EST130: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

MODULE 3

PRACTICE PROBLEMS

1. A resistor of 50Ω, an inductor of 0.1H and a capacitor of 40μF are connected in series and the combination is connected across 220V, 50 Hz supply. Calculate (i) the circuit impedance (ii) resulting current (iii) power factor (iv) phase angle and (v) power consumed by the circuit.

2. Three inductive coils, each with a resistance of 22 Ω and an inductance of 0.05 H are connected in first in star and then in delta, to a 3 phase 415 V, 50 Hz supply. Calculate for both star and delta connections, (i) phase current and line current and (ii) total power absorbed.

3. A sinusoidal voltage V=230 ∠15 of frequency 50 Hz is applied to a series RL circuit consisting of R=5 Ω and =0.1 H. Calculate (i) rms current and its phase angle (ii) power factor (iii) average power (iv) reactive power and (v) apparent power drawn by the circuit.

4. A balanced 3 phase load consists of 3 coils each of resistance 6 Ω and inductive reactance of 8 Ω. Determine the line current and power absorbed when the coils are (i) star connected (ii) delta connected across 400V, 3 phase supply.

5. A resistance of 10Ω, an inductance of 0.3 H and a capacitance of 100μF are connected in series across 230V, 50 Hz single phase supply. Calculate: i) the impedance of the circuit ii) Current through the circuit iii) Voltage across R, L and C, and iv) Power consumed by the circuit.

6. A balanced delta connected 3 phase load is fed from a 3 phase, 400 V, 50 Hz power supply. The line current is 20A and he total power absorbed by the load is 10kW. Calculate (i) the impedance in each branch (ii) the power factor and (ii) the total power consumed if the same impedances are star connected.

7. When an alternating voltage of (80+j60) V is applied to a circuit, the resulting current flow is (-4+ j10) A. Find the impedance, power consumed and the phase angle of the circuit.

8. Two impedances Z_1 and Z_2 when connected separately across a 220V, 50 Hz supply, consume 300W and 150W at a power factor of 0.4 lagging and 0.7 leading respectively. When the two impedances are connected in series across the same supply, find total power consumed and overall power factor.

9. A balanced three phase load has per phase impedance of (30+j50) Ω. If the load is connected across 400V, 3 phase supply, find (i) phase current (ii) line current and (iii) power supplied to load when it is connected in (a) star (b) delta.

10. Coil A having resistance of 20 Ω and inductance of 0.2 H is connected in series with another coil B having resistance of 15Ω and inductance of 0.1H. The two coils in series are fed from 220V, 50 Hz, single phase power supply. Determine (i) the voltage across each coil (ii) power dissipated in each coil (iii) power factor of the whole circuit.

11. Three similar coils connected in star draw a total power of 1.5kW at a power factor of 0.2 lagging from a 3 phase 400V, 50Hz power supply. Calculate the resistance and inductance of each coil.

12. A series RC circuit takes a power of 7000W when connected to 200V, 50Hz supply. The voltage across the resistor is 130V. Calculate: - i) Resistance ii) Power factor iii) Current iv) Capacitance v) Impedance of the circuit.

13. A balanced star connected load of (8+j6) Ω per phase is connected to a three phase 230V supply. Find the line current, power factor and power consumed by the load.

14. A 50Ω resistor in series with 120μF capacitor is connected to 230V 50Hz supply. Find i) impedance ii) current iii) power factor iv) voltage across the resistor v) voltage across the capacitor.

15. A 3 phase 4 wire 400V system feeds three loads (10 - j8)Ω each connected in star. Calculate the line currents in each phase.

16. A10 Ω resistor and 300 mH inductor are connected in series to a 230V sinusoidal supply. The circuit current is 4A. Calculate the supply frequency and phase angle between current and voltage.

17. Three inductive coils, each with a resistance of 22Ω and an inductance of 0.05 H are connected in (i) in star and (ii) in delta, to a three phase 415 V, 50 Hz supply. Calculate for each of the above case (i) phase current and line current and (ii) total power absorbed.

18. A 10Ω resistor & 400μF capacitor are connected in series to a 240V sinusoidal ac supply. The circuit current is 5A. Calculate the supply frequency & phase angle between current & voltage.

19. Three identical resistors of 20Ω each are connected in star to 415V, 50Hz three phase supply. Calculate (i) the total power consumed, (ii) total power consumed if they are connected in delta (iii) total power consumed, if one of the resistors is opened in both star connection and delta connections.

20. Each phase of a delta connected load has a resistance of 25 Ω and an inductance of 0.15 H. The load is connected across a 400 V, 50 Hz, three phase supply. Determine the line current, power factor and power consumed.

21. When a voltage of $v = 250 \sin (314 t + \pi/3)$ is applied to a series RL circuit. The current drawn is $i = 25 \sin (314t + \pi/6)$. Determine (i) power factor (ii) Active Power (iii) Impedance (iv) values of R and L.

