Kafrelsheikh University
Faculty of Engineering
Subject: **Electrical Machine 1 (DC)**
Year: Third Electrical Power (R.2007)
Exam Date: 20/1/2019

Final Exam of 1st semester-2018-2019
Department of Electrical Engineering
Course code: EPM3106 Full Mark: 90 Marks
Number of pages: 2 Time allowed: 3 hours

This exam measure ILOs (a1, a15, b2, b5, c3, c16, d5, d7)
Attempt to solve all questions (assume any missing data)

Q1: (15 Marks)

a) Define the following: magnetic field intensity, flux density and magnetic flux. [5Marks]

b) A closed magnetic circuit of cast steel contains a 6 cm long path of cross-sectional area 1 cm^2 and a 2 cm path of cross-sectional area 0.5 cm^2. A coil of 200 turns is wound around the 6 cm length of the circuit and a current of 0.4A flows. Determine the flux density in the 2 cm path, if the relative permeability of the cast steel is 750. [10 Marks]

Q2: (15 Marks)

a) Name the main parts of a D.C. machine and state the materials of which each part is made. [5 Marks]

b) A 25-kW 125-V separately-excited dc machine is operated at a constant speed of 3000 r/min with a constant field current such that the open-circuit armature voltage is 125 V. The armature resistance is 0.02 Ω.

Compute the armature current, terminal power and electromagnetic power and torque when the terminal voltage is (a) 128 V and (b) 124 V. [10 Marks]

Q3: (15 Marks)

a) Draw and explain the deferent form of air gap flux in a 4-pole dc generator. [5 Marks]

b) The separately-excited dc motor was operated at no-load and the following data were recorded: n = 1000 rpm, I_a = 0.95 A, V_t = 240 V, V_f = 150 V, R_a = 0.2Ω, R_f =75 Ω. The field voltage is unchanged, but the motor is loaded so that it supplies an output power 10 hp at 1000 rpm to a coupled mechanical load. At this load point, determine (a) the rotational losses, (b) the armature current, (c) the terminal voltage, and (d) the efficiency. Neglect armature reaction. [10 Marks]

Q4: (20 Marks)

a) Draw up the winding table for a 4 pole, wave connected armature having 30 coil sides and give a developed diagram of the winding showing the polarity and position of the brushes, the main poles and the direction of motion of the armature for a D.C. motor. [10 Marks]

b) Two compound generators A and B, fitted with an equalizing bar, supply a total load current of 500 A. The data regarding the machines are:

	A	B
Armature resistance (ohm)	0.01	0.02
Series field winding (ohm)	0.004	0.006
Generated e.m.fs. (volt)	240	244

Calculate (a) current in each armature (b) current in each series winding (c) the current flowing in the equalizer bar and (d) the bus-bar voltage. Shunt currents may be neglected. [10 Marks]

Q5: (15 Marks)

a) Discuss the commutation process, what is main cause of sparking and discuss the methods adopted for minimizing the sparking at the brushes? [5 Marks]

b) A 22.38 kW, 440-V, 4-pole wave-wound d.c. shunt motor has 840 armature conductors and 140 commutator segments. Its full-load efficiency is 88% and the shunt field current is 1.8 A. If brushes are shifted backward through 1.5 segments from the geometrical neutral axis, find the demagnetising and distorting amp-turns/pole. [10 Marks]

Q6: (10 Marks)

Determine the main dimensions, number of poles, number of conductors per slot and air gap length subjecting the results to design checks for a 600kW, 500V 900 rpm dc generator. Assume: Average flux density 0.6T, ampere-conductors per metre 35000. The ratio pole arc to pole pitch 0.67, efficiency 91%. Peripheral velocity should not exceed 40m/s. Armature mmf per pole should be below 7500A. Current per brush arm should not exceed 400A. Frequency of the flux reversal should not exceed 50Hz The mmf required for air gap is 50% of armature mmf and gap contraction factor is 1.15. [10 Marks]

With my best wishes
Dr. Eng./Mohamed I. Abd EL_Wanis