

15P405

(Pages:2)

Name.....

Reg. No.....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, MARCH 2017

(CUCSS - PG)

(Physics)

CC15P PHY4 C12 - ATOMIC AND MOLECULAR SPECTROSCOPY

(2015 Admission)

Time: 3 Hours

Maximum: 36 Weightage

SECTION-A

Answer *all* questions. *Weightage 1* each.

1. Determine the term symbols for a 'ps' configuration?
2. Explain the Lande interval rule
3. What is anharmonicity? How does it affect the vibrational spectrum?
4. Explain the vibrational modes of H₂O molecule
5. In the vibration spectrum of N₂ molecule the alternate lines in the P and R branches are less intense, why?
6. Explain inverse Raman effect
7. Explain mutual exclusion principle. Give example
8. What is mean by FTIR? How it is different from ordinary IR
9. Explain progressions and sequences
10. Explain what is spin-spin coupling? what it's effect on NMR
11. What are the different relaxation processes associated with ESR
12. Discuss the decay schemes of ⁵⁷Co and ¹¹⁹Sn

(12x1= 12 weightage)

SECTION-B

Answer any *two* questions. *Weightage 6* each.

13. Discuss the theoretical treatment of Zeeman effect and sketch out the Zeeman transitions and patterns for the Sodium doublet
14. Discuss the theory of a vibrating-rotator and comment on the spectrum
15. Discuss in detail the rotational fine structure of electronic-vibration transition
16. Derive Bloch equations and explain their significance

(2x6= 12 weightage)

SECTION- C

Answer any **four** questions. **Weightage 3** each.

17. Obtain the quantum numbers for the states (i) $4^2S_{1/2}$ (ii) $2^2P_{1/2}$ (iii) 3^3P_1 and (iv) $5^2D_{5/2}$
18. For a system of rigid diatomic molecules, some of the atoms of one element are replaced by a heavier isotope such that the reduced mass μ is changed to 1.05μ . Evaluate the shift in the spectral line in the rotational spectrum for the transition $J=4 \rightarrow J=5$
19. For the ground state of Oxygen, the values of $\bar{\nu}_e$ and $\bar{\nu}_e x_e$ are 1580.4 and 12.07cm^{-1} respectively. Calculate the zero point energy and the expected vibrational Raman shift.
20. Rotational analysis of an electronic band system is given by $\nu = 24760 + 24m - 2m^2$; Evaluate the band head position and the values of ν_0 , B'_v and B''_v .
21. Workout the ESR spectrum of an unpaired electron ($S=1/2$) when it interacts with a nuclear spin $I=3/2$
22. A Mossbeaur nucleus has spins $I_g=7/2$ and $I_e=5/2$ in to how many lines the gamma-ray spectrum splits, if the nucleus is influenced by an internal electric field gradient. Draw the energy levels and transitions for the same.

(4x3= 12 weightage)

SECTION-B

Answer any two questions. **Weightage 5** each.

13. Discuss the theoretical treatment of Zeeman effect and sketch out the Zeeman transitions and patterns for the Sodium doublet
14. Discuss the theory of a vibrating-rotator and comment on the spectrum
15. Discuss in detail the rotational fine structure of electronic-vibronic transition
16. Derive Bloch equations and explain their significance

(2x5= 10 weightage)