V/ PHY (viii) (A) (R)

2016

(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Revised)

(Spectroscopy)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. Deduce the Rutherford's formula for the scattering of alpha particles by a nucleus of charge Ze. "Rutherford's model of atoms failed to account for the stability of the atoms." Comment. 6+1=7

Or

Explain the Sommerfeld's relativistic correction and fine structure of spectral lines of hydrogen-like atoms. Give the selection rule. 6+1=7

2. What do you mean by vector model of atoms? Give the physical significances of various quantum numbers n, l, s, j, m_l and m_s. 1+6=7

Or

(a) What do you mean by Larmor's precession? Obtain an expression for Larmor's frequency.

(b) The ground state of chlorine is $^2P_{3/2}$. Find the value of Lande's splitting factor (g). In how many substates will the ground state split in a weak magnetic field? 1+4+1+1=7

3. What is Zeeman effect? Give the classical theory of normal Zeeman effect. Use this theory to determine the value of the specific charge (e/m) of electron. 1+5+1=7

Or

What do you mean by Einstein's A and B coefficients? Derive a relation between them. 2+5=7

4. Write down the expression for the allowed energy levels of a rotating diatomic molecule treated as a rigid rotator. Deduce its frequency of spectral lines. Discuss its spectrum and relevant selection rule. 1+2+3+1=7

Or

Write down the expression for the allowed energy levels of a vibrating diatomic molecule treated as a harmonic oscillator. Deduce its frequency of spectral lines. Discuss its spectrum and relevant selection rule. 1+2+3+1=7

5. *(a)* What is Raman effect? Explain it using quantum mechanics.

(b) With exciting line 2536 Å a Raman line for a sample is observed at 2612 Å. Calculate the Raman shift in cm^{-1} units.

1+4+2=7

Or

Write short notes on : 3½+3½=7

(a) Sequence and progression in electronic band system

(b) Fortrat diagram

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Subject Code : V/ PHY (viii) (A) (R)

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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(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Revised)

(Spectroscopy)

(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. In Rutherford's alpha particle scattering experiment, the number of alpha particles scattered at an angle 90° is 25. How many alpha particles are scattered at an angle 60°?

(a) 85 ( )

(b) 100 ( )

(c) 70 ( )

(d) 55 ( )

2. The maximum number of electrons in a sub-shell is

(a) $2n^2$ ( )

(b) $(2l-1)$ ( )

(c) $(2l+1)$ ( )

(d) $2(2l+1)$ ( )

where n is the principal quantum number and l is the orbital quantum number.

3. The splitting of spectral lines under the influence of an external electric field is called

(a) Zeeman effect ( )

(b) Faraday effect ( )

(c) Stark effect ( )

(d) Paschen-Back effect ( )

4. The change of energy of molecules which does not produce any spectral line is the change in

(a) translational kinetic energy ( )

(b) vibrational kinetic energy ( )

(c) rotational kinetic energy ( )

(d) electronic energy ( )

5. In a vibrational-rotational molecular band

(a) rotational transitions $\Delta J = +1$ produce *R*-branch ( )

(b) rotational transitions $\Delta J = +1$ produce *P*-branch ( )

(c) rotational transitions $\Delta J = -1$ produce *R*-branch ( )

(d) rotational transitions $\Delta J = -1$ produce *Q*-branch ( )

SECTION—II

(*Marks* : 15)

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

1. A hydrogen atom is in the ground state. What is the value of the principal quantum number to which it will be excited by absorbing a photon of energy 12·75 eV?

2. Explain space quantization with suitable diagram.

3. Explain 'Auger effect'.

4. Give the applications of vibrational spectroscopy.

5. Differentiate between Raman spectra and infrared spectra.

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