2022

(May/June)

PHYSICS

(Elective/Honours)

(Electromagnetism, Electronics—I)

[PHY–02 (T)]

Marks : 56

Time : 3 hours

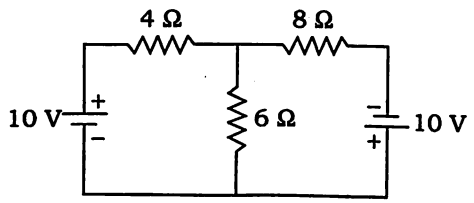
The figures in the margin indicate full marks for the questions

Answer Question No. **1** and *any* **four** from the rest

1. *(a)* Two drops of water each having a charge of 3×10^{-9} coulomb and a surface potential of 500 V combined to form a single drop. Calculate the surface potential of the single drop. 4

(b) A step-up transformer works on 220 V and gives 2 amperes of current to an external circuit. The turns ratio between primary and secondary coils is 2 : 25. Assuming 100% efficiency, find the secondary voltage, primary current and power delivered. 4

(c) Calculate the current through the 6Ω resistance using superposition theorem in the circuit below : 4



2. (a) Show that the work done around a closed path in an electrostatic field is zero. 2

(b) State Gauss' theorem in electrostatic. Show that the total flux over a surface due to a charge lying outside is zero. 1+2=3

(c) Obtain an expression for the potential and electric field intensity due to a uniformly charged disc of radius a at a finite distance r from it. Show that the disc behaves as a point charge for $r \gg a$. 4+2=6

3. (a) Find the magnetic field at a point on the axis in the inside of a solenoid. Show that for a very long solenoid, the magnetic field is twice that at a point on the end of the solenoid. 3+2=5

(b) Derive an expression for Gauss' law in presence of a dielectric. 3

(c) Discuss the behaviour of steel and soft iron in terms of hysteresis loops. 1½+1½=3

4. (a) Discuss the growth and decay of current in L-R circuit. What is the time constant of the circuit? 3+1=4

(b) An alternating e.m.f. $E_0 \sin \omega t$ is applied to the ends of the circuit containing resistance R, self-inductance L and capacitance C. Calculate the impedance of the circuit. 4

(c) Prove that the quality factor for an AC circuit is

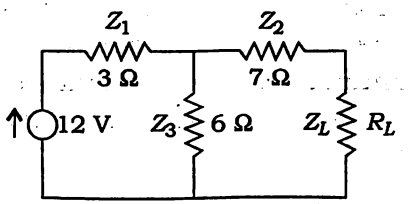
$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$ 3

5. (a) Explain star and delta connections in three-phase power supply. 1½+1½=3

(b) Show that Faraday's law of electromagnetic induction can be expressed as $\vec{\nabla} \times \vec{E} = \frac{\partial \vec{B}}{\partial t}$ and hence state its physical significance. 3½+1½=5

(c) What is Maxwell's displacement current? Explain its need in modifying Ampere's circuital law. 2+1=3

6. (a) Convert the linear network given below into Thevenin's equivalent network and then into Norton's equivalent network and show that the power delivered to the load resistance in both the cases is the same : 3+3=6



(b) Explain the meaning of hybrid parameters. 2

(c) Define ripple factor and show that its value is 1·21 for a half-wave rectifier. 1+2=3

7. (a) Draw a circuit diagram for static characteristics of a CE *n-p-n* transistor. What is output characteristics? Explain the meaning of cut-off region, saturation region and active region from this characteristics. 2+1½+1½=5

(*Continued*)

(b) Explain the terms load line and *Q*-point in the transistor characteristic. 1½+1½=3

(c) What is current amplification factor in a transistor? Establish the relation between the current amplification factors in CE and CB configuration. 1+2=3

8. (a) Draw the circuit diagram of a two-stage *R-C* coupled CE amplifier. Give its qualitative analysis. 1+2=3

(b) What is Barkhousen criterion for sustained oscillations? 2

(c) Explain the term 'common mode rejection ratio (CMRR)' of an OP-AMP. 2

(d) Show that OR, AND, NOR and NOT gates can be represented by using NAND gates only. 4

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