Ref. No. Ex/ES/EE/T101B/2023

B.E. Electrical Engineering First Year Second Semester Examination, 2023

Basic Electrical Engineering

Time: Three Hours **Full Marks: 100**

(50 Marks for each part)

Use a separate Answer Script for each Part

PART-I

Answer one question from each Group (3X16). 2 marks reserved for neatness and well organized answers

Group A (Answer any one question-16 marks)

1. a) Why parallel resonant circuit is called a ***rejecter circuit***? A coil of inductance 1H and resistance 50 Ω in series with a capacitor is supplied from a constant voltage variable frequency source. If the maximum current is 2A at 50Hz, determine the frequency when the current is 1A. [2+6]

b) Prove that the locus of the current in a series R-C circuit with variable R is a semicircle. Also draw the locus diagram of current when supply voltage is 50V and capacitive reactance is 10 ohm considering that R varies from zero to infinity. [4+4]

2. a) What is the importance of power factor correction of an electrical network? A lamp is taking 100 Watt at 0.75 power factor (lagging). Explain how can you correct the power factor to unity showing the circuit diagram and the value of necessary component to be used. [2+4]

b) In an a.c. circuit the impedances Z_A = (8+j6) Ω and Z_B = (6-j8) Ω are connected in parallel. This parallel combination is connected in series with another impedance Z_C = (3+j4) Ω. The entire combination of impedances is then connected across a voltage source of $100\angle 45°$ Volts. Determine the currents through the impedances Z_A and Z_B. Also determine the phase angle difference between these currents. [5]

c) For the trapezoidal current waveform as shown in **Fig. 1**, determine the rms and the average value of the current. Hence, find the form factor of the waveform. [5]

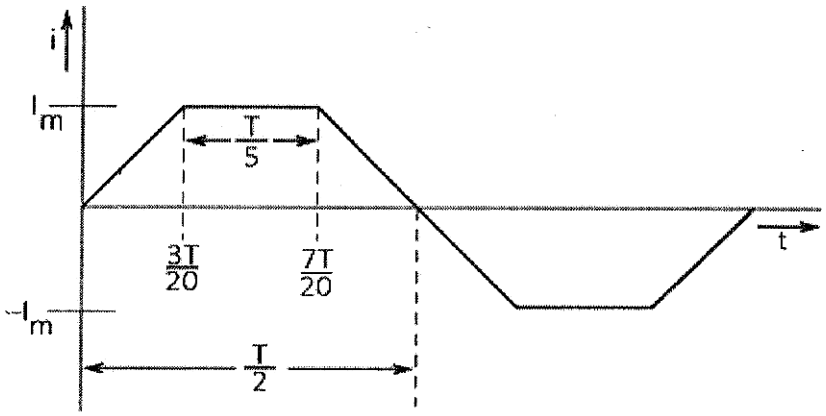

Fig. 1

[Turn over

Ref. No. Ex/ES/EE/T101B/2023

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Group B (Answer any one question- 16 marks)

3.a) State maximum power transfer theorem when applied to ac circuits. Prove maximum power transfer theorem when i) the load is purely resistive ii) when the load consists of variable reactance and fixed resistance. [2+6]

b) Determine Norton's equivalent circuit across AB in the circuit shown in **Fig. 2.** For what value of load impedance connected across AB, power delivered will be maximum? [6+2]

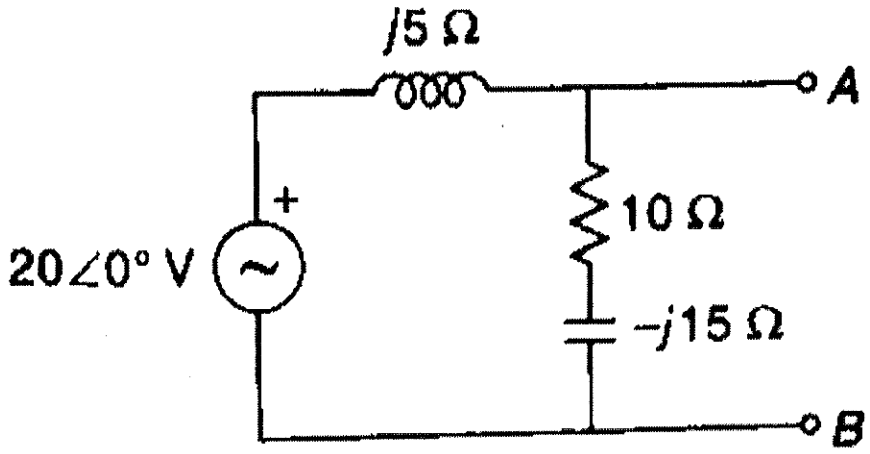

Fig. 2

4. a) State Superposition Theorem. Find out the value of current through the 10Ω resistor in the following circuit as shown in **Fig. 3** using Superposition theorem. [2+6]

