2017

(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 is a mass spectrograph? Describe the construction and working of Aston's mass spectrograph. 1+3+3=7

Or

(a) Define Compton effect. Deduce the equation for Compton shift. 1+4=5

(b) Differentiate between Compton effect and photoelectric effect. 2

2. Describe the construction and working of a cyclotron. What are its limitations? 6+1=7

Or

Describe the determination of mass of a neutron. Classify neutrons according to their kinetic energy. 5+2=7

3. *(a)* Define nuclear fusion. Give one representative equation. 2

(b) Differentiate between nuclear fusion and nuclear fission. 2

(c) Explain the proton-proton cycle. 3

Or

(a) Write a short note on nuclear shell model. 4

(b) A reactor is producing energy at the rate of 32 10^6 watts. How many atoms of U-235 undergo fission per second? Assume that on the average, an energy of 200 MeV is released per fission. 3

4. *(a)* What do you mean by diffraction of X-rays in crystals? Derive the Bragg's law for X-ray diffraction in crystals. 1+4=5

(b) In a crystal, a lattice plane cuts intercepts of a, $2b$ and $3c$ along the three axes, where a, b and c are primitive vectors of the unit cell. Calculate the Miller indices of the given plane. 2

5. *(a)* Deduce the Dulong and Petit's law for the specific heat of solids. 4

(b) Define the following : 1×3=3

(i) Electron collision

(ii) Mean free path

(iii) Relaxation time

Or

(a) State the Wiedemann-Franz law. 1

(b) Define Fermi energy and Fermi level. Show that the average energy of an electron in an electron gas at 0 K is $\frac{3}{5}E_F(0)$, where $E_F(0)$ is Fermi energy at 0 K. 2+4=6

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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., **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 .....

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

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2017

(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. The orbital energy of an electron revolving in Bohr's third orbit in a hydrogen atom is

(a) –13·6 eV ( )

(b) –4·53 eV ( )

(c) –1·51 eV ( )

(d) –0·85 eV ( )

2. Ionization chamber is a

(a) particle accelerator ( )

(b) particle detector ( )

(c) chamber for producing ions ( )

(d) voltmeter ( )

3. The dimension of nucleus is approximately

(a) 10^{-14} m ( )

(b) 10^{-12} m ( )

(c) 10^{-10} m ( )

(d) 10^{-8} m ( )

4. The coordination number of an f.c.c. lattice is

(a) 4 ( )

(b) 6 ( )

(c) 8 ( )

(d) 12 ( )

5. The ratio of Fermi energy to Fermi temperature is equal to

(a) Boltzmann's constant ( )

(b) Planck's constant ( )

(c) Rydberg's constant ( )

(d) universal constant ( )

SECTION—B

(*Marks* : 15)

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

1. Derive the Einstein's photoelectric equation.

2. Complete the following nuclear reactions :

(a) $_{17}Cl^{35} + ? \longrightarrow {}_{16}S^{32} + {}_{2}He^{4}$

(b) $_{5}B^{10} + ? \longrightarrow {}_{3}Li^{7} + {}_{2}He^{4}$

(c) $_{4}Be^{9} + {}_{2}He^{4} \longrightarrow ? + {}_{0}n^{1}$

3. Define controlled and uncontrolled chain reactions. Write one application of each.

4. Classify the following crystals according to their bonding :

Na ; NaCl ; Diamond ; Cu ; KBr ; Si

5. Discuss the difference between the assumption of Einstein and Debye's theory of specific heats of solids.

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