



K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

| WINTER-2025 | |
|------------------------------------|-----------------------|
| Exam Seat No.: | |
| Academic Year:2025-2026 | Semester:III |
| Class:SY | Program:B.Tech |
| Branch Code:CHE | Pattern:2022 |
| Name of Course:Process Calculation | Course Code:CHE222005 |
| Max. Marks:60 | Duration:2.30 Hrs. |

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 3 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome of the Question/sub-question.

Marks CO

Question No. 1

- 1a) A solution of H_2SO_4 has molarity of 11.24 and molality of 94. Calculate the density of solution. (6) CO1

Question No. 2

- 2a) Explain Following terms (6) CO2

1. Leaching (Solid-liquid) 2. Mixing 3. Drying

Question No. 3

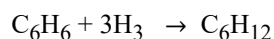
- 3a) In the shift reaction $CO + H_2O \rightarrow CO_2 + H_2$, a and b are mole % of CO in the inlet and dry outlet gas mixture to and from the reactor respectively. Prove that moles of CO converted (x) per 100kmol of inlet gas mixture can be calculated by using the formula. (8) CO3

$$x = \frac{a(100 - b)}{(100 + b)}$$

OR

- 3b) Explain following terms Conversion, Yield, Selectivity, Limiting reactant. (8) CO3

- 3c) Gaseous benzene (C_6H_6) reacts with hydrogen as per the following reaction (8) CO3



30 % excess hydrogen is used above that required by the reaction. Conversion is 50 % and yield is 90 %. Calculate the requirement of benzene and hydrogen gas for 100 moles of Cyclohexane.

OR

- 3d) A feed A, B and inert enters a reactor. The reaction taking place is $2A + B \rightarrow C$ (8) CO3

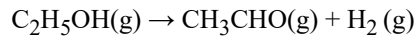
The product stream leaving the reactor is having the following composition by mole:

A = 23.08 %, B= 11.54 %, C= 46.15 % and inerts-19.25 %

Find the Feed composition.

Question No. 4

- 4a) Calculate the heat of reaction at 25 °C of the following reaction. (8) CO4



Data:

| Component | $\Delta H^\circ \text{C}$ (kJ/mol) |
|---|------------------------------------|
| $\text{C}_2\text{H}_5\text{OH}(\text{g})$ | -1410 |
| $\text{H}_2(\text{g})$ | -286 |
| $\text{CH}_3\text{CHO g}$ | -1193 |

OR

- 4b) Write a short note on Heat of Formation, Heat of reaction, and Heat of combustion with examples. (8) CO4

- 4c) A stream of nitrogen flowing at a rate of 150 kgmol/h is heated from 298 K to 373 K. (8) CO4

Calculate the heat that must be transferred.

$$C_{p\text{N}_2} = 29.49 - 5.14 \times 10^{-3}T + 13.18 \times 10^{-6}T^2 - 4.95 \times 10^{-9}T^3, \text{ kJ/kgmol. K}$$

OR

- 4d) Toluene is heated from 300 K to 340 K at the rate of 46 kg/s. Calculate the heat required to be added to toluene using the heat capacity data given below. (8) CO4

$$C_p^\circ = 1.80 + 812.21 \times 10^{-3}T - 1512.67 \times 10^{-6}T^2, \text{ kJ/kgmol}^{-1} \text{ K.}$$

The molecular weight of toluene = 92.

Question No. 5

- 5a) Explain in detail about the Humidity Chart and its practical applications in industry. (8) CO5

OR

- 5b) Explain different types of fuels with examples. Also write note on proximate analysis. (8) CO5

- 5c) An air (B)–water (A) sample has a dry bulb temperature 55°C and an absolute humidity 0.030 kg water/kg dry air at 1 std. atm pressure. (8) CO5

Data: Saturated humidity = 0.115 and $P_S = 15,730 \text{ N/m}^2$

Calculate:

- (i) The percentage humidity
- (ii) The molal absolute humidity
- (iii) The partial pressure of water vapour in the sample
- (iv) The relative humidity

OR

- 5d) What is Net calorific and Gross calorific value of the Fuel. Crude oil is analysed to contain 87 % carbon, 12.5 % hydrogen and 0.5 % Sulphur (by weight). Calculate the net calorific value of the crude oil at 298 k (8) CO5

Data- Gross calorific value of crude oil at 298k is 45071 Kj/kg oil

Latent heat of water vapours at 298k = 2442.5 kJ/kg

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