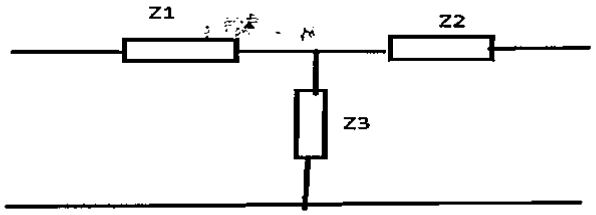
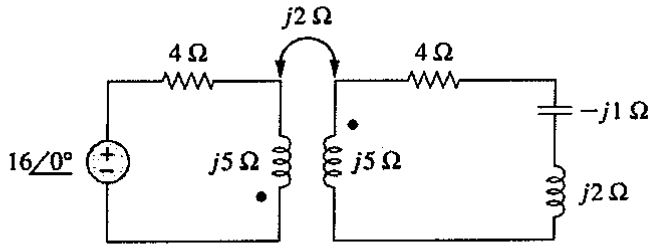
BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) 1ST YEAR 2ND SEMESTER EXAMINATION 2024

Subject: **PRINCIPLES OF ELECTRICAL ENGINEERING-II**

Time: 3 hours | Full Marks:100

Part-I (50 Marks)

Use Separate Answer scripts for each Part

	[Answer any Three Questions][Q.No. 3 carries 18 marks]	
Q.1.	State and prove the Compensation theorem. **OR** An inductor (j15Ω) is connected in parallel with a branch containing a resistor (6Ω) and an inductor (j5Ω) in series. This network is connected to an ac source of 20V, angle 45^0 and internal resistance of 7Ω. Apply Compensation theorem to determine the compensating voltage source and the change in current through the inductor (j5Ω), if the source internal resistance is reduced to 5Ω.	16
Q.2.	(A) State and prove establish the Millman's theorem for 'n' number of voltage sources connected in parallel. (B) State and explain Substitution theorem.	16
Q.3.	(A) State and explain the Tellegen's theorem. (B) Show that the Reciprocity theorem is applicable to the following T-network- 	18
Q.4.	(A) State the Reciprocity theorem. (B) Show that the end-point of the current phasor of a series R-C circuit, where the resistance and the supply voltage (V) are constant, but the capacitance is variable, traces a semicircle of radius (V/2R). OR Draw and explain the operation of (i) Simple band-pass filter and (ii) simple band-stop filter circuit.	16
Q.5.	Determine the voltage drop across the inductance (-j1Ω) - 	16

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BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION, 2024

(1st Year, 2nd Semester)

PRINCIPLES OF ELECTRICAL ENGINEERING -II

Time: Three Hours Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-II

Answer Any three questions

(*Two marks are reserved for neatness and well organized answers*)

1. a) Derive the relationship between the line and phase currents of a balanced three-phase star-connected system. Draw the relevant phasor diagram. 8

   b) A balanced load of $(4+j3)\Omega$ per phase is connected to a three-phase, 200V supply. Find the line current, power-factor, power, reactive VA and total VA when the load is (i) star connected and (ii) delta connected. 8

2. a) Explain how neutral shift can be determined with the help of Millman's theorem. 6

   b) A three-phase, 400V, 4-wire system has the following load impedances $Z_A = 5\angle -30^\circ$ Ω, $Z_B = 2.5\angle 0^\circ$ Ω and $Z_C = 5\angle 30^\circ$ Ω. Calculate the line currents, the neutral current and the power drawn by each load when phase sequence is (i) ABC and (ii) ACB. 10

3. a) Explain how reactive power can be measured for a balanced three-phase load using the one-wattmeter method. Draw the relevant circuit and phasor diagrams. 8

   b) Three loads are delta-connected to a symmetrical, three-phase, 400V system as shown in Fig.1. Load 'a' takes 20 kW at unity p.f., load 'b' takes 40 kVA at 0.9 p.f. (lead) and load 'c' takes 30 kVA at 0.7 p.f. (lag). Calculate the readings of the two wattmeter connected to measure the power input. 8

