

Name:	 UPES UNIVERSITY WITH A PURPOSE
Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, January 2021

Programme Name: M.Tech (CE+PDE)	Semester : I
Course Name : Catalysis and Catalytic Materials	Time : 3 h
Course Code : CHPD7020P	Max. Marks: 100

Instructions :

No of Pages : 2

Wherever you are asked to use SAP ID, strictly use the digits of your SAP ID only.

SECTION A **6 X 5 = 30 Marks**

S. No.		Marks	CO
Q 1	Give any two advantages of homogeneous catalysis over heterogeneous catalysis.	5	CO1
Q 2	Mention a process and the catalyst used in petroleum refining and petrochemical industries.	5	CO2
Q 3	Name the forces acting during drying and how does it affect the pore diameter?	5	CO3
Q 4	What are the shape selectivities shown by zeolite catalysts? Give an example each.	5	CO3
Q 5	Name a method each to determine the surface and bulk structure and composition of catalyst.	5	CO4
Q 6	What is the condition in which reactive distillation be employed and give any one of its advantage.	5	CO5

SECTION B **5 X 10 = 50 Marks**

Q 1	(a) Name the steps involved in a heterogeneous catalytic reaction and explain any one of them. (b) Give any two important selectivity shown by homogeneous catalysts with an example each.	6 4	CO1
Q 2	(a) What are the catalytic processes and catalyst involved in the conversion of naphtha to hydrogen. (b) Arrive the catalytic active center for alkylation of benzene to alkyl aromatics based on its mechanism.	6 4	CO2
Q 3	Arrive the catalytic active center for catalytic cracking from its reaction mechanism and discuss the manufacture of FCC catalyst containing the same with the help of flow diagram. (Or) Discuss the manufacturing schemes of hydrotreating catalysts of different forms with the help of flow diagram.	10	CO3
Q 4	What is the importance of particle size of catalyst on its activity? Describe any one method of its determination.	10	CO4
Q 5	Name the important air pollutants present in automobile exhaust and explain any one catalytic system to mitigate it.	10	CO5

SECTION C

1 X 20 = 20 Marks

Q 1

ZSM-12 is synthesized by hydrothermal crystallization using the autoclave of capacity x ml using the following reactants;

- (i) Ludox HS-30(30 wt% of SiO_2 dispersed in water)
- (ii) TEAOH (40% aqueous solution)
- (iii) NaOH
- (iv) Sodium aluminate (NaAlO_2)
- (v) water

Calculate the amount of each of the above reactant to be taken, when the starting gel composition is 0.5 TEAOH 0.3 Na_2O 0.1 Al_2O_3 SiO_2 250 H_2O .

x is equal to last three digits of your SAP ID. Assume that volume of gel to be taken is $\frac{2}{3}$ of the volume of the autoclave.

Compound	Molecular weight (g/mole)
SiO_2	60.08
TEAOH	147.6
NaOH	39.997
NaAlO_2	81.97
H_2O	18

(Or)

W kg of Iron-Cobalt oxide ($\text{Fe}_2\text{O}_3 - \text{Co}_2\text{O}_3$) having Fe/Co ratio of 2 is to be prepared from the following reactants by co-precipitation method;

- (i) Ferrous nitrate
- (ii) Cobaltous nitrate
- (iii) Sodium hydroxide.

Calculate the amount of each of the above reactant to be taken. W is equal to last two digits of your SAP ID.

Compound	Molecular weight (g/mole)
Ferrous nitrate	179.855
Cobaltous nitrate	182.943
Sodium hydroxide	39.997

20

CO3