PGCET-2013

003

DAY and TIME	COURSE	SUBJECT
DAY-1 10.30 am to 12.30 pm SESSION : FORENOON	ME/M.Tech/M.Arch/MBA (Infrastructure Management) courses offered by VTU/ UVCE/UBDTCE	CHEMICAL ENGINEERING

MAXIMUM MARKS	TOTAL DURATION	MAXIMUM TIME FOR ANSWERING
100	150 MINUTES	120 MINUTES

MENTION YOUR PGCET NO.	QUESTION BOOKLET DETAILS	
	VERSION CODE	SERIAL NUMBER
	A - 1	120157

DOs :

1. Check whether the PGCET No. has been entered and shaded in the respective circles on the OMR answer sheet.
2. Ensure whether the circles corresponding to course and the specific branch have been shaded on the OMR answer sheet.
3. This Question Booklet is issued to you by the invigilator after the **2nd Bell i.e., after 10.25 a.m.**
4. The Serial Number of this question booklet should be entered on the OMR answer sheet.
5. The Version Code of this question booklet should be entered on the OMR answer sheet and the respective circles should also be shaded completely.
6. Compulsorily sign at the bottom portion of the OMR answer sheet in the space provided.

DON'Ts :

1. **THE TIMING AND MARKS PRINTED ON THE OMR ANSWER SHEET SHOULD NOT BE DAMAGED / MUTILATED / SPOILED.**
2. The **3rd Bell rings at 10.30 a.m., till then;**
   - Do not remove the paper seal / polythene bag of this question booklet.
   - Do not look inside this question booklet.
   - Do not start answering on the OMR answer sheet.

SEAL

IMPORTANT INSTRUCTIONS TO CANDIDATES

1. This question booklet contains 75 (items) questions and each question will have one statement and four answers. (Four different options / responses.)
2. After the **3rd Bell is rung at 10.30 a.m.,** remove the paper seal / polythene bag of this question booklet and check that this booklet does not have any unprinted or torn or missing pages or items etc., if so, get it replaced by a complete test booklet. Read each item and start answering on the OMR answer sheet.
3. During the subsequent 120 minutes:
   - Read each question (item) carefully.
   - Choose one correct answer from out of the four available responses (options / choices) given under each question / item. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **only one response** for each item.
   - **Completely darken / shade the relevant circle with a BLUE OR BLACK INK BALL POINT PEN against the question number on the OMR answer sheet.**
4. Use the space provided on each page of the question booklet for Rough Work. Do not use the OMR answer sheet for the same.
5. After the **last Bell is rung at 12.30 pm,** stop marking on the OMR answer sheet and affix your **left hand thumb impression** on the OMR answer sheet as per the instructions.
6. Hand over the **OMR ANSWER SHEET** to the room invigilator as it is.
7. After separating the top sheet, the invigilator will return the bottom sheet replica (Candidate's copy) to you to carry home for self-evaluation.
8. Preserve the replica of the OMR answer sheet for a minimum period of **ONE year.**
9. Only **Non-programmable** calculators are allowed.

Marks Distribution

PART-I : 50 QUESTIONS CARRY ONE MARK EACH (1 TO 50)
PART-II : 25 QUESTIONS CARRY TWO MARKS EACH (51 TO 75)

CHEMICAL ENGINEERING
PART – I

Each question carries one mark. **(50 × 1 = 50)**

1. In a given system, extensive property of a thermodynamic system depends upon

   (A) Pressure & temperature (B) Viscosity

   (C) Mass (D) Volume

2. Enthalpy for the reaction $C + O_2 \rightarrow CO_2$ is

   (A) Positive (B) Negative

   (C) Zero (D) None of these

3. Specific heat at constant pressure (C_p) is

   (A) $\left(\frac{\partial E}{\partial T}\right)_P$ (B) $\left(\frac{\partial H}{\partial T}\right)_P$

   (C) $\left(\frac{\partial S}{\partial T}\right)_P$ (D) None of these

4. Joule – Thomson coefficient for a perfect gas is

   (A) Zero (B) Positive

   (C) Negative (D) None of these

5. For a chemical reaction occurring at equilibrium under constant temperature and pressure, the change in Gibbs free energy is

