Department of Electrical Engineering
Indian Institute of Technology Madras
EE 2005: Electrical Machines

Tutorial Sheet No.4 — 20 Feb 2018

1. A separately excited DC motor has k$\phi = 1.44$, $R_a = 0.86\,\Omega$. When it is operating at 150 rad/s, the armature current is $I_a = 40$ A. The terminal voltage V_t is held constant under all conditions
   a.) Compute V_t
   b.) Compute the no-load speed in rad/s.(Neglect core and mechanical losses)

   [**Ans:** a.) 250.4 V b.) 173.89 rad/s]

2. A 200 V DC shunt motor has an armature resistance of 0.4 Ω. When operated from the rated supply voltage at full load, the motor runs at 500 rpm and draws an armature current of 25 A. If a resistance of 1.6 Ω is placed in series with the armature, find the speed at (i) full load torque (ii) three times full load torque. Neglect core and mechanical losses.

   [**Ans:** (i) 394.736 rpm (ii) 131.58 rpm]

3. A separately excited D.C motor is rated for a full load torque of 100Nm. For an applied voltage of 240V and for flux (ϕ) per pole of 30 mWb, the no-load and full load speeds of the motor are 1595 rpm and 1195 rpm respectively. Find
   a.) i) The machine constant k
   ii) The armature resistance R_a
   b.) If the applied voltage and the flux per pole are reduced to 200V and 20mWb respectively, Find
   i) The corresponding no load speed
   ii) The corresponding full load speed

   [**Ans:** a.) (i) 47.896 (ii) $0.8648\,\Omega$ b.) (i) 1993.76 rpm (ii) 1093.79 rpm]

4. A 10 kW, 250 V, 1200 rpm DC shunt motor has a full load efficiency of 80%. The field and armature resistances are 125 Ω and 0.2 Ω respectively. The speed of the motor is to be reduced to 75% with load torque remaining constant. What resistance should be inserted in the armature circuit. Neglect stray losses.

   [**Ans:** 1.252 Ω]

5. A 250 V D.C. shunt motor has an armature resistance of 0.2 Ω and shunt field resistance of 100 Ω. It takes 60A when running at a speed of 600 rpm. If the speed is to be increased to 800 rpm, find the resistance of the field regulator to be inserted. Assume the magnetisation characteristic to be a straight line and the load torque remains constant.

   [**Ans:** 35.668 Ω]

6. A 250 V shunt motor develops a total torque of 105 Nm and takes 36 A at 750 rpm. The armature and shunt field resistances are 0.4 Ω and 250 Ω respectively. If the speed is to be increased to 1000 rpm, determine the percentage reduction of the field and additional resistance to be inserted in the field circuit. Total toque developed at 1000 rpm is 75 Nm. Assume the magnetisation characteristic to be a straight line.

   [**Ans:** 24.77%, 82.3 Ω]

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