THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) 2023

Signature of Invigilator _____

Roll. No. | | | | | | |

Paper - II
Chemical Engineering

Maximum Marks: 50 **No. Of Printed Pages: 8**

Instruction for the Candidate:

1. This paper consists of **FIFTY (50)** multiple choice type questions. Each Question carries **ONE (1)** mark.
2. There is no Negative Marking for Wrong Answer.
3. A separate OMR Answer Sheet has been provided to answer questions. Your answers will be evaluated based on your response in the OMR Sheet only. No credit will be given for any answering made in question booklet.
4. Defective question booklet or OMR if noticed may immediately replace by the concerned invigilator.
5. Write roll number, subject code, booklet type, category and other information correctly in the OMR Sheet else your OMR Sheet will not be evaluated by machine.
6. Select most appropriate answer to the question and darken appropriate oval on the OMR answer sheet, with black / blue ball pen only. DO NOT USE PENCIL for darkening. In case of over writing on any answer, the same will be treated as invalid. Each question has exactly one correct answer and has four alternative responses (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
   Example: Ⓐ ● Ⓒ Ⓓ where (B) is correct response.
7. Rough Work is to be done in the end of this booklet.
8. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, such as change of response by scratching or using white fluid, you will render yourself liable to disqualification.
9. Calculators, Log tables any other calculating devices, mobiles, slide rule, text manuals etc are NOT allowed in the examination hall. If any of above is seized from the candidates during examination time; he/ she will be immediately debarred from the examination and corresponding disciplinary action will be initiated by the Center Supervisor as deemed fit.
10. DO NOT FOLD or TEAR OMR Answer sheet as machine will not be able to recognize torn or folded OMR Answer sheet.
11. **You have to return the OMR Answer Sheet to the invigilator at the end of the examination compulsorily** and must not carry it with you outside the Examination Hall. You are however, allowed to carry original question booklet on conclusion of examination.

Paper - II
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Note: This paper contains **FIFTY (50)** multiple-choice questions. Each Question carries **ONE (1)** mark.

1. The reaction for which the rate expression corresponds to the stoichiometric expression is called:
   (a) Elementary reaction (b) Non-elementary reaction
   (c) First order reaction (d) Zero order reaction

2. The mechanism of heat conduction in non-metals is due to:
   (a) Longitudinal oscillations (b) Free electrons
   (c) Elastic deformation (d) Collision of molecules

3. Obsolescence is a type of:
   (a) Working cost (b) Fixed cost
   (c) Depreciation (d) Contingency

4. Which of the following is not the method to determine depreciation?
   (a) Straight line method
   (b) Polynomial method
   (c) Sinking fund method
   (d) Declining balance method

5. The parameter A in the Arrhenius equation $k = Ae^{-E/RT}$ is associated with:
   (a) Temperature (b) Orientation of molecules
   (c) Exothermicity (d) Pressure

6. Which of the following is associated with natural convection?
   (a) Peclet number (b) Grashoff number
   (c) Biot number (d) Nusselt number

7. The strength of phosphoric acid is usually specified in terms of:
   (a) P_2O_5 (b) H_3PO_4
   (c) PO_4 (d) P

8. Allocation for unforeseen events is termed as:
   (a) Contingency (b) Operating cost
   (c) Interest (d) Maintenance cost

9. Which flow reactor gives maximum conversion per unit volume
   (a) Plug flow (b) Mixed flow
   (c) Batch (d) None of these

10. Which of the following is formed at the cathode of the membrane cell?
   (a) Chlorine (b) Oxygen
   (c) Hydrogen (d) Water

11. Body which does not transmit any radiation is called:
   (a) Grey body (b) Black body
   (c) Opaque body (d) White body

12. In RTD, step input is associated with:
   (a) E curve (b) C curve
   (c) F curve (d) A curve

13. The role of baffles in a shell and tube heat exchanger is:
    (a) To hold the shell
    (b) To induce turbulence
    (c) To hold the tube-sheets
    (d) To hold tie rods
14. Capacity loss due to materials actually consumed is called:
    (a) Depletion
    (b) Functional depreciation
    (c) Working capital
    (d) Physical depreciation
15. Which of the following does not hold in the case of a catalyst?
    (a) Increases selectivity
    (b) Reduces activation energy
    (c) Changes reaction pathway
    (d) Alters equilibrium

