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**Reg. No. : .....**

**Name : .....**

**Fifth Semester B.Sc. Degree Examination, December 2021**

**First Degree Programme under CBCSS**

**Physics**

**Core Course VIII**

**PY 1544 – ATOMIC AND MOLECULAR PHYSICS**

**(2018 & 2019 Admission)**

Time : 3 Hours Max. Marks : 80

PART – A

Answer **all** questions in **one** or **two** sentences. **Each** question carries **1** mark.

1. Which experiment proves the spatial quantization of particle?
2. What is normal Zeeman effect?
3. What is Pauli's Exclusion Principle?
4. State Bragg's law of diffraction
5. A rotational spectrum lies in which range in electromagnetic spectra?
6. Write the selection rules for vibration transitions.
7. What are anti stokes lines?
8. State Franck-Condon principle.

P.T.O.

9. What do you mean by chemical shift in NMR spectroscopy?

10. What do you mean by isomer shift in Mossbauer spectroscopy?

**(10 × 1 = 10 Marks)**

## PART – B

Answer any **eight** questions not exceeding a paragraph. **Each** question carries **2** marks.

11. Write the important postulates of Bohr atom model.

12. Why the Balmer series of lines for hydrogen was the first to be observed rather than the Lyman and Paschen series.

13. What are singlet and triplet states?

14. Briefly explain anomalous Zeeman effect.

15. Explain term symbols with two examples.

16. What is Paschenbach Effect?

17. What do you mean by fine structure of atoms?

18. Briefly explain the characteristic X-ray spectrum.

19. How will you measure the wavelength of X-ray with a ruled grating?

20. What are the different types of energies possessed by a molecule?

21. Explain the effect of isotope substitution on the rotational spectrum of molecules

22. Explain the principle of mutual exclusion in vibration spectroscopy?

23. Briefly explain the quantum theory of Raman Scattering

24. What do you mean by sequences and progressions in electronic spectra?

25. What is the principle behind Mossbauer spectroscopy? Explain the term 'isomer shift'?

26. Using Bohr atom model, show prove that the sum of the frequencies emitted from two consecutive lines is the frequency emitted from the first and last.

**(8 × 2 = 16 Marks)**

## PART – C

Answer any **six** questions. **Each** question carries **4** marks.

27. The wavelength of the H line for hydrogen is 656.28 nm. What is the wavelength of the H line for Deuterium?

28. A carbon atom has its electrons with configuration $(1s)^2\ (2s)^2\ 2p\ 3p$. List all expected terms on the basis of the LS coupling scheme.

29. Draw the Zeeman pattern for the transition $6^1D_2 \rightarrow 5^1P_1$ of the cadmium atom.

30. Define Lande g factor and obtain the equation for Lande g factor in terms of angular momentum.

31. The electronic configuration of Mg is $1s^2\ 2s^3\ 2p^6\ 3s^2$. Obtain its ground state term.

32. Compute the energy of the $K_\alpha$, X-ray of Sodium (Z=11). The measured value of energy is 1.04 keV. Comment on the result.

33. Obtain the expression for rotational energy of a rigid rotor and show that the energy depends on the quantum number *(l)*.

34. The average spacing between adjacent rotational lines of CO molecule is 3.8626 $cm^{-1}$. Calculate the length of CO bond. (Given).

35. Rotation – vibration spectrum.

36. Classical description of Raman spectra.

37. Give three applications of NMR Spectroscopy.

38. Explain the principle of ESR spectroscopy.

**(6 × 4 = 24 Marks)**

## PART – D

Answer any **two**. **Each** question carries **15** marks.

39. Discuss the LS and JJ coupling schemes and explain how they are applying t study spatial quantization.

40. With the help of neat energy level diagrams, explain the Hyperfine structure o alkali metals.

41. Describe the origin of continuous and characteristic spectra of X rays.

42. Discuss the vibration spectra of diatomic molecules and obtain the fundamenta and overtone frequencies of molecules.

43. What is the principle of Raman spectra? Quantum theory of Raman spectra.

44. What is the principle of Electron Spin Resonance spectroscopy? Explain its resonance condition. Give at least three applications of ESR Spectroscopy.

**(2 × 15 = 30 Marks)**

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