22. A three phase star connected load consists of three identical inductive coils of resistance 50Ω and inductance 0.3H. The supply voltage is 415V, 50 Hz. Calculate (i) phase current (ii) line current (iii) power factor (iv) total power consumed.

23. In a single phase ac circuit consisting of an impedance of 10Ω, the RMS value of applied voltage is 230V. i) Write down the expression for instantaneous voltage, ii) If the current lags the applied voltage by 30º write down the expression for instantaneous current, iii) Calculate the power consumed in the circuit.

24. A resistance of 5 Ω and an inductor of 15mH are connected in series across a 230V 50Hz single phase ac supply. Calculate the (i) current (ii) power factor (iii) power consumed (iv) What value of capacitor must be connected in series with this combination to improve the power factor to 0.9.

25. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

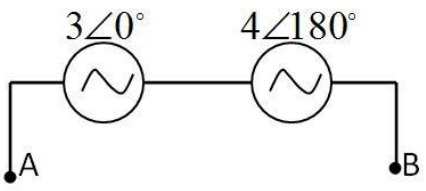
26. Find the values of circuit elements in a two element series circuit which consumes 700W at a power factor of 0.707 leading. The applied voltage is a single phase ac voltage given by

$$v = 141.4 \sin (314t).$$

27. A resistance of 120Ω and capacitive reactance of 250Ω are connected in series across a single phase ac voltage source. If a current of 0.9A is flowing in the circuit find (i) power factor (ii) supply voltage (iii) Active power (iv) reactive power

28. Find the total voltage across the terminals A and B of the circuit shown in Fig.

29.



30. A series circuit consisting of a capacitor of 2 μF and a resistance of 500 Ω. An AC source is connected to the circuit which draws a current of 50∠0 mA. The angular frequency of AC source is 400π.(i) draw the circuit and find the source voltage (ii) find the voltage across the capacitor and resistor (iii) draw the voltage phasor diagram.

31. A 220V, 50Hz single phase sinusoidal voltage produces a current of 2.2A in a purely inductive coil. Determine (i) inductive reactance of the coil (ii) inductance (iii) power absorbed (iv) expression for applied voltage and current.

32. A capacitor and resistor are connected in series across a 120 V, 50 Hz supply. The circuit draws a current of 1.144 A. If power loss in the circuit is 130.8 W, find the values of resistance and capacitance.

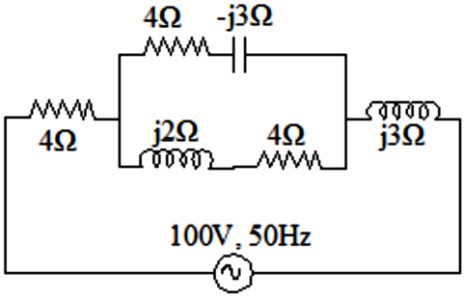
33. For an ac circuit, if **v(t) = 160 sin (ωt+ 10°)** and **i(t) = 5 sin (ωt - 20°)**; find the power factor and active power absorbed by the circuit. Draw the phasor diagram.

34. Two coils A and B are connected in series across a 240 V, 50 Hz ac supply. The resistance of A is 5 Ω and the inductance of B is 0.015 H. If the input from the supply is 3 kW and 2 kVAR, find the inductance of coil A and resistance of coil B. Calculate the voltage across each coil.

35. A three phase star connected load consumes a total of 12 kW at a power factor of 0.8 lagging when connected to a 3 phase, 400 V, 50 Hz power supply. Calculate the resistance and inductance of load per phase.

36. A 3 phase 4 wire star connected load of phase impedances $Z_1 = (16 + j12)$ Ω, $Z_2 = (14 - j21)$ Ω and $Z_3 = 25$ Ω is connected across a 254 V, 50 Hz ac supply. Calculate the current in each phase of the load and power consumed by the load.

37. Calculate the real power, reactive power, apparent power and power factor of the circuit.



38. Two impedances (10 + j5Ω) and (25-j10Ω) are connected in parallel across 100V, 50Hz supply. Find the total current, branch currents, power factor and power consumed.

39. The apparent power drawn by an AC circuit is 10KVA and active power is 8KW. What is the reactive power and power factor of the circuit?

40. A capacitor of capacitance 79.5 μF is connected in series with a non-inductive resistance of 30 Ω across 100 V, 50 Hz supply. Find (i) impedance (ii) current (iii) phase angle and (iv) equation for instantaneous value of current.

41. The voltage across 150 Ω resistor is **150 sin (2π × 103t)** V. At what value of 't' does the current through the resistor equal to -0.26 A and what is instantaneous power at this time t ?

42. A Coil of resistance 50 Ω and inductance 100 mH is connected in series with a capacitor of 500 μF is connected across a 230 V, 50 Hz ac supply. Find (i) Current through the coil (ii) Power consumed (iii) Reactive power and (iv) Voltage across the coil. Also draw the phasor diagram with voltage as the reference vector.

