



KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
General Instructions: Always maintain an accuracy of at least 3 decimal digits.

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. Determine the following for the circuit depicted in Fig. 1.
(a) $I_{3\Omega}$ (b) $I_{2\Omega}$ (c) $I_{1\Omega}$ (d) $I_{0.1\Omega}$ (e) Power supplied by the 11A current source.
(Answers for the currents must conform to the directions of the arrows shown in Fig. 1).

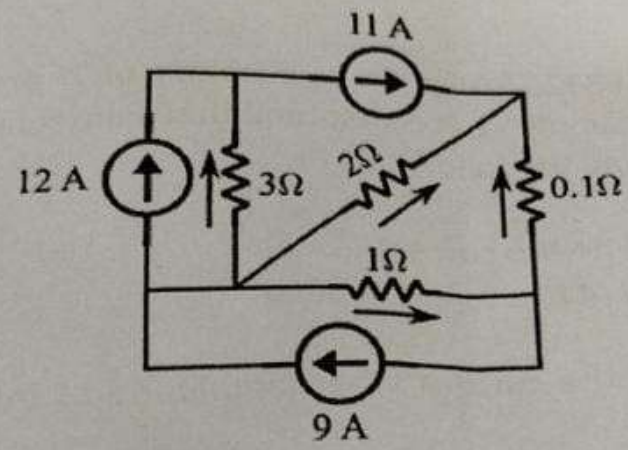


Fig. 1

2. a) Calculate the resistance between the terminals 'a' and 'b' as shown in Fig. 2(a). [4]

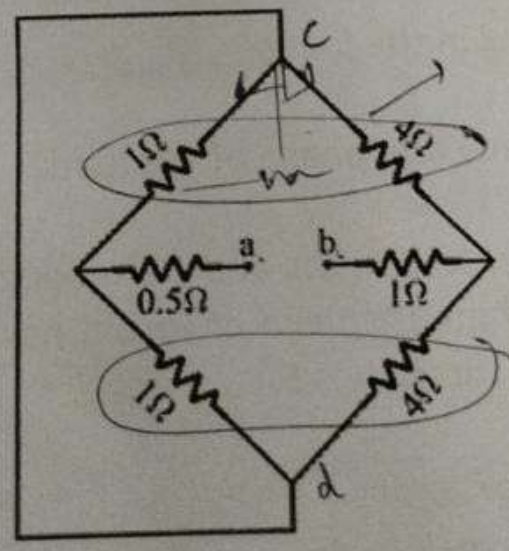
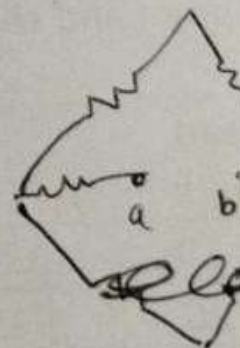
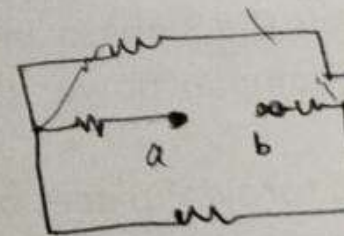


Fig. 2(a)



- b) Find the Thevenin voltage and Thevenin resistance across the terminals 'M' and 'N' of the circuit depicted in Fig. 2(b). [6]

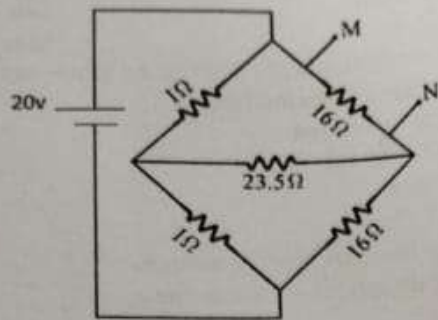


Fig. 2(b)

3. A resistance of 2Ω , an inductance of $0.633257\mu\text{H}$ and a capacitance of 1F are connected in series and fed with an AC supply V_s . It is assumed that sinusoidal steady state conditions prevail. Determine the following.
- If $V_s = 100 \cos(100t - 10^\circ)$ V, calculate the current.
 - Total impedance when frequency of the supply is 50Hz .
 - The resonant frequency in Hz.
 - Maximum possible amplitude of the current when amplitude of the supply is 2V .
 - Complex power absorbed from the source when $V_s = 200 \cos(400\pi t + 28.99^\circ)$ V.
4. Three generators of 120V_{RMS} form a balanced 3 phase delta connected source having phases a, b and c which supplies a balanced delta connected load of $(5+2j)\Omega$ per phase.
- Determine the 3 phase currents flowing in the loads.
 - Determine the 3 phase line currents.
 - Find the complex power absorbed by any one phase of the load.
5. Three concentric toroidal pieces of differing mean lengths and cross sectional area are arranged as depicted in Fig. 3. The thinnest piece of toroid has 200 turns of wire wrapped and the current flowing through is 5A .

Toroidal segment	Mean length (cm)	μ_r	Radius of cross section (cm)
Thinnest	$l_1 = 10$	2000	$R_1 = 1$
Thickest	$l_2 = 20$	1500	$R_2 = 5$
Middle	$l_3 = 18$	6500	$R_3 = 3$

- a) Compute reluctance of the entire structure.
- b) Calculate flux set up in the thickest piece.

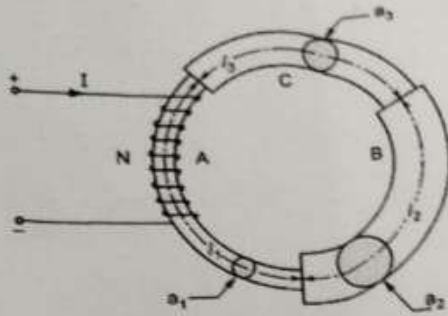


Fig. 3

6. a) Two electromagnetic coils having self-inductance of $L_1 = 50 \text{ mH}$ and $L_2 = 60 \text{ mH}$ are placed in such a way that 80% of the first coil is placed upon the second coil. Find the total mutual inductance of these coils. [3]
- b) When two coils are connected in series such that their fluxes aid each other, it is observed that their equivalent inductance is 750 mH . If the same coils are kept in series but in a configuration such that their fluxes oppose one another, it is observed that their net inductance comes to be 400 mH . If the self-inductance of coil 2 is only about one fourth that of coil 1, find L_1 , L_2 , M and coupling coefficient k . [7]
7. Explain the working principle and state the applications of (i) Transformer (ii) Stepper motor.
8. a) State Fleming's right hand rule and with a simple schematic explain how this law governs the generating action in a DC machine. [5]
- b) Explain the principle of operation of a 3 phase induction motor. List any 2 methods used for starting a single phase induction motor. [5]
9. a) Simply the following Boolean expression using only Boolean laws. [6]

$$F = (X_1 + X_2)(\overline{X_1} + X_1 X_2) + (\overline{X_2} + X_1 \overline{X_2})$$
- b) Design a 2:1 multiplexer using only NOR gates. [4]
10. Reduce the following expression using Karnaugh map and implement the final expression using minimum number of NAND gates.

$$f(A, B, C, D) = \sum(1, 2, 3, 4, 7, 9, 10, 12)$$
11. i. Draw and explain characteristics of a PN junction diode.
 ii. Explain how a Zener diode is used in voltage regulator circuits.
12. Explain the operation of BJT under common base (CB) configuration with a circuit diagram. State the reasoning behind its input and output characteristic curves.

