66721 ELECTRICAL CIRCUITS-I

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OBJECTVES

- To understand the concept of network theorems.
- To develop understanding of AC fundamentals.
- To understand the fundamental principles of single phase AC circuit in solving the different circuit problems.
- To develop skill in measuring current, voltage and power in RL, RC and RLC circuits.

SHORT *DESCRIPTION*

Network theorem-Circuit Parameters; Electrical network; Kirchhoff's Law; Thevenin's theorem; Norton's theorem; Superposition theorem; Maxwell's theorem; Maximum power transfer theorem; Single phase AC circuits; Principles of
basic circuits; Vectors; Impedance triangle; Power and power factor.

DETAIL DESCRIPTION

THEORY

1. **Circuit parameters**

1.1 Define direct current (DC)
1.2 Define circuit parameters.
1.3 List the circuit parameters.
1.4 Define circuit parameters with units.

2. Electric Network

2.1 Define electric networks.
2.2 List the different types of electric networks.
2.3 Explain the different types of electric networks.
2.4 Define active and passive network.
2.5 Define current source and voltage source.
2.6 Explain the current and voltage source in electric network.
2.7 Give example of current source & voltage source.

3. Circuit theorems

3.1 State & explain Kirchhoff's current Law (KCL) and Kirchhoff's voltage Law (KVL).
3.2 State & explain Thevenin's theorem.
3.3 State & explain Superposition theorem.
3.4 State & explain Norton's theorem.
3.5 State & explain Maxwell's theorem.
3.6 State & explain Maximum power transfer theorem.
3.7 Solve problems related to all Theorems.

4. **Star-Delta conversion**

4.1 State star-delta conversion.
4.2 Explain star-delta conversion.
4.3 Convert star to delta connection and vice versa.
4.4 Solve problems related to star-delta conversion.

5. AC circuit and AC fundamentals.

5.1 Define AC circuit (AC).
5.2 Explain the importance of AC systems.
5.3 Describe the advantages and disadvantages of AC circuit.
5.4 Principle of the generation of AC voltage.
5.5 Derive the equation: $e = E_{max}Sin\omega t$
5.6 Define cycle, frequency & time period with units.
5.7 Show the relation: f =

PN
120
5.8 List the commercial frequency of different countries.
5.9 Explain phase & phase difference with diagram.
5.10 Solve related problems.

6. **Alternating quantities and rms values.**
6.1 Define instantaneous values, average and maximum values of alternating quantities.
6.2 Generalize the rms values.
6.3 Define form factor and peak factor.
6.4 Define ohmic resistance & effective resistance.
6.5 Compare ohmic & effective resistance.
6.6 Solve problems on instantaneous, average and rms values.

7. Vectors and vector quantities.
7.1 Define vector quantities.
7.2 Explain vector representation of alternating voltage and current.
7.3 Explain vector in Polar form.
7.4 Explain vector in Rectangular form.
7.5 Formulate the relation between vectors expressed in rectangular and polar co-ordinate.
7.6 Solve problems relating to vector sum & difference, multiplication and division.

8. AC circuit (containing pure resistance, inductance and capacitance).
8.1 Sketch a circuit containing pure Resistance.
8.2 Explain the vector & phasor diagram of a pure resistive circuit.
8.3 Deduce the current and voltage relation in pure resistive circuit.
8.4 Sketch a circuit containing pure Inductance.
8.5 Explain the vector & phasor diagram of pure Inductive circuit.
8.6 Evaluate the relation among inductive reactance, current and voltage in pure Inductive circuit.
8.7 Sketch a circuit containing pure Capacitance.
8.8 Explain the vector & phasor diagram of pure capacitive circuit.
8.9 Formulate capacitive reactance.
8.10 Simplify current and voltage relation in pure capacitive circuit.

9. AC series circuit (containing resistance, inductance and capacitance).
9.1 Draw circuit containing resistance and inductance (RL) in series.
9.2 Explain vector & phasor diagram in RL series circuit.
9.3 Formulate impedance, current and voltage drop in RL series circuit.
9.4 Draw impedance triangle in RL series circuit.
9.5 Draw circuit containing resistance and capacitance (RC) in series.
9.6 Explain vector & phasor diagram in RC series circuit.
9.7 Formulate impedance, current and voltage drop in RC series circuit.
9.8 Draw impedance triangle of RC series circuit.
9.9 Solve problems on RL & RC series circuits.
9.10 Sketch a circuit containing resistance, inductance and capacitance (RLC) in series.
9.11 Explain vector & phasor diagram of RLC series circuit.
9.12 Draw impedance triangle of RLC series circuit.
9.13 Calculate inductive reactance, capacitive reactance, total impedance, current & voltage drop in RLC series circuit.
9.14 Solve problems on RLC series circuit.

10. Power & power factor in AC circuit.
10.1 Define power, power factor, active & reactive power.
10.2 Calculate power and power factor of pure resistive circuit.
10.3 Calculate power and power factor of pure Inductive circuit.
10.4 Calculate power and power factor of pure capacitive circuit.

10.5 Calculate power, power factor, active & reactive power of RL, RC & RLC series circuit.
10.6 Explain the power diagram of R, L, C, RL, RC & RLC series circuit.
10.7 Solve problems on power & power factor of different series circuit.

