



Attempt all questions before checking the answer key. Use ideal components unless stated. Numerical voltages/currents are rms unless identified as peak.

A. Very short answers - 1 mark each

1. Define rms value of an alternating current.
2. What is the mean value of sinusoidal current over a complete cycle?
3. State the phase relation between current and voltage in a pure inductor.
4. When is a series LCR circuit in resonance?
5. Why cannot an ordinary transformer operate continuously on steady DC?

B. Short answers / practice - 2 marks each

6. A sinusoidal current has peak 5 A. Find its rms value and average squared current.
7. Find the reactance of a 0.2 H inductor at 50 Hz. Use $\pi = 3.14$.
8. A 100 μF capacitor is connected to a 50 Hz source. Calculate its capacitive reactance.
9. Explain wattless current and name two ideal circuit elements that can carry it.
10. An ideal transformer has 1000 primary turns and 100 secondary turns. For a 220 V input, find output voltage and identify its type.
11. Can an ideal transformer increase power?
12. A 220 V rms supply feeds 110 Ω . Find rms current and power.
13. Find peak voltage for a 100 V rms sinusoidal source.
14. At resonance, a series RLC circuit has $R = 25 \Omega$ across 100 V. Find impedance and current.
15. How does capacitive reactance change when frequency doubles?
16. How does inductive reactance change when frequency doubles?
17. Why can large inductor and capacitor voltages coexist with a small source voltage at resonance?
18. Find power for $V = 200 \text{ V}$, $I = 2 \text{ A}$ and power factor 0.8.
19. Does current lead voltage in a pure capacitor?

20. A transformer has $N_s/N_p = 4$ and $I_p = 2 \text{ A}$. Find I_s ideally.

C. Short answers - 3 marks each

21. A series circuit has $R = 30 \Omega$, $X_L = 80 \Omega$ and $X_C = 40 \Omega$ across 100 V. Find impedance, current and power factor.
 22. For a series LCR circuit with $L = 0.5 \text{ H}$ and $C = 8 \mu\text{F}$, find resonant angular frequency. If $R = 20 \Omega$ and voltage is 100 V, find resonant current.
 23. An AC source gives $v = 200 \sin(100\pi t) \text{ V}$ to a 50 Ω resistor. Obtain $i(t)$, frequency and average power.
 24. An ideal transformer supplies 12 V at 4 A from a 240 V source. Find turns ratio, input current and output power.
 25. Compare current and voltage phasors for a pure resistor, inductor and capacitor. State average power in each.
- ### D. Long answers - 5 marks each
26. Derive the rms value of sinusoidal current. Use it to obtain the average power dissipated in a resistor.
 27. Using a phasor diagram, derive impedance and phase angle for a series LCR circuit. Explain resonance and its effect on power factor.
 28. Derive average AC power $P = V_{\text{rms}} I_{\text{rms}} \cos \phi$. Explain when it is positive, zero and maximum for a given rms voltage and current.
 29. Explain the principle, construction and working of an AC generator. Derive its instantaneous emf for a uniformly rotating coil.
 30. Explain transformer action with a labelled diagram. Derive the voltage and current ratios for an ideal transformer, then discuss major losses in a real transformer.

ANSWER KEY - Numerical / short answers

2) Zero. 6) $5/\sqrt{2} \approx 3.54 \text{ A}$; mean $I^2 = 12.5 \text{ A}^2$. 7) 62.8 Ω . 8) 31.8 Ω . 10) 22 V; step-down. 11) No; input and output powers are equal. 12) 2 A; 440 W. 13) $100\sqrt{2} \text{ V}$. 14) 25 Ω ; 4 A. 15) It halves. 16) It doubles. 18) 320 W. 19) Yes, by $\pi/2$. 20) 0.50 A. 21) 50 Ω ; 2 A; 0.60. 22) 500 rad/s; 5 A. 23) $i = 4 \sin(100\pi t) \text{ A}$; 50 Hz; 400 W. 24) $N_s/N_p = 1/20$; 0.20 A; 48 W.