UPES
End Semester Examination, December 2024

Course: Catalyst Design and Catalysis   **Semester: VII**
Program: B.Tech (Chemical Engineering)   **Time : 03 hrs.**
Course Code: CHCE3045P   **Max. Marks: 100**

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Calculate and compare the atom efficiency of the following non-catalytic and catalytic reactions. Non-catalytic route: $3CH_3–CHOH–CH_3 + 2CrO_3 + 3H_2SO_4 \rightarrow 3CH_3–CO–CH_3 + Cr_2(SO_4)_3 + 6H_2O$ Catalytic route: $CH_3–CHOH–CH_3 \xrightarrow{CuO\text{-}NiO} CH_3–CO–CH_3 + H_2$ Molecular weights: $CH_3–CO–CH_3 = 58$ g/mol; $Cr_2(SO_4)_3 = 392$ g/mol; $H_2O = 18$ g/mol $H_2 = 2$ g/mol	4	CO1
Q 2	Write the mechanism of isomerization over a bifunctional catalyst.	4	CO2
Q 3	Give any two changes that occur during the calcination of the catalyst.	4	CO2
Q 4	List any one method each for the surface and bulk composition and surface and bulk structure of the catalyst.	4	CO3
Q 5	Give the name of a catalysts each for any two biofuels and biochemicals production.	4	CO4

SECTION B
(4Qx10M= 40 Marks)

Q 6	Discuss the mechanism of the catalytic cracking and the generation of active sites required for the same in zeolites.	10	CO2
Q 7	Describe the manufacturing and activation of hydrotreating catalyst. **(Or)** Explain the manufacture of alumina support and its impregnation with platinum for the catalytic reforming catalyst.	10	CO2
Q 8	Explain the method of temperature programmed desorption of ammonia for the determination of the acidity of the catalyst.	10	CO3
Q 9	Explain the mechanism of hydrothermal liquefaction to convert waste into bio-oil and catalyst development for the same.	10	CO4

SECTION-C

		(2Qx20M=40 Marks)		
Q 10	The following data was obtained when nitrogen adsorption was carried out for Fe-MCM-41 catalyst at liquid nitrogen temperature after degassing at 300ºC and 200 mm Hg.		20	CO3

Relative Pressure (P/Po)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm³/g STP)
0.051868914	35.539452	8.6385
0.089397138	61.254021	12.3880
0.102701253	70.370468	13.6862
0.119825441	82.104591	15.3367
0.137284441	94.068733	17.0064
0.154740772	106.030899	18.6649
0.188910884	129.445923	21.8817
0.207519800	142.198380	23.6333
0.225672639	154.638535	25.3404
0.244013843	167.207977	27.0630
0.261430736	179.145020	28.6995
0.280918990	192.500961	30.5280
0.299163982	205.005173	32.2441
0.389007665	266.574890	40.7162
0.433498626	297.065704	44.9507
0.477861070	327.470367	49.2040
0.521783380	357.572662	53.4520
0.566832357	388.447571	57.8438
0.611029253	418.739075	62.1904
0.655588284	449.281189	66.6269
0.699965118	479.697174	71.1211
0.732527217	502.016785	74.4935
0.765442665	524.581177	77.9904
0.797959802	546.873169	81.5763
0.830979088	569.507446	85.3920
0.863010456	591.470093	89.4086
0.895715140	613.894958	94.0710
0.927088884	635.413818	99.8144
0.988075273	677.328735	173.7279
0.898067754	615.628296	95.9978
0.788424102	540.467224	80.7752
0.588543394	403.448364	60.0328
0.493425596	338.244812	50.7255
0.399925155	274.149963	41.7251
0.298981376	204.952682	32.1603
0.199751115	136.930023	22.8174
0.100871926	69.148026	13.4184

Calculate Langmuir surface area of the catalyst.

(Or)

For the above data, calculate the BET surface area of the catalyst.

11	(a) Discuss the mechanism of hydrocracking, the active centers and their amount on the product distribution.	10	CO2
	(b) List out the various steps involved in the assembly of solid catalyst and describe any two of them in detail.	10	