16. The basic law of heat conduction draws an analogy from:
    (a) Newton's law of cooling
    (b) Newton's law of viscosity
    (c) Joule-Thompson effect
    (d) Newton's law of velocity

17. The physical significance of Nusselt number is:
    (a) The ratio of molecular momentum diffusivity to molecular thermal diffusivity
    (b) The ratio of temperature gradient near the wall to the overall temperature gradient
    (c) The ratio of heat transfer by convection to heat transfer by conduction
    (d) The ratio of the rate of heat transfer by conduction to the rate of heat transfer by convection

18. Biological fouling is commonly encountered in:
    (a) Chilled water circuits
    (b) Hot water circuits
    (c) Steam generation
    (d) Cooling water circuits

19. With reference to specific gravity of crude oil, high API means:
    (a) Rich in aromatics
    (b) Rich in paraffins
    (c) Rich in naphthenes
    (d) Rich in asphalt

20. Power number is the ratio of
    (a) $\frac{Inertial\ stress}{Shear\ stress}$
    (b) $\frac{Drag\ stress}{Inertial\ stress}$
    (c) $\frac{Inertial\ \ stress}{Drag\ stress}$
    (d) $\frac{Shear\ stress}{Inertial\ stress}$

21. Which catalyst is used in the manufacture of nitric acid?
    (a) Pt-Rh
    (b) MgO
    (c) Vanadium pentoxide
    (d) ZnO

22. Hummer screen is a type of:
    (a) Stationary screen
    (b) Revolving screen
    (c) Vibrating screen
    (d) Gyratory screen

23. The dimensionless groups obtained by making Navier-Stokes equation dimensionless are
   (a) Reynolds number, Weber number
   (b) Reynolds number, Euler number
   (c) Euler number, Weber number
   (d) Reynolds number, Froude number

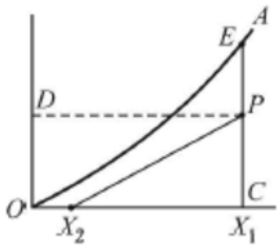
24. The commercial strength of caustic lye is:
   (a) 69% (b) 33%
   (c) 98% (d) 45%

25. The equation of continuity is $\frac{\partial u_x}{\partial x} + \frac{\partial u_y}{\partial y} + \frac{\partial u_z}{\partial z} + \frac{1}{\rho}\frac{D\rho}{Dt} = 0$. The sum of the first three terms is called:
   (a) Divergence of velocity vector
   (b) Substantial derivative
   (c) Divergence of momentum
   (d) Curl of velocity vector

26. Which of the following is not a tool to visualize fluid motion?
   (a) Streamlines
   (b) Trajectories
   (c) Streak lines
   (d) Stream function

27. Mechanism of transport through a reverse osmosis membrane is by
   (a) Solution diffusion
   (b) Sieving
   (c) Diffusion through pores
   (d) Restricted diffusion through pores

28. Benzene is to be stripped from oil using steam in a packed column. The mole ratio of benzene in the inlet stream is X_1 and that in the lean oil leaving the column is X_2. For a fixed liquid rate and at constant values of X_1 and X_2, if the steam rate is increased, the point P on the operating line will:



   (a) Shift towards C
   (b) Shift towards D
   (c) Shift towards E
   (d) Will remain in the same position

29. Select the correct order for the diffusion coefficients
   (a) Gases > Solids > Liquids
   (b) Solids > Liquids > Gases
   (c) Gases > Liquids > Solids
   (d) Liquids > Solids > Gases

30. Which of the following is an example of a gas film-controlled process?
(a) Absorption of ammonia in water
(b) Absorption of carbon dioxide in water
(c) Absorption of oxygen in water
(d) Absorption of sulfur dioxide in water

31. Which of the following assumes constant molal vaporization and overflow?
(a) Ponchon Savarit method
(b) Enthalpy concentration method
(c) Mc Cabe Thiele method
(d) FUG method

