

B.Sc. Semester - 6 (CBCS) Examination

Oct/Nov -2020

SPECTROSCOPY AND APPLIED OPTICS (CORE)

Time: 2:00 Hours

Marks: 56

Instructions:

1. Figures to the right indicate marks.
2. There are five questions in the question paper.
3. Answer any four of the following questions.

1(a) Answer the following question (any one). (7)

- (1) Explain : Quantum numbers and their physical interpretations .
- (2) What is Zeeman effect ? Draw the schematic diagram of experimental arrangement for studying Zeeman effect ? Explain the normal Zeeman effect , using the vector atom model .

1(b) Answer the following question (any one). (4)

- (1) Explain Stark effect and write its features .
- (2) Explain the types of optical spectra .

1(c) Answer the following question (any three). (3)

- (1) Why Bohr has considered hydrogen atom to explain observed fact of spectra ?
- (2) How is the frequency of the electron in Bohr's orbit related to the principal quantum number?
- (3) What is Paschen-back effect ?
- (4) What is the unit of Bohr-magneton in M.K.S ?
- (5) Write the methods of producing light for spectroscopic purpose.

2(a) Answer the following question (any one). (7)

- (1) In which regions of electro-magnetic spectrum , the pure rotational spectra are observed ? Derive an expression for frequency in the pure rotational spectra .
- (2) What is Raman effect ? Explain Raman effect using the classical theory. Which are the discrepancies of this theory ?

2(b) Answer the following question (any one). (4)

- (1) Describe the experimental arrangement for Raman effect with suitable diagram.
- (2) The moment of inertia of the CO molecule is $1.46 \times 10^{-46} \text{ kg} \cdot \text{m}^2$. Calculate the energy in eV . (Given: $1\text{eV} = 1.6 \times 10^{-19} \text{ Joules}$)

2(c) Answer the following question (any three). (3)

- (1) When do Raman spectrum consist of stoke lines ?
- (2) In Raman spectra , whether Raman lines are polarised or not ?
- (3) Is it true that Raman effect in crystals is complementary to X-ray crystal study ?
- (4) Give the examples of homonuclear diatomic molecules .
- (5) Which type of molecular spectra is the most complex ?

3(a) Answer the following question (any one). (7)

- (1) What is pumping ? Mention the various techniques used for pumping in various types of lasers . Explain the three-level and four-level pumping schemes with suitable diagrams.
- (2) Explain the construction and working of Nd-YAG laser with suitable diagrams .

3(b) Answer the following question (any one). (4)

- (1) Explain the recording and reconstruction of image in the process of Holography, with suitable diagrams .
- (2) In a laser ,the emission wavelength is $6500 \text{ \AA}$ and the coefficient of spontaneous emission is 10^6 per sec. . Determine the coefficient for the stimulated emission .
(Given : $h = 6.625 \times 10^{-34} \text{ Joule-sec.}$)

- 3(c) Answer the following question. (any three). (3)**
- (1) Define: Rate of stimulated emission .
 - (2) Mention the special characteristics of a laser which separate it from ordinary (traditional) light sources .
 - (3) Is the light resulting from the process of stimulated emission, coherent and non monochromatic ?
 - (4) Which type of pumping scheme gives the pulsed output in a laser ?
 - (5) What is the advantage of using ellipsoidal reflector in Nd: YAG laser ?
- 4(a) Answer the following question (any one). (7)**
- (1) Describe the rotating crystal method for X-rays diffraction with suitable diagrams .
 - (2) Explain : Brillouin zones .
- 4(b) Answer the following question (any one). (4)**
- (1) Obtain the expression for Bragg's law . Write the important conclusions .
 - (2) Show that the direct lattice is the reciprocal of its own reciprocal lattice .
- 4(c) Answer the following questions.(any three). (3)**
- (1) Write the methods for generation of X-rays .
 - (2) Mention the merits of Laue method .
 - (3) Give the two merits of powder crystal method .
 - (4) Write the expression for atomic scattering factor .
 - (5) Do X-rays produce photoelectric effect ?
- 5(a) Answer the following question (any one). (7)**
- (1) Define : Acceptance angle of optical fibre . Derive an expression for acceptance angle in terms of refractive index of the core and the cladding of an optical fibre. How it is related to numerical aperture ?
 - (2) Describe a fibre optic communication system with a suitable block diagram .
Why it is more preferable to use light source emitting light in the infra-red range for such a system? For long distance communication , what are the advantages and disadvantages of such a system over conventional communication system using conducting wire cables ?
- 5(b) Answer the following question (any one). (4)**
- (1) Calculate the numerical aperture and acceptance angle of an optical fibre from the following data :
 n_1 (core) = 1.55 and n_2 (cladding) = 1.50
 - (2) Discuss : losses in optical fibre .
- 5(c) Answer the following question (any three). (3)**
- (1) Which are the two basic conditions necessary for light propagation in optical fibre ?
 - (2) Which parameter determines the light gathering ability of an optical fibre ?
 - (3) Do the higher order modes arrive at the output end of the optical fibre later than the lower order modes ?
 - (4) Costly laser diodes are needed to launch light into the single-mode optical fibre . Why?
 - (5) Which unit is used to express pulse dispersion in optical fibre ?