   (A) Maximum (B) Minimum

   (C) Zero (D) None of these

Space For Rough Work

6. The number of degrees of freedom for a system prepared by partially decomposing $CaCO_3$ into an evacuated space is

(A) 0 (B) 1

(C) 2 (D) 3

7. A rotameter is a device used to measure

(A) Velocity of fluid in pipes (B) Velocity of gauges

(C) Vortex flow (D) Flow of fluids

8. Cavitation is caused by

(A) High velocity (B) Low Barometric pressure

(C) High pressure (D) Low pressure

9. For measuring flow by a Venturimeter, it should be installed in

(A) Vertical line (B) Inclined line with upward flow

(C) Horizontal line (D) In any direction & in any location

10. A large Reynold's number is indication of

(A) Laminar flow (B) Steady flow

(C) Smooth and stream line flow (D) Highly turbulent flow

11. Mesh is defined as the number of openings per linear

(A) Feet of screen surface (B) Inch of screen surface

(C) Meter of screen surface (D) None of these

12. Specific surface of spherical particles is given by

(A) $6 / D\rho$ (B) $2 / D\rho$

(C) $4 / D\rho$ (D) $12 / D\rho$

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13. For non – spherical particle, the sphericity (ϕ) is defined by the relation

(A) $\phi_S = V_P / (D_P S_P)$ (B) $\phi_S = (D_P S_P) / V_P$

(C) $\phi_S = 6V_P / (D_P S_P)$ (D) $\phi_S = V_P / (6D_P S_P)$

14. Ball mill is used for

(A) Crushing (B) Coarse grinding

(C) Fine grinding (D) Attrition

15. The unit of specific cake resistance is

(A) kg/m^2 (B) m/kg

(C) m/kg^2 (D) kg/m^3

16. Dropwise condensation usually occurs on

(A) Glazed surface (B) Smooth surface

(C) Oil surface (D) Coated surface

17. In a heat exchanger with one fluid evaporating or condensing, the surface area required is least in

(A) Parallel flow (B) Counter flow

(C) Cross flow (D) Same in all above

18. Heat pipe is widely used because it acts as

(A) an insulator (B) conductor and insulator

(C) a super conductor (D) a fin

19. Emissivity of a body is equal to absorptivity if the body is

(A) in thermal equilibrium (B) at low temperature

(C) at high temperature (D) none of these

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20. A radiation shield should have

(A) Zero reflectivity
(B) Low reflectivity
(C) High reflectivity
(D) None of these

21. The effect of scaling in a heat exchanger is accounted through

(A) Heat transfer coefficient
(B) Fouling factors
(C) Insulation factors
(D) Diffusivity factors

22. Mass transfer coefficient (K) and diffusivity (D) are related according to film theory is

(A) $K \propto D$
(B) $K \propto \sqrt{D}$
(C) $K \propto D^{1.5}$
(D) $K \propto D^2$

23. The binary diffusivity in gases depends upon

(A) Temperature
(B) Pressure
(C) Nature of components
(D) None of these

24. Raoult's law is applicable to

(A) Ideal solutions
(B) Real solutions
(C) Mixture of water and alcohol
(D) All of these

25. Ratio of the partial pressure of the vapour to the vapour pressure of liquid is called

(A) Humidity
(B) Saturated humidity
(C) Relative humidity
(D) None of these

26. Cox chart is used in the design of

(A) Distillation column
(B) Condensor
(C) Heat exchanger
(D) Crystallizer

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27. The rate of leaching depends on

(A) The particle size
(B) The temperature
(C) The agitation
(D) All of these

28. Schmidt number (N_{SC}) is defined as

(A) μ / D_{AB}
(B) $\mu / \rho D_{AB}$
(C) $\rho\mu / D_{AB}$
(D) $\mu D_{AB} / \rho$

29. Ficks second law of diffusion in one dimension is

(A) $\partial C_A / \partial t = D_{AB} (\partial^2 C_A) / (\partial x^2)$
(B) $\partial C_A / \partial t = D_{AB} (\partial C_A) / (\partial x)$
(C) $\partial C_A / \partial t = (\partial C_A) / (\partial x)$
(D) None of these

30. The rate of chemical reaction depends upon

(A) Temperature
(B) Pressure
(C) Concentration
(D) All of these

31. Space time in flow reactor is

(A) Usually equal to the residence time
(B) The reciprocal of the space velocity
(C) Both (A) and (B)
(D) None of these

32. BET apparatus is used to determine

(A) Specific surface of porous catalyst
(B) Pure size distribution
(C) Pore diameter
(D) Porosity of the catalyst bed

