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BBH-003-1016033 Seat No. _____

B. Sc. (Sem. VI) (W.E.F.-2016) (CBCS) Examination

July – 2021

Physics : Paper-603

(Spectroscopy and applied optics)

(New Course)

Faculty Code : 003

Subject Code : 1016033

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions :

(1) Attempt any five questions.
(2) Numbers on right side indicates marks.
(3) Symbols have their usual meanings.

1 (a) Answer following questions : (1 mark each) **4**

(1) Write the names of two types of emission spectra.
(2) The dark lines of Sun's absorption spectra is called _____.
(3) Frank Hertz's experiment gives confirmation that electron occupied _____ energy level.
(4) Bohr's theory of atomic model also predicts about the intensity of spectral line. [True or False ?]

(b) Calculate the wavelength of light emitted by an atom, excited to higher state by applying 2V. **2**

(c) Explain continuous spectra. **3**

(d) Explain Bohr's theory. [Postulates only] **5**

2 (a) Answer following objective questions : (1 mark each) **4**

1) To cover the complexity of spectra line, Uhlenbeck and Goudsmith extended the Somerfield model is known as _____.
2) Famous hypothesis of electron spin is put forward by _____.
3) The orbits having l values 0,1,2,3.. is labeled as _____, _____, _____, and _____,
4) The projection of orbital quantum number l on magnetic field gives _____.

(b) Under uniform magnetic field of 4 Webbers/metere^2; find Δv for normal Zeeman splitting. **2**

(c) Explain Paschen-back effect. **3**

(d) Explain Frank-Hertz's experiment. **5**

3 (a) Answer following questions : (1 mark each) **4**

1) Molecular spectra is discontinuous spectra. [True or False?]

2) Electronics band spectra is falls on _____ Å to _____ Å.

3) $E_e << E_V << E_r$ [True or False?]

4) In molecular spectra, vibrational energy is given by E_v = _____.

(b) In rotational spectrum of CO gas, the spacing is observed between the spectral line is 3.84 cm^{-1}. Calculate the moment of inertia of CO molecule. **2**

(c) Give the brief review on radiation source of experimental setup of Raman effect. **3**

(d) Explain pure rotational spectra. **5**

4 (a) Answer following questions : (1 mark each) **4**

1) Frequency difference between incident radiation and scattered radiation from molecule is called _____.

2) For Stokes lines, Δv is negative. [True or False?]

3) Write the range of intensity of Raman scattered light, with respect to intensity of incident light.

4) On both side of exciting line in Raman spectra, we can observe equidistance lines, that is pure rotational spectra. [True or False?]

(b) Vibration transition occurs with energy change of 1.6×10^{-20} erg/mol, calculate the frequency of radiation. **2**

(c) Give the difference between Raman spectra and Fluorescence spectra, **3**

(d) Discuss salient feature of Raman effect. **5**

5 (a) Answer following questions : (1 mark each) **4**

1) Light emits from LASER source is incoherent. [True or False?]

2) The probability of spontaneous transition from level E_1 to E_2 is

3) The process of spontaneous emission is depending upon the incident light energy. [True or False?]

4) When spontaneous emission is occurred, the emitted light is not monochromatic. [True or False?]

(b) The wavelength of emission is 5000 Å and the coefficient of spontaneous emission is 10^6 per second and coefficient for stimulated emission is 0.7510×10^{10}. Find Plank's constant. (Take $\mu = 1$) **2**

(c) Explain Three level pumping scheme. **3**

(d) Explain the properties of LASER beam. **5**

6 (a) Answer following questions : (1 mark each) **4**

1) All induced (stimulated) photons propagate in the different direction. [True or False?]
2) Write the names of LASER properties.
3) Write the formula of Einstein's relation between B_{12} and B_{21}.
4) For population inversion, the condition $N_2 > N_1$ should be achieved, where N_1 is population in lower energy level and N_2 is population in higher energy level. [True or False?]

(b) Find the temperature at which the rate of spontaneous emission and rate of stimulated emission are equal. Take $\lambda = 5000$ Å. **2**

(c) Discuss the characteristic of stimulated emission. **3**

(d) Deduce the relation between Einstein coefficient for spontaneous emission and Einstein coefficient for stimulated emission. **5**

7 (a) Answer following objective questions: (1 mark of each) **4**

1) X-ray is not effective on photographic plate. [True or False?]
2) X-ray of-energy more than _____ MeV are capable to produced electron-positron pairs.
3) Write Bragg's law formula.
4) If the glancing angle of X-ray having wavelength λ_1 and λ_2 are θ_1 and θ_2 respectively, for first order, what is the ratio of two wavelength ?

(b) Calculate the minimum voltage that must be applied to produce X-Ray of 2 Å wavelength. **2**

(c) Write the properties of X-ray. **3**

(d) Write a note on continue X-ray spectrum. **5**

8 (a) Answer following objective questions : (1 mark each) **4**

1) $(\overline{a} \cdot \overline{b} \times \overline{c})$ quantity gives _____ of the primitive cell.
2) The degree of non-monochromaticity of LASER wave is given by η = _____.
3) The rate of spontaneous transition in the terms of Einstein co-efficient and population in higher level is given by _____.
4) Einstein coefficient for stimulated emission represents the probability for _____.

(b) If the minimum wavelength recorded in an X-ray spectrum is 24.7×10^{-12} m, when voltage across tube is given by an amount of 50 kV. Calculate the Plank's constant. **2**

(c) Write a note on Coolidge tube. **3**

(d) Explain X-ray emission spectra. **5**

9 (a) Answer following objective questions : (1 mark each) **4**

1) Cladding layer is necessary in optical fiber to prevent the leakage of light energy through evanescent waves. [True or False?]
2) Write Snell's law formula.
3) If angle of incidence is greater than critical angle for given medium, the ray refracts into the rarer medium. [True or False?]
4) If rarer medium is air, and angle of incident is equal to critical angle, the formula of Snell's law is reduced to _____.

(b) Calculate the fractional refractive index change for given optical fiber, with refractive index of core and cladding, 1.5 and 1.49 respectively. From this data, find the numerical aperture (N.A.) of optical fiber. **2**

(c) Discuss the necessity of cladding in optical fiber. **3**

(d) Discuss acceptance angle for optical fiber. **5**

10 (a) Answer following objective questions : (1 mark each) **4**

1) Light rays enter the fiber with an angle more then acceptance angle, will lost optical energy at core-cladding interface. [True or False?]
2) Write the formula for fractional refractive index change.
3) The fractional refractive index change is typically more than one in value. [True or False?]
4) Write the formula of numerical aperture of optical fiber.

(b) Calculate fractional index change for an optical fiber having core and cladding refractive indices 1.563 and 1.498 respectively. **2**

(c) Explain numerical aperture of optical fiber. **3**

(d) Explain intrinsic attenuation in optical fiber. **5**
