Name:

Enrolment No:

UPES
UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Mass Transfer-II **Semester: VI**
Program: B.Tech (CE+RP) **Time 03 hrs.**
Course Code: CHEG313 **Max. Marks: 100**
Instructions: In case of data missing make necessary assumptions

S. No.	**SECTION A (4X5=20) (**Attempt **all** questions**)**	**Marks**	**CO**
Q 1	Explain the procedure to determine the number of theoretical stages for multi stage counter-current leaching.	**5 M**	**CO1**
Q 2	What are the factors which influence the adsorption of a gas on a solid?	**5 M**	**CO3**
Q 3	Justify the statement "Drying and evaporation are not the same unit operation".	**5 M**	**CO4**
Q 4	In a graph, draw the equilibrium and operating lines for absorption and stripping with help of material balance expressions.	**5 M**	**CO2**
	SECTION B (4X10=40) (Answer **all** the questions and **any one** in question **no. 8)**		
Q 5	With the help of a typical drying curve, explain the following: i) Constant and falling rate periods ii) Equilibrium moisture content iii) Bound moisture iv) Free moisture content v) Critical moisture content	**10 M**	**CO4**
Q 6	500 kg/min of dry air at 20 °C, carrying 5 kg water vapor per minute are to be dehumidified with silica gel to 0.001 kg water per kg of dry air. The operation has to be conducted isothermally and counter-currently with 25 kg per minute of silica gel. How many theoretical stages will be required and what will be the water content of the silica gel leaving the bottom stage? Equilibrium data at 20 °C are as follows:	**10 M**	**CO3**
Q 7	1000 m^3/h of a gas mixture containing 10 mole% solute and rest inert enters the absorber at 300 K temperature &106.6 kpa pressure to remove 90% of original solute. Solute free water used for absorption contains 5 mole% solute when it leaves the tower at the bottom. Calculate the solvent flow rate to tower.	**10 M**	**CO2**

Kg water/Kg dry silica gel	0	0.05	0.10	0.15	0.20
Kg water/Kg dry air	0	0.0018	0.0036	0.0050	0.0062

Q 8	Give classification of cooling towers. Explain mechanical draft cooling tower in detail. OR Define the following: a) Dry bulb temperature c) Humid heat b) Relative humidity d) Humid volume e) Enthalpy	**10 M**	**CO5**
SECTION C (2X20=40M) Question **No. 9** compulsory. Answer **any one** in question **No. 10**			
Q 9	Develop an expression to determine the height of packing in terms of overall mass transfer coefficient when the driving force is the pressure difference.	**20 M**	**CO2**
Q 10	A porous solid is dried in a batch dryer under constant drying conditions. Five hours are required to reduce the moisture content from 25 to 6%. The critical moisture content was found to be 14% and the equilibrium moisture 4%. All the moisture contents are on the dry basis. Assuming that the rate of drying during falling rate period is proportional to the free moisture content, how long should it take to dry a sample of same solid from 20 to 6% under the same drying conditions? OR Explain the working principle and application of dryers with neat schematic diagram?	**20 M**	**CO4**

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S. No.	**SECTION A (4X5=20) (**Attempt **all** questions**)**	**Marks**	**CO**
Q 1	Explain the procedure to determine the number of theoretical stages for multi stage cross current extraction.	**5 M**	**CO1**
Q 2	What is adsorption isotherm? List out equations for Langmuir and Freundlich adsorption isotherms.	**5 M**	**CO3**
Q 3	List out various physical mechanisms of moisture transportation during drying.	**5 M**	**CO4**
Q 4	Define stripping? Draw the operating line equation for counter current stripping.	**5 M**	**CO2**
	SECTION B (4X10=40) (Attempt a**ll** questions**)**		
Q 5	Explain the working principle of spray dryer and tray dryers with neat schematic diagram. Also, give the relative merits and demerits.	**10 M**	**CO4**
Q 6	An aqueous solution containing a valuable solute is colored by small amounts of an impurity. It is to be decolorized 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:	**10 M**	**CO3**

Kg carbon/kg solution	0	0.001	0.004	0.008	0.02	0.04
Equilibrium color	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 20% of its original value. Determine the quantity of fresh carbon required per 500 kg of solution for single stage adsorption.

Q 7	With neat schematic diagram, describe different types of packing materials used to carry out absorption operation. Also, explain their characteristics.	**10 M**	**CO2**
Q 8	Define the following: a) Dry bulb temperature b) Relative humidity c) Humid heat d) Humid volume e) Enthalpy	**10 M**	**CO5**
	SECTION C (2X20=40M) Question **No. 9** compulsory. Answer **any one** in question **No. 10**		
Q 9	Develop an expression to determine the height of packing in terms of individual	**20 M**	**CO2**

	mass transfer coefficient.		
Q 10	A wet solid is dried from 35% to 10% moisture under constant drying conditions in 5 hours. If the equilibrium moisture content is 4% and the critical moisture content is 14%, how long will it take to dry from 30% to 6% moisture under the same conditions. All percentages are on wet basis. Assume linear relation between rate of drying and moisture content during falling rate period. OR Derive the relation to determine the time needed for constant drying and falling rate period of the batch drying operations.	**20 M**	**CO4**