MANIPAL INSTITUTE OF TECHNOLOGY, MANIPAL

(A Constituent Institute of Manipal Academy of Higher Education)

Department of Electrical and Electronics Engineering

SECOND SEMESTER B. TECH DEGREE – IN-SEMESTER EXAMINATION
ELE 1051: BASIC ELECTRICAL TECHNOLOGY

Time: 2 hours + 15 minutes **19th JUNE 2021** **Max. Marks: 30**

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1. For the circuit shown in Fig. 01, write the node voltage equations in matrix form. **[03]**

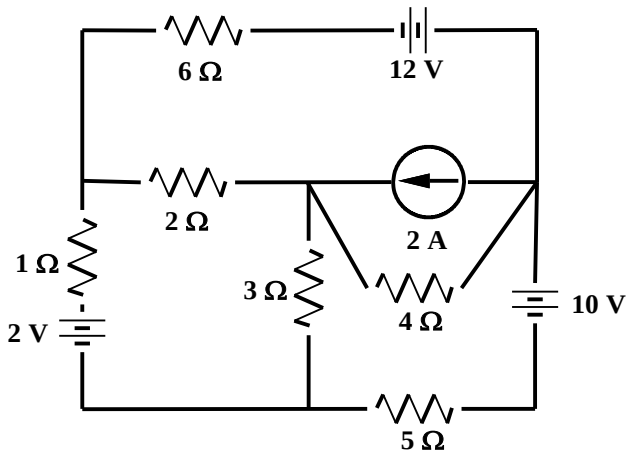

Fig. 01

2. For the circuit shown in Fig. 02, find the equivalent resistance R_{AB} across the terminals A & B. **[03]**

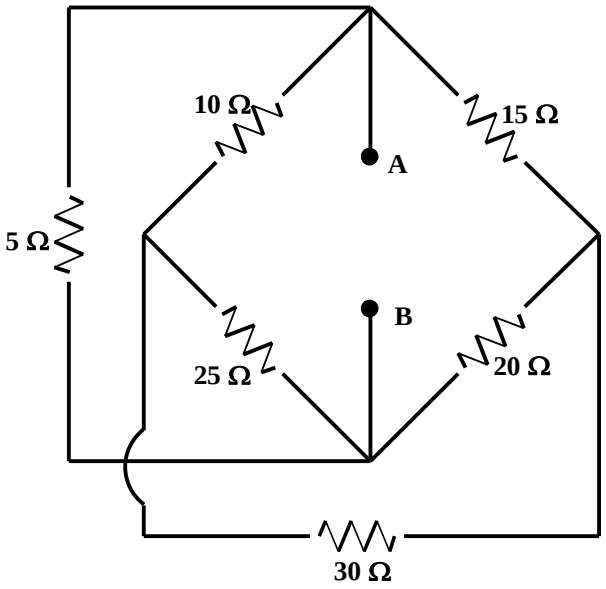

Fig. 02

3. In the circuit shown in Fig. 03, the switch S is open, and the capacitor is relaxed initially. At t = 0, S is closed for a duration of 40 msec and then opened. **[04]**

a) Determine (or derive) the capacitor voltage $v_c(t)$ expression(s).
b) Sketch the capacitor voltage for 100 msec from the instant the switch S was closed and mark couple of salient points on it.
c) After how much time from the instant the switch S was closed, will the capacitor voltage drop to 2 V?

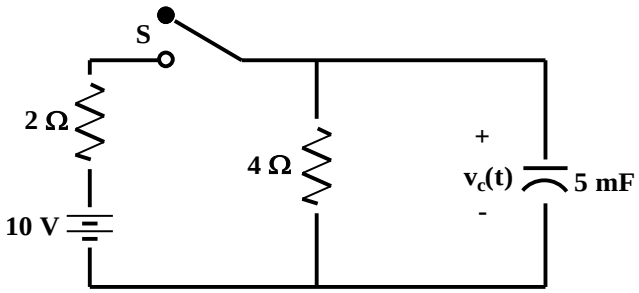

Fig. 03

4. Three identical coupled coils of self-inductance 40 mH are wound on a rectangular core as shown in Fig. 04. Calculate the maximum and the minimum equivalent inductances possible for this arrangement assuming that same current flows through all the coils. **[03]**

Given, the coupling co-efficient K_{12} = 0.95, K_{23} = 0.9, K_{31} = 0.8.

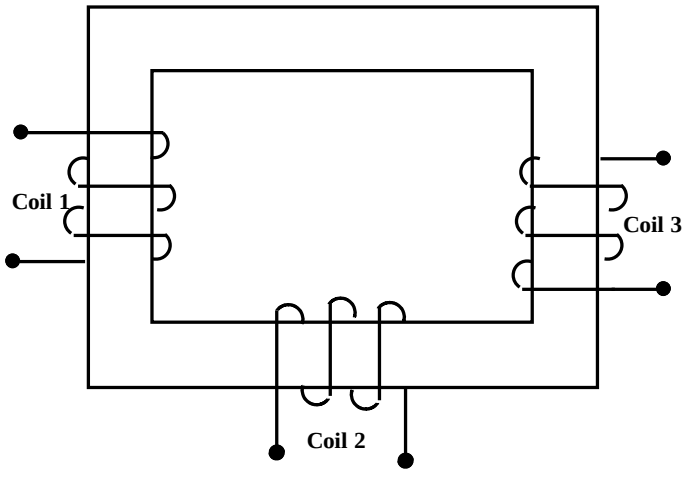

Fig. 04

5. Fig. 05 shows a symmetrical iron core of uniform square cross-section. The central limb of the core is wound with a coil of 1000 turns. **[04]**

a) What is the current required in the coil to produce a flux of 2 mWb in the side limbs?

b) If a saw-cut of 2 mm is made in both the side limbs, then what is the current required in the coil to maintain the same flux in the side limbs as mentioned above?

