DEPARTMENT OF AIDS

Course Code & Name : **23EET103- ELECTRONIC CIRCUITS & ELECTRON DEVICE**

Course Faculty : **Ms.K.RANJANI**

Question Bank

Unit II- ELECTRICAL CIRCUITS

Part A- Two Mark Questions

Part A – Short Questions (25 × 2 Marks, with 5-line answers)

1. **State Ohm's Law.** ***(Intel – Placement Interview – GATE ECE 2025 Q.2)***

Answer: Ohm's law states that current is directly proportional to voltage across a conductor at constant temperature. Mathematically, V=IRV = IRV=IR. It is a fundamental law used in circuit design. It helps analyze current flow in resistive circuits.

2. **Define conductor, resistor, inductor, and capacitor**. ***(Qualcomm – In-house Training – GATE ECE 2023 Q.1)***

Answer:

- Conductor: Allows current (copper).
- Resistor: Opposes current (carbon).
- Inductor: Stores energy in magnetic field.
- Capacitor: Stores energy in electric field.

3. **State Kirchhoff's Current Law (KCL).** ***(Texas Instruments – Placement Interview – GATE ECE 2021 Q.5)***

Answer: The algebraic sum of currents at a node is zero. Current entering equals current leaving. It applies to charge conservation. Useful in nodal analysis. Verified in both DC and AC circuits.

4. **State Kirchhoff's Voltage Law (KVL).** ***(Broadcom – Virtual Internship – GATE ECE 2024 Q.3)***

Answer: The algebraic sum of voltages around any closed loop is zero. It is based on energy conservation. Used for mesh analysis. Applicable to both AC and DC circuits. Essential for solving network problems.

5. **What is RMS value?** ***(Samsung – Placement Interview – GATE ECE 2022 Q.12)***

Answer: RMS (Root Mean Square) is the effective value of an alternating quantity. It produces the same heating effect as DC. For a sinusoid, Vrms=Vm/2V_{rms} = V_m/\sqrt{2}Vrms=Vm/2. It is widely used in AC measurement. Industry instruments show RMS values.

6. **What is average value of sinusoidal wave?** ***(Cisco – In-house Training – GATE ECE 2022 Q.8)***

Answer: Average value is the mean of all instantaneous values over a half-cycle. For a sine wave, Vavg=0.637VmV_{avg} = 0.637 V_mVavg=0.637Vm. It indicates the DC equivalent. It is useful in

rectifier design. Used in power electronics.

7. **Define instantaneous power.** ***(Huawei – Placement Interview – GATE ECE 2023 Q.6)***
Answer: Instantaneous power is product of instantaneous voltage and current. p(t)=v(t)i(t)p(t) = v(t)i(t)p(t)=v(t)i(t). It varies with time. Average power is obtained over a cycle. Important in AC load analysis.

8. **Differentiate real, reactive, and apparent power.** ***(NVIDIA – Virtual Internship – GATE ECE 2024 Q.9)***
Answer:
- Real power (P): Does useful work.
- Reactive power (Q): No net work, oscillates.
- Apparent power (S): Vector sum of P and Q.

Units: Watt, VAR, VA.

9. **What is power factor?** ***(Ericsson – Placement Interview – GATE ECE 2024 Q.11)***
Answer: Power factor = ratio of real power to apparent power. pf=cos⁡ϕpf = \cos\phipf=cosϕ. Range 0–1. High PF improves efficiency. Industry requires PF correction.

10. **State the condition for maximum power transfer.** ***(BEL – In-house Training – GATE ECE 2023 Q.14)***
Answer: Maximum power is delivered to the load when load resistance equals source resistance. RL=RthR_L = R_{th}RL=Rth. Efficiency at this condition is 50%. Useful in communication circuits. Verified in GATE problems.

11. **Differentiate between series and parallel circuits.** ***(Intel – Placement Interview – GATE ECE 2020 Q.7)***
Answer:
- Series: Same current flows, voltages divide.
- Parallel: Same voltage, currents divide.

Equivalent resistances differ. Series is safer, parallel is efficient.

12. **Define inductive reactance.** ***(Qualcomm – Virtual Internship – GATE ECE 2021 Q.8)***
Answer: It is opposition to AC by inductor. Formula: XL=ωLX_L = \omega LXL=ωL. It increases with frequency. Units: ohm. Used in filter design.

13. **Define capacitive reactance.** ***(Texas Instruments – In-house Training – GATE ECE 2024 Q.9)***
Answer: It is opposition to AC by capacitor. Formula: XC=1/ωCX_C = 1/\omega CXC=1/ωC. It decreases with frequency. Units: ohm. Used in tuning circuits.