43. The load to a three phase power supply consists of three similar coils connected in star. The line currents are 25A and the kVA and kW inputs are 20 and 11 respectively. Find (i) the phase and line voltages (ii) the reactive power input (iii) the resistance and reactance of each coil.

44. An R-L series circuit is supplied from an ac voltage source v(t) = 12 cos 4t V. The complex power delivered by the source is S = 3.6+j7.2 VA. Calculate the values of the resistance, R, and the inductance, L. Evaluate the power factor.

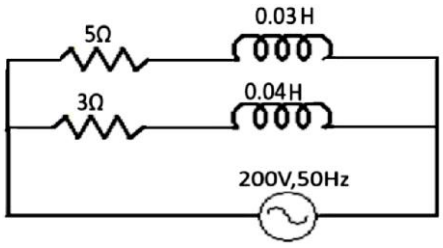
45. A three-phase four-wire system has a balanced load in Y-connection. The phase impedance of the load is $Z_{ph} = 10\angle 30\ \Omega$. If the line-to-line voltage is V_{ll} = 400 V rms, evaluate the phase currents in polar form. Evaluate the total active power.

46. Two impedances, $10\angle -30°$ and $20\angle 60°$ are connected in parallel. Evaluate the equivalent impedance. What is the nature (capacitive or inductive) of the equivalent impedance? If a current of $10\angle 45°$ is passing through the parallel combination, calculate the voltage across the combination and express it in rectangular form. Evaluate the currents in each of the impedances.

47. A coil of resistance 8Ω and inductance 0.03H is connected to an a.c supply of 240V, 50Hz. Calculate: i) The current, power and power factor of the circuit. ii) The value of capacitance which when connected in series with the above coil causes no change in the value of current and power taken from the supply.

48. A non-inductive resistor of 10Ω is connected in series with a choke coil having internal resistance of 1.2Ω and is fed from a 200V, 50 Hz supply. Current flowing through the circuit is 8A. Calculate: i) Inductance of the choke coil, ii) Voltage across the choke coil, iii) Power absorbed by the choke coil, iv) Power absorbed by non-inductive resistor v) Total power absorbed.

49. For the circuit shown in figure determine: i) The admittance in each branch, ii) Total admittance, iii) Total current drawn, iv) Circuit power factor, v) Power absorbed.



50. A balanced delta connected load consists of (5+j3)Ω in each branch. The line voltage is $300\sqrt{2}$ volts. Find: i) Line and phase currents, ii) Real and apparent power.

51. Two impedances Z_1 and Z_2 when connected separately across a 200 V 50 Hz supply consume powers of 100 W and 60 W at power factors of 0.5 lagging and 0.6 leading respectively. If the impedances are now connected in series across the same supply, determine the power absorbed and resulting power factor.

52. A current of 5A flows through a non inductive resistance in series with a choke coil when supplied at 250V, 50Hz. If the voltage across the resistance is 125V and that across the coil is 200V, calculate (i) Impedance, reactance and resistance of the coil (ii) Power absorbed by the coil and (iii) Total power absorbed by the circuit.

53. A balanced delta connected load of each arm has a resistance of 40 Ω per phase. Calculate the line, phase currents and power of the circuit if it is connected across a 440V, 50 Hz supply.

54. A series connected load draws a current **i(t) = 4 cos (100πt + 10)** A when applied across **v(t) = 120 cos (100πt - 20)** V. Find the value of load impedance and circuit power factor.

55. A resistance R, an inductance L= 0.01H and a capacitance C are connected in series. When a voltage $\boldsymbol{v = 400\ cos\ (3000t - 10)}\ V$ is applied, the current flowing is $\mathbf{10\sqrt{2}\ cos\ (3000t - 55)}\ A$. Find R and C.

56. The total power consumed in a balanced star connected load is 20kW at 0.8 pf lag when supplied from a three phase 400 V, 50 Hz source. Calculate the line current, resistance and inductance of the load impedance.

57. A balanced delta connected load connected across a 440V, 50 Hz three phase supply draws a line current of 16 A which lags behind the phase voltage by an angle of 36.86º. Calculate the impedance of the load, phase current, power factor, and total power.

58. A non inductive resistor of 10Ω is connected in series with a choke coil having an internal resistance of 1.2 Ω and is fed from a 200 V, 50 Hz supply. The current flowing through the circuit is 8 A. Calculate (i) Inductance of the choke coil (ii) Voltage across the choke coil (iii) Power absorbed by the choke coil (iv) Power absorbed by the non-inductive resistor (v) Phasor diagram of voltage.

59. A 50Hz sinusoidal voltage of (40+j30) V is applied to a series RL circuit resulting in a current of (4+j1) A. Calculate (i) Impedance of the circuit (ii) Power consumed in the circuit (ii) Power factor of the circuit.

60. A 3 phase four wire 400V, RYB system supplies a star connected load with $Z_R=10\angle 0^o$, $Z_Y=15\angle 30^o$ and $Z_B=10\angle -30^o$. Find the line currents and neutral current.