Space For Rough Work

33. What is the dispersion number for a CSTR ?

(A) 0 (B) 1

(C) < 1 (D) ∞

34. Which of the following explains the mechanism of catalysis ?

(A) Activated complex theory (B) Collosion theory

(C) Thermodynamics (D) None of these

35. Those material which improves the activity of a catalyst is called

(A) Carrier (B) Promoter

(C) Inhibitor (D) None of these

36. If E is the age distribution of fluid leaving a vessel, then

(A) $\int_0^\infty E.dt = 0$ (B) $\int_0^\infty E.dt = 1$

(C) $\int_0^\infty E.dt = \infty$ (D) $\int_0^\infty E.dt = \frac{2}{\pi}$

37. Characterization of a dynamic system by a transfer function can be done for

(A) Linear system (B) Non – linear system

(C) Both (A) & (B) (D) None of these

38. Phase angle (ϕ) of the sinsusoidal response of first order system is given by

(A) $\phi = \tan h^{-1} (\omega\tau)$ (B) $\phi = \tan^{-1} (-\omega\tau)$

(C) $\phi = \tan^{-1} (\omega\tau)$ (D) $\phi = \tan h^{-1} (-\omega\tau)$

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39. With a damping coefficient more than 1 the second order will be

(A) Under damped
(B) Oscillatory
(C) Over damped
(D) Critically damped

40. Routh test cannot be used to test the stability of a control system containing

(A) Controller
(B) Transportation lag
(C) Final control element
(D) None of these

41. Diameter of the distillation column is set by

(A) Number of theoretical plates
(B) Allowable vapour velocity
(C) Static submergence
(D) Length of straight rectangular weir on cross flow tray

42. Slope of the operating line in the stripping section of a distillation column is

(A) 0
(B) ∞
(C) > 1
(D) < 1

43. Break – even point is the ratio of fixed cost to

(A) Unit price
(B) Unit variable cost
(C) Unit price + Unit variable cost
(D) Unit price – Unit variable cost

44. Sucrose content in cane sugar may be around

(A) 30%
(B) 70%
(C) 80%
(D) 95%

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45. Ultimate analysis of coal determines

(A) Carbon
(B) Hydrogen
(C) Sulphur
(D) All of these

46. A solution of specific gravity 1.0 consists of 35% A by weight and the remaining 'B' if the specific gravity of A is 0.7, the specific gravity of 'B' is

(A) 1.25
(B) 1.3
(C) 1.35
(D) 1.2

47. For the case of fuel gas undergoing combustion with air, if the air/fuel ratio is increased, the adiabatic flame temperature

(A) Increases
(B) Decreases
(C) Depends on fuel type
(D) None of these

48. An aqueous solution of 2.45% by weight H_2SO_4 has a specific gravity of 1.011. The composition expressed in normality is

(A) 0.25
(B) 0.2528
(C) 0.5
(D) 0.5055

49. Knudson diffusion is directly proportional to

(A) T
(B) $\sqrt{T}$
(C) $1/\sqrt{T}$
(D) T^2

50. Rate of autocatalytic chemical reaction is a function of

(A) Temperature only
(B) Pressure only
(C) Composition only
(D) All of these

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PART – II

Each question carries two marks. **(25 × 2 = 50)**

51. The change in free energy when a real gas undergoes an isothermal change in state is

(A) $\Delta G = RT \ln (V_2/V_1)$ (B) $\Delta G = RT \ln (P_2/P_1)$

(C) $\Delta G = RT \ln (f_2/f_1)$ (D) $\Delta G = RT \ln (\gamma_2/\gamma_1)$

52. The equilibrium constant for the reaction $N_2 + 3H_2 \rightarrow 2\ NH_3$ is 0.1084. Under the same conditions, the equilibrium constant for the reaction $1/2\ N_2 + 3/2\ H_2 \leftrightarrow NH_3$ is

(A) 0.1084 (B) 0.3292

(C) 0.0118 (D) 0.0542

53. What is the change in entropy when 1 gm of ice at 0°C is converted to steam at 100°C? C_p of water is 1 cal/g, $\lambda_{vap} = 540$ cal/g

(A) 0.553 cal/g K (B) 1.053 cal/g K

(C) 2.053 cal/g K (D) None of these

54. Critical speed of ball mill is equal to

(A) $1 / (D - d)$ (B) $1 / \sqrt{D - d}$

(C) $76.65 / \sqrt{D - d}$ (D) $76.75 / \sqrt{D - d}$

55. Percentage of drum submerged in slurry in case of rotary drum filter is

(A) 3 (B) 30

(C) 85 (D) None of these

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56. A steel ball of mass 1 kg and specific heat 0.4 kJ/kg is at a temperature of 60 °C. It is dropped into 1 kg water at 20 °C. The final steady state temperature of water is

(A) 23.5 °C
(B) 30 °C
(C) 35 °C
(D) 40 °C

57. For a current wire of 20 mm diameter exposed to air (h = 20 W/m^2 K), maximum heat dissipation occurs when thickness of insulation (K = 0.5 W/mK) is

