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:IV
Class:SY	Program:B.Tech (chemical Engineering)
Branch Code:CHE	Pattern:2023
Name of Course:Process Calculations	Course Code:2307211
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)	The strength of a phosphoric acid sample is found to be 40% P_2O_5 by weight. Find out the actual concentration of H_3PO_4 (weight%) in the acid.	(6)	CO1
Question No. 2			
2a)	Explain following terms and write one example of each 1. Extraction (liquid-liquid) 2. Drying 3. Crystallization	(6)	CO2
Question No. 3			
3a)	In the manufacture of acetic acid by oxidation of acetaldehyde, 100 kmol of acetaldehyde is fed to a reactor per hour. The product leaving the reactor contains 14.81 % acetaldehyde, 59.26 % acetic acid and rest oxygen (on mole basis). Find the percentage conversion of acetaldehyde.	(8)	CO2
	OR		
3b)	Explain following terms Conversion, Yield, Selectivity, Limiting reactant	(8)	CO3
3c)	Gaseous benzene (C6H6) reacts with hydrogen as per the following reaction $C_6H_6 + 3H_3 \rightarrow C_6H_{12}$ 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.	(8)	CO3
	OR		
3d)	A feed A, B and inert enters a reactor. The reaction taking place is $2A + B \rightarrow C$ 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 Feed composition of A, B and inert	(8)	CO3

Question No. 4

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

$C_2H_5OH(g) \rightarrow CH_3CHO(g) + H_2(g)$)

Data:

Component	ΔH °C (kJ/mol)
$C_2H_5OH(g)$	–1410
$H_2(g)$	-286
CH3CHO 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.

$C_{PN2} = 29.49 – 5.14 \times 10^{-3}T + 13.18 \times 10^{-6}T^2 – 4.95 \times 10^{-9}T^3$, 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

$C^o_p = 1.80 + 812.21 \times 10^{-3}T – 1512.67 \times 10^{-6}T^2$, kJ/kgmol^{-1} 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) Write note on Proximate and Ultimate 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 $P_S = 15{,}730$ 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) Q5 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

····· End of question paper·····