

ECE370 POWER & ENERGY SYSTEMS

Homework Set 5

- 5.1 A six-pole dc machine has an armature connected as a lap winding. The armature has 32 slots with six conductors per slot. The armature is rotated at 600 rpm, and the flux per pole is 30 mWb. Calculate the induced voltage.
- 5.2 A four-pole dc generator has a wave-wound armature containing 48 slots with eight conductors per slot. The generator is driven at 1180 rpm and generates a voltage of 480 V. What is the flux per pole?
- 5.3 A 600 V dc series motor is rated at 250 hp, 2000 rpm. It has an armature resistance of 0.1Ω and a field resistance of 0.05Ω . It draws a current of 360 A from the supply when delivering rated load. Ignore magnetic saturation and determine:
- a) Rated output torque.
 - b) Rated developed torque.
 - c) Rated efficiency.
 - d) Rotational losses at rated speed.
 - e) Speed when the load is changed, causing the line current to drop to 90 A.
 - f) Developed torque for the conditions in part (e).
 - g) Horsepower output for the conditions in (e) if the rotational losses are proportional to speed (not speed²).
 - h) Efficiency for the conditions in part (e).
- 5.4 A 1200 V dc shunt motor is rated at 500 hp, 3000 rpm. It has an armature resistance of 0.17Ω and a total field circuit resistance of 120Ω . It draws a current of 350 A from the supply when delivering rated load. Ignore magnetic saturation and determine:
- a) Rated output torque.
 - b) Rated developed torque.
 - c) Rated efficiency.
 - d) Rotational losses at rated speed.
 - e) Speed when the load is changed, causing the line current to drop to 70 A. (Field resistance is unaltered.)
 - f) Horsepower output for the conditions in (e) if the rotational losses are proportional to speed².
 - g) Efficiency for the conditions in part (e).

- 5.5 A 1200 V dc shunt motor is rated at 850 hp, 2500 rpm. It has an armature resistance of 0.1Ω and a total field circuit resistance of 150Ω . It draws a current of 600 A from the supply when delivering rated load. Ignore magnetic saturation and determine:
- a) Rated output torque.
 - b) Rated developed torque.
 - c) Rated efficiency.
 - d) Rotational losses at rated speed.
 - e) Line current when the total field circuit resistance is changed to 50Ω , while the developed torque remains constant.
 - f) Speed for the conditions in part (e).
 - g) Horsepower output for the conditions in (e) if the rotational losses are proportional to speed².
 - h) Efficiency for the conditions in (e).

- 5.6 The following information is taken from the nameplate of a separately-excited dc generator.

Armature:	120 kW,	600 V,	0.15 Ω .
Field:	100 V,	6.0 A	

At its rated speed of 3600 rpm the no-load torque is measured at 16 Nm. Ignore armature reaction and magnetic saturation.

- a) For rated load conditions determine:
 - i) Rated Shaft Horsepower
 - ii) Rated Efficiency
 - iii) Load Impedance
- b) Determine the terminal voltage, kW output and the efficiency if the field current is reduced to 4.5 A and the speed is reduced to 3000 rpm, causing the rotational losses to become 4 kW. The load impedance is unchanged.