of centrifugal pump. 08
- b) Starting from fundamental s derive Ergun’s equation. 07
- Q.9 a) With the help of sketch explain pitot tube. 07
- b) What is terminal velocity? How is it determined? 08
- Q.10 Write short note on
- a) Boundary layer separation 05
 - b) Fluidization 05
 - c) Pipeline in series and parallel flow. 05

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-344
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Process Equipment Design & Drawing- II
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

N.B

Please check whether you have got the right question paper.

- 1) Solve any one questions from Section A.
- 2) Solve any two question from Section B.
- 3) Steam table & heat & mass transfer data book allowed.

Section A

Q.1 Design 1-2 pass shell & tube heat exchanger to sub cool condensate from methanol condenser 40 from 95°C to 40°C flow rate of methanol $10 \times 10^4 \text{ kg/hr}$. Brakish water will be used as coolant with temp rise from 25°C to 40°C use tube.

OD=20 mm

ID=16mm

Length=4.88 mm

Effective length 4.83 m

Bundle dia clearance = 68mm

Heat capacity of methanol = 2.84 kJ/kg°C

Heat capacity of water = 4.2 kJ/kg°C

 $F_t=0.85$

Baffle spacing = 178 mm

Assume $U = 560 \text{ W/m}^2\text{°C}$

25 % cut baffle, triangular pitch = 1.25 do

$$Do = do \left(\frac{N_t}{K_1} \right)^{1/n_1}$$

$$K_1 = 0.249, n_1 = 2.207$$

For tube side water mass velocity = 749 kg/s.m^2 Density of water = 995 kg/m^3

$$hi = \frac{4200 (1.35 + 0.02 t)}{d_i^{0.2}} u_t^{0.8}$$

$$\frac{h_i d_i}{K} = J_n \cdot Re \cdot Pr^{0.33} \left(\frac{\mu}{\mu_w} \right)^{0.14}$$

Viscosity of water = 0.8 mN.S/m^2 Thermal conductivity of moc = 0.59 W/m°C

$$J_n = 3.9 \times 10^{-3}$$

Shell side mass velocity = $868 \text{ kg/m}^2.S$

$$de = \frac{1.10}{do} (P_t^2 - 0.917 do^2)$$

Methanol: density = 750 kg/m^3 Viscosity = 0.34 mN.S/m^2 Heat capacity = 2.84 KJ/kg°C

Thermal conductivity = $0.19 \text{ W/m}^\circ\text{C}$

$$J_n = 3.3 \times 10^{-3}$$

For tube side

$$\Delta P_t = N_p \left[8 J_f \left(\frac{L}{d_i} \right) \left(\frac{\mu}{\mu W} \right)^{-0.14} 12.5 \right] \frac{\rho u_t^2}{2}$$

$$J_f = 4.3 \times 10^{-3}$$

For shell side

$$\Delta P_t = 8 J_f \left(\frac{D_s}{de} \right) \left(\frac{L}{lb} \right) \frac{\rho u_s^2}{2} \left(- \frac{\mu}{\mu W} \right)^{-0.14}$$

$$j_f = 4 \times 10^{-2}$$

- Q.2 It is define to concentrate $2 \times 10^4 \text{ kg/m}$ a chemical solution at 40°C & 10% solvent to product containing 50% solids steam is available at 200 kN/m^2 in last effect of triple effect evaporator with equal heat transfer surface is operated at 15 kN/m^2 pressure specific heat of all solution 4.18 kJ/kg k . Calculate steam consumption & heat transfer area in each effect. Overall heat transfer = 3.4, 1.4 & 0.71 kW/m^2 or in Ist , IInd & IIIrd effect respectively. Triangular pitch = 30 mm
OD tube = 20 mm
Thickness of tube = 2mm
Length of tube = 2.5 m 40

Section B

- Q.3 Explain the following in detail. (any four) 20
- 1) Piping size for gases & liquids
 - 2) Vessels with external coil jacket
 - 3) Design overhead pipeline
 - 4) Significance of fouling factor
 - 5) Type of baffles
- Q.4 Give detail design of 20
- i) Batch dryer
 - ii) Binary distillation column
- Q.5 Design steps of Double pipe heat exchanger with necessary equation & significance of these equations. 20

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-334
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Fluid Mechanics
(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 each section from remaining.
 3. Draw neat & labeled diagram wherever required.
 4. Make suitable assumptions if required

Section A

- | | | |
|-----|---|----------|
| Q.1 | Solve any five from the following | 10 |
| | <ol style="list-style-type: none"> a) Give one example of uniform flow and non-uniform flow. b) Give classification of manometers. c) Define potential flow. d) Explain the term stream line. e) What do you mean by buoyancy? f) What do you mean by Reynolds Numbers? g) What is Mech Number h) Define viscosity. | |
| Q.2 | <ol style="list-style-type: none"> a) Define discharge. State and explain continuity equation. b) The pressure intensity at a point in a fluid is given by 3.58N/cm^2. Find the corresponding height of fluid when fluid is <ol style="list-style-type: none"> a) Water b) Oil, specific gravity is 0.9 | 08
07 |
| Q.3 | <ol style="list-style-type: none"> a) Derive the equation for ideal gas. b) Derive an equation for angular momentum. | 08
07 |
| Q.4 | <ol style="list-style-type: none"> a) Explain the one dimensional flow by using Euler's equation. b) Explain the effect of temperature on viscosity of fluid. | 10
05 |
| Q.5 | Differentiate between. <ol style="list-style-type: none"> a) Newtonian and non- Newtonian fluids. b) Laminar and turbulent flow. c) Simple manometer and differential manometer. | 15 |

