Chemical Engineering Question Bank

Saiket Chakraborty

1. Reynolds analogy correlations and its importance? What message does it convey and how does it relate mass, energy and momentum?
2. NS equations each term significance. Which term corresponds to friction factor?
3. What are different types of viscosity? (No, it's not dynamic and kinematic viscosity)
4. As a Zeroth order reaction is independent of concentration term and it takes infinite time for the completion, how will you control the reaction? What is the expression for its completion time?
5. How will you calculate the heat transfer resistance for three cylinders kept in series?
6. Which region has thicker boundary layer laminar or turbulent flow ? Why?
7. If you want to add a mass transfer term in the Navier Stokes equation, what should be that term?
8. Name some equilibrium and non equilibrium distillation process.
9. Drying a mass transfer process or a heat transfer process.Give suitable reason.
10. Heat transfer basic equation
11. Combination of conduction convection and radiation
12. PID CONTROLLER EQUATION & DIFFERENCES AND HOW WE MEASURE IN LAB
13. He gave two parallel reactions and it is cstr and isothermal. How do we get the final product? Like what parameters we need to change for getting the final product.
14. Diff between laminar and turbulent boundary layer.
15. What is eddy?
16. How does the NS equation change for turbulent flow?
17. Kolmogorov exp for eddy?
18. Stefan law for heat transfer?
19. Analogy between heat, mass and momentum . mathematically prove it?
20. Pressure gradient resembling terms in NS equation for mass and heat transfer?
21. How k is related to riv and IRR reaction
22. What is the genesis of all momentum analogies and their uses in transport.
23. How you will write the surface tension force in the NS equation and how it will look like.
24. Thermal conductivity in turbulent flow ?
25. Distillation is either mass transfer operation or heat and mass transfer both?
26. All the terms in the NS equation and their appearance in different different situations and differences between navier stoke and navier equation.
27. Energy equation in detail in heat transfer.

JK Basu

1. What is the difference between ideal and non ideal reactors?

2. What does residence time mean? Tell the expression and suggest an experimental method to determine the mean residence time?
3. Explain RTD curve (E curve)?
4. What are the different types of input ways of injecting a tracer? What is step input and pulse input?
5. What is Thiele Modulus? Tell the expression for first order reaction?
6. What is Dispersion number? Write the expression.
7. Define heat transfer coefficient.
8. Explain boiling phenomena, explain its different regimes and draw the curve.
9. Gave a reaction A + 2B ---> 3C and told me to calculate epsilon for A for the reaction. The mixture consists of 25% Nitrogen and 75% A.
10. What is the effectiveness factor?
11. Write Damkohlar no for 1st and 2nd order.
12. How to find equilibrium constant?
13. Difference between bomb and vessel.
14. When the performance equation of a PFR and a Batch reactor become the same.
15. How to design a batch reactor?
16. Why do we use multiple reactors?
17. State first and second law of thermodynamics.
18. Tell Clausius Clapeyron equation.
19. Why do we use interstage coolers in the compression cycle?
20. Can you tell me the Van't Hoff equation?
21. What is the expression of the Dittius Boelter equation?
22. What is the Damkohler number?
23. What is the significance of adiabatic line?
24. Why we use adiabatic reactors and describe its uses as compared to other reactors.
25. Fanning friction factor is used for?
26. Difference between Nusselt number and Sherwood number.

Jayanta Chakraborty
1. Different heat transfer correlation
2. What is viscosity correction factor and why is it used in heat transfer correlations?
3. Natural convection
4. Types of condensation and it's explanation
5. Single effect and multiple effect evaporator
6. Rankine cycle
7. Joule Thomson effect
8. Different definitions of chemical potential
9. What is a cooling tower and its application?
10. What is the friction factor and it's expression?
11. How to calculate pressure drop in fluid flow through circular pipe and turbulent flow. Friction factor correlation for turbulent flow.

