DC MACHINES

1. A dc machine (6 kW, 120 V, 1200 rpm) has the following magnetization characteristics at 1200 rpm.

I_f [A]	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.2
E_a[V]	5	20	40	60	79	93	102	114	120	125

   The machine parameters are R_a=0.2 Ω, R_{fw}=100 Ω. The machine is driven at 800 rpm and is separately excited. The field current is adjusted at I_f=0.8 A. A load resistance R_L=2Ω is connected to the armature terminals. Neglect armature reaction fields.
   a) Determine the quantity $K_a\Phi$ for the machine.
   b) Determine E_a and I_a.
   c) Determine the torque T and load power P_L.

2. The dc machine in the previous problem has a field control resistance whose value can be changed from 0 to 150 Ω. The machine is driven at 1200 rpm. The machine is separately excited and the field winding is supplied from a 120 V supply.
   a) Determine the maximum and minimum values of the no-load terminal voltage.
   b) The field control resistance (R_{fc}) is adjusted to provide a no-load terminal voltage of 120V. Determine the value of R_{fc}. Determine the terminal voltage at full load for no armature reaction an also if $I_{f(AR)}$=0.1 A.

3. The dc machine in the first problem is separately excited. The machine is driven at 1200 rpm and operates as a generator. The rotational loss 400 W at 1200 rpm and the rotational loss is proportional to speed.
   a) For field current of 1.0A, with the generator delivering rated current, determine the terminal voltage, the output power and the efficiency.
   b) Repeat part a) if the generator is driven at 1500 rpm.

DC MACHINES (2)

4. A dc shunt generator (20kW, 200V, 1800rpm) has R_a=0.1Ω, R_{fw}=150 Ω. Assume that E_a=U_t at no load. The machine is self-excited. Data for the magnetization curve at 1800 rpm are:

I_f [A]	0.0	0.125	0.25	0.5	0.625	0.75	0.875	1.0	1.25	1.5
E_a[V]	5	33.5	67	134	160	175	190	200	214	223

   a) At full-load condition, U_t=U_t (rated), I_a=I_a (rated), I_f =1.25 A. Determine the value of the field control resistance (R_{fc}).
   b) Determine the electromagnetic power and torque developed at full-load condition.
   c) Determine the armature reaction effect in equivalent field amperes ($I_{f(AR)}$) at full load.
   d) Determine the maximum value of the armature current assuming that $I_{f(AR)}$ is proportional to I_a.

5. A dc shunt motor is connected to a 230V supply and delivers power to a load drawing an armature current of 200A and running at a speed of 1200rpm. The armature resistance is R_a=0.2Ω.
   a) Determine the value of the generated voltage at this load condition.
   b) Determine the value of the load torque. The rotational losses are 500W.
   c) Determine the efficiency of the motor if the field circuit resistance is 115Ω.

6. A dc shunt machine (10kW, 250 V, 1200 rpm) has R_a=0.25Ω. The machine is connected to a 250V dc supply, draws rated armature current and rotates at 1200rpm.
   a) Determine the generated voltage, the electromagnetic power developed and the torque developed.
   b) The mechanical load on the motor shaft is thrown off and the motor draws 4A armature current. Determine the rotational loss and the speed assuming no armature reaction.