Section B

- Q.6 Answer any five 10
- Define form drag.
 - Define drag coefficients
 - Explain term Bubbling fluidization
 - Define pumps.
 - Define kinetic energy correction factor.
 - Define non-Newtonian fluid.
 - What is minimum fluidization velocity?
- Q.7 a) Starting from fundamentals derive the Ergun's equation. 08
b) Obtain the expression for the Blake Plummer equation. 07
- Q.8 A centrifugal fan is used to take flue gas at rest and at a pressure of 695mm. Hg and a temperature as 93.0°C and discharge it at a pressure 743mm. Hg and velocity of 42.7m/s. Calculate the power needed to move 16.990m³/h of gas using standard condition as 29.92in. Hg and 32°F. The efficiency of the fan is 65 percent and the molecular weight of the gas is 31.3. 15
- Q.9 a) Derive the equation for pressure by formula Hagen-Poiseuille. 08
b) Derive the equation for velocity distribution equation for turbulent flow in pipes. 07
- Q.10 Write notes on 15
- Friction factor chart
 - Working of venturimeter with neat sketch
 - Fluidization

Total No. of Printed Pages:2

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

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- 1) Q.No.1 and 6 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 the following terms. 10
- a) Activity of solution.
 - b) Fugacity.
 - c) Bubble point temperature.
 - d) Dew point temperature.
 - e) Enthalpy.
- Q.2 a) What are Maxwell's equation and their importance in establishing relationships between thermodynamics properties? 08
- b) What is the fundamental differential equation for Helmholtz free energy properties? List the canonical variable for A. 07
- Q.3 a) Give the classification of thermodynamics properties with example. 07
- b) Define Gibbs free energy, and show that at constant temperature and pressure the decrease in the Gibbs free energy measure the maximum net work available from a given change of state. 08
- Q.4 a) Calculate the fugacity of liquid water at 303K and 10bar if the saturation pressure at 303 K is 4.241 KPa and specific volume of liquid water at 303K is $1.004 \times 10^{-3} \text{ m}^3/\text{kg}$. 07
- b) Define fugacity and derive an equation for fugacity of pure gas using compressibility factor. 08
- Q.5 Write short note on. 15
- a) Gibbs free energy.
 - b) Excess properties.
 - c) Property change of mixing.

Section B

- Q.6 Explain following terms. 10
- Chemical potential.
 - Reaction coordinates.
 - Gibbs free energy.
 - Maxing boiling Azeotropes.
 - Minimum boiling Azeotropes.
- Q.7 a) The standard heat of formation and standard free energy of formation of ammonia at 298K are 46100J/mol and 16500J/mol respectively. Calculate equilibrium constant for the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$. At 500K assuming that standard heat of reaction is constant in the temperature rang 298 to 500 K. 10
- b) Define equilibrium constant K of a chemical reaction. How it is related to k_f and k_p ? 05
- Q.8 a) How would you state the criterion of equilibrium in terms of entropy, the work function and the Gibbs free energy? 08
- b) How do you calculate the constant pressure y-x data of binary mixture using an average value of relative volatility? 07
- Q.9 Write down the equation for solving a general VLE problem. How does this equation get simplified for 15
- Ideal gas phase, ideal liquid phase.
 - Low pressure equilibrium and
 - High Pressure equilibrium?
- Q.10 Write short note on 15
- UNIQUAC equation.
 - Reaction stoichiometry.
 - Duhem's theorem.

Total No. of Printed Pages:03

SUBJECT CODE NO:- H-369
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Engineering Chemistry
(OLD)

[Time: Three Hours]

[Max.Marks:80]

Please check whether you have got the right question paper.

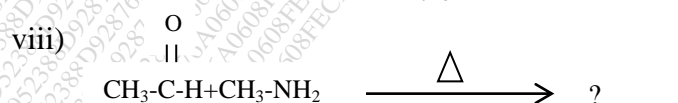
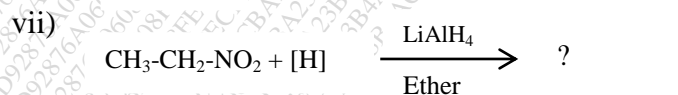
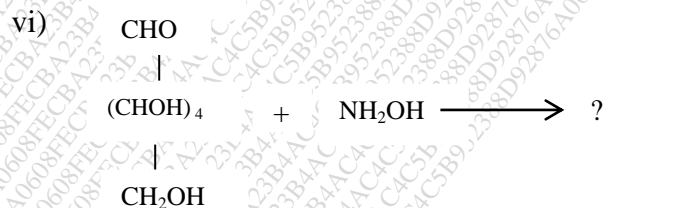
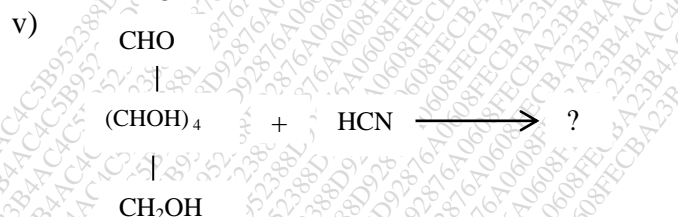
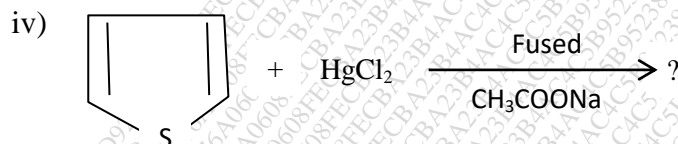
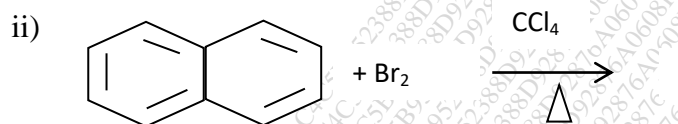
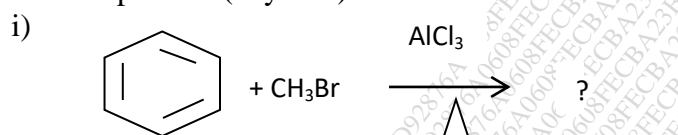
N.B

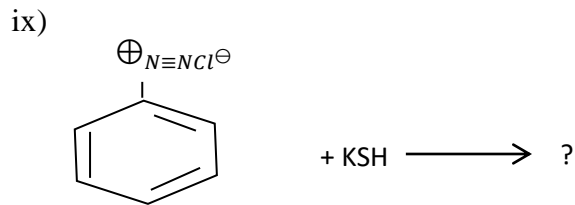
- i. Question number 01 and 06 are compulsory.
- ii. Solve any two questions from remaining each section.