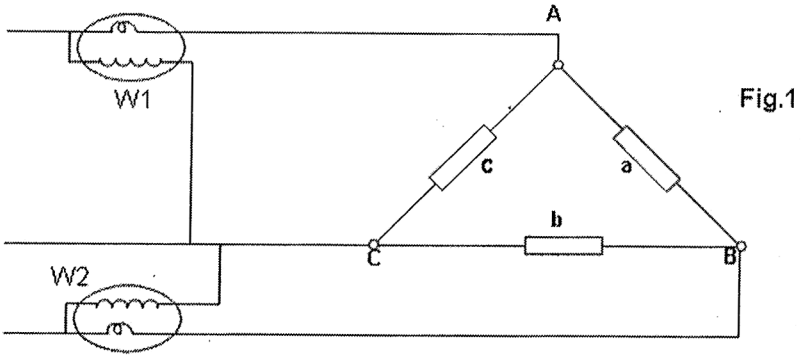

Fig.1

4. a) Write the general expression for the following non-sinusoidal wave. 4

$$v = 4\sin\omega t - 5\cos\omega t + 12\sin 2\omega t - 11\cos 2\omega t - 8\sin 3\omega t - 6\cos 3\omega t$$

b) Determine the Fourier series for the saw-tooth waveform shown in Fig. 2. 8

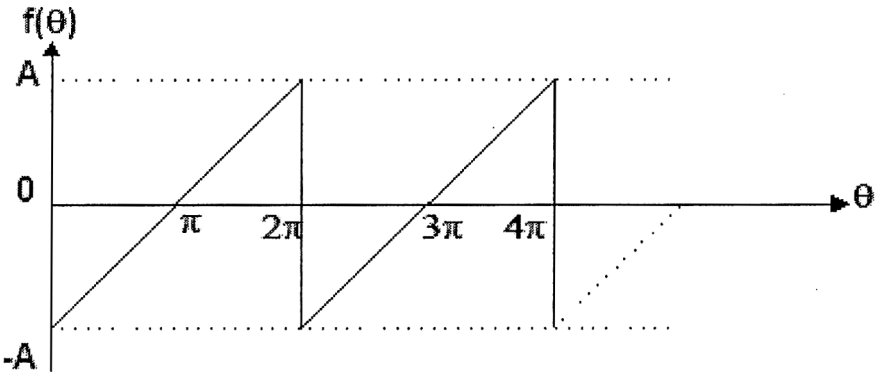

Fig.2

c) Determine whether the following two non-sinusoidal voltage waves are of similar wave shape or not. 4

$$v = 80\sin(\omega t + 70^o) - 70\sin(2\omega t - 30^o) + 60\sin(3\omega t - 60^o)V$$
$$i = 40\cos(\omega t - 60^o) + 35\sin(2\omega t + 70^o) - 30\cos(3\omega t - 90^o)A$$

5. a) Define the positive, negative and zero sequence components of an unbalanced three-phase voltage and show the relation between sequence components with the unbalanced voltage. 8

b) When the line conductors of a three-phase system are short-circuited to earth, the three line currents are given by $I_A = 1000\angle 50^0$A, $I_B = 3000\angle 20^0$A and $I_C = 2000\angle 25^0$A. Resolve these currents into their symmetrical components. 8

6. a) Calculate the power and power-factor and volt-ampere due to the following waves. 8

$$v = 50\sin(\omega t + 60^o) + 35\sin(3\omega t - 30^o) \text{ V}$$
$$i = 20\sin(\omega t + 30^o) + 15\cos(3\omega t + 20^o) \text{ A}$$

b) If the phase voltage of a star-connected three-phase alternator contains a fundamental of 220V amplitude and 3rd, 5th, 7th and 9th harmonics of 45V, 30V, 25V and 15V amplitude, respectively, calculate the ratio of line to phase voltage. 8

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