Total No. of printed pages = 4

63/2 (SEM-2) CHM 201

2022

CHEMISTRY

(Theory Paper)

Paper Code : CHM 201

(Physical Chemistry-II)

Full Marks – 80

Time – Three hours

The figures in the margin indicate full marks for the questions.

1. Answer any *three* of the following questions : 5×3=15

(a) What is Schwarz's inequality ? What is the difference between observable and operators ? 2+3=5

(b) What are the basic requirements for a wave-function to be acceptable in quantum chemistry ? 5

(c) Prove that the eigen-functions of a Hermitian operator are orthogonal. 5

[Turn over

(d) Justify the statement "A system that is specified by a set of states ψ_1, ψ_2,..... has simultaneously and precisely specifiable quantities P and Q if and only if their operators P and Q commute for all the wave-functions ψ". 5

(e) What do you mean by eigenvector matrix ? Write down the properties of eigenvector matrix. 2+3=5

2. Answer any *four* of the following questions : 5×4=20

(a) What are oscillatory chemical reactions ? Mention three essential conditions for chemical oscillations to occur. What is bistability ? 1+3+1=5

(b) Write short notes on chemical chaos. 5

(c) Explain branching chain reaction taking the example of reaction between hydrogen and oxygen. What do you mean by explosion limits ? 3+2=5

(d) What is Belousov-Zhabotinski reaction ? Write its mechanism. 5

(e) Write Michaelis-Menten mechanism. 5

(f) Explain Lineweaver-Burk and Eadie plots. What is enzyme inhibition ? 4+1=5

3. Answer any *three* of the following questions : 5×3=15

(a) Explain the transition state theory of reaction rate. 5

(b) Consider a bimolecular reaction and illustrate how reactive cross-section varies with energy. What is the significance of this variation ? 5

(c) How do you calculate trajectory of colliding molecules ? How does TST differ from hard sphere model of collisions ? 3+2=5

(d) What are the advantages of transition state theory over collision theory ? 5

4. Answer any *two* of the following questions : 5×2=10

(a) What are atom transfer and electron transfer reactions ? Explain with examples. 5

(b) What are metal cluster catalysts ? Explain the role of $OS_3(CO)_{12}$ in the isomerization of alkene. What are the disadvantages of metal cluster catalysts ? 5

(c) What type of catalysts is used in hydrogenation of organic compounds ? Discuss the mode of action of one such catalyst. 5

5. Answer any *four* of the following questions : $5 \times 4 = 20$

(a) Explain the factors that ensure the stability of a colloid with examples. 5

(b) Write short notes on : $2\frac{1}{2}+2\frac{1}{2}=5$

(i) Zeta potential

(ii) Electrical double layer.

(c) How are micelles and reverse micelles formed ? Describe with examples. 5

(d) Derive an expression for Langmuir theory of adsorption. 5

(e) Write down the differences between coarse emulsions and micro emulsions. 5

(f) Draw an activation energy profile for dissociative adsorption of hydrogen on clean Ni-surface. 5

(g) Explain the kinetics of heterogeneous catalysis with Riedel-Eley model. 5