Section A

Q.1 Predict the product (any five)

10

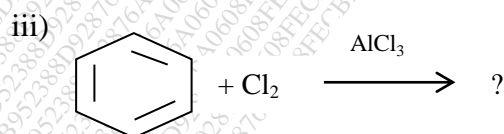
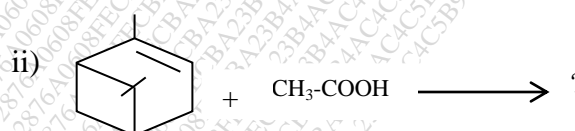
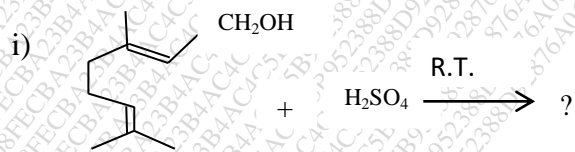


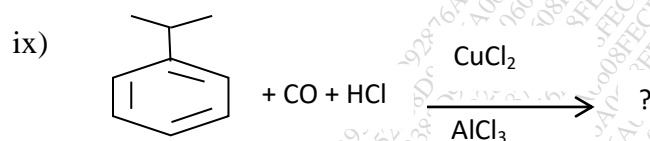
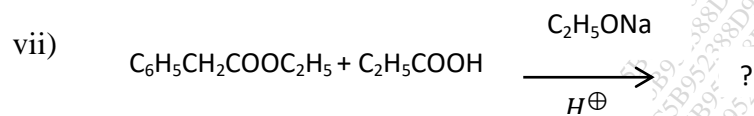
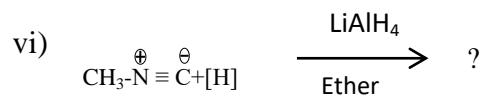
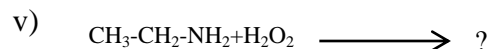


- Q.2
- How can you prepare furan from 1,4-dialdehyde and 1,4-diketone? Explain with mechanism. 06
 - Discuss any five chemical properties of benzene. 05
 - Write any four electrophilic substitution reactions of quinolone. 04
- Q.3
- How can you prepare glucose from sucrose? Explain general physical properties and uses of glucose. 06
 - How is alizarin is prepared in large scale? How would you fix it on cotton fibre? 05
 - Discuss the manufacturing of sucrose. 04
- Q.4
- How amines are separated from their mixtures using benzene sulphonyl chloride as an reagent? Explain in detail. 06
 - Discuss any five preparation methods of primary amines. 05
 - Give any four chemical properties of aniline. 04
- Q.5 Write a short note on (any three) 15
- Haworth synthesis of naphthalene
 - Chemical properties of pyridine
 - Applications of benzene diazonium chloride
 - Chemical properties of glucose
 - General chemical properties of amines

Section B

- Q.6 Predict the product (any five) 10





- Q.7 a) What is sulphonation reaction? Explain with mechanism sulphonation of benzene with concentrated sulphuric acid. 06
 b) Give any five uses of lithium aluminum hydride 05
 c) How BHC is made from benzene? Explain its uses. 04
- Q.8 a) What is claisen condensation? Explain with mechanism crossed claisen condensation between ethyl benzoate and ethyl acetate. 08
 b) How ketoximes are converted into N-substituted amines using Beckmann's rearrangement? Explain with mechanism. 07
- Q.9 a) How geraneol is isolated from palmrosa oil? Explain any four chemical properties of geraneol. 06
 b) Explain in brief isolation of terpenes using solvent extraction and fat adsorption methods. 05
 c) Give general physical properties and uses of α -pinene. 04
- Q.10 Write a short note on (any three) 15
 i) Use of hydrogen peroxide
 ii) Nitration of chlorobenzene
 iii) Pinacol-pinacolone rearrangement
 iv) Classification of terpenes
 v) DDT

Total No. of Printed Pages:2

SUBJECT CODE NO: H-481
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Elective-I: Biochemical Engineering
(REVISED)

[Time: Three Hours]

[Max.Marks:80]

Please check whether you have got the right question paper.

N.B

- 1) Q. No. 01 & Q. No.6 are compulsory.
- 2) Solve any two questions from remaining of each section.
- 3) Assume suitable data if required.

Section A

- | | | |
|-----|---|--------------|
| Q.1 | Write notes on
a) Transport across cell membranes
b) Enzyme deactivation | 10 |
| Q.2 | a) By lowering the activation energy for a reaction a catalyst makes it possible for substrate molecules with smaller internal energies to react. Explain how?

b) Explain the TCA cycle in details with utility and characteristics. | 07

08 |
| Q.3 | With examples discuss the methods of enzyme immobilization. | 15 |
| Q.4 | a) Differentiate between eukaryotic cells & prokaryotic cells.

b) Why is biomass sterilized? Explain the continuous sterilization technique. | 07

08 |
| Q.5 | With neat sketch explain the details of primary and secondary protein structure. | 15 |

Section B

- | | | |
|-----|--|----|
| Q.6 | Define the following:
1) Yield constant
2) Aseptic fermentation
3) Optimization
4) Log time
5) Catabolism | 10 |
|-----|--|----|

- Q.7 a) Give a complete analysis of cell CSTR with recycle and wall growth. 07
- b) With neat sketch explain in detail the secondary protein structure. 08
- Q.8 A feed reactor, a CSTR with recycle and a PFR are available for a biochemical process. Evaluate the performance of each type of the reactor and justify the same. 15
- Q.9 Explain the following
- a. Medium formulation 07
 - b. Product recovery trends 08
- Q.10 Explain the following 15
- a. Monod growth kinetics.
 - b. Sterilization reactors
 - c. Antibiotics

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-379
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Transport Phenomena
(REVISED)

[Time: Three Hours]

[Max.Marks:80]

Please check whether you have got the right question paper.

- N.B
- 1) Q. No.01 & Q. No.6 are compulsory.
 - 2) Solve any two questions from remaining of each section.
 - 3) Assume suitable data if required.

Section A

- | | | |
|-----|---|----------|
| Q.1 | Explain the following term
a) Isothermal system
b) Mechanism of momentum transport | 10 |
| Q.2 | (a) Define Newtonian and Non-Newtonian fluids. Explain different types of Non Newtonian fluids.
(b) Oil is flowing down a vertical wall as a film 1.7mm thick. The oil density is 820 kg/m^3 and the viscosity is 0.2 Pa s . Calculate the mass flow rate per unit width of wall needed and the Reynolds number. Also calculate the average velocity. | 07
08 |
| Q.3 | (a) Derive temperature profile for unsteady state heat conduction in solids.
(b) Pure water at 25°C is flowing down through a vertical wetted column at rate 0.124 kg/m.sec . Calculate the film thickness and average velocity, μ of water at $25^\circ\text{C} = \text{lcp}$ and $\rho = 10^3 \text{ kg/m}$. | 07
08 |
| Q.4 | (a) Derive time smoothed equation of continuity and motion and explain Reynold's stresses.
(b) A plastic panel of area $A = 929 \text{ cm}^2$ and thickness $Y = 0.64 \text{ cm}$ was found to conduct heat at a rate of 3 watts at steady state with temperature of $T_0 = 24^\circ\text{C}$ and $T_1 = 26^\circ\text{C}$ on the two mail surface. What is the thermal conductivity if the plastic at 25°C ? | 07
08 |
| Q.5 | (a) Calculate the steady state mass flux of helium at 500k, if a thin Pyrex plate of thickness 10 mm is brought in contact with helium. The partial pressure of helium is 1 atm at the bottom of plate and zero at the upper surface of the plate. The density of Pyrex is 2.6 g/cm^3 . The solubility and diffusion of helium in Pyrex is 0.0084 volumes of gaseous helium per volume of glass and $D_{AB} = 2 \times 10^{-7} \text{ cm}^2/\text{Sec}$. | 15 |

Section B

- Q.6 Explain the following terms 10
- Heat conduction through conduction wall
 - Newton's law of viscosity.
- Q.7 (a) Derive an equation for flow of a falling film. 07
- (b) Derive the equation for molecular theory of the viscosity of gases at low density as 08
- $$\mu = \frac{2}{3\pi} \frac{\sqrt{\pi m R T}}{\pi d^2}$$
- Q.8 (a) Compute the value of D_{AB} for mixture for Argon (A) and oxygen (B) at 293.2 K and 1 atm 15
- total pressure $\Omega_{DAB} = 1.003$
- Data: Argon (A) $M_A = 39.944$ $\sigma_A = 3.418 \text{ \AA}$ $\epsilon_{A/K} = 224\text{K}$
- Oxygen (B) $M_B = 32.00$ $\sigma_A = 3.433 \text{ \AA}$ $\epsilon_{A/K} = 113\text{K}$
- Q.9 (a) Derive an expression for Fick's law of binary diffusion. 07
- (b) The density of liquid CCl_4 , at 20°C and the isothermal compressibility is $90.7 \times 10^{-6} \text{ atm}^{-1}$. 08
- What is its thermal conductivity?
- Q.10 Write Short Notes on 15
- Momentum transport
 - Fick's Law
 - Porous Catalyst

Total No. of Printed Pages:2

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

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i) Q. No. 1 and Q. No.6 are compulsory
 - ii) Answer any two questions from remaining sections
 - iii) Assume relevant data where necessary

Section A

- Q.1
- a) Explain in detail Maxwell's law of diffusion 05
 - b) Explain concepts of theoretical stages and stage efficiency 05
- Q.2
- a) Explain two film theory and state its limitations 07
 - b) Prove that for equimolar counter diffusion, $DAB = DBA$. 08
- Q.3
- a) An insoluble crystalline solid wet with water is placed in a pan of size $0.7m \times 0.7m$ and 25 mm deep made up of 0.8 mm thick metal sheet. Air is flowing parallel at $65^\circ C$ with 3m/s humidity 0.01 kg water/kg dry air. Top surface of solid (assume at $38^\circ C$) is at a distance 100mm away from steam pipe heated at $120^\circ C$. Estimate rate of drying at a constant rate (Data: Emissivity = 0.94, humid volume of air $U_H = 0.972 m^3/kg$ dry air, humid heat of air $C_s = 1023 kJ/kg$, $\lambda_s = 2411.4 kJ/kg$). Assume relevant data where necessary with proper justification 08
 - b) Add detail construction and working of pneumatic dryer. Also write advantages of this dryer 07
- Q.4
- a) With the help of a neat diagram, explain construction & working of tunnel dryer 05
 - b) Oxygen is diffusing through carbon monoxide under steady state condition, with carbon monoxide non-diffusing. The total pressure is $100000 N/m^2$ and the temperature $0^\circ C$. The partial pressure of oxygen at two planes 2 mm apart is 13000 and $6500 N/m^2$ respectively. The diffusivity for the mixture is $1.87 \times 10^{-5} m^2/s$. Calculate the rate of diffusion of oxygen in kmol/sec through each square meter of the two planes 10
- Q.5 Write short notes
- a) Rate calculations in ion exchange 05
 - b) HETP calculation 05
 - c) Adsorption hysteresis 05

Section B

Q.6 Answer the following

- a) Define : HETP, HTU and NTU 02
- b) Name the adsorbents used in industry 02
- c) Explain the term wet bulb temperature 02
- d) The pore size of molecular sieve $5A^\circ$ is 02
- i) 5nm
- ii) 0.5nm
- iii) 0.05nm
- iv) 0.05m
- e) Separation of a binary mixture of gases by absorption in liquid solvent depends upon their different in 02
- i) Density
- ii) Viscosity
- iii) Solubility
- iv) Kinematic viscosity