32. Compare the membrane separation operation with the type of the membrane

P	Reverse osmosis	I	Non-porous membrane
Q	Ultrafiltration	II	Porous membrane
R	Dialysis	III	Microporous
S	Gas Permeation		

(a) P-I, Q-II, R-III, S-I
(b) P-I, Q-III, R-II, S-I
(c) P-I, Q-II, R-II, S-III
(d) P-III, Q-II, R-III, S-I

33. Which of the following is more appropriate for the concept of an ideal gas?
(a) Is represented by PV=nRT
(b) Absence of attractive and repulsive forces
(c) Volume of the molecules is negligible compared to the volume of the container and absence of intermolecular forces
(d) Volume of the molecules contribute but intermolecular forces are absent

34. Time constant of a liquid level tank is equal to:
(a) hA/mC_p (b) mC_p/hA
(c) AR (d) V/q

35. Which of the following is not an extensive entity?
(a) Mass
(b) Volume
(c) Moles
(d) Density

36. Carnot cycle involves:
(a) Two isothermal and two isochoric steps
(b) Two isothermal and two adiabatic steps
(c) Two isobaric and two isochoric steps
(d) Two isobaric and two adiabatic steps

37. The Laplace transform of f(t) = t is:
(a) A/S^2 (b) A/S
(c) S (d) $1/S^2$

38. Which of the following sequences is true in the case of refrigeration?
(a) Compressor – Condenser – Throttle valve - Evaporator
(b) Compressor – Evaporator – Throttle valve - Condenser
(c) Condenser – Compressor – Evaporator – Throttle valve
(d) Evaporator – Compressor – Condenser – Throttle valve

39. Two interacting tanks in series is an example of:
(a) Critically underdamped system (b) Overdamped system
(c) Critically damped system (d) Undamped system

40. The iterative matrix method for solution of system of algebraic equations is
(a) Gauss Elimination
(b) Gauss-Jordan method
(c) Jacobi method
(d) LU decomposition

41. Which of the following is more appropriate with respect to the requirement of process control?
(a) Enhances productivity
(b) To reduce labour
(c) Raw material specifications
(d) Environmental regulations

42. The differential equation:

$$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - \alpha^2)y = 0$$

Used in solving many chemical engineering problems is
(a) Bessel equation
(b) Laplace equation
(c) Legendre's equation
(d) Euler equation

43. If the degree of freedom of a system is zero, then the system is
(a) Underspecified
(b) Correctly specified
(c) Overspecified
(d) Unspecified

44. Match the non-Newtonian Fluids with their relevant examples

(P) Thixotropic fluids	(1) Gelatin solution
(Q) Dilatant	(2) Starch solutions
(S) Bingham Plastic	(3) Tooth paste
(T) Rheopectic	(4) Bentonite Solutions

(a) P1Q2S3T4 (b) P4Q2S3T1
(c) P2Q1S3T4 (d) P3Q4S1T4

45. Root locus method is based on:
(a) Closed loop transfer function (b) Frequency response
(c) Open loop transfer function (d) Amplitude ratio

46. The appropriate term for reducing the impurities from a stream is called:
(a) Purging (b) Recycling
(c) Venting (d) Entraining

47. Match the following:

(P) Flooding	(1) Low gas rates
(Q) Blowing	(2) Excessive liquid buildup
(R) Weeping	(3) Very low gas rates
(S) Dumping	(4) Low liquid rates

(a) P2Q3R1S4 (b) P2Q4R1S3
(c) P2Q4R3S1 (d) P2Q1R4S3

48. For an irreversible unimolecular first order reaction, which of the following is true?
(a) $ln(1 - X_A) = kt$ (b) $ln(1/X_A) = kt$
(c) $ln(X_A) = kt$ (d) $-ln(1 - X_A) = kt$

49. Normality is defined as:
(a) g moles per liter of solution
(b) g moles per liter of solvent
(c) kg per kg of solvent
(d) g equivalent per liter of solution

50. Screen interval for the Tyler standard screens is
(a) $\sqrt{2}$ (b) $\sqrt[4]{2}$ (c) 2 (d) $\frac{1}{\sqrt{2}}$

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Rough Work: