TB145170

B.Sc. DEGREE (C.B.C.S.S) EXAMINATION, OCTOBER 2016

SEMESTER V – CHEMISTRY

CHE5QMS – QUANTUM MECHANICS AND SPECTROSCOPY

Time: Three hours   **Maximum: 60 Marks**

PART A

I.Short answer questions (Answer all questions. Each question carries 1 mark)

1. State de Brogglie hypothesis.
2. What is an orbital?
3. Calculate the radius of the third orbit of hydrogen atom.
4. What is the condition for a molecule to be IR active?
5. What is Bathochromic shift?
6. State Grothus-Draper law.
7. What is fluorescence?
8. Define quantum yield.

                                                                                                            (8×1=8)

PART B

II.Brief answer questions (Answer any six questions. Each question carries 2 marks)

9. What is the expression for energy of a particle of mass m moving in a one dimensional box of width a? Calculate the energy of the particle when n=5.
10. What are the possible values of azimuthal quantum number, magnetic quantum number and spin quantum number when principal quantum number is 2?
11. The symmetric stretching of CO_2 molecule is Raman active, whereas asymmetric stretching is Raman inactive. Give reason.
12. What are Stoke's and Antistoke's lines?
13. Mention any 4 spectroscopic techniques and the region of electromagnetic spectrum associated with it.
14. Give the condition for a molecule to be microwave active and its selection rule.
15. What is the condition for a nucleus to be NMR active?
16. Why TMS is used as an internal standard in NMR spectroscopy?
17. What is Franck Condon principle?
18. What is Beer Lambert's law?   **(6×2=12)**

PART C

III. Descriptive (Short essay questions) (Answer any four questions. Each question carries 4 marks)

19. What are the postulates of quantum mechanics?
20. Explain Mutual exclusion principle.
21. What are fundamental frequencies and overtones?
22. Explain the principle of Mass spectrometry.
23. Briefly explain the principle of NMR spectroscopy.
24. Explain Jablonski diagram.

$(4\times4=16)$

PART D

IV. Long essay type questions (Answer any two questions. Each question carries 12 marks)

25. Explain molecular orbital theory.
26. Derive the expression for energy and radius for hydrogen like atoms.
27. Derive the expression for moment of inertia and rotational energy of a rigid diatomic molecule. Draw and label various rotational energy levels.
28. Explain nuclear shielding and deshielding using suitable examples. Sketch the NMR spectrum in high resolution of a) ethanol b) acetophenone c) ethyl acetate

$(2\times12=24)$