2018

(April)

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

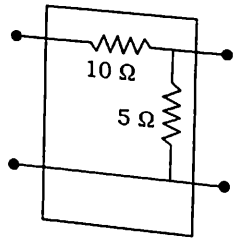
Answer Question No. **1** and *any* **four** from the rest

1. *(a)* Find the electric potential on the surface of a nucleus having mass number 64, atomic number 30. Taking charge on proton to be $1{\cdot}6\times10^{-19}$ C and radius of proton $1{\cdot}2\times10^{-15}$ m. 3

(b) A conductor of length 64 cm is bent into a square and a current of 4 A is passed through it. Find the magnetic field at the centre of the square. 3

(c) A straight solenoid of length 1 m has 50 turns in the primary and 200 turns in the secondary. If the area of cross-section of the solenoid is 4×10^{-4} sq m, find its mutual inductance. 3

(d) Find the h-parameters of the circuit as shown in the figure below : 3



2. (a) State and prove Gauss' theorem in electrostatics and hence show that the total flux over a surface due to a charge lying outside is zero. 1+4+2=7

(b) Obtain an expression for the potential due to a uniformly charged their spherical shell at an external point. 4

3. (a) A point charge $+q$ is placed at a distance d from the centre of an earthed conductor of radius R. Apply the method of electrical images to calculate the field on the sphere. 4

(b) Derive an expression for Gauss' law in the presence of a dielectric. Also discuss the integral form of Gauss' law. 4+3=7

4. (a) An alternating e.m.f. $E_0 \sin \omega t$ is applied to the ends of a circuit containing resistance R, self-inductance L and capacitance C. Calculate the impedance of the circuit, phase angle and the current at any instant. 4+1+2=7

(b) What is the quality factor for an AC circuit? Prove that quality factor

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$ 1+3=4

5. (a) What do you mean by mutual inductance? On what factors does mutual induction depend? 2+2=4

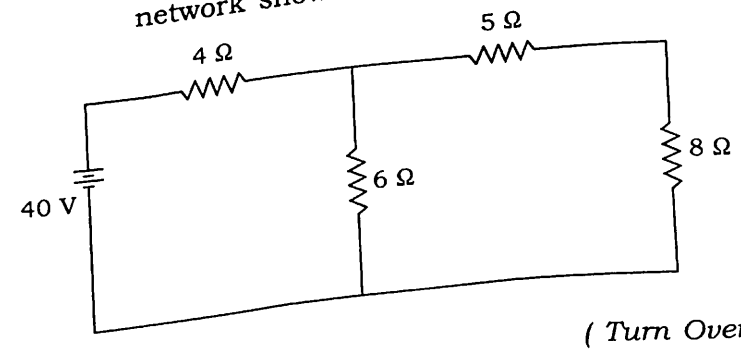
(b) State Faraday's law of electromagnetic induction. Prove that Faraday's law of electromagnetic induction can be expressed in the differential form

$$\vec{\nabla} \times \vec{E} = \frac{\partial \vec{B}}{\partial t}$$

and hence give the physical significance of the equation. 1+4+2=7

6. (a) State and explain Thevenin's theorem. 1+5=6

(b) Using Norton's theorem, find the current through the 8 Ω resistor in the network shown in the figure below : 5



(Turn Over)

7. (a) Describe with the help of a block diagram the working principle of a feedback amplifier. Derive an expression for the overall transfer gain. When does a feedback amplifier become oscillatory? 2+2+1=5

(b) What is a clipper circuit? Draw the circuit of a diode clipper which 'clips' the upper half of an input sin-wave lying above a reference voltage. 1+2=3

(c) Draw and describe in brief about a two-stage *R-C* coupled amplifier in CE mode. 3

8. (a) Write down the characteristics of an ideal Op-Amp. What are inverting and non-inverting terminals of an Op-Amp? Discuss the concept of virtual ground in Op-Amp. 3+2+2=7

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

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