

For a 100-hp, 3-phase, Y-connected, 440-V, 50-Hz, 8-pole squirrel cage induction motor with no-load rotational loss of 2.7 kW and has the following equivalent-circuit constants all expressed in ohms/phase referred to the stator:

$$R_1=0.085 \Omega \quad R_2'=0.067 \Omega \quad X_1=0.196 \Omega \quad X_2'=0.161 \Omega \quad X_\mu = 6.65 \Omega$$

Write a program to draw the **torque-speed** characteristics for a slip range from 2 to -1 at:

- Rated conditions.
- $V = 0.8, 0.6 V_{\text{rated}}, 0.4 V_{\text{rated}}$ and $0.2 V_{\text{rated}}$.
- $f = 15 \text{ Hz}, 25 \text{ Hz}, 50 \text{ Hz},$ and 65 Hz .
- V/f operation for $f = 10 \text{ Hz}, 30 \text{ Hz}, 50 \text{ Hz},$ and 60 Hz .
- $R_2' = 2R_2', R_2' = 3R_2', R_2' = 4R_2'$ and $R_2' = 5R_2'$.
- $R_1 = 2R_1, R_1 = 3R_1$ and $R_1 = 4R_1$.

For all the above curves, determine the **operating points** if the motor is required to drive a load of 400 N.m.

Write a computer program to calculate the starting torque and starting terminal current for a three phase induction motor at different conditions. Use the same data as in assignment #3 with a constant load torque of 500 N.m. Run the program for the following cases:

1. A series resistor of $R_1=2R_1$, $R_1=3R_1$, $R_1=4R_1$ and $R_1=5R_1$. Choose the best value for driving the given load. Justify your choice.
2. A series reactor of $X_1=2X_1$, $X_1=3X_1$, $X_1=4X_1$ and $X_1=5X_1$. Choose the best value for driving the given load. Justify your choice.
3. An auto transformer with 30%, 40%, 50%, 60% and 70% tapping. Choose the best value for driving the given load. Justify your choice.
4. A star-delta starter and state if it's suitable for this load or not.

A 480-V, 50-Hz, Y -connected, six-pole synchronous generator has a per-phase synchronous reactance of 1.0Ω . Its full-load armature current is 60 A at 0.8 PF lagging. This generator has friction and windage losses of 1.5 kW and core losses of 1.0 kW at 60 Hz at full load. Since the armature resistance is being ignored, assume that the copper losses are negligible. The field current has been adjusted so that the terminal voltage is 480 V at no load. Plot the terminal characteristic (terminal voltage versus line current) of this generator as its armature current varies from no-load to full load at a power factor of (a) 0.8 lagging, (b) unity power factor, and (c) 0.8 leading. Assume that the field current remains constant at all times.