2019 MSC(O)-EE-I/19

ELECTRICAL ENGINEERING

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

The figures in the margin indicate marks for each question.

All symbols have their usual significance.

Group-A

Answer **any three** *questions.*

1. (a) Use superposition theorem to find the value of voltage '*v*' in the network of Fig.- 1. 10

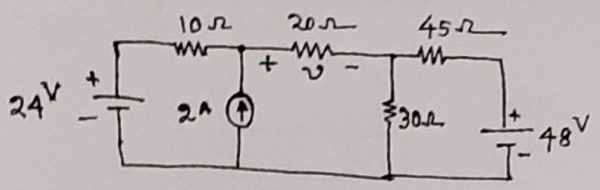

Fig.-1

(b) Use Millman's theorem to find the current through R_4=5Ω in the network shown in Fig.- 2. 10

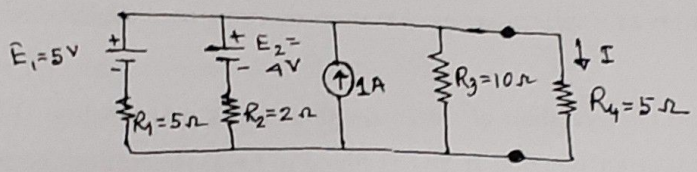

Fig.-2

(c) Find the Y parameters for the network shown in Fig.-3. 10

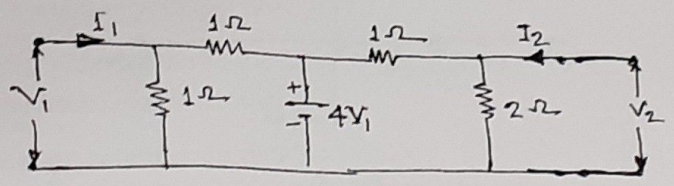

Fig.-3

(d) The resistivity of a ferric-chromium-aluminium alloy is $51\times10^{-8}\Omega$.m. A sheet of the material is 15cm long, 6 cm wide and 0·014cm thick. Determine the resistance between (i) opposite ends and (ii) opposite sides. 5+5=10

Please Turn Over

2. (a) A balanced star-connected load of (8+j6)Ω per phase is connected to a balanced 3-phase 400 volt supply. Find the line current, power factor, power and total volt-amperes. 10

(b) A discharged battery is charged at 8A for 2 hours after which it is discharged through a resistor R. If discharge period is 6 hours and the terminal voltage remains fixed at 12 volt, find the value of R assuming the Ah efficiency of the battery as 80%. 10

(c) Two coils A and B have a coupling coefficient of 1/3. When connected cumulatively in series, the total inductance is 8·5 mH and when connected differentially, the total inductance is 4.5 mH. Find (i) the self-inductance of each coil and (ii) the mutual inductance between the coils. 10

(d) A resistance R, an inductance L=0.01H and a capacitance C are connected in series. When a voltage v= 400 cos (3000t–10°) volts is applied to the series combination, the current flowing is $10\sqrt{2}$ cos (3000t–55°) amp. Find R and C. 10

3. (a) Find the laplace transform of a train of pulses of width a, amplitube A and periodic time T as shown in Fig.-4. 10

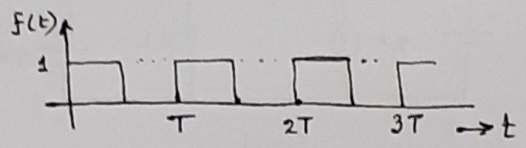

Fig.-4

(b) Test the stability of a system having characteristic equation, $F(S)=S^3+6S^2+12S+8=0$, use routh array. 10

(c) The pole-zero configuration of a transfer function is given below (Fig.- 5) of which the value of the transfer function at S=1 is found to be 5. Determine the transfer function and gain value K. 10

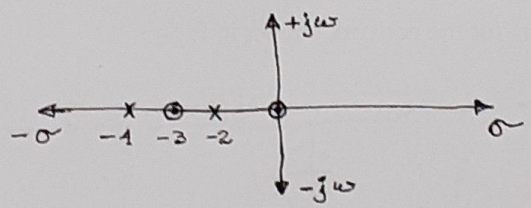

Fig.-5

(d) Find the Z-transform of $f(t) = e^{at}$. 10

4. (a) Show that $\nabla \times \overline{H} = \overline{J}$. 10

(b) Explain $\nabla \cdot \overline{B} = 0$ and $\nabla \cdot \overline{J} = 0$. 10

(c) A (+ve) charge is situated at (0, 2) of magnitude $4 \times 10^{-6} C$. Another charge of $-2 \times 10^{-6} C$ is located at $(0, -2)$. Find $\overline{E}$ and V at the point $(0, -1)$ as shown in Fig.-6. 10

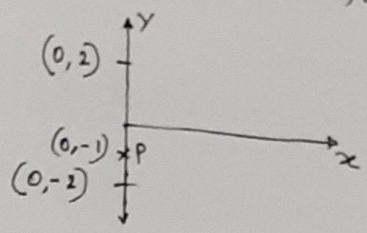

Fig.-6

(d) Establish $\nabla \times \overline{E} = \frac{-\partial \overline{B}}{\partial t}$. 10

5. (a) Show that, $\nabla \times \overline{H} = \overline{J} + \frac{\partial \overline{D}}{\partial t}$. 10

(b) Stating Maxwell's Equations, derive electromagnetic wave equations in a lossy medium. 10

(c) What do you understand by E.M. wave polarisation? 10

(d) Establish 'Poynting Theorem'. 10

Group-B

Answer **any two** *questions.*

6. (a) A half-wave rectifier is used to supply 50V dc to a resistive load of 800Ω. The diode has a resistance of 25Ω. Calculate ac voltage required. 10

(b) Draw the equivalent circuit of UJT and discuss its working from the circuits. 10

(c) The following parameters are available of a FET.

$$I_{DSS} = 18mA;\ V_{GS(off)} = -9V;\ V_{GS} = -5{\cdot}5V.$$

Find the value of drain current. 10

(d) Draw the static characteristics of JFET. 10

7. (a) Describe the working principle of MOSFET. 10

(b) A change of 250 mV in the base-emitter voltage causes a change of 100 μA in the base current. Find the input resistance of the transistor. 10

(c) For a single stage amplifier the data is as under:

Collector load, $R_L = 8\ K\Omega$

Input resistance, $R_L = 800\Omega$

Current gain, $\beta = 50$

Determine the voltage gain of the amplifier. 10

(d) Find the decimal equivalent of the binary number $(1111.101)_2$. 10

8. (a) Find the DFT of the sequence $x(n) = \{1, 1, 0, 0\}$ 10

(b) The measured value of a capacitor is 205.3 μF, whereas its true value is 201.4 μF. Determine the relative error. 10

(c) Describe the principle of thermocouple. 10

(d) What is the use and importance of feedback in closed loop control systems? Describe. 10

9. (a) The block diagram of a unity feedback control system is shown in Fig.-7.

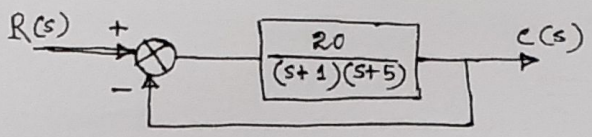

Fig.-7

Determine the characteristic equation of the system, w_n, r, w_d, t_p, M_p, the time at which the first overshoot occurs, the time period of oscillations and the number of cycles completed before reaching the steady state. 15

(b) Discuss the mapping from S-plane to Z-plane and explain the consequence of stability. 10

(c) What is a microprocessor? What is the difference between a microprocessor and a CPU? 15
