2016

(April)

PHYSICS

(Elective/Honours)

SECOND PAPER

(Electromagnetism, Electronics—I)

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)* State Gauss' law. Apply this law to calculate the electric field of a charged infinite plane. 1+2½=3½

(b) What is an electrical image? Use the method of electrical images to find the electric field at a point near a conducting plane. 1+3½=4½

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

2. *(a)* Find the magnetic field at a point on the axis of the solenoid. Then obtain the magnetic field *(i)* when the solenoid is very long, *(ii)* at a point on the end of the solenoid. 3+1+1=5

(b) Define gyromagnetic ratio and susceptibility. 1½+1½=3

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

3. *(a)* Discuss the growth and decay of electric current in CR circuit. What is the time constant of the circuit? 4+1=5

(b) Explain the terms resonance and power factor in a.c. electrical circuits. 1½+1½=3

(c) A coil of resistance 20 Ω and inductance 0·5 H is switched to direct current 200 V supply. Calculate the rate of increase of current at the instant of closing the switch.

4. *(a)* Explain what is meant by mutual and self-inductances. Derive the relation

$$M = \sqrt{L_1 L_2}$$

where the symbols have their usual significance. 1+1+3=5

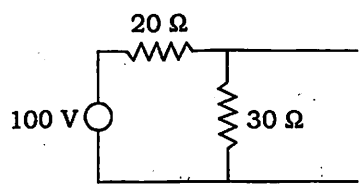
(Continued)

(b) Write down Maxwell's equations in free space. 2

(c) A step-up transformer works on 220 V and gives 2 amperes 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

5. *(a)* State Thevenin's theorem and prove it for a two-terminal network. 2+4=6

(b) Find the open-circuit voltage and Thevenin resistance for a terminal network shown in the diagram below : 3



(c) Explain the meaning of hybrid parameters. 2

6. *(a)* Draw a circuit diagram for static characteristics of a CE *p-n-p* transistor. What is output characteristics? Explain the meaning of cut-off region, saturation region and active region from this characteristics. 2+2+1½=5½

(Turn Over)

(b) Explain the terms load line and Q-point. $1\frac{1}{2}+1\frac{1}{2}=3$

(c) The current gain of a transistor in a CE circuit is 49. Calculate the CB current gain. Find the base current when the emitter current is 3 mA. $2\frac{1}{2}$

7. (a) What is a multistage transistor amplifier? Draw and describe the circuit of a two-stage RC-coupled CE amplifier. $1+2+2=5$

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

(c) What is feedback ratio in feedback amplifiers? An amplifier has a gain of 400. When negative feedback is applied, the gain is reduced to 300. Find the feedback ratio. $1\frac{1}{2}+2\frac{1}{2}=4$

8. (a) Describe the principle of working of an operational amplifier (OP-AMP). Explain the common-mode rejection ratio. What is the advantage of OP-AMP? $2\frac{1}{2}+1\frac{1}{2}+1=5$

(b) Explain NAND and NOR logic gates with circuit diagrams. Write down the truth table for both. $2+2+2=6$

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