Name:

Enrolment No:

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

Programme Name: B.Tech. CERP **Semester : VI**
Course Name : Chemical Reaction Engineering II **Time : 03 hrs**
Course Code : CHCE3006/CHEG334 **Max. Marks: 100**
Nos. of page(s) : 02

Instructions: (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.		Marks	CO
Q 1	**(a).** What is the importance of pores in a catalyst particle? Differentiate micro and macro pore. **(b).** The rate law of hydrogenation (H) of ethylene (E) to form ethane (A) over a cobalt-molybdenum catalyst is: $-r_R = \frac{k P_E P_H}{1 + K_E P_E}$ Suggest a mechanism & rate limiting step consistent with the rate law given.	**5+15**	**CO2**
Q 2.	**(a).** What is effectiveness factor? Derive a relationship between effectiveness factor and Thiele Modulus. **(b).** Develop Langmuir Hinshelwood model for the following reaction when adsorption of A is rate limiting step A + B $\longleftrightarrow$ R +S	**10+10**	**CO 3**
Q 3.	The following data on an irreversible reaction are obtained with decaying catalyst in a batch reactor (batch-solids, batch-fluid) what can you say about kinetics: C_A: 1.000, 0.802, 0.675, 0.532, 0.422, 0.363 T, hr: 0, 0.25, 0.5, 1, 2, (∞)	**20**	**CO 5**
Q 4.	Water is drawn from a lake with the help of a pump. The drawn water passes through a long pipe in turbulent flow. A slug of tracer (not an ideal pulse input) enters in the intake line at the lake and is recorded downstream at two locations in the pipe. These locations are L meters apart from each other. The mean residence time of fluid between recording points is 100sec and variances of the two recorded signals are $\sigma_1^2 = 800\ Sec^2$	**20**	**CO1**

	$\sigma_2^2 = 900\ Sec^2$ What would be the spread of an ideal pulse response for a section of this pipe, free from end effects and of length L/5?		
Q 5.	**(a).** A first-order reaction $A \rightarrow 3B$ is taking place in a PBR. The particles are 10 mm in diameter and the intrinsic rate constant (k) is 0.8 lit/kg-cat-s. A conversion of 75% is desired. Feed at 4 mol/s, containing 40% A and 60% inerts enters the reactor at $127^{O}C$ and 5 atmospheres. The engineer designing the reactor neglects to consider that there might be internal diffusion to consider. **(i).** How much weight of the catalyst does the engineer pack the reactor with, if the engineer designing the reactor neglects any internal diffusion? **(ii).** If the diffusion coefficient is 0.08 cm^2/s ad bulk density of the catalyst is 2.8 kg/liter, what conversion would actually result with the catalyst packed? **(b).** How much catalyst is needed in a packed bed reactor for 80% conversion of 1000 m^3/hr of pure gaseous A (C_{Ao} = 100 mol/m^3) if the stoichiometry and rate are given by, **A** $\longrightarrow$ **R** $\quad -r'_A = \frac{50C_A}{1+0.02C_A}\ \frac{mol}{kg.hr}$	**10+10**	**CO4**