PRACTICAL

1 Show skill in using oscilloscope in measuring AC voltage & frequency.

1.1 Select the oscilloscope.
1.2 Select required tools and equipment.
1.3 Identify the control & function knobs of oscilloscope
1.4 Set the function knobs of oscilloscope as instructed.
1.5 Identify the control & function knobs of a signal generator.
1.6 Set the function knobs as instructed
1.7 Check all connections.

2 Show skill in verifying kerchief's laws.

2.1 Select experiment circuit, components, meters and necessary materials.
2.2 Construct a series-parallel circuit.
2.3 Select the series section of the circuit.
2.4 Verify Kirchhoff's voltage law.
2.5 Select the parallel section of the circuit.
2.6 Verify Kirchhoff's current law.

3 Show skill in verifying Thevenin's theorem.

3.1 Select an experiment circuit.
3.2 Select tools, equipment and circuit.
3.3 Construct the circuit as per diagram.
3.4 Mark the circuit as per diagram.
3.5 Measure open circuit voltage across the points.
3.6 Measure the equivalent resistance from the two points with appropriate condition.
3.7 Record Thevenin's voltage and resistance.
3.8 Verify the data with the theoretical calculation.

4 Show skill in verifying Norton's theorem.

4.1 Select an experiment circuit.
4.2 Select tools, equipment and circuit.
4.3 Construct the circuit as per diagram.
4.4 Mark the points for Norton's equivalence.
4.5 Measure short circuit current at the points.
4.6 Measure the equivalent resistance/ conductance at the points with appropriate condition.

5 Show skill in verifying Superposition theorem.

5.1 Select an experiment-circuit.
5.2 Select tools, equipment and materials.
5.3 Construct the circuit with at least two sources of power supply.
5.4 Select a branch for superposition.
5.5 Activate one source at a time making other sources short circuited.
5.6 Measure the current though the selected branch.
5.7 Repeat the steps with all the .sources.
5.8 Add all the measured current algebraically for the selected branch.
5.9 Measure the current though the branch activating all the sources.
5.10 Compare the measured value with that of calculated value.

6 Show skill in maximum power transfer theorem.

6.1 Select an experiment-circuit.
6.2 Select tools, equipment and materials.
6.3 Connect the source according to circuit diagram.

6.4 Record and computing data.
6.5 Calculate the P_L (Load power) using $P_L=I_L^2 R_L$ equation.
6.6 Verify maximum power transfer theorem.

7 Show skill in measuring effective resistance of a coll.
7.1 Draw the circuit diagram for determining the effective resistance.
7.2 Collect tools & equipment.
7.3 Correct the circuit according to the circuit diagram using proper equipment.
7.4 Check all connection points before actual operation.
7.5 Connect DC supply and record readings.
7.6 Calculate Ohmic resistance from the formula by recording relevant data:$R_{dc}=P_{dc}/I_{dc}^2$
7.8 Determine effective resistance from the formula $R_{ac}=P_{ac}/I_{ac}^2$
7.9 Compare the Ohmic resistance and effective resistance and find the ratio.

8 Show skill in determining the values of resistance & inductance and draw the vector diagram of RL series circuit.
8.1 Sketch the circuit diagram for determining resistance and inductance of a RL series circuit.
8.2 Collect tools, equipment and materials for the experiment.
8.3 Connect the circuit according to the circuit diagram using proper.
8.4 Check all connection points before actual operation.
8.5 Apply proper voltage & record readings from the meter.
8.6 Find the value of resistance & phase angle from relevant data.
8.7 Sketch the vector diagram with the relevant data as obtains.

9 Show skill in determining the values of resistance & capacitance and drawing vector diagram of RC series circuit.
9.1 Sketch the circuit diagram for RC series circuit.
9.2 Collect tools, equipment and materials for the experiment.
9.3 Connect the circuit according to the circuit diagram using proper equipment.
9.4 Check all connection points before actual operation & apply the voltage and record the relevant readings.
9.5 Determine the value if resistance, capacitance & phase angle from the data.
9.6 Sketch the vector diagram with the help of relevant data as obtained.

10. Show skill in determining the values of resistance & inductance, capacitance and draw the vector diagram from of RLC series circuit.
10.1 Sketch the circuit diagram for RLC series circuit
10.2 List tools, equipment and materials and for the experiment.
10.3 Connect the circuit according to the circuit diagram using proper equipment.
10.4 Check all connection points before actual operation.
10.5 Apply proper power supply to the circuit and record the readings from the meter.
10.6 Determine the values of resistance, inductance, capacitance and phase angle from the relevant data.
10.7 Verify the supply voltage is equal to the vector sum of voltage drop in each parameter.
10.8 Sketch the vector diagram with the help of relevant data as obtained.

11 Show skills in determining power factor of a RLC series circuit and drawing vector diagram.
11.1 Sketch the circuit diagram for RLC series circuit.
11.2 Collect tools, equipment and materials for the experiment
11.3 Connect the circuit according to the circuit diagram using proper equipment.
11.4 Check all connection point before actual operation.
11.5 Apply proper power supply to the circuit and record the readings from the meter.
11.6 Determine the value of phase angle and power factor from the relevant data.
11.7 Sketch the vector diagram with the relevant data.