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(3rd Semester)

PHYSICS

THIRD PAPER

(Electromagnetism, Quantum Mechanics—I and Electronics—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. *(a)* Explain the physical meaning of—

(i) gradient of a scalar field;

(ii) divergence of a vector field. 2+2=4

(b) If $\vec{A}$ is irrotational, show that ($\vec{A}$ $\vec{r}$) is solenoidal. 3

Or

(c) Derive the equation for intensity of electric field at a point $\vec{E}$ $\vec{\ }$, where the symbol is electric potential at that point. 4

(d) Using Gauss' law in electrostatic, derive the relation $\vec{\ }$ $\vec{E}$ $\frac{\ }{\ _0}$, where $\vec{E}$ and are electric field and charge density respectively. 3

2. *(a)* What do you mean electric displacement vector $\vec{D}$? 2

(b) Derive the continuity equation $\vec{\ }$ $\vec{J}$ $\frac{\ }{t}$ 0, where $\vec{J}$ and have their usual meanings. 5

Or

(c) What are electric current and current density? 2

(d) Derive an equation for the rise and decay of current in *L-R* circuit and hence define the time constant. 5

3. *(a)* What do you mean by skin effect? How does it vary with the frequency of alternating voltage supply? 1+2=3 *(b)* What are AC bridges? With the help of circuit diagram, derive the condition for balance point in Anderson's bridge. 1+3=4

Or

(c) Obtain the Lorentz force equation for a moving charge. 3

(d) State Ampere circuital law and hence using this law, show that $\vec{} \quad \vec{B} \quad {}_0\vec{J}$, where $\vec{B}$, ${}_0$ and $\vec{J}$ have their usual meanings. 1+3=4

4. *(a)* Discuss the failure of classical physics to explain the black-body radiation and photoelectric phenomena. 3

(b) State and prove the de Broglie hypothesis and hence derive an expression for the de Broglie's wavelength in terms of kinetic energy. 1+1+2=4

Or

(c) State and explain Heisenberg's uncertainty principle. 1+2=3

(d) Using one-dimensional time-independent Schrödinger's equation, derive an equation for the wave function   for a particle of mass m confined in a one-dimensional closed box with rigid walls. 4

5. *(a)* What is Hall effect? Derive an expression of Hall coefficient for an n-type semiconductor. 1+6=7

Or

(b) Write a note on any *one* of the following : 7

(i) R-C couple amplifier

(ii) Transformer couple amplifier

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Subject Code : PHY/III/03 (PR)

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 ....

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 ....

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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2 0 1 7

(3rd Semester)

PHYSICS

THIRD PAPER

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

(Pre-Revised)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 5)

Put a Tick ☑ mark against the correct answer in the box provided : 1×5=5

1. Which of the following relations is true?

(a) $\vec{\ }\ (\vec{\ }\ \vec{A})\ \ 0$ ☐

(b) $\vec{\ }\ \ (\vec{\ }\ \vec{A})\ \ 0$ ☐

(c) $\vec{\ }\ \ (\vec{\ }\ \ \vec{A})\ \ 0$ ☐

(d) $\vec{\ }\ (\vec{\ }\ \ \vec{A})\ \ 0$ ☐

2. Capacitance of a parallel-plate capacitor partly filled with dielectric slab is given by (where the symbol used has their usual meanings)

(a) $C \quad \dfrac{{}_0 A}{(d \quad t) \quad \dfrac{t}{r}}$ ☐

(b) $C \quad \dfrac{{}_0 d}{(A \quad t) \quad \dfrac{t}{r}}$ ☐

(c) $C \quad \dfrac{{}_0 t}{(d \quad A) \quad \dfrac{t}{r}}$ ☐

(d) $C \quad \dfrac{{}_r A}{(d \quad t) \quad \dfrac{t}{0}}$ ☐

3. Resistor R and capacitor C are connected in parallel, the equivalent impedance will be

(a) $\dfrac{R}{1 \quad j \quad CR}$ ☐

(b) $\dfrac{R}{1 \quad j \quad CR}$ ☐

(c) $\dfrac{1}{1 \quad j \quad CR}$ ☐

(d) $\dfrac{1}{1 \quad j \quad CR}$ ☐

4. The relation between the wave velocity v_p and the group velocity v_g is (wavelength of the wave)

(a) $v_p \quad v_g \qquad \frac{v_p}{\quad}$ ☐

(b) $v_p \quad v_g \qquad \frac{v_g}{\quad}$ ☐

(c) $v_g \quad v_p \qquad \frac{v_g}{\quad}$ ☐

(d) $v_g \quad v_p \qquad \frac{v_p}{\quad}$ ☐

5. The potential barrier in a *p*-*n* junction diode is

(a) 0·3 V for Ge and 0·8 V for Si

(b) 0·2 V for Ge and 0·7 V for Si

(c) 0·3 V for Ge and 0·7 V for Si

(d) 0·5 V for Ge and 0·7 V for Si

SECTION—B

(*Marks* : 15)

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

1. If two vectors $A \quad 2\hat{i} \quad \hat{j} \quad 2\hat{k}$ and $B \quad \hat{i} \quad 4\hat{j} \quad \hat{k}$, find $\vec{A} \quad \vec{B}$ and $\vec{A} \quad \vec{B}$.

2. State and explain Kirchhoff's voltage law.

3. Define total impedance in L-C-R circuit connected in series.

4. What do you mean by quantization of energy?

5. What is Zener diode? Explain the working of Zener diode as a voltage stabilizer.

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