2 0 1 6

(3rd Semester)

PHYSICS

THIRD PAPER

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

Full Marks : 55

Time : $2\frac{1}{2}$ hours

(Revised)

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* State and prove the Stokes theorem. 4

(b) Prove that

$$(\vec{B}\quad \vec{C})\ \{\vec{A}\quad (\vec{B}\quad \vec{C})\}\quad 0$$ 3

Or

(a) Give the statement of Gauss' law and hence prove the relation

$$\vec{\ }\ \vec{E}\quad \frac{\ }{_0}$$

where $\vec{\ }$, $\vec{E}$, and $_0$ have their usual meanings. 1+3=4

(b) Derive the Poisson's equation in electrostatic and hence obtain the Laplace's equation. 2+1=3

2. *(a)* A parallel-plate capacitor with space between the plates filled with composite dielectric of thicknesses d_1 and d_2, and relative permittivities k_1 and k_2 respectively. Show that its capacitance is

$$C\quad \frac{{}_0A}{\frac{d_1}{k_1}\quad \frac{d_2}{k_2}}$$

If the medium is made up of several dielectrics of relative permittivities and thicknesses, find the expression for its capacitance, where A is the area of the plate. 4+1=5

(b) Define dielectric constant of the medium. What is the approximate value for air? 1+1=2

Or

(a) State and prove the Norton's theorem. 1+4=5

(b) Describe the transient response of a current in RC circuit. 2

3. *(a)* What do you mean by resonance in an a.c. circuit? 2

(b) What are a.c. bridges? Derive the necessary equation for the balance condition in Anderson bridge. 5

Or

(a) What is torque? Obtain an equation for torque on a current loop in a uniform magnetic field. 1+4=5

(b) Write the concept of displacement current. 2

4. *(a)* State the Heisenberg's uncertainty principle and prove the principle for one-dimensional wave packet. 1+4=5

(b) The life-time of an excited state of an atom is about 10^{8} sec. Calculate the uncertainty in the determination of the energy of the excited state. 2

Or

Deduce the Schrödinger time-dependent wave equation and hence obtain the time-independent form of Schrödinger equation. 5+2=7

5. *(a)* What is Zener diode? Obtain an equation for Zener breakdown voltage and explain how it is used as a voltage stabilizer. 1+2=3

(b) Explain Hall effect with diagram. Hence derive Hall coefficient and Hall voltage. 1+3=4

Or

Describe the transformer-coupled amplifier, with a neat circuit diagram. Obtain the efficiency for the transformer-coupled amplifier. 4+3=7

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Subject Code :

III/ PHY (iii) (R)

Booklet No. A

Date Stamp ....

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To be filled in by the Candidate

DEGREE 3rd Semester
(Arts / Science / Commerce /
.......................) Exam., **2016**

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., **2016**

Roll No. ....
Regn. No. ....

Subject ....
Paper ....

Descriptive Type
Booklet No. B ....

Signature of Scrutiniser(s)

Signature of Examiner(s)

Signature of Invigilator(s)

/53

III/PHY (iii) (R)

2 0 1 6

(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. Two vectors $\vec{A}$ and $\vec{B}$ are collinear if

(a) $\vec{A} \quad \vec{B} \quad 0$ ( )

(b) $\vec{A} \quad \vec{B} \quad 1$ ( )

(c) $\vec{A}\ \vec{B} \quad 0$ ( )

(d) $\vec{A}\ \vec{B} \quad 1$ ( )

2. During discharging of the capacitor in RC circuit, the instantaneous voltage across the resistance is

(a) $V_R(t) \quad E\,e^{\quad t/CR}$ ( )

(b) $V_R(t) \qquad E\,e^{\quad t/CR}$ ( )

(c) $V_R(t) \quad E\,e^{t/CR}$ ( )

(d) $V_R(t) \qquad E\,e^{t/CR}$ ( )

3. Resistor R and inductor L are connected in parallel, the equivalent impedance is

(a) $\frac{R}{1 \quad 1/\,j \quad L}$ ( )

(b) $\frac{R}{1 \quad R/\,j \quad L}$ ( )

(c) $\frac{R}{1 \quad 1/\,j \quad L}$ ( )

(d) $\frac{R}{1 \quad R/\,j \quad L}$ ( )

4. The relation between group velocity ( ) and wave velocity (u) in a dispersive medium is

(a) $u \quad \frac{1}{}\,\frac{du}{d}$ ( )

(b) $u \quad \frac{1}{}\,\frac{du}{d}$ ( )

(c) $u \quad \frac{du}{d}$ ( )

(d) $u \quad \frac{du}{d}$ ( )

where $\frac{2}{k}$ and k propagation constant.

5. Input characteristic of CE transistor amplifier is a plot of (at constant V_{CE})

(a) V_{CE} against I_C ( )

(b) V_{CE} against I_B ( )

(c) V_{BE} against I_C ( )

(d) V_{BE} against I_B ( )

SECTION—II

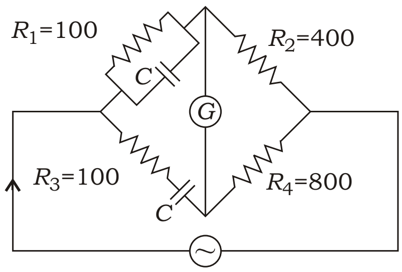
(*Marks* : 15)

Answer the following questions : 3×5=15

1. Show that the vectors—$\vec{A} \quad 2\hat{i} \quad 3\hat{j} \quad \hat{k}$ and $\vec{B} \quad 6\hat{i} \quad 9\hat{j} \quad 3\hat{k}$ are parallel vectors.

2. Using suitable circuit diagram, explain the Kirchhoff's law.

3. In an a.c. bridge as shown in the figure below, calculate the frequency of the bridge at balance condition if C 1 F :



4. Calculate the expectation value p_x of the momentum of a particle trapped in a one-dimensional box.

5. Explain the formation and biasing of the PN junction diode.

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