2017

(4th Semester)

PHYSICS

FOURTH PAPER

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

(Revised)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* Derive Einstein's photoelectric equation. 4

(b) Verify Einstein's photoelectric equation from Millikan's experiment. 3

OR

(a) State and explain Moseley's law. Mention its importance. 4

(b) Distinguish between the continuous and characteristic X-ray spectra. 3

2. *(a)* State and explain the law of radioactive disintegration. 4

(b) Calculate the time required to disintegrate the sample of thorium by 10%. Assume the half life of thorium is 1 4 10^{10} years. 3

OR

(a) What are packing fraction and binding energy of a nucleus? 2

(b) Explain the phenomenon of nuclear fission. 3

(c) Why does U^{235} and not U^{238} nucleus undergo fission with thermal neutrons? 2

3. *(a)* What are Miller indices? How are they determined? 2+2=4

(b) Derive an expression for the spacing between lattice planes of a simple cubic crystal. 3

OR

(a) What is a coordination number? 1

(b) Calculate the packing fraction of simple cubic, body-centred cubic and face-centred cubic structures. 6

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4. *(a)* Deduce Bragg's law of X-ray diffraction. 3

(b) Establish a relation between crystal lattice and reciprocal lattice. 4

OR

(a) Define ionic, covalent, metallic and van der Waal's bondings. 4

(b) Determine the Madelung constant for NaCl crystal. 3

5. *(a)* Discuss Einstein's theory of specific heat and discuss its failures in solid. 5

(b) Discuss Debye T^3 law of specific heat. 2

OR

(a) State and explain free electron model (classical model). 3

(b) Deduce the expression for electrical conductivity from free electron model. 4

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Subject Code : PHY/IV/04 (R)

Booklet No. A

Date Stamp .....

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To be filled in by the Candidate

DEGREE 4th Semester
(Arts / Science / Commerce / .....) Exam., **2017**

Subject .....

Paper .....

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.**

To be filled in by the Candidate

DEGREE 4th Semester
(Arts / Science / Commerce / .....) Exam., **2017**

Roll No. .....

Regn. No. .....

Subject .....

Paper .....

Descriptive Type

Booklet No. B .....

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Signature of Invigilator(s)

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(4th Semester)

PHYSICS

FOURTH PAPER

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

(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. The coordination number of b.c.c. crystal is

(a) 4 ( )

(b) 6 ( )

(c) 8 ( )

(d) 12 ( )

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2. Which type of radiations is stopped by a sheet of a paper?

(a) α ( )

(b) β ( )

(c) γ ( )

(d) X-ray ( )

3. The average kinetic energy of the electrons in metal at 0 K is

(a) 0 ( )

(b) $\frac{1}{2} mv^2$ ( )

(c) KT ( )

(d) $\frac{3}{4}\varepsilon_F$ ( )

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4. Complete the nuclear reaction :

$$_{94}Pu^{239} \longrightarrow {}_{92}U^{235} + ?$$

(a) $_{0}n^{1}$ ( )

(b) $_{1}H^{1}$ ( )

(c) $_{2}He^{4}$ ( )

(d) None of the above ( )

5. The nature of positive rays depends on

(a) the nature of residual gas ( )

(b) the nature of discharge tube ( )

(c) All of the above ( )

(d) the nature of electrode ( )

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SECTION—B

(*Marks* : 15)

Write very short answers to the following questions : 3×5=15

1. State at least three properties of positive rays.

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2. A simple Helium nucleus ($_2He^4$) is formed by the fusion of two deuterium nuclei ($_1H^2$) :

Mass of $_1H^2 = 2 \cdot 01410\,\mu$

Mass of $_2He^4 = 4 \cdot 00260\,\mu$

$_1H^2 + {}_1H^2 = {}_2He^4$ $(1\mu = 931 \cdot 5$ MeV)

Find the amount of energy released in fusion.

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3. In a tetragonal lattice, $a = b = 2 \cdot 5 \times 10^{-10}$ m and $c = 5 \times 10^{-10}$ m. Calculate the lattice spacing between (111) planes.

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4. Describe Ewald's sphere and Ewald's construction in brief.

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5. State and explain Wiedemann-Franz law.

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