2017

(3rd Semester)

PHYSICS

THIRD PAPER

(Electromagnetism, Quantum Mechanics—I and Electronics—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)* State and prove the Gauss' divergence theorem. 5

(b) Prove that $\vec{} \quad \vec{}$ 0, where is a scalar function. 2

Or

(a) Using Gauss' law, show that the electric field between two oppositely charged plates having equal charge density is given by E —. 4
0

(b) A vector field in free space is given by
A_x 0, A_y $A_0 \sin(kx$ $t)$, A_z 0
B_x 0, B_y 0, B_z $A_0 \sin(kx$ $t)$
Show that

$$\vec{} \quad \frac{1}{c}\frac{\vec{B}}{t}$$

where c / k. 3

2. *(a)* Show that the force per unit area on the surface of a charged conductor acting normally to the surface in the presence of an electric field $\vec{E}$ is given by

$$F \quad \frac{1}{2} \; {}_0E^2$$

5

(b) Define polarization vector and displacement vector. 2

Or

(a) Using Kirchhoff's laws, obtain the balance condition of Wheatstone bridge. 4

(b) Write down the expressions for current in a *C-R* circuit while charging and discharging of the capacitor. Show the variation of current graphically. 3

3. *(a)* State Biot-Savart law. Using this law, find the magnetic field due to an infinitely long straight wire carrying current. 1+3=4

(b) Obtain Faraday's laws of electro-magnetic induction in differential form. 3

Or

An alternating e.m.f. $E_0 \sin \quad t$ is applied to a series *L-C-R* circuit. Obtain the expressions for impedance, phase angle and current in the circuit at any instant. Also deduce an expression for current at resonance. 7

4. *(a)* Discuss the failure of classical physics to explain photoelectric phenomena and also discuss Einstein's explanation of the phenomena. 4

(b) Using Heisenberg's uncertainty principle, show that an electron cannot be contained within a nucleus. 3

Or

(a) Obtain the wave functions and energies of the ground and excited states of a particle confined in a one-dimensional box with rigid walls. 4

(b) A one-dimensional wave function is given by (x) $\sqrt{a}e^{\ ax}$. Find the probability of finding the particle between $x \quad \frac{1}{a}$ and $x \quad \frac{2}{a}$. 3

5. Using a neat circuit diagram, explain the working of two-stage *R-C* coupled amplifier. Also draw and explain the frequency-response curve. 7

Or

(a) Draw the circuit diagram of a transistor in common-emitter configuration. Explain the input and output characteristics with the help of appropriate characteristic graphs. 5

(b) Show that the base current amplification factor

$$\frac{\quad}{1}$$

where is the current gain in common-base configuration. 2

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Subject Code : PHY/III/03 (R)

Booklet No. A

Date Stamp .....

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To be filled in by the Candidate

DEGREE 3rd 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 3rd 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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(3rd Semester)

PHYSICS

THIRD PAPER

(Electromagnetism, Quantum Mechanics—I and Electronics—I)

(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. A vector $\vec{A}$ is called irrotational if

(a) $\vec{\nabla} \vec{A} = 0$ ( )

(b) $\vec{\nabla} \vec{A} = 1$ ( )

(c) $\vec{\nabla} \vec{A} = 0$ ( )

(d) $\vec{\nabla} \vec{A} = 1$ ( )

2. According to Thevenin's theorem, a two-terminal linear active network can be replaced by

(a) a voltage source in series with an impedance ( )

(b) a current source and a shunt admittance in parallel ( )

(c) a current source and an impedance in series ( )

(d) a voltage source and a shunt admittance ( )

3. The magnitude of a magnetic dipole moment of a current loop carrying a current I and having cross-sectional area of A is given by

(a) IA ( )

(b) $\frac{I}{A}$ ( )

(c) $\frac{1}{IA}$ ( )

(d) $\frac{A}{I}$ ( )

4. Let v be the velocity of motion of a moving particle. If v_g and v_p are the group velocity and phase velocity respectively of the matter wave associated with the particle in motion, then

(a) $v_g \quad v_p$ ( )

(b) $v_g \quad v_p$ ( )

(c) $v_g \quad v$ ( )

(d) $v_g \quad v$ ( )

5. Mobility of a charge carrier is related to the Hall coefficient R_H as (where is conductivity)

(a) R_H ( )

(b) $\overline{R_H}$ ( )

(c) $\frac{|q|}{R_H}$ ( )

(d) $\overline{|q|R_H}$ ( )

SECTION—II

(*Marks* : 15)

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

1. Write the statements of Stokes' theorem and Green's theorem in a plane.

2. Show that for a given potential difference, a capacitor stores more charge with a dielectric than without dielectric.

3. An alpha particle is moving in a magnetic field of $(3\hat{i} \quad 2\hat{j})$ tesla with a velocity of $5 \quad 10^{5}\hat{i}$ ms ^{1}. Find the magnetic force acting on the particle.

4. Electrons of 400 eV are diffracted through a crystal and a second-order maximum is observed where the angle between the diffracted beam and incident beam is 30°. Calculate the wavelength of the electron matter wave and the interplanar distance of those lattice planes which are responsible for this maximum.

5. What are class *A* and class *B* amplifiers? How do they differ from each other?

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