CSM—28/23

PART—II/PAPER—VI

ELECTRICAL ENGINEERING

PAPER—I

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Time : 3 Hours

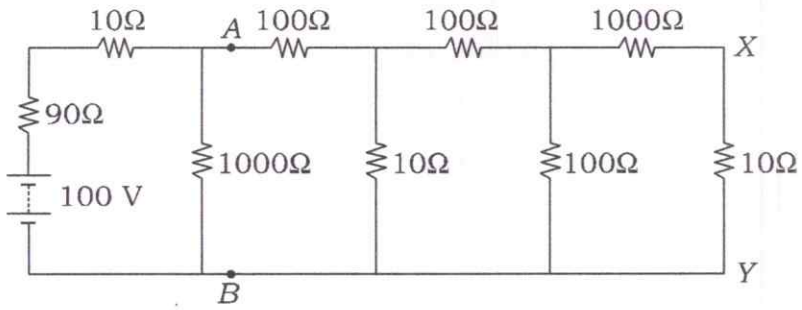
Full Marks : 250

The question paper contains **18 (Eighteen)** *questions in* **GROUP—A (12)** *and* **GROUP—B (06)** *together.*

GROUP—A

Candidates to attempt **10** ***(ten)*** *questions within word limit of* **250**. *Each question carries* **15** *marks.*

1. By the iterated use of Thevenin's theorem, reduce the circuit shown in the figure to a single emf acting in series with a single resistor. Hence calculate the current in the 10 ohm resistor *XY*.



2. Realize the following impedance function using both first and second forms of Foster and Cauer canonical networks.

$$Z(s) = \frac{(s+1)(s+4)}{s(s+2)}$$

3. Obtain Maxwell's equations in integral and differential forms as derived from Faraday's laws.

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4. What are Digital to Analog converters? Describe, with necessary diagrams, working of a 'binary weighted resistance D/A converter'.

5. Draw the circuit diagram of an "Up-Down" ripple counter and explain its operation. How, with the help of four J-K flip-flops and associated circuitry, a "decade counter" can be obtained? Discuss its operation.

6. What should be the ideal characteristics of an operational amplifier? Name it. Distinguish between virtual ground and actual ground. Define the term "Common mode rejection ratio". How will you measure it?

7. Develop a voltage follower circuit using a JFET. Bring out the distinctions between the constructional and operational features of a JFET and MOSFET.

8. Make a distinction between the "voltage" feedback and "current" feedback in amplifier circuits. Discuss the merits in each case and derive the expression for the net output impedance in each case.

9. A 100 kVA transformer has its maximum efficiency of 98% at full load and unity p.f. During the day it is loaded as follows :

12 hrs.	—	20 kW at a p.f. of 0.5 lag
6 hrs.	—	50 kW at a p.f. of 0.9 lag
6 hrs.	—	75 kW at a p.f. of 0.8 lag

Calculate the "all day efficiency" of the transformer.

10. Consider a carrier waveform $10\cos\omega_c t$ and a modulating message signal $3\cos\omega_m t$ with f_c = 100 kHz and f_m = 4 kHz. Calculate the modulation index and the channel bandwidth for amplitude and frequency modulation. Assume the sensitivity of the frequency modulator to be 5 kHz per volt.

11. What are the systems employed for generation of SSB? Name them. How does balanced modulator suppress the carrier? Draw the circuit of a balanced modulator using FFT and explain it. Discuss the filter method of side band suppression with the help of a block diagram.

12. In a commercial broadcasting system, the FM signal has a centre frequency of 105 MHz and the highest frequency of 105.03 MHz, when modulate by a signal of frequency 5 kHz. Determine

(i) Frequency deviation

(ii) Carrier swing

(iii) Modulation index

(iv) Percent modulation

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GROUP—B

Candidates to attempt **05** ***(five)*** *questions within word limit of* **300**.