12. What is ficks law
13. What is view factor
14. Laws of radiation.
15. Working of a shell and tube heat exchanger.
16. What is absorption and stripping, and difference between them.
17. WHAT IS AN EVAPORATOR?
18. DRAW A MULTISTAGE EVAPORATOR WITH SENSIBLE FLOW DIRECTION WITH PERCENTAGE OF SOLUTE?
19. TEMPERATURE PROFILE IN A CYLINDRICAL PIPE
20. WHAT IS UNIVERSAL VELOCITY
21. WHAT IS AN IDEAL GAS
22. GIVE SOME EXAMPLE OF NON IDEAL GAS EQUATION
23. HOW TO CALCULATE MASS TRANSFER COEFFICIENT
24. NAME SOME DIMENSIONLESS NUMBER WHICH IS USED TO CALCULATE MASS TRANSFER COEFFICIENT.
25. NAME SOME ANALOGIES
26. Define joule thomson effect and joule thomson coefficient
27. Importance of activity, activity coeff, fugacity coeff, fugacity
28. Cooling tower, multipass heat exchanger. And difference between them
29. What is universal velocity profile
30. What is Raoult's law, henry law and differentiate
31. How can you measure activity coeff?
32. What is the Grashof number, it's physical significance?
33. Name some non-ideal gas law
34. How many parameters are there in the van der Waals equation & what are they?
35. What is the significance of a & b in the van der Waals equation?
36. A -> B -> C is a series reaction. What will the concentration profile look like of A, B, C with time.
37. What is the difference between hydrodynamic and thermal boundary layer? Which constant is used to specify their thickness?
38. Where do we use a ternary diagram? Can you draw it?
39. What is Stoke's law? Show the balancing used in Stoke's law.
40. What is a Jaw Crusher?
41. Equations used to find heat transfer coefficient.
42. Significance of Nusselt's, Reynolds and Prandtl no.
43. Various equations of states?
44. Various laws of thermodynamics?

Narayana Chandra Pradhan
1. Assumption taken during the interfacial mass transfer (Ans both phase are in equilibrium)

2. Is that assumption valid? Why? (Yes, because interfacial surface is very thin and provides negligible resistance)
3. How to calculate overall mass transfer coefficient? On which parameter it is dependent?
4. Solubility of ammonia in water.
5. How can we decided solute is soluble in particular solvent (Ans based on polarization and type of chemical weather it organic or inorganic)
6. In which type of chemical reaction mass transfer rate is important? (Heterogeneous reactions)
7. How can we increase the mass transfer rate or mass transfer coefficient (not remember exactly)?
8. External mass transfer and internal mass transfer in chemical reaction engineering. On which parameter both depend?
9. What is Reynolds no. And significance
10. What is nusselt no. And significance
11. Overall mtc and parameters on which it depends.
12. What is Gibbs free energy?
13. Difference in biot and nusselt no.
14. Why concentration should be measured on the basis of limiting reactant.
15. WHAT HAPPENS AT THE INTERPHASE IN INTERPHASE MASS TRANSFER. (REACH EQUILIBRIUM)
16. IN HYDROGENATION OF VEGETABLE OIL WITH NICKEL CATALYST WHICH TYPE OF REACTOR WOULD YOU PREFER. (MECHANICAL AGITATED TANK OR A PACKED COLUMN)
17. IN CASE OF A SHELL AND TUBE HEAT EXCHANGER WHERE A SATURATED STEAM IS USED TO HEAT A LIQUID FROM 25-50 DEGREE WHAT TYPE OF CONFIGURATION WOULD YOU PREFER COUNTER CURRENT OR CO CURRENT?
18. Define selectivity
19. Design aspect of reactor for max selectivity
20. Differentiate tray column and packed absorption tower
21. In any kind of reaction with 2 reactants, why is always 1 reactant taken as a limiting reactant?
22. Difference between evaporator and distillation column?
23. Why is evaporation a heat transfer process and distillation a mass transfer process?
24. Interphase mass transfer? Explain Film theory.
25. What is Thiele modulus?
26. Define mass transfer coefficient.
27. What are the difficulties during finding mass transfer coefficients?
28. Different ways to find mass transfer coefficient.
29. Absorption is taking place in tray column and packed column, what will be the dispersed phase in respective columns?
30. Tray column vs packed column difference.
31. What are three basic transport phenomena?