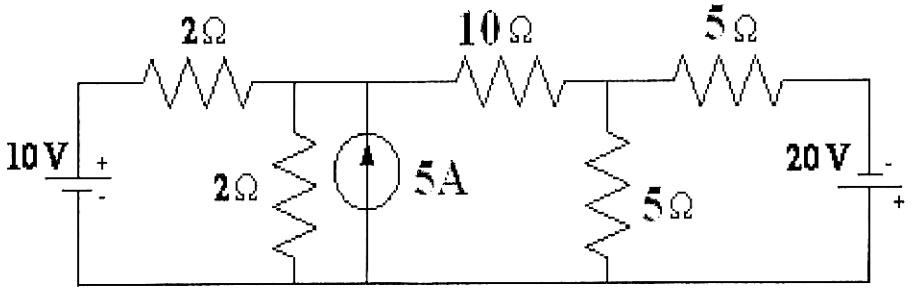

Fig. 3

Ref. No. Ex/ES/EE/T101B/2023

B.E. Electrical Engineering First Year Second Semester Examination, 2023

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b) Find the current through (2+j3) Ω branch of the circuit given below (**Fig. 4**) using Thevenin's theorem. Show the Thevenin's equivalent circuit for the same. [8]

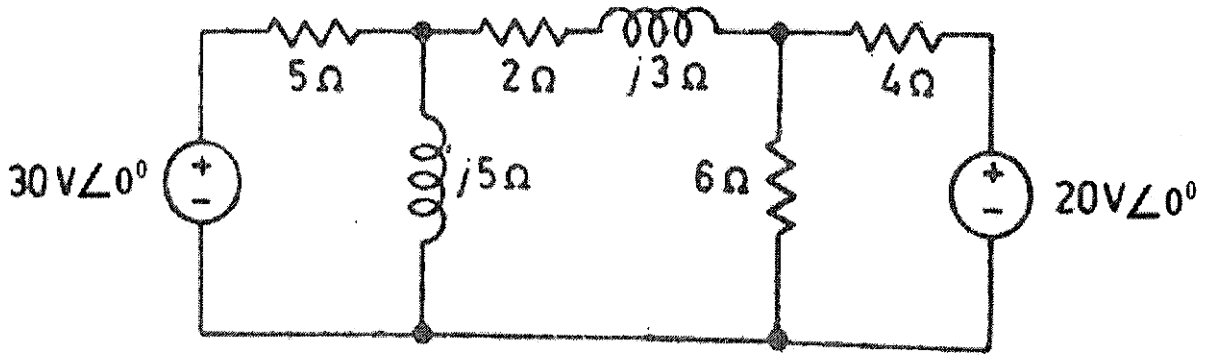

Fig. 4

Group C (Answer any one question- 16 marks)

5. a) Explain the physical significance of hysteresis loop of a magnetic material. The hysteresis and eddy current loss of a ferromagnetic material is 25W and 30 W respectively at 50Hz and with flux density is 0.75Wb/m^2. Determine the total iron loss when frequency is 400Hz and flux density is 0.3Wb/m^2. [4+4]

b) What do you understand by the term ***"reluctance"*** of a magnetic circuit?

A steel ring having mean circumference of 30cm and cross sectional area of 6cm^2 has a winding of 500 turns on it. The ring is cut to provide an air gap of 1mm in the magnetic circuit. If a current of 4A in the winding produces a flux density of 1Wb/m^2 in the air gap, determine the inductance of the winding and permeability of steel. [2+6]

6. a) Draw and explain the phasor diagram of an ideal transformer under no load condition. [8]

b) Find the current in magnitude and phase supplied by the source for the circuit given below (**Fig. 5**). Show all necessary calculations and equivalent circuit diagrams. [8]