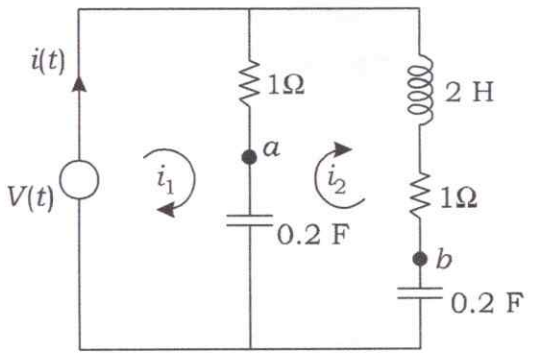
Each question carries **20** *marks.*

13. Define the following network functions with reference to a 2-port network :

(i) Driving point impedance

(ii) Transfer admittance

Obtain $\frac{Vab(s)}{V(s)}$ for the network shown in the figure



14. Find the current $i(t)$ in a series RLC circuit comprising resistor $R = 4\Omega$, inductor $L = 1$ henry and capacitor $C = 1/3$ Farad when each of the following driving force voltages is applied.

(i) Ramp voltage $9r(t-2)$

(ii) Step voltage $4u(t-3)$

(iii) Impulse voltage $2\delta(t-1)$

15. Discuss where the sinusoidal oscillators are used. For phase shift oscillator, why three sections of '*R-C*' circuits are cascaded? Draw and explain a simple phase shift oscillator using three sections of *R-C* circuit and a transistor. Derive the formula for the frequency of oscillation. Make comments on the transistor current gain. Design the values of *R-C* to give oscillation of say nearly 1 kHz.

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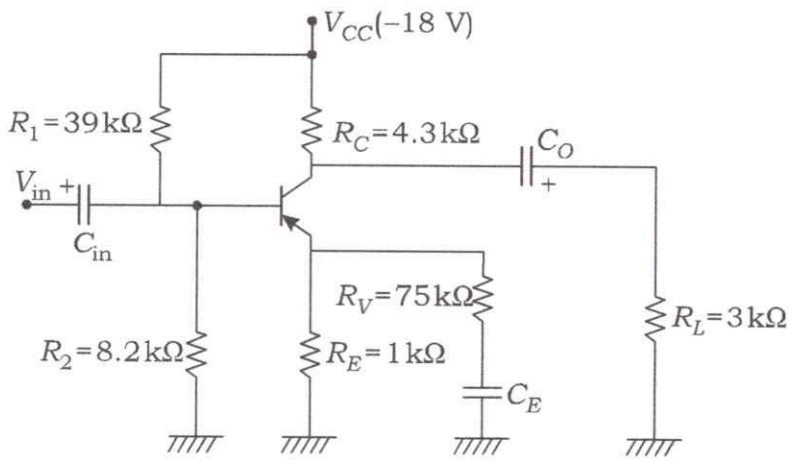
16. A series generator of total resistance 0.5 ohm is running at 1000 RPM and delivering 5 kW at a terminal p.d. of 100 V. If the speed is raised to 1500 RPM and the power is adjusted to 8 kW, find the new current and terminal voltage. Assume that the m/c is working on the straight portion of the characteristics such that the flux is proportional to the current and the emf generated is proportional to product of flux and speed.

17. A star-connected alternator is synchronized with an infinite bus of 11 kV; its steam input is then increased till its output power is 15 MW. Now, when its excitation e.m.f. is increased to 130%, the synchronous machine starts operating at a p.f of 0.8 lagging. Compute the synchronous reactance of the machine. Neglect armature resistance. Determine the power factor, load angle and armature current of the machine before the excitation e.m.f. is increased.

18. For a single-stage transistor amplifier shown in the circuit below, find the voltage gain A_v, input impedance Z_{in} and V_{CE}. Take $\beta = 200$ and $r_e = \frac{30\text{ mV}}{Ie}$.



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