Given,

mean length of the side limbs = 55 cm,
mean length of the central limb = 15 cm,
area of cross-section = 16 cm^2,
relative permeability, μ_r = 1200.

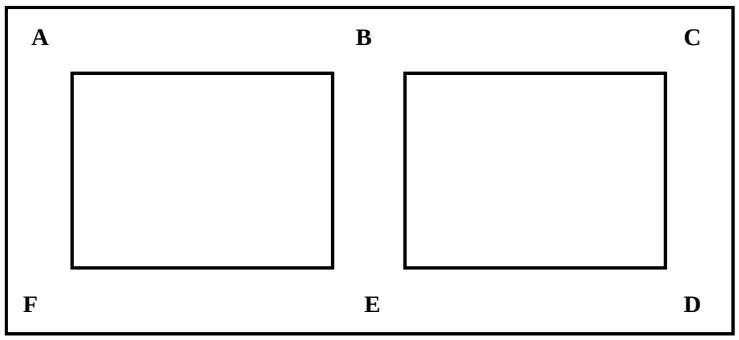

Fig. 05

6. An alternating voltage source, waveform as shown in Fig. 06, is connected to a 10 Ω resistor. Find the heat dissipated in the resistor. **[02]**

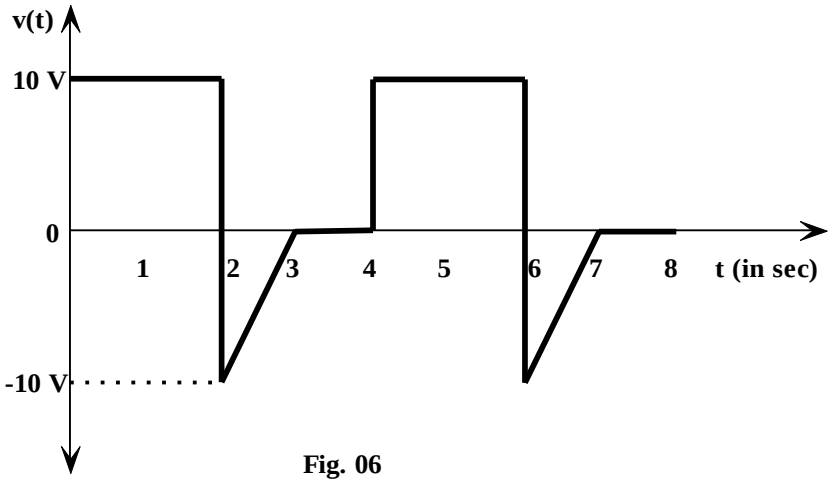

Fig. 06

7. The bandwidth of a series resonant circuit is 200 Hz. The resonant frequency is 4000 Hz If R = 5 Ω, calculate, **[02]**
   a) The inductive reactance at resonance.
   b) The quality factor Q.
   c) The voltage-drop across the inductor at resonance if supply voltage is 100 V.
   d) The capacitance of the circuit at resonance.

8. A voltage source $v(t) = 282.85\sin(100\pi t + 50°)$ is connected to an impedance which draws a current of $i(t) = 14.15\cos(100\pi t + 30°)$. **[02]**
   a) Find the average active and reactive powers.
   b) Is the impedance inductive or capacitive or purely resistive in nature?

9. For the circuit shown in Fig. 09, find the maximum power dissipated in the load impedance Z_L. Assume that both, the resistance and the reactance of the load impedance are variable. **[03]**

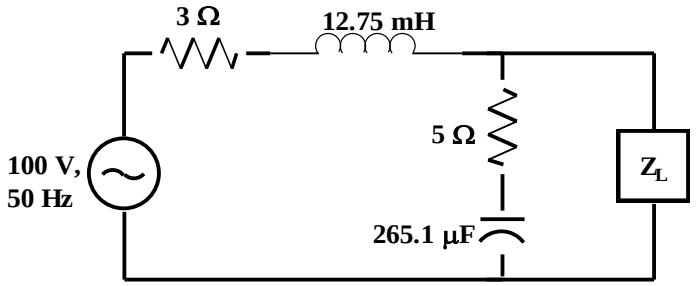

Fig. 09

10. A single-phase 220 V, 50 Hz supply is connected across the following loads: **[04]**
   i. An induction motor drawing a current of 12 A at 0.76 pf lagging.
   ii. A 1-ton AC drawing a current of 15 A at 0.61 lagging.

   Calculate,
   a) The total average active and reactive powers drawn from the source.
   b) The capacitance to be connected in parallel with the source to raise the overall power factor to 0.95 lagging.