Course: Special Machines **Code:** EE512 **Semester:** 2nd 2014/2015

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Sheet (2)

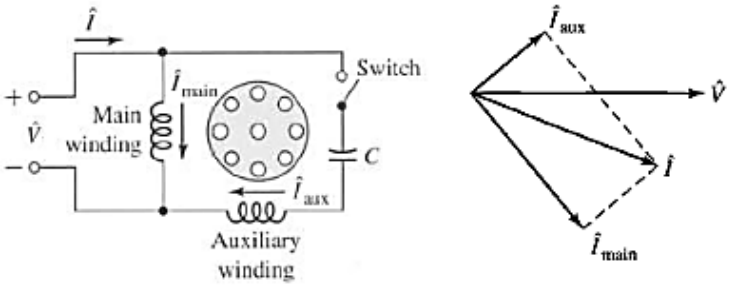
Single-Phase Induction Motor

Q1 A 2.5-kW 120-V 60-Hz capacitor-start motor has the following impedances for the main and auxiliary windings (at starting):

$$Z_{main} = 4.5 + j3.7\ \Omega \quad \text{main winding}$$

$$Z_{aux} = 9.5 + j3.5\ \Omega \quad \text{auxiliary winding}$$

Find the value of starting capacitance that will place the main and auxiliary winding currents in quadrature at starting.



Q2 **Example 10–1.** A ½-hp, 110-V, 60-Hz, six-pole, split-phase induction motor has the following impedances:

$$R_1 = 1.52\ \Omega \qquad X_1 = 2.10\ \Omega \qquad X_M = 58.2\ \Omega$$
$$R_2 = 3.13\ \Omega \qquad X_2 = 1.56\ \Omega$$

The core losses of this motor are 35 W, and the friction, windage, and stray losses are 16 W. The motor is operating at the rated voltage and frequency with its starting winding open, and the motor's slip is 5 percent. Find the following quantities in the motor at these conditions:

(a) Speed in revolutions per minute
(b) Stator current in amperes
(c) Stator power factor
(d) P_{in}
(e) P_{AG}
(f) P_{conv}
(g) τ_{ind}
(h) P_{out}
(i) τ_{load}
(j) Efficiency

Assignments Questions:

Q1 Considering the motor of the first question, find the phase angle between the main and auxiliary winding currents if the 177 uF capacitor is replaced by a 200 uF capacitor.

Q2.a **10-1.** A 120-V, 1/3-hp 60-Hz, four-pole, split-phase induction motor has the following impedances:

$R_1 = 1.80\,\Omega$ $X_1 = 2.40\,\Omega$ $X_M = 60\,\Omega$

$R_2 = 2.50\,\Omega$ $X_2 = 2.40\,\Omega$

At a slip of 0.05, the motor's rotational losses are 51 W. The rotational losses may be assumed constant over the normal operating range of the motor. If the slip is 0.05, find the following quantities for this motor:

(a) Input power
(b) Air-gap power
(c) P_{conv}
(d) P_{out}
(e) τ_{ind}
(f) τ_{load}
(g) Overall motor efficiency
(h) Stator power factor

Q2.B

Suppose that the motor in Q2.A is started and the auxiliary winding fails open while the rotor is accelerating through 400 rpm. How much induced torque will the motor be able to produce on its main winding alone? Assuming that the rotational losses are still 51 W, will this motor continue accelerating or will it slow down again? Prove your answer.