Department of Electrical Engineering, IIT Bombay
EE111 : Introduction to Electrical Systems
Assignment 10

Submit solutions to Problems

1. A shunt machine connected to 250V mains, has an armature resistance (including brushes) of 0.12Ω, and the resistance of the field circuit is 100Ω. Find the ratio of the speed as a generator to the speed as a motor, the line current in each case being 80A. [Ans: 1.08]

2. Estimate the reduction of speed of a generator working with constant excitation on 500V source to decrease its load from 500kW to 250kW. The resistance between armature terminals is 0.015Ω; neglect armature reaction. [Ans: 1.45 %]

3. A separately excited generator, when running at 1200 rpm, supplies 200A at 125V to a circuit of constant resistance. What will be the current when the speed is dropped to 1000 rpm if the field current is unaltered? Armature resistance: 0.04Ω; total drop at brushes:2V; ignore the effect of armature reaction. [Ans: 166]

4. A shunt generator has an induced voltage on open circuit of 127V. When the machine is on load, the terminal voltage is 120V. Find the load current if the field current resistance be 15Ω and the armature resistance be 0.02Ω. Ignore armature reaction. [Ans: 342A]

5. A shunt generator delivers 50kW at 250V and 400 rpm. The armature and field resistances are 0.02Ω and 50Ω respectively. Calculate the speed of the machine running as a shunt motor and taking 50kW input at 250V. Allow 1V per brush for contact drop and neglect armature reaction. [Ans: 382 rpm]

6. A dc shunt machine generates 250V on open circuit at 1000 rpm. Armature resistance including brushes, 0.5Ω; field resistance, 250Ω; input to machine running as a motor

on no load, 4A at 250V. Calculate the speed and efficiency of the machine as a motor taking 40A at 250V. Armature reaction weakens the field by 4%. [Ans: 960 rpm, 82.5%]

7. The following data refer to a dc shunt machine: total armature resistance, 0.3Ω; field resistance, 40Ω; open circuit characteristics at 1000 rpm is such that the field current is 5A for an electromotive force of 220 V and 4A for 200V. Neglecting armature reaction, find the resistance in circuit in the shunt regulator to obtain a speed of 1000 rpm when running as a motor on 220V supply at the full load armature current of 35A. [Ans: 9.2Ω]

8. A 200V shunt motor develops 23 hp when taking 20.3 kW. The field resistance is 50Ω and armature resistance is 0.06Ω. What is the efficiency and power input when the output is 10 hp? [Ans: 74.6%, 10kW]

9. A 500V, 10 hp shunt motor has a full load efficiency of 85%. With the same field and armature current, it is desired to reduce the speed by 30% by insertion of resistance in the armature circuit. Assuming that all losses except copper losses vary directly with the speed, calculate the value of the inserted resistance and the efficiency of the motor when running at the reduced speed. The resistance of the field and the armature are 400Ω and 0.25Ω respectively. [Ans: 9.12Ω, 59.6%]

10. A 250V shunt motor has an armature resistance of 0.5Ω and a field resistance of 250Ω. When driving at 600rpm a load, the torque of which is constant, the armature takes 20A. If it be desired to raise the speed from 600 rpm to 800 rpm, what resistance must be inserted in the shunt field circuit assuming the magnetization curve to be a straight line. [Ans: 88Ω]

11. A 220V shunt motor has an armature resistance of 0.5Ω and takes a current of 40A on full load. By how much must be the main flux be reduced to raise the speed by 50% if the developed torque is constant. [Ans: 37.5%]