V/ PHY (viii) (A) (PR)

2016

(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Spectroscopy)

(Pre-Revised)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. Derive the formula for Rutherford's scattering cross-section, and discuss the drawback of the Rutherford's model of the atom. 4+3=7

Or

Discuss the principle and the experimental arrangement of Stern-Gerlach experiment, and explain its significance. 5+2=7

2. State and explain Pauli's exclusion principle. On the basis of this principle, how do you calculate the number of electrons that can occupy in a sub-shell inside an atom? 1+2+4=7

Or

What is Zeeman effect? Give the classical interpretation of normal Zeeman effect, and derive the expression for Zeeman shift. 2+3+2=7

3. What is Einstein's coefficient in LASER system? Hence derive the necessary equations to express the Einstein's *A* and *B* coefficients. 1+6=7

Or

With necessary diagram, explain the construction and working of any *one* of the following : 7

(a) He-Ne LASER

(b) Semiconductor LASER

4. With necessary diagram, obtain an expression for the energy level, frequency of spectral line and the selection rule in a rigid diatomic rotator. 3+3+1=7

Or

Calculate the moment of inertia and inter-nuclear distance of HCl molecule by approximating it as a rigid rotator if the

radiation associated with the transition $j = 3$ to $j = 4$ is $83{\cdot}03\ \text{cm}^{-1}$. 5+2=7

Given,

$h = 6{\cdot}62 \times 10^{-27}$ erg sec

$c = 3 \times 10^{10}$ cm sec^{-1}

5. Explain the sequence and progression in electronic spectra, and hence derive the frequency of the spectrum due to a change in total energy of the molecule. 7

Or

(a) Define the *P*, *Q* and *R* branches in the spectrum of rotational fine structure in electronic vibrational transition. 4

(b) What is Fortrat diagram? Mention the information observed in the Fortrat diagram. 2+1=3

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Subject Code :

V/ PHY (viii) (A) (PR)

Booklet No. A

Date Stamp .....

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To be filled in by the Candidate

DEGREE 5th Semester
(Arts / Science / Commerce / .....) Exam., **2016**

Subject .....
Paper .....

To be filled in by the Candidate

DEGREE 5th Semester
(Arts / Science / Commerce / .....) Exam., **2016**

Roll No. .....
Regn. No. .....

Subject .....
Paper .....

Descriptive Type
Booklet No. B .....

INSTRUCTIONS TO CANDIDATES

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

Signature of Scrutiniser(s) *Signature of Examiner(s)* *Signature of Invigilator(s)*

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2016

(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Spectroscopy)

(Pre-Revised)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. According to Bohr's postulate, an electron of mass m moving in a circular path of radius r with velocity v will satisfy the relation

(a) $\frac{mv}{r} = \frac{nh}{2\pi}$ ( )

(b) $\frac{mv}{r} = \frac{2\pi}{nh}$ ( )

(c) $mvr = \frac{2\pi}{nh}$ ( )

(d) $mvr = \frac{nh}{2\pi}$ ( )

where $n = 1, 2, 3, \ldots$ is called the principal quantum number.

2. The Auger effect is also called

(a) radiationless transition ( )

(b) positron transition ( )

(c) radiation transition ( )

(d) electron transition ( )

3. A LASER action is based on the amplification of

(a) atomic vibration ( )

(b) electromagnetic vibration ( )

(c) molecular interaction ( )

(d) electromagnetic oscillation ( )

4. The zero-point energy of a vibrating diatomic molecule is

(a) $\frac{1}{4} h\omega_{os}$ joule ( )

(b) $\frac{1}{2} h\omega_{os}$ joule ( )

(c) $h\omega_{os}$ joule ( )

(d) $2h\omega_{os}$ joule ( )

here, ω_{os} is oscillating frequency.

5. Raman spectra is appeared due to the scattering of radiation by the

(a) dipole moment of molecules ( )

(b) rotating molecules ( )

(c) vibrating molecules ( )

(d) absorption of molecules ( )

SECTION—II

(*Marks* : 15)

Give very short answers of the following questions : 3×5=15

1. The wavelength of the Balmer series in hydrogen is 3646 Å. Calculate Rydberg constant in cm^{-1}.

2. What is Paschen-Back effect?

3. Explain the population inversion in LASER action.

4. Explain the general idea of Born-Oppenheimer approximation.

5. What do you understand by band origin and band head in the rotational fine structure of electronic vibration spectra of the molecule?

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