- Q.7 a) Add detail construction and working of pneumatic dryer. Also write advantages of this dryer 08
- b) Explain the idealized break through curve of adsorption 07

- Q.8 a) Compare natural and forced draft cooling tower 05
- b) Describe Langmuir and BET adsorption isotherm 10

- Q.9 a) Gas from petroleum distillation column has a concentration of H_2S reduced from 0.03 (Kmol H_2S /kmol of inert hydrocarbon gas) to 1% of this value by scrubbing with tri. Ethanol amine water solvent in a counter current tower, operating at 300K & atmospheric pressure. The equilibrium relation for the solution may be taken as $y=2x$. The solvent enters the tower free of H_2S and leaves containing 0.013 kmol of H_2S /kmol of solvent if the flow of inert gas is 0.015 kmol/s. m^2 of tower cross section. Calculate a) height of coefficient b) NTU required. The overall coefficient of absorption KG_{11} may be taken as 0.04 kmol/s. m^3 (unit mole fraction driving force) 10

- b) Explain absorption factor 05

Q.10 Write short note

- a) Unsaturated surface drying 05
- b) Use of solvents for absorption 05
- c) Humidification equipment's 05

Total No. of Printed Pages:2

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

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i) Q. No. 1 and Q. No.6 are compulsory
 - ii) Answer any two questions from remaining sections
 - iii) Assume relevant data where necessary

Section A

- Q.1
- a) Explain in detail Maxwell's law of diffusion 05
 - b) Explain concepts of theoretical stages and stage efficiency 05
- Q.2
- a) Explain two film theory and state its limitations 07
 - b) Prove that for equimolar counter diffusion, $DAB = DBA$. 08
- Q.3
- a) An insoluble crystalline solid wet with water is placed in a pan of size $0.7m \times 0.7m$ and 25 mm deep made up of 0.8 mm thick metal sheet. Air is flowing parallel at $65^\circ C$ with 3m/s humidity 0.01 kg water/kg dry air. Top surface of solid (assume at $38^\circ C$) is at a distance 100mm away from steam pipe heated at $120^\circ C$. Estimate rate of drying at a constant rate (Data: Emissivity = 0.94, humid volume of air $U_H = 0.972 m^3/kg$ dry air, humid heat of air $C_s = 1023 kJ/kg$, $\lambda_s = 2411.4 kJ/kg$). Assume relevant data where necessary with proper justification 08
 - b) Add detail construction and working of pneumatic dryer. Also write advantages of this dryer 07
- Q.4
- a) With the help of a neat diagram, explain construction & working of tunnel dryer 05
 - b) Oxygen is diffusing through carbon monoxide under steady state condition, with carbon monoxide non-diffusing. The total pressure is $100000 N/m^2$ and the temperature $0^\circ C$. The partial pressure of oxygen at two planes 2 mm apart is 13000 and $6500 N/m^2$ respectively. The diffusivity for the mixture is $1.87 \times 10^{-5} m^2/s$. Calculate the rate of diffusion of oxygen in kmol/sec through each square meter of the two planes 10
- Q.5 Write short notes
- a) Rate calculations in ion exchange 05
 - b) HETP calculation 05
 - c) Adsorption hysteresis 05

Section B

Q.6 Answer the following

- a) Define : HETP, HTU and NTU 02
- b) Name the adsorbents used in industry 02
- c) Explain the term wet bulb temperature 02
- d) The pore size of molecular sieve $5A^\circ$ is 02
- i) 5nm
- ii) 0.5nm
- iii) 0.05nm
- iv) 0.05m
- e) Separation of a binary mixture of gases by absorption in liquid solvent depends upon their different in 02
- i) Density
- ii) Viscosity
- iii) Solubility
- iv) Kinematic viscosity

- Q.7 a) Add detail construction and working of pneumatic dryer. Also write advantages of this dryer 08
- b) Explain the idealized break through curve of adsorption 07

- Q.8 a) Compare natural and forced draft cooling tower 05
- b) Describe Langmuir and BET adsorption isotherm 10

- Q.9 a) Gas from petroleum distillation column has a concentration of H_2S reduced from 0.03 (Kmol H_2S /kmol of inert hydrocarbon gas) to 1% of this value by scrubbing with tri. Ethanol amine water solvent in a counter current tower, operating at 300K & atmospheric pressure. The equilibrium relation for the solution may be taken as $y=2x$. The solvent enters the tower free of H_2S and leaves containing 0.013 kmol of H_2S /kmol of solvent if the flow of inert gas is 0.015 kmol/s. m^2 of tower cross section. Calculate a) height of coefficient b) NTU required. The overall coefficient of absorption KG_{11} may be taken as 0.04 kmol/s. m^3 (unit mole fraction driving force) 10
- b) Explain absorption factor 05

Q.10 Write short note

- a) Unsaturated surface drying 05
- b) Use of solvents for absorption 05
- c) Humidification equipment's 05

Total No. of Printed Pages:2

SUBJECT CODE NO: H-483
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Elective-I: Energy Engineering
(REVISED)

[Time: Three Hours]

[Max.Marks: 80]

Please check whether you have got the right question paper.

- N.B
- i) Q. No. 1 & Q. No. 6 are compulsory
 - ii) Solve any two form remaining in each section
 - iii) Draw neat sketches whenever required

Section A

- Q.1 Solve any five 10
- 1) Renewable energy
 - 2) Cogeneration
 - 3) Solar collectors
 - 4) Biogas composition
 - 5) Wave energy
 - 6) Centralized pattern
- Q.2 07
- a) Compare conventional vs. non-conventional energy sources
 - b) Write down note on energy resources of India & its current status. 08
- Q.3 08
- a) Explain solar energy storage & its utilization
 - b) What are scope of wind power generation in India 07
- Q.4 08
- a) Explain design & construction of Biogas plants
 - b) Describe tidal phenomenon & generation of power from ocean 07
- Q.5 Write short note 15
- a) Nuclear energy
 - b) Energy efficiency indices
 - c) Solar dryers

Section B

- Q.6 Solve any five 10
- 1) Bottoming cycle
 - 2) Neat heat to process
 - 3) Energy survey
 - 4) Water audit
 - 5) Steam trap
 - 6) DSM

- Q.7 a) Write down construction & working of recuperator with neat sketch 08
b) Explain analysis of energy recovery systems 07
- Q.8 a) Explain energy conservation in pulp & paper industry 08
b) Describe efficient steam generation 07
- Q.9 a) Explain reduction in losses & improvements in operation 08
b) Describe matching energy use to requirement 07
- Q.10 Write short note 15
 - a) Waste heat Boilers
 - b) Heat exchanger network analysis
 - c) Importance of energy audit

Total No. of Printed Pages:2

SUBJECT CODE NO: H-482
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Chemical)
Elective-I: Industrial Piping
(REVISED)

[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.
 - 2) Solve any two questions from remaining question in each section.
 - 3) Assume suitable data & draw neat sketches wherever required.