Saubrata Ray

1. What is Boundary layer?
2. Boundary layer in inviscid flow.
3. What is Laminar And Turbulent layer?
4. How do you identify that your waste is hazardous?
5. Thiele Modulus ,Its physical significance.
6. Split Range control
7. Cascade Control
8. What is an ODE,when will it be called non-linear?
9. Cost components in Refinery operation,he mentioned Raw material is primary and accounts for most of the cost,and asked for second most .
10. Unit of mass transfer coefficient and molecular diffusivity and the difference between them
11. Difference between ode & pde
12. Lightest product from the refinery?
13. How is boundary layer flow different from mainstream flow?
14. What are transcendental equations?
15. Difference between diffusivity and mass transfer coefficient?
16. In several different cases a controlled variable was asked and vice versa where no. of controlled and manipulated variables were stated and system or process was asked?
17. What do you mean by tclp?
18. For a 1 m * 1 m tray suggests the suitable polymeric material of construction, processing steps and technique used?

Sonali Sengupta

1. What is the unit of MTC?
2. aikEfficiency of HEX, how to calculate this.
3. Dirt factor,(Fouling factor)-Its causes and how to account for that.
4. Overall U expression in HEX,including Rf and Ri.
5. Hydraulic Radius,where it is used?
6. Ficks Second Law.
7. What is the q line ? Value of q for different types of feed
8. Why do we use hydraulic radius and not the normal radius?

Swati Neogi
(ma'am's favourite subject: Mass transfer)

1) How to calculate rate of mass transfer if mass transfer coefficient is not given?
2) How to calculate heat transfer coefficient?
3) Number analogous to Nusselt Number in mass transfer

4) There are two tanks one filled with oil and other with water, both tanks are separated by a wall. How will heat transfer take place?
5) How can you say mass transfer is taking place in a G-L system?
6) Knudsen diffusion application?
7) Define boundary layer.
8) What are the different types of boundary layer?
9) What makes the boundary layer different from the free stream ?

Debasis Sarkar

(Sir's favourite subject: heat transfer and advance control)-
1) Which equation do you use in presence of convective and conductive heat transfer with chemical reaction?
2) What are the various advanced controllers?
3) What is bifurcation?
4) Three analytical methods to solve PDE
5) How to calculate Diffusivity?
6) What are the assumptions taken in deriving Fourier's equation?
7) How can you model a crystal water system?
8) What is the difference between binary and multicomponent distillation (He actually wanted to know based on operating conditions)?
9) How to control top product purity in a binary distillation column?(Describe the control scheme).
10) Name 3 analytical methods to solve a PDE.
11) What is stiff ODE?
12) How can we find the eigenvalues of a given matrix?
13) What is the conservation form of equation in mass transfer involving molecular diffusion and convection?

Arnab Atta

1) What is the difference between evaporation and drying?
2) Why do we study evaporation in HT and drying in MT?
3) Dispersion number?
4) Difference between nusselt and biot number?
5) Explain dry bulb and wet bulb temperature
6) Convection and advection difference
7. What is thermal diffusivity? Tell the expression.
8. Prandtl no.? Physical significance?
9. Any 3 dimensionless number with their physical significance.
10. What is entropy? How do we measure it?
11. What is fugacity? Which chemical engineering subject deals with it?
12. What is the radiation view factor?
13. What is a grey body?

Sudarsan Neogi

Choose subject CRE

1. What do you mean by molecularity and order ? What is the order of bimolecular reaction?
2. What do you mean by elementary and non - elementary reaction ?
3. How do we measure the temperature and pressure of a reactor?
4. What is the principle of thermocouple ? What materials are used ? Give an example.
5. What do we need for designing a reactor ? Explain
6. What is a pseudo 1st order reaction ? Give an example
7. What is a homogeneous and heterogeneous reaction? Which one is popular ? Give an example.
8. Define space time.
9. Define role of a catalyst in reaction.
10. Define driving force in mass transfer.
11. What is the role of dimensionless numbers in chemical engineering?

Chosen Subject: Process Dynamics and Control.

12. Basic difference between feed forward and feedback control system.
13. Applications of P, PI and PID controllers. Which controller is used in which case?
14. How do we measure liquid level in a tank?
15. Instruments used to measure Temperature and Pressure? What is a thermocouple? What is a transducer?
16. Basic consideration while designing a Reactor?
17. What is Buckingham Pi theorem?
18. What is Chemical Potential?
19. Difference between Homogeneous and Heterogeneous rxn systems. Out of the 2, in which case, catalyst is used?
20. What is fouling of a catalyst? How does it affect the conversion of products?

