This question paper contains 8 printed pages]

CODE : FRO-2017

ELECTRONICS ENGINEERING

Roll No. ....

Time : 3 Hours *Maximum Marks :* 200

Note :— (1) Question paper consists of *two* parts viz. Part I and Part II. Each part contains *four* questions. The paper as a whole carries eight questions. Question Nos. **1** and **5** are compulsory. The candidates are required to attempt *three* more questions out of the remaining six questions taking at least *one* question from each part *i.e.*, this is in addition to the compulsory question of each part. Attempt *five* questions in all. All questions carry equal marks. The parts of a question are to be attempted at one place in continuation. Answers should be brief and to the point.

(2) Parts of same question must be attempted together and not to be attempted in between the answers to other questions.

Part-I

1. (*a*) Define Matthiessen's rule. Draw the graph between electrical resistivity and temperature for metals showing residual resistivity. What happens to the electrical conductivity of semiconductor with increase in temperature ? Give reason for your answer. 20

(*b*) We wish to design a weighted-summer circuit that will produce the output

$$V_0 = -0.9V_1 - 0.1V_2$$

The design specifications call for use of one op-amp and no more than three resistors. Furthermore, we wish to minimize power while using resistors no larger than 10 kΩ. 20

2. (*a*) Find the inverse Laplace transform of the following function : 20

$$\frac{60(s+4)}{s(s+2)(s+12)}.$$

(*b*) Thyristor in Fig. 1 has a latching current level of 50 mA and is fired by a pulse of width 50 ms. Show that without R, SCR will fail to remain ON when the firing pulse ends. Find the maximum value of R to ensure firing. Neglect the SCR volt-drop and assume that the initial value of rate of rise of current remains constant over the entire pulse width. 20

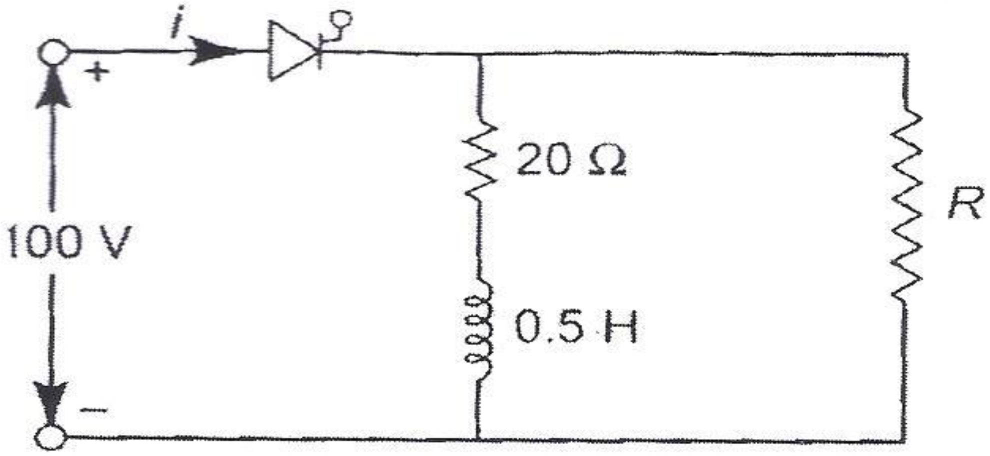

Figure 1

3. (*a*) For the circuit shown in Fig. 2, the switch opens at time t = 0s. Find $i(t)$ and $v(t)$ for all time. 20

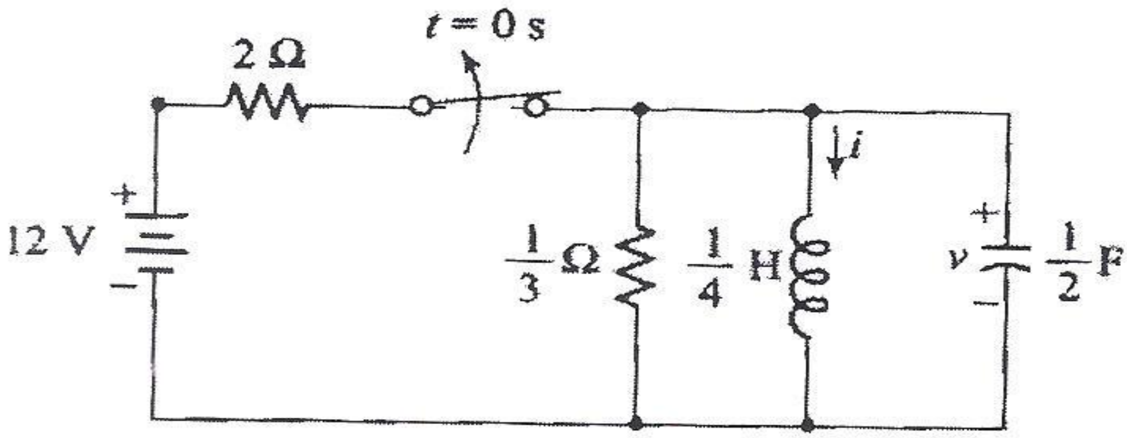

Figure 2

(b) For the circuit shown in Fig. 3, calculate the power of the 3 Ω resistor using nodal anlaysis. 20

