Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2163506 **Date:06/05/2016**

Subject Name: Unit Operations II

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) A slab of paper pulp 1.5 m x 1.5 m x 5 mm is to be dried under constant drying conditions from 65% to 30% moisture (wet basis) and the critical moisture is 1.67 kg free water per kg dry pulp. The drying rate at the critical point has been estimated to be 1.40kg/ (m^2) (hr). The dry weight of each slab is 2.5 kg. Assuming drying to take place from the two large faces only, calculate the drying time to be provided. **07**

(b) Give applications of Reverse Osmosis method and explain any one in short. **07**

Q.2 (a) Give and explain mechanism used in microfiltration process with diagram. **07**

(b) Sheet material measuring 1m^2 and 5 cm thick is to be dried from 45% to 5% moisture under constant drying conditions. The dry density of the material is 450 kg per cubic meter and its equilibrium moisture content is 2%. The available drying surface is 1 m^2. Experiments showed that the rate of drying was constant at 4.8 kg / (hr) (m^2) between moisture contents of 45% and 20% and thereafter the rate decreased linearly. Calculate the total time required to dry the material from 45% to 5%. **07**

OR

(b) Under constant drying conditions, a wet solid is dried from 30 percent to 4 percent. The time taken is 4 hours. All are on dry basis. The equilibrium moisture content is 2 percent. Critical moisture content is 10 percent. How long it takes to dry to 7 percent? Assume the falling rate period is linear i.e. rate of drying is proportional to free moisture content. **07**

Q.3 (a) What are the different modules used for membrane separation? Explain any one in short. **07**

(b) A wet solid of 28 % moisture is to be dried to 0.5% moisture in a tray dryer. A laboratory test shows that it requires 8 hours to reduce the moisture content of the same solid to 2 %. The critical moisture content is 6 % and the equilibrium moisture is 0.2%. The falling rate of drying is linear in the free moisture content. Calculate the drying time of the solid if the drying conditions similar to those in the laboratory test are maintained. All moistures are expressed as per cent of bone dry mass of the solid **07**

OR

Q.3 (a) Explain drying curves with suitable diagram **07**

(b) 1400Kg (bone dry) of granular solid is to be dried under constant drying conditions from a moisture content of 0.2Kg/Kg dry solid to a final moisture content of 0.02Kg/Kg dry solid. The drying surface is given as 0.0615m2 /Kg dry solid. Under the same conditions the following rates were previously know. Estimate the time required for drying. **07**

Moisture content	0.3	0.2	0.14	0.096	0.056	0.046	0.026	0.016
Rate of Drying	1.71	1.71	1.71	1.46	1.29	0.88	0.54	0.376

Where ,X=kg /kg of dry solid,N=kg/hr.m^2

Q.4 (a) Explain in detail the principle and working of venturi Scrubber **07**

(b) Explain fluidization process with suitable diagram of Pressure drop and bed height versus superficial velocity for a bed of solids **07**

OR

Q.4 **(a)** Write a short note Clarifocculator **07**

(b) Explain environmental carbon filters for water purification **07**

Q.5 **(a)** Give and explain advantages and commercial applications of fluidized beds? **07**

(b) A continuous counter-current dryer is used to dry 425.6 kg dry solid/h containing 0.035 kg total moisture/ kg dry solid to a value of 0.0017 kg total moisture/ kg dry solid. The granular solid enters at 25°C & leaves at 60°C. The heating medium is air which enters at 84.2°C, has a humidity of 0.0175 kg H_2O/kg dry air & leaves at 32.8°C. Calculate the air flow rate & the outlet humidity, assuming the heat losses from the dryer to be 9300 kJ/hr. The constant heat capacity of the dry solid is 1.465 kJ/kg.K. **07**

Latent heat of water at 0^0C = 2501 kJ/kg, Heat capacity of water = 4.187 kJ/kg.K , Latent heat of condensation of steam = 2215 kJ/kg

OR

Q.5 **(a)** Give the classification of dryers and give the factors to be consider while selection of the dryer **07**

(b) An uninsulated hot air countercurrent rotary dryer (1200 mm dia. * 6.7 m long) is used to dry ammonium sulphate from 3.5 to 0.2% moisture. The atmospheric air at 25^0C, 50% relative humidity will be heated by passing it over steam coils to 90^0C before it enters the dryer. The air leaves the dryer at 32^0C. The solid enters at 25^0C and leaves the dryer at 60^0C. The dried ammonium sulphate (i. e product) rate from dryer is 900 kg/h. Determine the air flow rate to the dryer (on dry basis) and steam consumption per kg of water evaporated (in to the air). **07**

Latent heat of water at 0^0C = 2501 kJ/kg, Heat capacity of water = 4.187 kJ/kg.K , Latent heat of condensation of steam = 2215 kJ/kg

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