Section A

- | | | |
|-----|--|----|
| Q.1 | Solve <u>any five</u> . | 10 |
| | <ol style="list-style-type: none"> a) Tubing b) NPSH c) Bleed d) Cathode protection e) Steam traps f) Standard symbols | |
| Q.2 | a) What is importance of piping in chemical industry? | 08 |
| | b) What are the different pipe codes used in the industry? | 07 |
| Q.3 | a) Explain pressure drop for Newtonian & non – Newtonian fluids | 08 |
| | b) What are types of pressure relieving devices? Explain in detail. | 07 |
| Q.4 | a) What are types of vibrations & explain their prevention & control. | 08 |
| | b) Write down various methods of protection of pipe. | 07 |
| Q.5 | Write short note | 15 |
| | <ol style="list-style-type: none"> a) Distinguish between pipe & tube b) Equivalent length c) Piping diagram. | |

Section B

- Q.6 Solve any five 10
- ISO thermal flow
 - Homogenous slurries
 - Piping for pumps
 - Insulation
 - Pipeline storage capacity
 - Hydrocarbons
- Q.7 a) Explain piping for heat exchanger piping & reactor piping. 08
- b) Write down correlations for flow of oil, gasoline & hydrocarbons. 07
- Q.8 a) Explain critical thickness of insulation. 08
- b) What is role of heat transfer in selecting insulation? 07
- Q.9 Write short note 15
- Cold & Hot insulation
 - Natural gas
 - Slurry rheology
- Q.10 A pipe line of 0.6m diam. is 1.5km long to increase the discharge another line of the same diameter is introduced parallel to the first in second half of the length. Neglecting minor losses. Find the increase in discharge if $4f = 0.04$. The heat at in let is 300mm. 15

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-178
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Physical Chemistry & Thermodynamics
(REVISED)

[Time: Three Hours]

[Max.Marks:80]

Please check whether you have got the right question paper.

- N.B
1. Q.No.1 and 6 are compulsory.
 2. Solve any two questions from remaining questions from each section.
 3. Draw a well labeled diagram wherever necessary.

Section A

- | | | |
|-----|---|----------|
| Q.1 | Solve the following (any five) | 10 |
| | <ol style="list-style-type: none"> i) Electrode ii) Absorption iii) Quantum yield iv) Crystalloids v) Emulsions vi) Electrolytic conduction vii) Define Photochemistry | |
| Q.2 | <ol style="list-style-type: none"> a) Explain BET theory of multimolecular adsorption in detail. b) Explain Langmuir's unimolecular adsorption. | 08
07 |
| Q.3 | <ol style="list-style-type: none"> a) Define & explain Debye Huckel Theory of strong electrolytes by explaining electrophoretic & relaxation effect. b) Explain:- <ol style="list-style-type: none"> i) Viscosity ii) Viscosity index iii) Refractive index | 08
07 |
| Q.4 | <ol style="list-style-type: none"> a) Explain in detail with the help of Diagram. Lambertz law & Beer's law of photochemistry. b) Explain photochemical equilibrium reaction with example (any one) | 08
07 |
| Q.5 | Write short note <ol style="list-style-type: none"> a) Quantum efficiency / yields b) Some photochemical reactions along with primary process & secondary process. c) Colligative property of colloids | 15 |

Section B

- Q.6 Solve the following (any five) 10
- State second law of thermodynamics
 - Ideal gas
 - Phase rule
 - Specific heat
 - Entropy
 - Irreversibility
 - Define thermodynamics
- Q.7 a) Determine the values of C_p and C_v in units of J/ (kg/k) for Helium provided $\gamma = 2.21$ and average molecular weight of air to be 4.002. 07
- b) Derive mathematical expression for first law of thermodynamics 08
- Q.8 a) Calculate Enthalpy change methane, when one k. mol of it is heated from 300K to 450K. 08
for this temperature range C_p^{ig} is given by $C_p^{ig} = R(a + bT + cT^2)$, where
 $a = 1.402, b = 9.081 \times 10^{-3}$ & $c = -2.184 \times 10^{-6}$
- b) With neat sketch explain the working of flow calorimeter. 07
- Q.9 a) State & explain and derive mathematical expression for third law of thermodynamics. 08
- b) Explain the concept of reversible & irreversible process with example. 07
- Q.10 Write short note 15
- Expression for calculation of work done in adiabatic process
 - Discuss in detail thermodynamic state function & path function
 - What do you mean by steady state & equilibrium condition?

Total No. of Printed Pages:02

SUBJECT CODE NO: H-370
FACULTY OF SCIENCE AND TECHNOLOGY
S.E. (Chemical)
Process Instrumentation & Analytical Tech.
(REVISED)

[Time: Three Hours]

[Max.Marks:80]

Please check whether you have got the right question paper.