Ref. No. Ex/ES/EE/T101B/2023

B.E. Electrical Engineering First Year Second Semester Examination, 2023

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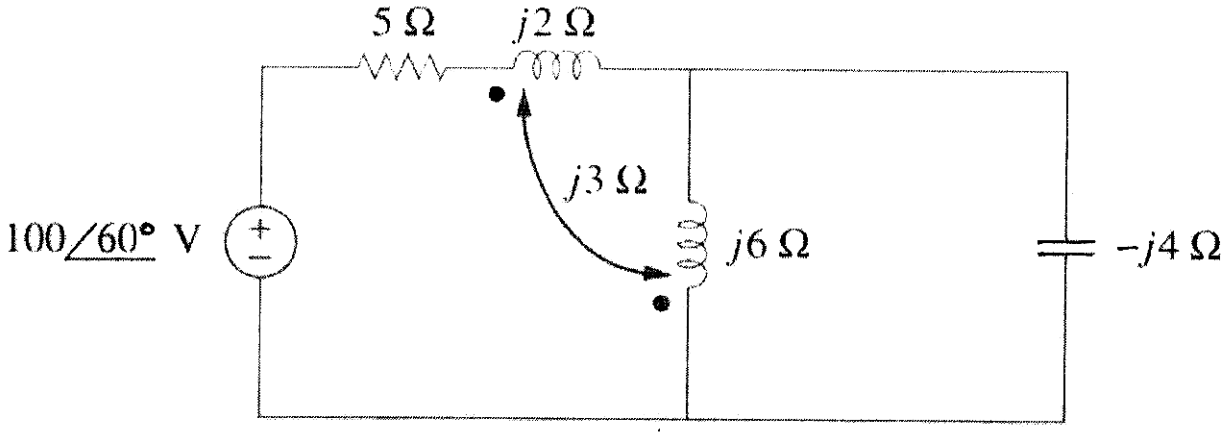

Fig. 5

EX/ES/EE/T101B/2023

B. E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION, 2023

BASIC ELECTRICAL ENGINEERING

Time: Three hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part.

PART II

Marks

Answer any three questions.
Two marks are reserved for neat and well organized answers.

1.a) Show that in a single core cable the ratio between the maximum to minimum value of stresses is equal to the ratio between the maximum radius of the cable to the radius of the conductor. 4

1.b) Deduce an expression for the force of attraction between two oppositely charged parallel plates. 4

1.c) A capacitor consists of two parallel metal plates each of area 2000 cm^2 and 5 mm apart. The space between the plates is filled with a layer of paper 2 mm thick and a sheet of glass 3 mm thick. The relative permittivities of the paper and glass are 2 and 8 respectively. A potential difference of 5 kV is applied between the plates. Calculate (a) the capacitance of the capacitor (b) the potential gradient in each dielectric and (c) the total energy stored in the capacitor. 8

2.a) Show that requirement of copper in a three phase three wire system is 0.75 times than that in a single phase system for same voltage between lines and when a fixed amount of power is transmitted over a fixed distance with same amount of power loss. 4

2.b) Deduce the relationship between the phase and line quantities in a three phase delta connected circuit. Draw necessary phasor diagram. 4

2.c) Three equal star connected inductors take 8 kW at a power factor of 0.8, when connected across a 460 V, 50Hz, 3-phase, 3-wire supply. Find the values of the circuit elements of the load per phase. Draw the phasor diagram showing the phase and the line voltages and current. 8

3.a) State with the help of a phasor diagram what do you mean by neutral shift. Explain how neutral shift can be determined with the help of Millman's theorem. 6

EX/ES/EE/T101B/2023

B. E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION, 2023

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3.b) A 400- V, 50- Hz, 3- phase, supply feeds an unbalanced three-phase, three – wire, star – connected load. The branch impedances of the load are $Z_R = (4+j8)$ Ω; $Z_Y = (3+j4)$ Ω and $Z_B = (15+j20)$ Ω. Find the line currents and voltage across each phase impedance for RYB phase sequence. Also calculate the neutral shift. Draw the phasor diagram. 10

4.a) State and explain how active and reactive power can be measured in the case of balanced three phase load using one wattmeter. State when three phase power measurement requires the use of three wattmeters. 8

or

With the help of a diagram explain the major parts of a dc machine. 8

4.b) Three equal impedances of (8+j6) Ω are connected in star across a 3-phase, 3-wire supply. The phase voltages are $V_A = (220+j0)$ V, $V_B = -j220$ V and $V_C = (-100+j220)$ V. Calculate the symmetrical components of A-phase current and the three line currents. 8

5.a) An alternating voltage $v = 200\sin\omega t + 20\sin 3\omega t$ is applied to a coil of 25 Ω resistance and 0.02 H inductance connected in series with a 40 μF capacitor. Calculate (a) the total current entering the circuit, (b) the power input to the circuit and (c) the power factor of the circuit. Frequency is 50 Hz. 2+2+2

5.b) Three similar star connected coils each of resistance 25 Ω and inductance 0.05 H are supplied from a three phase star connected alternator. The phase voltage is $v = 360 \sin \omega t + 60 \sin 3\omega t + 50 \sin 5\omega t$. The star point of the load and that of the alternator are connected. Calculate the effective values of (a) the line current, (b) the line voltage, (c) the current in the neutral conductor, (d) the total power absorbed by the load and (e) what do these values become if the neutral wire is disconnected. Frequency is 50 Hz. 10