P.A.D

Choose subject: CRE and thermodynamics

(He said that you have chosen the wrong subjects and Immediately in regret *sigh*)

1. What is chemical potential? What is the condition for equilibrium ?
2. Given a reaction $aA \rightleftarrows bB$ write equilibrium constant and its dimension.
3. Write rate expression. What are the ways of calculating rate constant?
4. Role of activation energy
5. How can we linearize the rate constant arrhenius equation. What does the slope signify?
6. What is the driving force in the distillation column? (Its chemical potential)
7. Consider a reactor (let say CSTR) for the above reaction, how do we calculate rate constant? How will you proceed ?
8. Does the change in reaction will affects the rate constant

Chosen Subjects: CRE and PDC

- For the same conversion which will require higher volume:CSTR and PFR. Explain this graphically.
- The curve obtained between 1/(-rA) and XA : what is the name of this curve?
- Which will be a more preferable model for positive order reactions: (CSTR followed by PFR) OR (PFR followed by CSTR) and why?
- Write Step by Step Mechanism for rxn on a solid(catalyst) surface. Provide the name of each step.
- Write the expression for rate of adsorption and desorption of any one of the reactants.
- Find the expression for void fraction at equilibrium and plot 'void fraction' (y-axis) versus 'partial pressure' (x-axis).
- Provided equation: $dy/dt = y^2 + y + C$. Find the equilibrium points for this equation. How does they vary with the change in value of C? Draw the bifurcation plot for this system.
- Linearize the expression $y^2 + y + C$ (I have used Taylor series expansion for this)
- Provided equation: $dy/dx = y + u(x)$. Derive the Transfer function of this system and determine its order. What will happen to the response of the system if we add a pole to such a system?

BC Meikap
1. Steps to design a multicomponent distillation column
2. What is the heavy key component?
3. How do you calculate column diameter?
4. Which has higher efficiency between bubble cap tray and sieve tray?
5. Role of baffle in heat exchangers? Any other except increasing 'h' value?
6. Maximum height upto which groundwater can be pumped using tube well/hand pump etc. How to calculate it?
7. Can rotameter be used in a horizontal pipe with sweet crude passing through it?
8. Grashof number, its significance? In which unit operation it is used., definition?
9. Are zero order reactions practically possible?
10. In a CSTR, which among 0,1,2,3rd order reactions would you prefer and why?

Prof. Saikat Chakraborty

Asked to select 3 or 4 favorite subjects. (CRE, mass transfer and heat transfer)

1. Given A (gaseous phase) and B (liquid phase) they react only in the presence of C (solid catalyst). What are the steps in which this reaction takes place?

2. Give an example each for equilibrium and non-equilibrium distillation columns and why?

3. Given an isothermal CSTR in which the following reaction takes place:

$$A + B \rightarrow R \quad (\text{rate constant, } k_1)$$

$$B + R \rightarrow S \quad (\text{rate constant, } k_2)$$
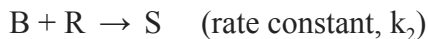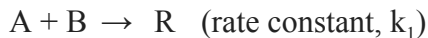
A and B enter as separate streams in 1:1 ratio. We want the product S, so what are the parameters we need when $(k_1/k_2 \rightarrow \infty)$.

4.   Is drying a mass transfer operation or not and why? (simultaneous heat and mass transfer) What type of heat transfer takes place?

5.   We have two cases in the first case the Re=100 and in the second Re=8000. In which case the boundary layer is thicker? And what if the boundary layer itself is turbulent? How do you determine the size of an eddy and what is the length scale?

Prof. Jayanta K. Basu

1.   In a series reaction A $\rightarrow$ B $\rightarrow$ C (rate constants are k_1 and k_2 respectively) generally we know that B reaches a maximum concentration and after that it decreases. In this case concentration of B was negligible in the whole reaction. What is the condition for such a reaction?

2.   In parallel reaction what is selectivity?

3.   Suppose a two-stage compression is taking place. In the first stage the gas is compressed from P_1 to P_2. In the second stage from P_2 to P_3. What is the maximum amount of work required?

4.   In which case work is higher, isothermal or adiabatic?

5.   Explain the working of a centrifugal pump.

6.   What is the Damköhler number, Nusselt number and Prandtl number?

7.   Write the Dittus-Boelter equation.

8.   Condition of same performance equation of batch and pfr

9.   Thermodynamic point of view of riv and irriv reaction.calculation of equilibrium constant and its connection with irr and riv reaction

10. What is the need of multiple reactor connections?

11. Design of batch reactors and its advantage in how you will optimise time and volume.

12. Difference between vessel and bomb reactor.

Prof. Sudipto chakrabarty:

1.What is Boundary layer?

