BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION, 2023

(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-I

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 delta-connected system. Draw the relevant phasor diagram. 4+2

   b) Three star-connected impedances $Z_1 = 15 + j25\ \Omega$ per phase are in parallel with three delta-connected impedances $Z_2 = 24 - j54\Omega$ per phase. The line voltage is 400V. Find the line current, power-factor, power and reactive VA taken by the combination. 10

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

   b) A 3-wire, three-phase system of 400V has the following impedances: $Z_A = (15 - j15)\Omega$, $Z_B = (20 + j0)\Omega$ and $Z_C = (10 + j20)\Omega$. Calculate the phase currents and phase voltages of the load. 10

3. a) Explain how three-phase power can be measured by two-wattmeter method. Draw the relevant circuit and phasor diagrams. 4+3

   b) Three loads are delta-connected to a symmetrical, three-phase, 440V system as shown in Fig.1. Load 'a' takes 10 kW at unity p.f., load 'b' takes 50 kVA at 0.9 p.f. (lead) and load 'c' takes 50 kVA at 0.7 p.f. (lag). Calculate the readings of the two wattmeter connected to measure the power input. 9

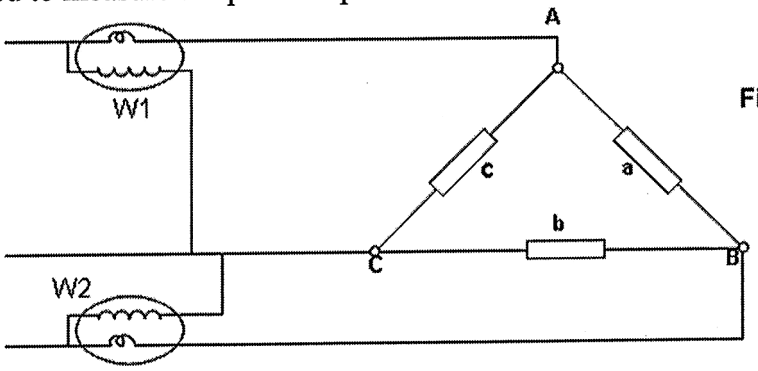

Fig.1

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

$$v = 6\sin\omega t - 9\cos\omega t + 13\sin 2\omega t - 5\cos 2\omega t - 11\sin 3\omega t - 14\cos 3\omega t$$

b) Find out the Fourier series for the non-sinusoidal wave as shown in Fig.2. 8

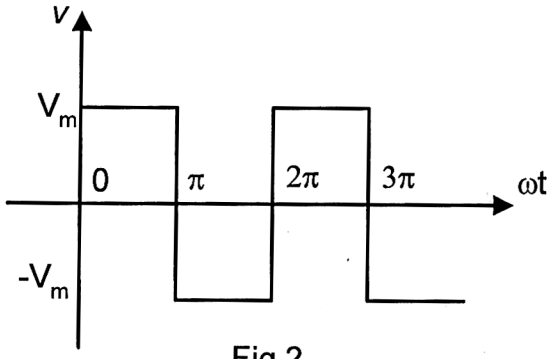

Fig.2

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

$$v = 40\sin(\omega t + 70^o) - 60\sin(2\omega t - 30^o) + 50\sin(3\omega t - 60^o)V$$
$$i = 20\cos(\omega t - 60^o) + 30\sin(2\omega t + 70^o) - 25\cos(3\omega t - 90^o)A$$

5. a) A star-connected generator has a generated voltage per phase that contains only the fundamental, third, fifth and seventh harmonics. The line voltage as measured by a voltmeter is 250V and the voltage to neutral is 180V. Calculate the magnitude of the 3rd harmonic in the generated voltage? 8

b) When the line conductors of a three-phase system are short-circuited to earth, the three line currents are given by $I_A = 1000\angle 70^0$A, $I_B = 3000\angle 10^0$A and $I_C = 2000\angle 27^0$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

$$v = 75\sin(\omega t + 30^o) + 25\sin(3\omega t - 45^o) \text{ V}$$
$$i = 10\sin(\omega t + 60^o) + 15\cos(3\omega t + 30^o) \text{ A}$$

b) A voltage $v = 10 \sin(\omega t+30^{\circ}) - 25 \sin(3\omega t+60^{\circ})$ V is impressed on a resistance of 5 Ω in series with a capacitance of 88.4μF and an inductance of 0.01061H. Find the ammeter reading for the current, power dissipated by the circuit, power-factor of the whole circuit and the voltage drop across the capacitance if $\omega = 314$ rad/s. 8

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Ref.No. Ex/EE/5/T/121/2023

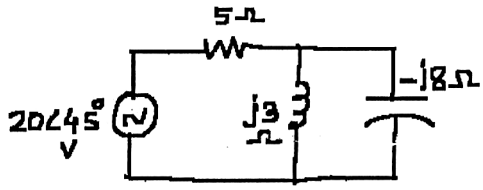
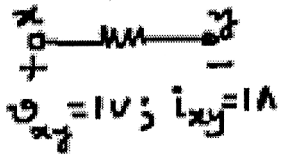
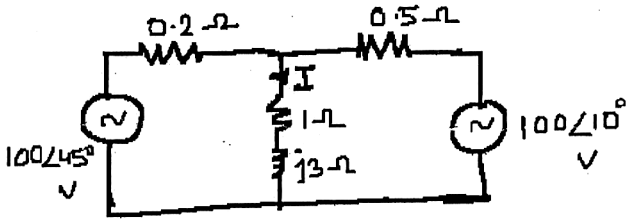
BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) 1ST YEAR 2ND SEMESTER EXAMINATION 2023

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

Time: 3 hours Full Marks:100

Part-II (50 Marks)

Use Separate Answer scripts for each Part

	[Answer any Three Questions] [Q.No. 1 carries 18 marks]	
Q.1.	State the Tellegen's theorem and verify this theorem for the following circuit- 	18
Q.2.	(A) State and explain the Substitution theorem. (B) Replace the resistor in the following branch 'xy' by a reactive impedance of 0.5jΩ 	16
Q.3.	State and establish the Compensation theorem.	16
Q.4.	(A) State and establish the Millman's theorem for 'n' number of current sources connected in series. (B) Determine 'I' by applying the Millman's theorem- 	16
Q.5.	Show that the end-point of the current phasor of a series R-L circuit, where the resistance and the supply voltage (V) are constant, but the inductance is variable, traces a semicircle of diameter (V/R).	16