N.B

- 1) Q. No.01 & Q. No. 06 are compulsory
- 2) Solve any two questions from remaining of each section.
- 3) Wherever necessary draw the neat sketch

SECTION – A

- Q.1 Explain the following terms (Any Five) 10
- 1) Static error
 - 2) Vena contracta
 - 3) Dynamic error
 - 4) Recording type instrument
 - 5) Bourdon tube
 - 6) Area meter
- Q.2 a) Explain the principle of industrial thermocouples with it working and industrial application. 07
- b) Explain the dynamic characteristic of the instruments. 08
- Q.3 a) Explain the bimetallic thermometer with neat figure and industrial applications. 07
- b) Explain inclined leg manometer with its principle, construction and working. 08
- Q.4 a) Describe the principle and working of the ultra-sonic level measurement. 07
- b) Describe the principle, construction and working of the Bellows pressure gauge. 08
- Q.5 Write short notes on
- a) Bubbler system for level measurement 07
 - b) Liquid filled thermometer 08

SECTION – B

- Q.6 Explain the following terms. 10
- 1) Galvanometer
 - 2) Transmittance
 - 3) Monochromator
 - 4) Column length
 - 5) TLC Plate
- Q.7 a) Explain the principle and construction of Infrared spectroscopy. 07
- b) Explain in detail the instrumentation of Flame photometry. 08
- Q.8 a) Explain the procedure used for the Amperometric titrations. 07
- b) Explain the stapes and instrumentation of the Coulometric titrations. 08
- Q.9 a) Describe the principle and construction of the gas chromatography. 07
- b) Explain the various applications of Infrared spectroscopy. 08
- Q.10 a) Explain the various applications of Colorimetric titrations. 07
- b) Explain the factors affecting on separation process of chromatography. 08

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-547
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Material Science And Technology
(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 questions from remaining questions in each section.
3. Assume suitable data if required.
4. Draw neat sketches wherever required.

Section A

- | | | |
|-----|---|----------------|
| Q.1 | Explain the following: | 10 |
| | a) Geometry of cry stab | |
| | b) Electron negativity | |
| | c) Electronegativity | |
| | d) Ionization potential | |
| | e) F.C.C structure | |
| Q.2 | What are various types of materials used for construction of equipment in a chemical industry?
Explain in detail any two. | 15 |
| Q.3 | a) Explain Bragg's law of X-ray diffraction?
b) Describe the crystal powder method with neat sketch. | 07
08 |
| Q.4 | a) Differentiate between covalent bonds and metallic bonds.
b) Differentiate between metals and alloys.
c) Differentiate between atom and electron. | 05
05
05 |
| Q.5 | Write notes on:
a) Dipole bonding
b) Quantum states
c) Periodic table | 15 |

Section B

- | | | |
|-----|---|----|
| Q.6 | Explain the following terms:
a) Hysterisis
b) Eutectoid mixture
c) Pauli's exclusion rule
d) Relative permeability
e) Flux density | 10 |
|-----|---|----|

- Q.7 Explain the phase transformation with a binary phase diagram of Fe and Fe₃C. 15
- Q.8 a) What are different types of corrosion? Explain in detail any two. 10
b) What are the preventive measures used to reduce corrosion. 05
- Q.9 Explain any one type of nonmetal along with its properties and applications. 15
- Q.10 Write notes on: 15
 - a) Mechanism of fatigue failure
 - b) Super conductors
 - c) Electrical properties of material

Total No. of Printed Pages:02

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

[Time: Three Hours]

[Max.Marks:80]

N.B 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 |
| | <ol style="list-style-type: none"> 1) Diffusivity 2) Maxwell law of diffusion 3) Weeping 4) Regular packing's 5) Free moisture 6) Indirect driers | |
| Q.2 | a) Describe in detail cascade interphase mass transfer. | 08 |
| | b) Explain local two phase mass transfer. | 07 |
| Q.3 | a) Differentiate between truss tower & packed towers. | 07 |
| | b) With neat sketch write down working of Venturi scrubbers. | 08 |
| Q.4 | a) Calculate rate of diffusion of acetic acid A) Across a film of non-diffusing water
B) Solution 1mm thick at tic when conc. on opposite side of film are respt. 9 & 3% wt. acid. The diffusivity of acetic acid in solution is $0.95 \times 10^{-9} m^2/s$ Data-density of 9% sol ⁿ = 1012 kg/m ³ . Density of 3% sol ⁿ =1003.2 kg/m ³ | 10 |
| | b) Explain Drum Driers. | 05 |
| Q.5 | Write short note:- | 15 |
| | <ol style="list-style-type: none"> 1) Vapor diffusion 2) Mechanism of batch drying 3) Fick's law | |

Section B

- Q.6 Solve any five: 10
- 1) Tray efficiency
 - 2) Overall transfer unity
 - 3) Vander Waals adsorption
 - 4) Adsorbate
 - 5) Dew point
 - 6) Wet bulb temperature
- Q.7 a) What is absorption factor. 05
- b) Write down expression for material balance for counter current flow in gas absorption. 10
- Q.8 a) With neat sketch write down construction & working of pressure swing adsorption. 08
- b) Describe theories of adsorption & adsorption isotherms. 07
- Q.9 a) Moist air at 310 k has a wet bulb temperature of 300k. If the latent heat of vaporization of water at 300k is 2440 kJ/kg. Estimate the humidity of the air & % relative humidity. The total pressure is 105 kN/m² and vapor pressure of water vapour at 300k is 3.60 kN/m² & 6.33 kN/m² at 310 K. $(h/h_0 \varphi_A) = 1 \text{ kJ/kgk}$ 10
- b) Describe term the wet bulb temperature. 05
- Q.10 Write short note: 15
- 1) VLE & Enthalpy for pure substance.
 - 2) Rate calculation in ion exchange
 - 3) Absorption with chemical reaction.

