UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
DEHRADUN
End Semester Examination - May, 2022

Program/Course : M. Tech Chemical Engineering
Subject: Scale up Methods
Code: CHPD 7025P
No. of pages: 01

Semester: II
Max. Marks: 100
Duration: 3 hrs

NOTE:

(A) **OPEN BOOK and OPEN NOTES EXAMINATION**

(B) Assume all missing data. **State your assumptions clearly.** Sketch wherever necessary.

ANSWER ANY TWO QUESTIONS

1. A pilot plant vessel having a diameter of 305 mm is agitated by a six-bladed turbine impeller (with diameter 102 mm). The impeller Reynolds number is 10^4 and the mixing time is 15 s. The power required for mixing is 0.4 kW/m^3. If it has been planned to scale up this mixing vessel to industrial scale with a ratio of 1:6,

   (a) Calculate the power required with same blending time? [15 marks]

   (b) Comment on the power requirement with same blending time.
   Hint: For intense agitation 4-5 kW/m^3 power is the maximum required, including power to drive gear reduction units, agitator shaft rotation, etc.
   [20 marks]

   (c) Calculate the blending time if the same power of pilot plant has to be used? [15 marks]

   [CO2, CO3]

2. In a pilot plant, a viscous oil is being cooled from 200 to 110°C, using 1 inch jacked pipe with the water flowing at average temperature of 30°C. To get greater cooling of the oil, exchanger has to be replaced with 1.5 inch diameter pipe with the same length. If the flow is in laminar condition what is the effect of this change with increased diameter.

   [50 marks]
   [CO1, CO3]

3. In an adsorption tower, the width of the mass transfer zone depends on the mass transfer rate, the flow rate and the shape of the equilibrium curve. Usually lab scale adsorbers are designed with small diameter bed and the large units are designed for same particle size and superficial velocity. Deduce all the dimensionless parameters connecting the scale up of adsorber from a lab-scale to an industrial scale.

   [50 marks]
   [CO1, CO2]