Sr. No. of Question Paper: 808 E

Unique Paper Code: 222453

Name of Course: B.Sc. (Hons)

Name of Paper: Physics II [PHCT 402]

Semester: IV

Duration: 3 hours Maximum marks: 75

(Write your roll number on the top immediately on receipt of this question paper.)

Q 1 is compulsory

Answer *five* questions in all, taking at

least *two* questions from each section

1) Answer any five of the following:

a) Show that electric field can be expressed as the gradient of a scalar potential.
b) Use Ampere's circuital law to find the magnetic field inside an infinite solenoid.
c) Write the continuity equation in electromagnetism. What is the significance of displacement current in this equation?
d) Use Gauss's law to determine the electric field due to an infinite straight wire with uniform charge per unit length.
e) Subtract $(1000111)_2$ from $(10010000)_2$ using the 2's complement method.
f) If V_{PP} for an AC voltage is 110 V, what is the value of V_{rms}?
g) Define the Q point of a transistor.
h) Draw the circuit diagram of a C filter and a LC filter. 5×3

Section A

2) a) Use Gauss's law to determine the electric field inside and outside a uniformly charged solid sphere, with radius R and total charge Q. 6

b) Determine the total energy stored in this electric field. How is it related to the potential energy of the charge configuration? 9

3) a) Write Maxwell's equations in free space. Show that **E** and **B** satisfy the wave equation. 7

b) Define a plane wave. Show that for such a wave **E**, **B**, and the wave vector **k** are mutually perpendicular. 8

4) a) Briefly explain diamagnetism, paramagnetism, and ferromagnetism. 9

b) Show that when a piece of dielectric material is polarized, there appears a charge on its surface with surface charge density $\mathbf{P}\cdot\mathbf{n}$, where $\mathbf{P}$ is the polarization density and $\mathbf{n}$ is the unit normal to the surface. 6

Section B

5) a) Draw the circuit diagram of a full-wave bridge rectifier and explain its working. Obtain expressions for its ripple factor and its efficiency. 10

b) Draw the input and output characteristics of a common-base transistor. 5

6) a) Define positive feedback. Explain the criterion for self-sustained oscillations. 6

b) What is the need for biasing a transistor? Draw the circuit diagram for self-biasing and explain how it works. 9

7) a) Draw the symbols and truth tables for the following gates: (i) NXOR, (ii) NOR, and (iii) AND. 6

b) Draw a half-adder and a full-adder using NAND gates only. Also give their truth tables. 9