M.Sc. CHEMISTRY
Third Semester (Repeat)
PHYSICAL CHEMISTRY-III
(MSC - 303)

Duration: 3Hrs.   **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins.   **Marks: 50**

Answer any *four* from *Question no.* 2 to 8
Question no. 1 is compulsory.

1. (i) Define FRET. What are the essential criteria to occur energy transfer between a donor-acceptor pair? What is Forster distance of FRET?   (3)

   (ii) Draw the Jablonski diagram and explain all the deactivation processes. (3)

   (iii) Write short notes on: (2+2=4)

   (a) Stoke's shift   (b) Heavy atom effect

2. (a) Define overpotential and exchange current density.   (3)

   (b) How equivalent conductance is related to specific conductance?   (2)

   (c) What is active transport and passive transport? Discuss the primary active transport.   (2)

   (d) Discuss briefly about chemiluminescence.   (3)

3. (i) Discuss briefly-   (5)

   (a) E-type delayed fluorescence

   (b) P-type delayed fluorescence.

   (ii) What do mean by fluorescence quenching? Derive Stern-Volmer equation of fluorescence quenching.   (5)

4. (a) What is meant by ionic strength of a solution? Calculate the ionic strength of a solution prepared by mixing 0.2 M KNO_3, 0.15 M K_2SO_4 and 0.05M $Cu(NO_3)_2$. (5)

(b) Discuss sliding filament model in muscle contraction along with the energy requirement for the process. (5)

5. (a) What is a coupled reaction? How a coupled reaction can drive an endergonic reaction to exergonic? Illustrate with an example. (5)

(b) What is ATP? Why ATP is considered as high energy molecule? (3)

(c) What is the free energy change for the active transport for glucose having 30000 times higher concentration inside the cell as compared to outside at 27° C. (2)

6. (a) What is Pilling Bedworth rule? (3)

(b) Explain the following terms with suitable example: (3)

   (i) Autocatalysis   (ii) Induced catalysis   (iii) Promoters

(c) Discuss about the mechanism of heterogeneous catalysis. (4)

7. (a) Work out the thermodynamic relationship to determine the surface excess from surface tension. (5)

(b) Discuss the Conductometric titration of a mixture of HCl and acetic acid with NaOH along with suitable plots. (5)

8. (a) What do you mean by phase transfer catalyst (PTC)? Write briefly about the mechanism of its action. (4)

(b) Explain the following term regarding hetereogenous catalysis with suitable example- (6)

   (i) Reactant Selectivity

   (ii) Product Selectivity

   (iii) Transition State Selectivity

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Duration: 20 minutes   **Marks – 20**

(PART A - Objective Type)

I. Choose the correct answer: **1×20=20**

1. Main energy supply during muscle contraction happens from-
   (a) ATP   (b) Phospho-enol pyruvate
   (c) creatine phosphate   (d) GTP

2. For chemiluminescence, the chemical reaction must be-
   (a) endothermic,   (b) exothermic,
   (c) product is in the excited state   (d) both (ii) and (iii)

3. The electrocapillary maximum is defined as-
   (a) Potential of zero charge
   (b) Potential at which surface tension is maximum
   (c) Summit of the γ vs V curve (parabola)
   (d) All above

4. Norrish type I cleavage is-
   (a) α-cleavage   (b) β-cleavage
   (c) γ-cleavage   (d) None of these

5. Critical Forster distance is defined as the distance where energy transfer efficiency is-
   (a) 0.40   (b) 0.50   (c) 0.60   (d) 1.00

6. "The constant capacity with change of potential is a weakness of parallel-plate model", which theory overcame this weakness?
   (a) Helmholtz-Perrin Theory   (b) Gouy-Chapman Theory
   (c) Stern Theory   (d) Devanathan Theory

7. The electronic transition corresponding to the highest energy is-
   (a) $\sigma \to \sigma^*$ (b) $\pi \to \pi^*$ (c) $n \to \pi^*$ (d) $n \to \sigma^*$

8. In Linear polarization resistance (LPR) technique for measuring corrosion monitoring, the probe used is-
   (a) mechanical probe
   (b) electrical probe
   (c) electrochemical probe
   (d) microbial probe

9. Under low field approximation of *Butler-Volmer equation*, current density varies-
   (a) Exponentially with overpotential
   (b) Linearly with overpotential
   (c) Quadratically with overpotential
   (d) None above

10. In polarography DME acts as-
    (a) Reference electrode   (b) Working electrode
    (c) Counter electrode   (d) None of the above

11. In polarography, if 'm' is the mass of the mercury drop and 't' is the drop time, the diffusion current proportional to-
    (a) $m^{2/3}t^{1/3}$ (b) $m^{3/2}t^{1/3}$
    (c) $m^{2/3}t^{1/6}$ (d) $m^{3/2}t^{1/6}$

12. Choose the correct statement.
    (a) production of ATP is exergonic process.
    (b) ATP is thermodynamically unstable but kinetically stable.
    (c) no ATP is produced in TCA cycle.
    (d) all statements are correct.

13. The main energy cycle in biological system involves-
    (a) NAD^+-NADH   (b) ATP-ADP
    (c) Creatine-Creatine phosphate   (d) FAD-$FADH_2$

14. The role of promoter is-
    (a) Increases the rate of the reaction
    (b) Decreases the rate of the reaction
    (c) Increases the activity of the catalyst
    (d) Decreases the activity of the catalyst

15. During glycolysis number of ATP molecule produced is-
    (a) 6   (b) 2   (c) 3   (d) 1

16. Intersystem crossing is favoured by-
    (a) Low $S_1 \to S_2$ energy gap   (b) High $S_1 \to T_1$ energy gap
    (c) Low $S_1 \to T_1$ energy gap   (d) High $S_0 \to S_1$ energy gap

17. Eosin shows-
    (a) Excimer   (b) P-type delayed fluorescence
    (c) E-type delayed fluorescence   (d) Both (i) and (ii)

18. The rate constant for fluorescence is the lowest for-
    (a) Br   (b) I   (c) Cl   (d) F

19. For P-type delayed fluorescence-
    (a) Low $S_0 \to S_1$ gap,   (b) High $S_0 \to S_1$ gap,
    (c) Low $S_1 \to T_1$ gap,   (d) High $S_1 \to T_1$ gap

20. One Dobson unit (DU) is the thickness of ozone layer that consist of number ozone molecules per unit area is-

(a) 2.69×10^{16}

(b) 2.69×10^{10}

(c) 3.0×10^{23}

(d) 5.0×10^{23}

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