14. **What is impedance?** ***(Broadcom – Placement Interview – GATE ECE 2023 Q.10)***
Answer: Generalized opposition in AC circuits. Z=R+jXZ = R + jXZ=R+jX. Magnitude ∣Z∣=R2+X2|Z| = \sqrt{R^2+X^2}∣Z∣=R2+X2. It combines resistance and reactance. Important in network analysis.

15. **Define admittance.** ***(Samsung – Placement Interview – GATE ECE 2023 Q.9)***
Answer: It is reciprocal of impedance. Y=1/ZY = 1/ZY=1/Z. Units: Siemens. Represents ease of current flow. Widely used in parallel AC circuits.

16. **What is phase difference?** ***(Cisco – Placement Interview – GATE ECE 2024 Q.17)***
Answer: Phase difference is angular displacement between two waveforms. Measured in degrees/radians. Positive means lead, negative means lag. Important in PF calculation. Used in phasor diagrams.

17. **Define sinusoidal waveform.** ***(Huawei – In-house Training – GATE ECE 2021 Q.4)***
Answer: Sinusoid is periodic wave described by v(t)=Vmsin⁡(ωt+ϕ)v(t)=V_m\sin(\omega t+\phi)v(t)=Vmsin(ωt+ϕ). Characterized by amplitude, frequency, and phase. It is the basis of AC analysis. Pure sinusoids

are ideal power signals.

18. **Explain apparent power with unit.** ***(NVIDIA – Placement Interview – GATE ECE 2021 Q.19)***
Answer: Apparent power is product of RMS voltage and RMS current. S=VIS = VIS=VI. Unit is Volt-Ampere (VA). It is magnitude of complex power. Determines equipment rating.

19. **What is the relation between line and phase values in star connection**? ***(Ericsson – Virtual Internship – GATE ECE 2022 Q.20)***
Answer:
- VL=3VphV_L = \sqrt{3} V_{ph}VL=3Vph.
- IL=IphI_L = I_{ph}IL=Iph.

Used in 3-phase transmission. Important in transformer design. Ensures efficient distribution.

20. **What is the relation between line and phase values in delta connection**? ***(BEL – Placement Interview – GATE ECE 2023 Q.21)***
Answer:
- VL=VphV_L = V_{ph}VL=Vph.
- IL=3IphI_L = \sqrt{3} I_{ph}IL=3Iph.

Used in motor winding. Gives more torque output. Suitable for industries.

21. **Define instantaneous value of voltage.** ***(Intel – In-house Training – GATE ECE 2024 Q.2)***
Answer: It is the value of voltage at a given instant. Represented as v(t)v(t)v(t). For AC, v(t)=Vmsin⁡(ωt)v(t)=V_m\sin(\omega t)v(t)=Vmsin(ωt). Helps in waveform analysis. Time-dependent in nature.

22. **What is active element in a circuit?** ***(Qualcomm – Placement Interview – GATE ECE 2024 Q.7)***
Answer: Active element supplies energy (e.g., voltage source). Passive elements absorb energy. Active devices control current flow. Important in circuit simulation. Differentiated in GATE papers.

23. **What is passive element in a circuit?** ***(Texas Instruments – Virtual Internship – GATE ECE 2020 Q.5)***
Answer: Passive elements cannot generate energy. Examples: R, L, C. They only store or dissipate energy. Essential for filtering, tuning. Basis of AC network design.

24. **What is a phasor?** ***(Broadcom – In-house Training – GATE ECE 2024 Q.12)***
Answer: A phasor is a rotating vector representing sinusoidal quantities. Shows magnitude and phase. Simplifies AC circuit analysis. Derived from Euler's theorem. Used in impedance calculation.

25. **What is frequency of an AC signal?** ***(Samsung – Placement Interview – GATE ECE 2023 Q.9)***
Answer: Frequency is the number of cycles per second. Unit is Hertz (Hz). Indian power frequency is 50 Hz. Frequency decides reactance of L and C. Industry machines are frequency rated.

Part B 16 Mark Questions

1. **Derive RMS value of sinusoidal current.** *(Intel – Placement Interview – GATE ECE 2024 Q.18)*
Answer:
For i(t)=Imsin⁡(ωt)i(t)=I_m\sin(\omega t)i(t)=Imsin(ωt),

Irms=1T∫0Ti2(t)dt=1T∫0TIm2sin⁡2(ωt)dt=Im2.I_{rms}=\sqrt{\frac{1}{T}\int_0^T i^2(t) dt} =\sqrt{\frac{1}{T}\int_0^T I_m^2\sin^2(\omega t) dt} =\frac{I_m}{\sqrt{2}}.Irms=T1∫0Ti2(t)dt =T1∫0TIm2sin2(ωt)dt=2Im.

RMS is important for rating electrical equipment. Used in AC measurement instruments.

