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Reg.No :

Name :

MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) Regular EXAMINATION October 2025

Third SEMESTER

**Discipline Specific Core Course (DSC) - MG3DSCPHY202 - ATOMIC AND
MOLECULAR SPECTROSCOPY**

(2024 ADMISSION ONWARDS)

Duration: 1 Hour 30 Minutes

Maximum Marks: 50

***Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S), Interest(I)
and Appreciation(Ap)***

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short Answer Type Questions

Answer any **10** questions

Each question carries **2** marks

1. What do you mean by term symbols? [K] / [CO1]
2. Distinguish different molecular energies possessed by the molecule. [K] / [CO2]
3. State the condition required for a nucleus to be NMR active. [K] / [CO3]
4. What are the expressions for the energy of the states due to the Paschen-Bach effect when the magnetic spin quantum number is $\pm 1/2$? [K] / [CO1]
5. List two main limitations of Bohr's model. [U] / [CO1]
6. What is meant by j-j coupling in many-electron atoms? [U] / [CO1]
7. CH_4 is considered as a spherical top molecule. Why? [U] / [CO2]
8. Specify the spectral regions in which NMR and ESR belong. [U] / [CO3]

9. Calculate the magnitude of the orbital magnetic moment for an electron with orbital quantum number $l = 1$, expressed in terms of the Bohr magneton (μ_B). [K] / [CO1]
10. State the rule of mutual exclusion in centrosymmetric molecules. [U] / [CO2]
11. What is spin-orbit interaction? [K] / [CO1]
12. What is phosphorescence? [K] / [CO2]
13. Which types of species are typically studied by ESR spectroscopy? [U] / [CO3]
14. What is the Raman shift? [U] / [CO2]
- [2x10 = 20]**

Part B

Short Essay Type Questions

Answer any **6** questions

Each question carries **5** marks

15. Differentiate between normal and anomalous Zeeman effects in terms of cause, splitting pattern, and examples. [U] / [CO1]
16. What is the colour, frequency and energy of light of wavelength 460 nm in vacuum? [U] / [CO1]
17. What is zero-point energy? Derive its expression and discuss its significance. [U] / [CO2]
18. For a given nucleus under NMR, show that the energy splitting is proportional to the applied magnetic field. [U] / [CO3]
19. List and explain the various spectral line series of hydrogen. [U] / [CO1]
20. Plot the rotational energy levels and allowed transitions for a rigid diatomic molecule up to the rotational quantum number 3. Give the nature of the spectra if an isotope of higher mass is replaced one atom in the molecule. [U] / [CO2]
21. Explain how the sodium D-line doublet splits in the presence of a magnetic field as a brief explanation of the anomalous Zeeman effect. [U] / [CO1]
22. Compare rotational, vibrational and electronic spectra. [U] / [CO2]
- [5x6 = 30]**