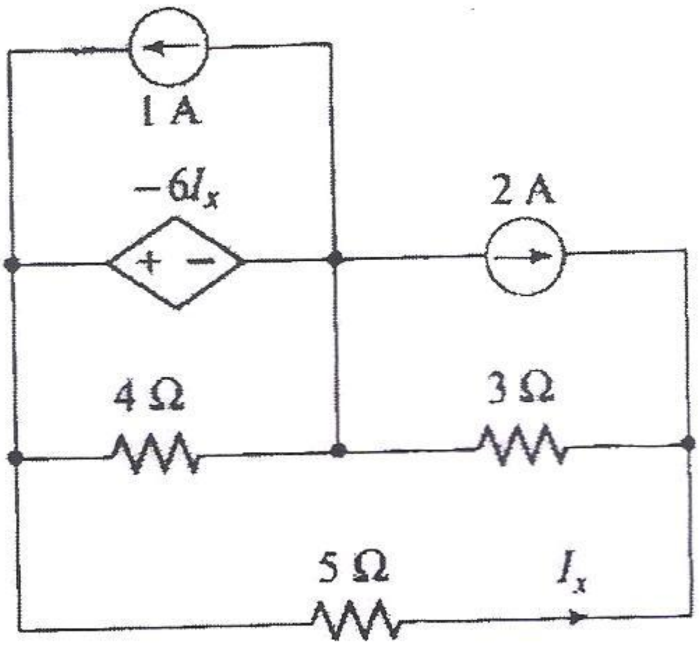

Figure 3

2.

4. (a) Explain why doping in pure semiconductors ? At 300 K, Si has 5×10^{28} atoms/m^3 and an intrinsic concentration of 1.5×10^{16} m^{-3}. The free-electron and hole mobilities are 0.13 m^2/V-s and 0.05 m^2/V-s, respectively. Determine the concentration of acceptor impurity required to dope silicon such that the resulting conductivity is 20.8 mho/m. How many parts per 10^8 is this doping ? 20

(b) What is meant by Nyquist Stability Criterion ? For the unity feedback system below, where

$$G(s) = \frac{K}{s(s+3)(s+5)}$$

Find the range of gain, K, for stability, instability and the value of K for marginal stability. For marginal stability, also find the frequency of oscillation. 20

Part-II

5. (a) Use algebraic manipulations to simplify the following : 15

$$\overline{(A\overline{B} + \overline{A}B) + (\overline{A + B})}$$

(b) Show that the channel capacity of an ideal AWGN channel with infinite bandwidth is given by

$$C_\infty = \frac{1}{\ln 2}\frac{S}{\eta} \approx 1.44\frac{S}{\eta}\, b/s$$

where S is the average signal power and $\eta/2$ is the power spectral density of white Gaussian noise. 15

(c) Calculate the numerical aperture and hence the acceptance angle for an optical fiber given that refractive indices of core and the cladding are 1.45 and 1.40 respectively. 10

6. (a) Define modulation index and deviation ratio in communication. Assuming maximum frequency deviation (referred to as 100 percent modulation), find the deviation ratio for monophonic FM radio. 20

(b) What is meant by time division and frequency division multiplexing ? Explain their significance in communication theory. 20

7. (a) Consider a wave travelling in z-direction in TE_{10} mode in a rectangular waveguide having sides $a = 2.29$ cm and $b = 1.02$ cm operated at a frequency of 7 GHz. If the amplitude of the electric field is 1000 V/m, determine the total-average power in the z-direction over the guide across section (in mW). 20

(*b*) What is meant by standing wave ratio (SWR) in transmission line theory ? A lossless transmission line is terminated with a 100 Ω load. If the SWR on the line is 1.5, find the two possible values for the characteristic impedance of the line. 20

8. (*a*) For the logic circuit shown in Fig. 4, the inputs are S and R, whereas the outputs are Q and $\overline{Q}$. Construct a truth table including the present state Q and the next state $Q(t + 1)$ for this circuit. Assuming that the input condition R = S = 1 does not occur, what type of sequential circuit is this ? 20

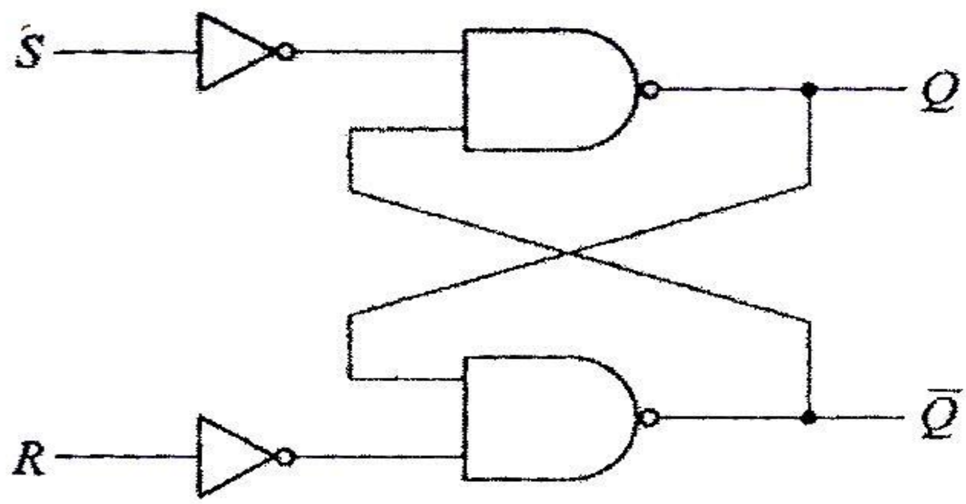

Figure 4

(*b*) What is meant by OSI in internet protocol ? How many layers are there in this protocol ? Name these layers in proper sequence with reference to sending data. Also write functioning of each layer in just one line. 20