Assiut University
Faculty of Eng.
Term Ex., January 2015

Electrical Machines (1)
DC Machines

Elect. Eng. Dept.
2 nd Year Elect.
Time : 3 Hours

Answer All Questions. <u>The solution must include the necessary equations , curves and connections diagrams .</u>

(Max. Marks : 50)

1) Give an account about :

Failure of excitation and re-excitation in self- excited dc generators.
Comparison between <u>the short-shunt</u> dc generator and <u>long-shunt</u> <u>differential</u> dc motor.
The unstable ranges in the external characteristic of dc generators .
Two methods used for speed control of each shunt and series dc motors . **(11 Marks)**

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2) A short-shunt **dc motor** , 2p=8 , 240 V , 70 A , 19 BHP has 200 conductors in the armature . The armature slot contains 4 coil sides , each coil side has 2 **conductors** . The no load air-gap flux = 0.03 Wb .

$$R_{fs} = 0.2 \ \Omega \ , \ R_a = 0.1 \ \Omega \ , \ R_f/\text{pole} = 10 \ \Omega \ \text{ and } \ R_g = 33 \ \Omega .$$

At rated load , the air-gap flux becomes 95 % of its value at no load due to the AR effect.

Find S , C , number of commutator segments and brushes , the type of winding used and its pitches ?
Draw a sketch of the developed diagram of the used winding ?
At rated values , calculate the speed of the motor , the developed torque in kg.m (state its name ?) , P_{ML} and efficiency ? (Neglect saturation). **(12 Marks)**

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3) The OCC of a separately–excited **dc generator** at **800 rpm** is

I_f /A	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
E / V	150	220	250	265	275	282	290	295	300

If the generator feeds a load **at 1000 rpm** , obtain its OCC and **draw it only** ?
The generator is excited from 225 V mains and has $R_a = 0.2 \ \Omega$, $R_{fc} = 125 \ \Omega$.
At the speed 1000 rpm and $I_a = 100$ A , the AR reduces the induced emf by 22 V .
Find the load voltage , load resistance and draw the load line .
At 1000 rpm and the load current = 70 A , calculate the load voltage regulation and the developed torque in kg. m . (state its name). **(9 Marks)**

P T O →

4) A 100 V , 1500 rpm shunt dc generator has OCC as

I_f /A	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
E /V	3	22.5	45	67.5	88	100	108	113	116	118	120	122

The O C voltage = 120 V and R_a = 0.2 Ω .
At full-load , the voltage drop due AR equals 5 V .
Calculate R_{fc} and the short circuit current ?
Find I_a at full-load and the load resistance ?
Find the voltage regulation at half full-load armature current ?
Calculate the critical resistance of the shunt field circuit at 1500 rpm and also the critical speed ?   (9 Marks)

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5) A 9 HP , 220 V , 35 A , 300 rpm dc series motor has R_a = 0.1 Ω and R_{fs} = 0.05 Ω .
Find at full-load the P_{ML} and   output torque in N.m.
At constant supply voltage , a diverter resistance of 0.08 Ω is used . The developed
torque becomes 0.75 of its full-load value .   Calculate the new value of the armatu
current and speed, then find the efficiency. Take P_{ML} α N .
(Neglect AR and saturation)   (9 marks)

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Prof. Hassan I. Abou-faddan   End of Questions