ADYA SINGHAL
2410110027

End-Semester Exam (Spring2025)

ECE 101: Basics of Electrical and Electronic Circuits (2nd May 2025)

Answer any FOUR questions. Each carries 10 marks (Total marks: 40). Time allowed: 85 minutes.

Only first four answers will be evaluated (cross out the remaining).

Write Code: XQN in bold letters on front page (below S.No. of answer book).

(Q1) The circuit shown on right (Fig.1) is fed from ac supply of 50 Hz and 60 V (rms) magnitude. With this supply, the passive elements inside the rectangular block draw active power = 300 Watts and reactive power (capacitive) = 480 VAR. In addition to the load in rectangular block, a resistance of 30Ω and an inductive reactance of 15Ω are also connected across the supply. Note: Supply phasor is 60V /_0^0

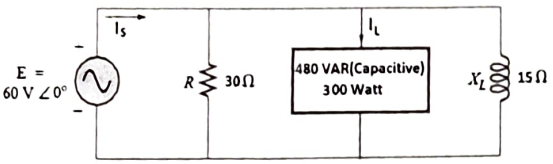

Fig. 1

(a) Find rms magnitude of current supplied by the source 'E'. **[4]**

(b) Find supply power factor (mention leading or lagging). **[2]**

(c) What is the total VAR supplied by the source 'E'? **[2]**

(d) Write phasor expression for 'I_L' (see figure) **[2]**

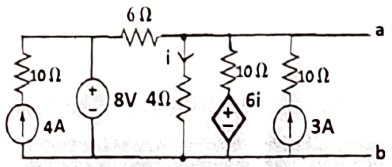

Fig. 2

(Q2) Find Norton's equivalent of circuit connected between terminals 'a' and 'b' of Fig.2. Note the presence of a dependent voltage source. Calculate the magnitude of external load resistance connected across terminals 'a' and 'b' for drawing maximum load power. Also, calculate this maximum power. **[4+4+2] marks.**

(Q3) For circuit in Fig.3 use superposition principle and find current through 6Ω in the direction of arrow. There are three current sources and three voltage sources. Show calculation of current (to 6Ω along arrow) due to each source and then apply principle of superposition. Next, find power supplied by 5V source (use any method). **[6+1+3] marks**

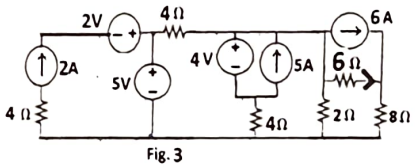

Fig. 3

(Q4a) A linear time varying inductor (L) is connected in series with a linear time varying resistor (R). Variation in magnitude of 'L' and 'R' (w.r.t. time) is shown in Fig.4. Inductance changes linearly but resistance changes in steps (note the scale of time axis). When a dc voltage of 25 V is applied to the series combination, the current through it is found to be constant = 5 milli-amp. Find magnitudes of R1 and R2. **[5] marks**

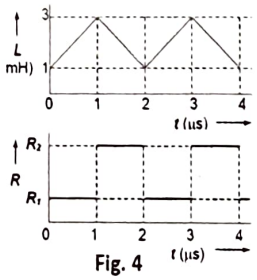

Fig. 4

(Q4b) Consider a 555 IC based ASTABLE circuit with following details: V_{CC} = 12V, control (pin5) voltage = 9V. Threshold (pin6) and trigger (pin2) inputs are shorted and a capacitor of 0.1 micro-farad is connected between the shorted pins and ground. A resistor of 8 kΩ is connected between shorted pins (6&2) and pin7 (discharge pin). Another resistor of 1 kΩ is connected between V_{CC} and pin 7. Reset pin (pin4) is deactivated by connecting it to V_{CC}. As, usual, pin 1 is ground pin. Draw the ASTABLE circuit described and derive an expression for ON (high) time duration of output pin (pin3) during any steady state oscillator cycle. **[1+4] marks**

(Q5a) Consider the op-amp circuit shown in Fig.5. What is the loop- gain of the circuit? Under what condition the circuit will satisfy "Barkhausen criterion" for sustained oscillation and what will be the corresponding output frequency (in Hertz)? **[4] marks**

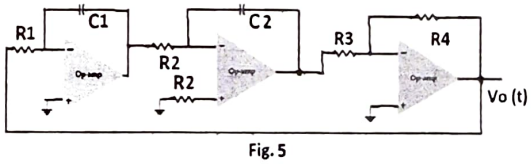

Fig. 5

(Q5b) Clearly draw a Wien bridge R-C oscillator circuit. Suggest the values of resistors and capacitors to get an output frequency of 1800 Hz. **[2+4] marks**

(End of Question Paper)