35. A three phase Y connected synchronous motor has a per phase voltage of 254 V, and a synchronous reactance of 4 Ω. Suppose that the generated emf is 200 V and the torque angle is 36.87^0.
(a) Find the armature current.
(b) Determine the power factor at which the motor operates.
(c) Find the generated emf and torque angle that result in a power factor of unity and the same armature current. (Ans: 38.1 A; 0.787 lagging; 296.2 V, 30.96^0.)

36. A three phase, 60-Hz induction motor has 4 poles. Find the speed of the motor given that the emf induced in the rotor has a frequency of 3 Hz. (Ans: 1710 rpm.)

37. For a three phase, 60-Hz, 15 horse power induction motor at rated speed of 1750 rpm, determine:
(a) the speed of the rotor with respect to the stator (Ans: 1750 rpm.),
(b) the speed of the rotor field with respect to the rotor (Ans: 50 rpm.),
(c) the speed of the rotor field with respect to the stator field (Ans: 0 rpm.),
(d) the frequency of the currents in the rotor. (Ans: 1.7 Hz.)

Solutions to Home-Work Problems

Problem 1. The magnitude of the magnetic force on the first charge is given by quB since the angle θ between the velocity and the magnetic field is 90^0. Therefore,
$B = \frac{7.31\times10^{-3}}{25\times10^{-6}\times4.5\times10^{3}} = 6.5 \times 10^{-2}$ T.
Let us consider next the second charge.
$f_2 = q_2 u_2 B \sin\theta \Rightarrow 1.9 \times 10^{-3} = 5 \times 10^{-6}(u_2)(6.5 \times 10^{-2}) \sin 40^0$
Thus, $u_2 = 9.1 \times 10^3$ m/s.

Problem 2. The result is obtained using the Ampere's law in a straightforward manner.

Problem 3. Again, the result is obtained using the Ampere's law in a straightforward manner.

Problem 4. $B = \frac{(500/3)(4\pi\times10^{-7})}{(2\pi)(0.1)} = 3.33 \times 10^{-4}$ T.

Problem 5. It is straightforward.

Problem 6. Use Lenz's law in a straightforward manner.

Problem 7. Use the formula $L = \frac{N^2}{\text{Reluctance of the magnetic path}}$.

Problem 8. Let I_1 and I_2 be the clockwise loop currents in phasor domain in primary and secondary coils of the mutual inductance. Then, we can write two loop equations as
$5\angle30^0 = 3I_1 + j6I_1 - j6I_2$
$0 = -j6I_1 + j12I_2 + 8I_2$.
Solving the second equation, we get
$I_1 = \frac{8+j12}{j6} I_2$.
Substituting the above in the first equation, we get
$I_2 = \frac{5(0.866+j0.5)(j6)}{(3+j6)(8+j12)+36} = 0.3535\angle23^0$.
Hence $v_2(t) = 8i_2(t) = 2.828\cos(6t + 23^0)$.