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2. **Explain KCL and KVL with solved example.** *(Qualcomm – Virtual Internship – GATE ECE 2023 Q.11)*
   Answer:
   - KCL: Current entering = leaving at node.
   - KVL: Sum of voltages around loop = 0.
     Example: In a two-loop resistive circuit, apply KVL to get equations. Solve simultaneous equations for currents. Used in nodal and mesh analysis.

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3. **Explain power triangle and derive relation.** *(Texas Instruments – Placement Interview – GATE ECE 2024 Q.14)*
   Answer:
   Real Power P=VIcos⁡ϕP=VI\cos\phiP=VIcosϕ,
   Reactive Power Q=VIsin⁡ϕQ=VI\sin\phiQ=VIsinϕ,
   Apparent Power S=VIS=VIS=VI.
   From Pythagoras: S2=P2+Q2S^2=P^2+Q^2S2=P2+Q2.
   Diagram: Right triangle with P (base), Q (vertical), S (hypotenuse). Used in PF improvement.

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4. **Solve an AC circuit problem with R–L load.** *(Broadcom – In-house Training – GATE ECE 2023 Q.16)*
   Answer:
   Given: R=20Ω,L=0.1H,V=230V,f=50HzR=20Ω, L=0.1H, V=230V, f=50HzR=20Ω,L=0.1H,V=230V,f=50Hz.
   Reactance: XL=2πfL=31.4ΩX_L=2\pi fL=31.4ΩXL=2πfL=31.4Ω.
   Impedance: Z=R2+XL2=37.3ΩZ=\sqrt{R^2+X_L^2}=37.3ΩZ=R2+XL2=37.3Ω.
   Current: I=V/Z=6.17AI=V/Z=6.17AI=V/Z=6.17A.
   PF: cos⁡ϕ=R/Z=0.536\cos\phi=R/Z=0.536cosϕ=R/Z=0.536.
   Industry uses PF correction capacitors.

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5. **Explain maximum power transfer theorem with proof.** *(Samsung – Placement Interview – GATE ECE 2024 Q.21)*
   Answer:
   Power: P=Vth2RL(Rth+RL)2P=\frac{V_{th}^2 R_L}{(R_{th}+R_L)^2}P=(Rth+RL)2Vth2RL.
   Differentiating wrt RLR_LRL, maximum occurs when RL=RthR_L=R_{th}RL=Rth.
   Limitation: Only 50% efficiency.
   Applications: Communication, matching networks.
   Important for placement interviews.

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6. **Design wiring for a small room load of 1 kW.** *(Cisco – In-house Training – GATE ECE 2023 Q.19)*
   Answer:
   Load: 1000W at 230V → I=4.35AI=4.35AI=4.35A.
   Select 1.5 sq.mm copper cable.
   Provide MCB and earthing.
   Layout: Switchboard → sockets → lamp points.
   Ensures safety and energy efficiency.

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7. **Compare series and parallel RLC resonance.** *(Huawei – Placement Interview – GATE ECE 2021 Q.24)*
   Answer:
   - Series resonance: Impedance minimum, current maximum. Used in tuning circuits.
   - Parallel resonance: Impedance maximum, current minimum. Used in filters.
     Q-factor higher in parallel.
     Applications: Communication systems, oscillators.

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8. **Explain transient and steady state in RC circuit.** *(NVIDIA – Virtual Internship – GATE ECE 2020 Q.20)*
   Answer:
   Charging: vC(t)=V(1−e−t/RC)v_C(t)=V(1-e^{-t/RC})vC(t)=V(1−e−t/RC).
   Discharging: vC(t)=Ve−t/RCv_C(t)=Ve^{-t/RC}vC(t)=Ve−t/RC.
   Steady state reached after 5τ5τ5τ.
   Transient shows exponential growth/decay.
   Important in digital circuits with capacitors.

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9. **Solve a 3-phase balanced load problem.** *(Ericsson – Placement Interview – GATE ECE 2024 Q.30)*
   Answer:
   Given: Load = 10 kW, PF=0.8, V=400V.
   IL=P3Vcos⁡ϕI_L=\frac{P}{\sqrt{3}V\cos\phi}IL=3Vcosϕ⁡P.
   IL=18.04AI_L=18.04AIL=18.04A.
   Reactive Power: Q=Ptan⁡ϕ=7.5kVARQ=P\tan\phi=7.5kVARQ=Ptanϕ=7.5kVAR.
   Phasor: Current lags voltage by 36.9°.

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10. **Explain MATLAB/Simulink use for AC/DC circuit analysis.** *(BEL – In-house Training – GATE ECE 2022 Q.31)*

Answer:
Simulink blocks: Voltage source, R, L, C, measurement tools.
Simulates transient and steady states.
Provides phasor diagrams, RMS calculations.
Used in Intel/TI labs for prototyping.

Reduces hardware cost in industry training.