

2.0 AC CIRCUITS

Today the ac supply system is universally used. In order to understand ac systems, it is necessary to be familiar with the generation of sinusoidal varying ac voltage, which is discussed in this chapter. For the analysis of ac network, new terms related to alternating waveforms are used. The concept of average and root mean square values are introduced.

The representation of a sinusoidal quantity by a phasor, which simplifies the analysis of the circuits, is discussed. The analysis of series and parallel ac circuits containing resistances, inductances and capacitances and the analytical techniques that greatly simplify the solution of the circuit with sinusoidal excitation are also presented.

2.0.1 GENERATION OF AC VOLTAGE

The generation of ac voltage may be explained by considering a rectangular coil AA' whose conductor length is l meter and width is b meter. The coil is mounted on a spindle DD' as shown in Figure 2 below

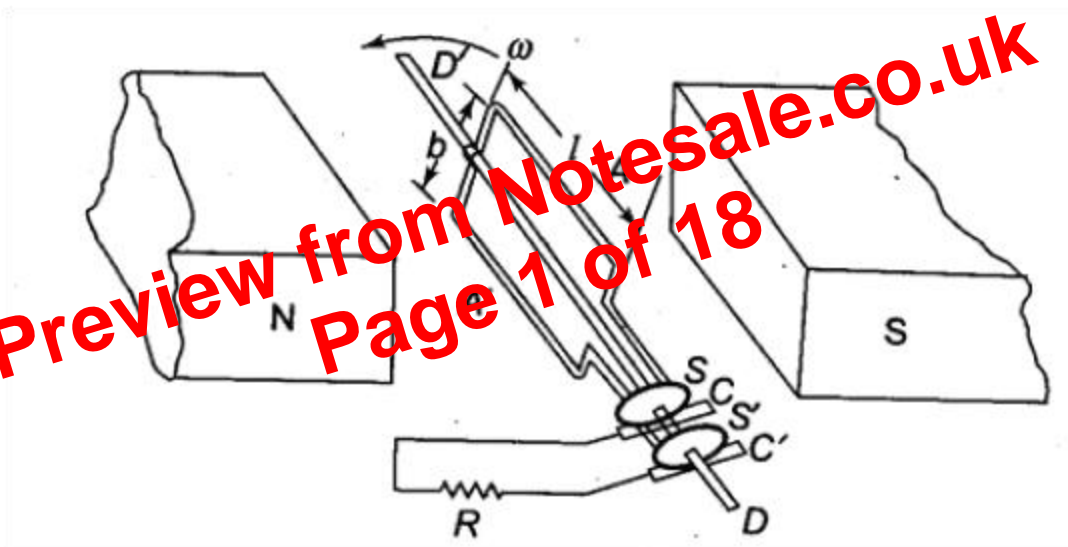
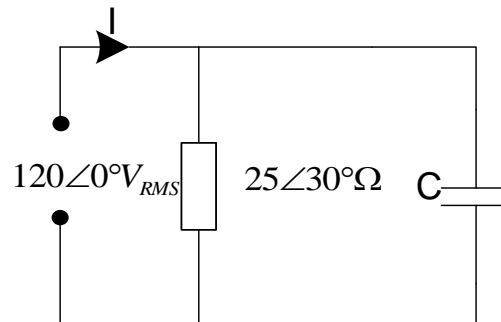


Fig. 2

The coil is rotated in the anti-clockwise direction with angular velocity ω rad/sec in a uniform magnetic field having a flux density of B Wb/m². The ends of the coil are connected to two slip rings S and S' which are rigidly fixed to an insulated shaft DD' which is used to rotate the coil. The slip rings maintain a sliding contact with carbon brushes C and C' , which is connected to a resistor R .

EXAMPLE

Calculate the corresponding capacitor value to increase the power factor to lagging 0.95 p.f. The frequency of the supply is set at 50 Hz.

**Step 1: Calculate the current**

$$I = \frac{V_{RMS}}{Z_{TOTAL}} = \frac{120\angle 0^\circ V}{25\angle 30^\circ \Omega} = 4.8\angle -30^\circ A$$

Step 2: Get the Real power and reactive power using old power factor (θ is taken from the angle of current)

$$P_1 = V_{RMS} I_{RMS} \cos \theta$$

$$P_1 = (120V_{RMS}) \times (4.8A) \cos(30^\circ)$$

$$P_1 = 498.83W$$

$$Q_{OLD} = V_{RMS} I_{RMS} \sin \theta$$

$$Q_{OLD} = (120V_{RMS}) \times (4.8A) \times \sin(30^\circ)$$

$$Q_{OLD} = j288 \text{ var } s$$

Complex Power, S

$$S = (488.83 + j288)VA$$

Step 3: Compare parameters between old p.f and new p.f

$$\text{old.p.f} = 30^\circ$$

$$\text{new.p.f} = \cos^{-1} 0.95$$

$$\text{new.p.f} = 18.19^\circ$$

- 12) A 240V (rms), 50Hz power line is connected to a load .The connected load absorbs 5kW at a lagging power factor of 0.85. Find the value of capacitance needed to raise the power factor to 0.95.
- 13) Three loads A, B and C are connected in parallel across a 1400 V_{rms} 50 Hz line. Load A has an apparent power of 25 kVA with an 80 percent lagging power factor. Load B consumes 10 kW with a 0.9 percent leading power factor and Load C consumes 20 kW at unity power factor. Determine the following:
- Total apparent power in the system.
 - The current drawn from the supply.
 - Calculate the capacitance necessary to establish 0.99 lagging power factor.

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