Total No. of Printed Pages:2

SUBJECT CODE NO:- H-533
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Industrial Pollution And Control
(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
1) COD
2) Suspended solids
3) Stack sampling
4) Inversions
5) ESP
6) Solid traps. | 10 |
| Q.2 | a) Describe concept of waste water analysis in detail.
b) Write down environmental legislation Act. | 08
07 |
| Q.3 | a) Describe Meteorological aspects of Air pollutant dispersion
b) Write down sampling methods of Air pollutant. | 08
07 |
| Q.4 | Describe construction & working of following equipment.
i) Gravity settling chamber
ii) Cyclone separator | 15 |
| Q.5 | Write short
1) Topographical effects
2) Wet scrubbers
3) Plume behavior | 15 |

Section – B

- Q.6 Solve any five 10
- 1) TDS
 - 2) Alkalinity
 - 3) Radioactive substances
 - 4) Growth kinetics
 - 5) Waste stabilization ponds
 - 6) Steam stripping
- Q.7 a) State BOD analysis procedure. 08
- b) Write down various types of sources & effect of waste water. 07
- Q.8 a) Describe Advanced Biological systems of waste water treatment. 08
- b) Discuss in detail sludge treatment & disposal. 07
- Q.9 a) Write down process of phenol removal in detail 08
- b) Write down pollution control in petroleum refineries. 07
- Q.10 Write short note 15
- 1) Coagulation & filtration
 - 2) Electro dialysis
 - 3) TOC

Total No. of Printed Pages:02

SUBJECT CODE NO:- H-562
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Chemical)
Chemical Engineering Thermodynamics
(REVISED)

[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
- a) What is the standard state for fugacity for a real gas? 02
 - b) Write down Maxwell's equation and its significance. 04
 - c) Define chemical potential. What is its physical significance? 04
- Q.2
- a) Define free energy, and show that at constant temperature and pressure decrease in free energy measure the maximum network from given state of change. 08
 - b) Derive the fundamental differential equation for Helmholtz free energy properties? List the canonical variable for A. 07
- Q.3
- a) How would you obtain the Clapeyron equation from Maxwell's equation? 07
 - b) Mixture of n-heptane (A) and n-octane (B) are expected to behave ideally. The total pressure over the system is 101.3 kPa. Using vapor pressure data given below construct boiling point diagram. 08

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

- Q.4
- a) Calculate the fugacity of liquid water at 303 K and 10 bar if the saturation pressure at 303 K is 4.241 KPa and specific volume of liquid water at 303 K is $1.004 \times 10^{-3} m^3/kg$. 05
 - b) Discuss the Gibbs-Duhem equation and its various forms. 10
- Q.5 Write short note on 15
- a) Henrys law and dilute solutions
 - b) Determination of partial molar properties.
 - c) Property change of mixing

Section B

- Q.6 Explain the following terms. 10
- Tie line
 - Bubble point temperature
 - Dew point temperature
 - Azeotropes
 - Equilibrium constant
- Q.7 a) A gas mixture containing 3 mol CO₂, 5 mol H₂ and 1 mol water is undergoing the following reaction. 07
- $$CO_2 + 3 H_2 \rightarrow CH_3OH + H_2O$$
- $$CO_2 + H_2 \rightarrow CO + H_2O$$
- Develop expression for the mole fraction of the species in terms of extent of reaction.
- b) How would you predict the feasibility of reaction from the value of the standard state free energy change? Explain with example. 08
- Q.8 a) Write Van Laar Equation and Give its physical significance. 07
- b) How do you calculate the constant pressure y-x data of binary mixture using an average value of relative volatility? 08
- Q.9 Write down the equation for solving a general VLE problem. How does this equation get simplified for 15
- Ideal gas phase, ideal liquid phase
 - Low pressure equilibrium and
 - High pressure equilibrium?
- Q.10 Write short note on 15
- Criterion of stability
 - Factors affecting equilibrium constant
 - Margules equation

Code No: H – 540 – 2018

FACULTY OF SCIENCE & TECHNOLOGY
T.E. (Chemical) (Revised) (CGPA) Examination
DECEMBER – 2018

Chemical Reaction Engineering – I

Time: Three Hours

Max. Marks: 80

“Please check whether you have got the right the question paper”

- N.B. (i) Question No. 1 and 6 are compulsory.
(ii) Answer any two questions from remaining sections.
(iii) Assume relevant data wherever necessary.

Section A

- Q.1 Answer following terms 10
- Space time
 - Classification of reactions
 - Rate constant of reaction
 - Non-elementary reactions
 - Reaction mechanism
- Q.2 a. The pyrolysis of an ethane proceeds with an activation energy of about 300 KJ/mol. How much faster is the decomposition at 650°C than at 500°C? 8
- b. Give detail steps for searching for reaction mechanism 7
- Q.3 a. The rate constant of a zero order. Reaction is 0.2 mol/lit .hr. what will be the initial concentration of the reactant if after half an hour, its concentration is 0.05 mole/lit? 8
- b. Explain the temperature dependency term in rate equation using thermodynamics and collision theory 7
- Q.4 A constant volume batch reactor was operated at 100 °C. the following data were found at different internals of time for a gas: 15
- | | | | | | |
|-------------------------|-----|-----|-----|-----|-----|
| Time (min.) | 0 | 4 | 8 | 12 | 16 |
| Partial pressure (mmHg) | 760 | 475 | 320 | 240 | 150 |
- Using the above mentioned data find out reaction rate equation
- Q.5 Write notes on 15
- Variables affecting rate of reaction
 - Integral method of analysis
 - Reaction rates

Section - B

- Q.6 Explain 10
- Heterogeneous reactions. Give example
 - Selectivity
 - Space time and space velocity
 - Write Performance equation for a batch reactor with variable volume
 - Recycle reactor
- Q.7 Consider a gas phase reaction $2A \rightarrow R+2S$ with unknown kinetics. If for 90% conversion of A in a plug flow reactor, the space velocity of one per minute is needed. Find the corresponding space time and 15

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mean resistance time of a fluid in the reactor.

- | | | | |
|------|----|--|----|
| Q.8 | a. | Derive the performance equations of the steady state plug flow reactor. Also show neat graphical representation | 8 |
| | b. | Explain the effect of temperature on equilibrium conversion | 7 |
| Q.9 | | Explain different types of ideal reactors used for homogeneous reaction. Write Performance equation for each of them | 15 |
| Q.10 | | Write notes on | 15 |
| | a. | Optimum temperature progression | |
| | b. | Adiabatic operation in single reaction | |
| | c. | Steady state PFR | |