

Registration No. :

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Total number of printed pages – 2

B. Tech
PCCH 4203

Special Examination – 2012

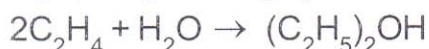
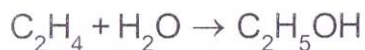
CHEMICAL PROCESS AND CALCULATION

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 × 10
- (a) How many molecules are present in 700 gm of K_2CO_3 ?
 - (b) Determine the volume of oxygen obtained under standard conditions, by the decomposition of 100 kg of potassium chlorate.
 - (c) What are valency and equivalent weight ?
 - (d) A body weighs 1 kg in air, 0.9 kg in water, and 0.8 kg in a liquid. Find the specific gravity of the liquid.
 - (e) Define normality and molarity.
 - (f) Explain yield and selectivity with example.
 - (g) An automobile tyre is inflated to a pressure of 190 kPa at 273 K. If the pressure inside the tyre is not to exceed 250 kPa, what is the maximum temperature the tyre may be heated ?
 - (h) What are wet bulb temperature and humid heat ?
 - (i) Write Hess's law.
 - (j) Differentiate between heat of solution and heat of mixing.
2. In the vapour-phase hydration of ethylene to ethanol, diethyl ether is obtained as a by-product.



A feed mixture consisting of 60% ethylene, 3% inerts, and rest water is sent to a reactor. The products analyzed to contain 54% ethylene, 14% ethanol, 2% ether,

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- 26% water, and rest inerts. Calculate: (i) conversion of ethylene and (ii) yield of ethanol and ether based on ethylene. 10
3. Natural gas is piped from the well at 300 K and 400 kPa. The gas is found to contain 93 % methane, 4 % ethane, and rest nitrogen. Calculate : (i) partial pressure of nitrogen, (ii) pure component volume of ethane in 10 m³ of the gas, (iii) density at standard conditions in kg/m³, and (iv) average molecular weight of the gas. 10
4. An aqueous solution of Na₂CO₃ contains 15 % carbonate by weight. 80 % of the carbonate is recovered as Na₂CO₃·10H₂O by evaporation of water and subsequent cooling to 273 K. The solubility of Na₂CO₃ at 278 K is 9 % (weight). On the basis of 100 kg of solution treated, determine the quantity of crystals formed and the amount of water evaporated. 10
5. (a) Using humidity chart find the dew point, % RH, and H for a mixture of air-water vapour system having DB = 35°C and WB = 26°C. 4
- (b) 10,000 kg/h of solution containing 20 % methanol is continuously fed to a distillation column. Distillate is found to contain 98 % methanol and waste solution from column carries 1 % methanol. All percentages are by wt %. Calculate the mass flow rate of distillate and product and the percent loss of methanol. 6
6. In a sulphuric acid plant, pyrites containing 50 % (weight) sulphur is burnt to give SO₂ which is subsequently converted to SO₃ in a converter. The analysis of the burner gas shows 9% SO₂ and 7% O₂. The cinder is analysed and it is found that it contains 3% sulphur as SO₃. Assuming that all the sulphur in the feed is burnt, calculate the weight of pyrites burnt per 100 kmol SO₃-free burner gas. 10
7. (a) Calculate the heat of reaction for the esterification of ethyl alcohol with acetic acid if the standard heats of combustion are: ethyl alcohol (l), - 1367 kJ/mol; acetic acid (l), - 872 kJ/mol; and ethyl acetate (l), - 2275 kJ/mol. 5
- (b) Discuss on the effect of temperature on heat of reaction. 5
8. Write short notes on any **two** : 5×2
- (a) Van der Waal's theory
- (b) Effect of temperature on heat capacity
- (c) Adiabatic flame temperature
- (d) Humidity chart.