Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 19

M.Sc. (Chemistry) (Campus) (2015 to 2017) (Sem.–2)

PHYSICAL CHEMISTRY-II(QUANTUM AND STATISTICAL CHEMISTRY)

Subject Code : CHL-413

M.Code : 51150

Time : 3 Hrs. Max. Marks : 70

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains SIX questions carrying FIVE marks each and students have to attempt ALL questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Determine whether the following operator is linear or nonlinear :

   d^2/dx^2

2. Determine whether the following functions are normizable or not over the indicated intervals : e^x $(0,\infty)$

3. What is the complex conjugate of the wave function ($\psi = 4 + 3i$)?

4. Write the conditions for two wavefunctions, $\psi_i(x)$ and $\psi_j(x)$ to be orthonormal.

5. Arrange the following states (term symbols) for p^2 configuration in the increasing order of energy : ^1D, ^3P and ^1S.

6. How many microstates are possible for d^3 configuration?

7. Write down time independent Schrodinger equation of one dimensional harmonic oscillator.

8. Write down the relation between thermodynamic probability and entropy.

9. Define the term partition function.

10. What is Einstein characteristic temperature? Explain its significance.

SECTION-B

11. Normalise the wave function $\psi = \cos(n\pi x/L)$ over the interval $-a<x<a$.

12. The energy of particle in 3-d box is $E = 25h^2/8mL^2$. How many degenerate states are possible and also write down the states?

13. Write a short note on degenerate perturbation theory.

14. Calculate the Bond Orders (B.O.) of O_2^+, O_2 and O_2^- using Molecular Orbital (MO) theory. Which one has the highest bond distance among the above three molecules?

15. Define heat capacities at constant pressure and constant volume. Mention the relationship between them.

16. Calculate the number of microstates for the distribution of three distinguishable particles in four boxes.

SECTION-C

17. Derive the Hückel MO theory for ethylene. Draw simple schematics of the bonding and anti-bonding energy level diagrams.

18. Show that if the linear operators A and B have common complete set of eigen functions, then A and B commute.

    Calculate the probability that a particle in 1-D box of length L is found between 0 and L/2.

19. Derive the Bose-Einstein distribution law.

    Consider 40 molecules divided equally between 4 non-degenerate energy levels. Calculate the thermodynamic probability (W) for this distribution?

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.