2.What is the minimum reflux ratio?

3.Difference between Nusselt number and Biot number?

4.Why it's impossible to completely eliminate the error in Proportional controllers?

5.Relation between thermal and momentum boundary layer?

6.What is terminal velocity ?

7.What is a fluidised bed?

8. Can you relate fluidisation with terminal velocity?

9. What is osmosis and reverse osmosis and any example in daily application?

Prof. Monojit chakrabarty:

1.Given two fluids ,how will you seperate them?

2.When to use Extraction and distillation and if both do not work what will you go for?

3.How to find heat transfer coefficient for a fluid flowing over a plate and its derivation ?

4.Derivation of hagen poiseuille equation?

5.What is turbulence and turbulent velocity and how to write the NSS equation in case of turbulent velocity ?

6.What is prandtl mixing length ?

7. What is the difference between feed forward and feed backward control?

8. What is the boundary layer ? If there are two packets of fluid one is inside the boundary layer and other is outside then what will be the main differences they will feel?

9. Can you relate mass transfer coefficient with diffusion coefficient? Any theory that relates these two?

Prof. Parag arvind Deshpande

Choose your fav subject: FM and Process dynamics

1. A flat plate is given and you have a fluid passing, how do you find the velocity along y direction?
2. Expression of velocity by scaling analysis
3. How do you find the expression of boundary layer thickness?
4. In Navier Stokes equation, what are the terms present
5. You are the professor and you want to formulate this above problem to an unsteady state problem, how will you do it?
6. What type of pad will that be?
7. What is the general expression for parabolic pde?
8. What are the boundary conditions needed to solve this steady state problem? What is the initial condition needed for the unsteady state problem?
   (He asked me something about Euclidean space, then he said "I do not expect you to know that")

Process dynamics

1. A nth order system can only be represented by nth order differential equation or a set of first order differential equation
2. What is the general expression of a 3rd order system
3. How to convert to laplace domain
4. How many new variables to be introduced to convert this 3rd order system to a set of first order differential equation
5. Is it compulsory to use a deviation variable? Can we proceed without using a deviation variable?
6. Why do we non dimensionalize?

Prof. Sundarsan Neogi

Fav sub FM
1. Example of variable head and variable area rotameter

2. Forces acting on float
3. Use of pitot tube
4. In a reactor or any column how to you measure temperature
5. What is the working principle of thermocouple
6. Pressure measurement devices in industry
7. Level measurement device
8. Types of distillation
9. Difference between binary and multicomponent distillation
10. Which type of heat exchanger will you use to when we have a corrosive liquid
11. What are the types of heat exchanger

D. Sarkar
1. You have a mixture of 5 components, how will you find specific heat and differentiate them.
2. Fav subject -heat and mass transfer.
3. Difference between thermodynamics and heat transfer.
4. What is controllability?
5. What is observability?
6. What is the state space model?
7. Why do we have 1-D slab analysis why not 3-D Or 2-D?
8. Difference between the dynamics of a manometer and 2 tanks in a series system?
9. What is dead time?
10. Analysis of heat transfer in polymer extrusion process?

Swati Neogi
1. Mass transfer theories?
2. Dimensionless no. Used in Boundary layer theory?
3. Difference between nusselts number and biot number?
4. Maximum value of nusselts number?
5. Why are chemical engineers so fond of dimensionless numbers?
6. How can we remove fouling/salt deposition in a pipe using a solvent?
7. What are the equations and correlation to find out the flowrate of solvent used for cleaning the pipe?
8. What are dimensionless numbers involved in these correlations?

Prof. Arnab Atta
1. What is Knudsen Number?
2. Why is drying studied in Mass Transfer?

3. What is the it that we study in Heat Transfer which is analogous to Fick's Second Law in Mass Transfer?
4. About Nusselt number, Biot Number, Navier Stokes equation.

Prof. BC Meikap
   1. What is Raoult's Law?
   2. What is Fenske's equation?
   3. What is rotameter? What are the forces acting on float?
   4. What is the unit of k in second order rate law?
   5. About Nusselt number, Bernoullie's equation.