Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Course: Mass Transfer-II **Semester: VI**
Program: B.Tech (CE+RP) **Time 03 hrs.**
Course Code: CHCE 3005 **Max. Marks: 100**

Instructions: In case of data missing make necessary assumptions
(i) Read the instruction carefully before attempting.
(ii) This question paper has total five questions. All questions are compulsory. Attempt all the sub-parts of a question together.
(iii) Answer sheet to be submitted within 24 hrs from the scheduled time as the examination starts at 10:00 AM; the answers must be submitted by 09:59:59 AM next day.
(iv) No submission of Answer-sheet shall be entertained after 24 Hrs.
(v) The Answers should be attempted in blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sap-id at the top and signature at the bottom (right hand side bottom corner) of each page

S. No.	**SECTION A (5X20=100) (**Attempt **all** questions**)**	**Marks**	**CO**
Q 1	1500 m^3/h of a gas mixture containing 20 mole% solute and rest inert enters the absorber at 250 K temperature &106.6 kPa pressure to remove 80% of original solute. Solute free water used for absorption contains 10 mole% solute when it leaves the tower at the bottom. Calculate the solvent flow rate to tower.	**20 M**	**CO2**
Q 2	An aqueous solution containing valuable solute is coloured by small amounts of an impurity. It is to be decolourised by adsorption of an impurity on an adsorptive carbon. The equilibrium data obtained by stirring various amounts of adsorbent with original solution at constant temperatures are as follows: Kg carbon/kg solution: 0, 0.001, 0.004, 0.008, 0.02, 0.04 Equilibrium colour: 9.6, 8.6, 6.3, 4.3, 1.7, 0.7 The original solution has a colour concentration of 9.6 measured on an arbitrary scale and it is desired to reduce the colour to 15% of its original value. Determine the quantity of fresh carbon required per 2**XY** kg of solution for a two stage countercurrent adsorption. Where **XY** is the last two digits of student SAP ID.	**20 M**	**CO3**
Q 3	A wet solid is dried from 40% to 10% moisture under constant drying conditions in 5 hours. If the equilibrium moisture content is 0.0416 kg moisture/kg dry solid and the critical moisture content is 14%, how long will it take to dry from 40% to 5% moisture under the same conditions. All percentages other than equilibrium moisture content are on wet basis. Assume linear relation between rate of drying and moisture content during falling rate period.	**20 M**	**CO4**

Table for Q 2:

Kg carbon/kg solution	0	0.001	0.004	0.008	0.02	0.04
Equilibrium colour	9.6	8.6	6.3	4.3	1.7	0.7

Q 4	If 250 kg of a solution of acetic acid (C) and water (A) containing 30% acid is to be extracted two times cross currently with isopropyl ether (B) at 20 ^oC, using 50 kg of solvent in each stage, determine the quantities and compositions of the various streams. How much solvent would be required if the same final raffinate concentration were to be obtained with one stage? Equilibrium Data: (see table below)	**20 M**	**CO1**

Equilibrium Data:

Water layer (100 kg)			Isopropyl ether layer (100 kg)		
Acetic acid	Water	Isopropyl ether	Acetic acid	Water	Isopropyl ether
0.69	98.1	1.2	0.18	0.5	99.3
1.41	97.1	1.5	0.37	0.7	98.9
2.89	95.5	1.6	0.79	0.8	98.4
6.42	91.7	1.9	1.93	1.0	97.1
13.30	84.4	2.3	4.82	1.9	93.3
25.50	71.1	3.4	11.40	3.9	84.7
36.70	58.9	4.4	21.60	6.9	71.5
44.30	45.1	10.6	31.10	10.8	58.1
46.40	37.1	16.5	36.20	15.1	48.7

Q 5	i) Give classification of cooling towers. Explain natural draft and mechanical draft cooling tower in detail. ii) Determine the following psychrometric properties of a moist air sample having a dry bulb temperature 35 ^oC and a humidity of 0.025 kg/kg dry air using the psychrometric chart and the vapor pressure equation for water a) Relative humidity b) dew point The Antoine equation for water is $\ln P_A^V = 11.965 - 3984.9/(T-39.7)$. The total pressure is 1 atm.	**15+5 M**	**CO5**