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# B. M. S. College of Engineering, Bengaluru - 560019

**Autonomous Institute Affiliated to VTU**

## September / October 2023 Supplementary Examinations

**Programme: B.E.** **Semester: VII**
**Branch: Chemical Engineering** **Duration: 3 hrs.**
**Course Code: 19CH7DELE2** **Max Marks: 100**
**Course: Pilot Plant and Scale up Studies** **Date: 21.09.2023**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably assumed.





### UNIT - I

1. a) Explain the following terms: **10**
   i) Model and Prototype
   ii) Distorted model and Element

   b) The characteristics of the spillway are to be studied by means of geometrically similar model constructed to the scale ratio of 1:10 **10**
   i) If the maximum rate of flow in the prototype is 28.3 $m^3/s$, what will be the corresponding flow in the model?
   ii) If the measured velocity in the model at a point on the spillway is 2.4 m/s, what will be corresponding velocity in prototype?
   iii) If the hydraulic jump at the foot of the model is 50mm high, what will be the height of jump in prototype?
   iv) If the energy dissipates per second in the model is 3.5 Nm, What energy is dissipated per second in the prototype.

### UNIT - II

2. a) What is the principle of similarity? Explain in brief (i) Geometric similarity and (ii) Dynamic similarity with example. **08**

   b) Using dimensional analysis method, derive the dimensionless equation to represent the flow of fluid in isothermal condition. **12**

### UNIT – III

3. a) What is 10ºC temperature coefficient of reaction rate and effect of agitation? How it can be used to decide the controlling regime? **10**

   b) How are similarities achieved in static regime, when conditions are load controlling and mass controlling? **10**

## UNIT - IV

4. a) A heavy tar-oil emulsion is to be prepared batch wise in a steam jacketed pan 0.6 m fitted with a stirrer, Pilot scale experiments were conducted in a jacketed pan 0.1 m in diameter with a propeller stirrer at 1500 rpm. The heating up time for a batch was 2.4 min and power consumption was 0.004 hp determine the stirrer speed in the larger unit, power consumption. **10**

   b) Describe the scale up equations for liquid mixing equipment. **10**

**OR**

5. a) (i)What is power number? Convert pressure coefficient into power number. **08**
   (ii) Differentiate between baffled and un-baffled mixer.

   b) A Petroleum thermal cracking still contains 68 tubes and 30ft long by 3" ID followed by 78 tubes 30ft long by 4" ID, arranged to carry two systems of oil in parallel. The throughput is 3000 barrels per day of oil preheated to 300 F. It is desired to conduct a model still having a throughput of 10 stack and operating conditions in the large still. Calculate the diameter and length of the tube required in the model (if cracking 1500 barrels per day) **12**

   Data: Total length of 3" tube= 1020 ft

   Total length of 4" tube =1170ft

## UNIT - V

6. a) Describe liquid film and gas film controlling criteria for theoretical scaling up of absorption column. **10**

   b) Briefly explain and conclude the scaleup rules for different transfer operations. **10**

**OR**

7. a) Describe the scaleup procedure for gas absorption to determine the effect of packing diameter on HTU. **08**

   b) Briefly write about the scale up equation for natural convection heat transfer. **12**

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