2016

(4th Semester)

PHYSICS

FOURTH PAPER

(Atomic, Nuclear Physics—I and Solid-State Physics—I)

(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. What are positive rays? Discuss Thomson parabola method for analysis of positive ray. 1+6=7

Or

(a) Give the determination of Planck's constant by using Millikan's method. 4

(b) What is continuous X-ray spectra? Explain the Duane-Hunt law. 1+2=3

2. Describe the construction and working of Geiger-Müller counter. What do you mean by 'dead time' and the 'efficiency' of the counter? 2+3+2=7

Or

(a) What is artificial transmutation? Discuss, how artificial transmutation leads to the discovery of neutrons. 1+4=5

(b) What are slow neutrons and fast neutrons? 2

3. What is nuclear fission? How was it discovered? Explain the energy released in fission reaction using suitable example. 1+2+4=7

Or

(a) What is the threshold energy in nuclear reaction? 2

(b) Explain, in brief, the basic idea of nuclear liquid-drop model. 5

4. *(a)* What are Miller indices? 2

(b) Show that the distance between any two adjacent planes in a cubic lattice structure is $d = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$, where h, k and l are Miller indices and a is lattice constant. 5

Or

(a) What is packing fraction? 2

(b) Show that

$$\vec{a}^* = 2\pi \frac{\vec{b} \times \vec{c}}{\vec{a} \cdot \vec{b} \times \vec{c}} \qquad \vec{b}^* = 2\pi \frac{\vec{c} \times \vec{a}}{\vec{a} \cdot \vec{b} \times \vec{c}}$$

$$\vec{c}^* = 2\pi \frac{\vec{a} \times \vec{b}}{\vec{a} \cdot \vec{b} \times \vec{c}}$$

where $\vec{a}$, $\vec{b}$, $\vec{c}$ are the basis vectors in the direct lattice and $\vec{a}^*$, $\vec{b}^*$, $\vec{c}^*$ are those of the reciprocal lattice. 5

5. Derive Einstein's equation for the specific heat of solids at constant volume. Discuss how C_v varies with temperature. 4+3=7

Or

Explain how Debye modified Einstein's theory of specific heat of solids and obtain his formula for specific heat of solids. 3+4=7

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Subject Code : PHY/IV/04 (PR)

Booklet No. A

Date Stamp ....

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To be filled in by the Candidate

DEGREE 4th Semester
(Arts / Science / Commerce /
.......................) Exam., **2016**

Subject ....
Paper ....

To be filled in by the Candidate

DEGREE 4th 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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(4th Semester)

PHYSICS

FOURTH PAPER

(Atomic, Nuclear Physics—I and Solid-State Physics—I)

(Pre-revised)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 5)

Tick (✓) the correct answer in the brackets provided : 1×5=5

1. When an electron jumps from the L-shell to the K-shell in an atom, the spectral line observed will be

(a) K_α ( )

(b) K_β ( )

(c) L_α ( )

(d) L_β ( )

2. Cyclotron is used to

(a) accelerate electrons ( )

(b) accelerate +ve ion particle ( )

(c) accelerate –ve ion particle ( )

(d) accelerate frequency of the oscillation ( )

3. The size of nucleus can be determined by the relation

(a) $r = R_0 A^{-\frac{1}{3}}$ ( )

(b) $r = R_0 A^{-\frac{2}{3}}$ ( )

(c) $r = R_0 A^{\frac{1}{3}}$ ( )

(d) $r = R_0 A^{\frac{2}{3}}$ ( )

where the symbols used have their usual meanings.

4. The coordination number for a simple cubic structure is

(a) 12 ( )

(b) 9 ( )

(c) 8 ( )

(d) 6 ( )

5. The Wiedemann-Franz law represents the equation

(a) $\frac{k}{\sigma} \propto T^{-1}$ ( )

(b) $\frac{\sigma}{k} \propto T$ ( )

(c) $\frac{k}{\sigma} \propto T$ ( )

(d) $\frac{k}{\sigma} \propto T^{-2}$ ( )

Here k and σ are thermal conductivity and electrical conductivity of metal respectively. T is the temperature.

SECTION—B

(*Marks* : 15)

Write very short answers to the following questions : $3 \times 5 = 15$

1. What are isotopes in nuclei? Give example.

2. Write down the decay and spin properties of neutrons.

3. Calculate the energy produced by 1 kg of U^{235} during fission.

4. Mention any two evidences in favour of nuclear shell model.

5. Write the Dulong and Petit's law for the specific heat of solids.

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