(A) 20 mm
(B) 25 mm
(C) 35 mm
(D) 10 mm

58. In a certain heat exchanger, both the fluids have identical mass flow rate – specific heat product. The hot fluid enters at 76 °C and leaves at 47 °C and the cold fluid enters at 26 °C leaves at 55 °C. The effectiveness of heat exchanger is

(A) 0.16
(B) 0.58
(C) 0.72
(D) 1.0

59. NTU is calculated by the equation

(A) UA / C_{min}
(B) $UA\ C_{min}$
(C) C_{min} / UA
(D) C_{min} / C_{max}

60. Fourier's law of heat conduction gives the heat flow for

(A) One dimensional flow only
(B) Two dimensional flow only
(C) Irregular surfaces only
(D) All surfaces

Space For Rough Work

61. A binary hydrocarbon liquid mixture of A and B (K_A = 1.5) containing 60 mol % A is flash vapourised. If 40% of the feed is vapourised, the mole fraction of 'A' in the bottom and distillate is

(A) 0.5 & 0.75 (B) 0.25 & 0.5

(C) 0.85 & 0.95 (D) 0.75 & 0.75

62. Match list I with list II and select the correct answer from the codes given below the lists :

LIST – I	LIST – II
(a) Rotary atomizer	(1) Kinetic energy
(b) Relative volatility	(2) Centrifugal pump
(c) Pneumatic nozzle	(3) Distillation
(d) Selectivity	(4) Liquid – liquid extraction

	(a)	(b)	(c)	(d)
(A)	2	3	1	4
(B)	2	1	3	4
(C)	1	2	3	4
(D)	4	3	1	2

63. According to surface – renewal theory, mass transfer coefficient is directly proportional to

(A) D_{AB} (B) D^2_{AB}

(C) $D^{1.5}_{AB}$ (D) $D^{0.5}_{AB}$

64. The psychometric ratio is defined as

(A) h_G / Ky (B) K_y / h_G

(C) $h_G / K_y C_S$ (D) N_{SC} / N_{pr}

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65. Rotary driers are operated with the holdups of material in the range of

(A) 0.20 to 0.30 (B) 0.6 to 0.75

(C) 0.40 to 0.50 (D) 0.05 to 0.15

66. If $r_A = - d C_A / dt = 0.2$ mol/lit-sec when $C_A = 1$ mol/lit, what is the rate of reaction when $C_A = 10$ mol / lit ?

(A) 2 mol/lit.sec (B) 0.2 mol (lit.sec)

(C) 20 mol/sec (D) 0.02 mol/lit.sec

67. The rate equation for an autocatalytic reaction

$A + R \xrightarrow{k_1} R + R$ is $-r_A = d C_A/dt = k C_A C_R$ plot of $(-r_A)$ versus C_A gives a

(A) Straight line with slope k (B) Parabola

(C) Hyperbola (D) Straight line with zero slope

68. For an irreversible elementary first order reaction in parallel $A \xrightarrow{k_1} R$; $A \xrightarrow{k_2} S$. A plot of concentration of component R versus concentration of components gives a straight line with slope of

(A) $k_1 + k_2$ (B) $k_1 - k_2$

(C) k_2 / k_1 (D) k_1 / k_2

69. The transfer function of a PD controller is

(A) $K_C / \tau_D S$ (B) $K_C (1 + 1/ \tau_D S)$

(C) $K_C (1 + \tau_D S)$ (D) $K_C (1 + \tau_D / S)$

70. At the corner frequency, amplitude ratio (AR) for the sinusoidal response of first order system is

(A) $1 / \sqrt{2}$ (B) b

(C) $\sqrt{2}$ (D) $1/\sqrt{5}$

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71. In under damped second – order response

(A) Over shoot = decay ratio

(B) Over shoot = $(\text{decay ratio})^2$

(C) Over shoot = $\sqrt{\text{decay ratio}}$

(D) Over shoot = $(\text{decay ratio})^3$

72. Accuracy is specified as ± 0.5% of true value. At 5% of full scale, error of the instrument will be

(A) (±) 0.025%

(B) (±) 0.5%

(C) (±) 2.5%

(D) (±) 25%

73. Laminar region exists during agitation when Reynold's number is

(A) Less than 10

(B) More than 50

(C) More than 1000

(D) More than 2500

74. Mixing of plastic solids is generally facilitated by

(A) Dispersion

(B) Mastication

(C) Kneading

(D) None of these

75. Polytetrafluroethylene (PTFE) is known as

(A) Teflon

(B) Decron

(C) Perspex

(D) Nylon

Space For Rough Work

SEAL

A-1