**MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 4 (15th September 2017)**

1. What is the main difference between a DC Generator and a DC Motor? AS PER DISCUSSION IN CLASS
2. Write the mathematical formula expressing Rotary Mechanical Power in terms of Torque and RPM. AS PER DISCUSSION IN CLASS
3. Briefly discuss the main parts used in constructing DC generators. AS PER DISCUSSION IN CLASS
4. Briefly discuss the main parts used in constructing DC motors. AS PER DISCUSSION IN CLASS
5. Summarize the equations needed for analyzing DC generators with series, shunt and compound windings. AS PER DISCUSSION IN CLASS
6. Summarize the equations needed for analyzing DC motors with series, shunt and compound windings. AS PER DISCUSSION IN CLASS
7. Briefly discuss the need for a starter in a DC motor. AS PER DISCUSSION IN CLASS
8. What are the main performance characteristics of a DC generator? AS PER DISCUSSION IN CLASS
9. What are the main performance characteristics of a DC motor? AS PER DISCUSSION IN CLASS
10. What are the main reasons for power losses in DC machines? Discuss in brief. AS PER DISCUSSION IN CLASS
11. A 100-KW, 250 Volt DC Shunt Generator has armature-winding resistance = 0.05**Ω** and field-winding resistance = 60**Ω**. With the generator operating at rated voltage, determine the induced e.m.f. in the armature at a) full-load and b) half-full load. ANS: 270.2 Volts at full-load and 260.2 Volts at half-full load.
12. Calculate the full-load and half-load values of the percentage voltage regulation for the DC Shunt Generator in Q 11. 8.08% and 4.08%
13. Repeat Problems 11 and 12 assuming that brush drop is 1V per brush. 272.2 Volts, 262.2 Volts, 8.88%, and 4.88%
14. Repeat Problems 11, 12, and 13 assuming that stray losses (iron losses plus mechanical losses) in the Generator are equal to 647 Watts. 271.8 Volts, 263.4 Volts in Q 11, 8.72%, 5.36% in Q 12, 273.8 Volts, 265.4 Volts, 9.52%,6.16% in Q 13.
15. Consider a shunt-wound DC motor, running at full rated speed, with the following parameters:
16. Supply Voltage (V) = 440 volts
17. Armature Resistance (Ra) = 0.5 ohm
18. Field Resistance (Rf) = 100 ohm
19. No. of Conductors on Armature (Z) = 3000
20. No. of Parallel Paths on Armature (A) = 2
21. No. of poles (P) = 4
22. Armature Revolutions Per Minute (N) = 3000
23. Flux per pole () = 1.4 mWb

Calculate the following:

1. Back emf Eb
2. Armature Current (Ia)
3. Field Current (If)
4. Total Current drawn by the Motor (IL)
5. Efficiency of the Motor
6. Input Electrical Power
7. Output Mechanical Power
8. Power Loss in Armature
9. Power Loss in field windings, and
10. The torque produced by the Motor.

SOLUTION: a) Using Eb = (ZNP)/60A, we get Eb = 420 volts.

b) Using Ia = (V-Eb)/Ra, we get Ia = 40 Amperes.

c) Using If = V/Rf, we get 4.4 Amperes.

d) Total Current IL = Ia + If = 44.4 Amperes.

e) Efficiency = (EbIa)/ (VIL) = almost 0.86 i.e. 86%.

f) Input Power = VIL = 19536 Watts.

g) Output Power = EbIa = 16800 Watts.

h) Power Loss in armature = Ia2Ra = 800 Watts.

i) Power Loss in Field Windings = If2Rf = 1936 Watts.

j) Torque Ta = Output Power/ (2πN/60) =53.48 N-m approximately.

NOTE: As a double check on your calculations, the difference between input power and output power should be equal to copper losses (which are equal to power loss in armature plus power loss in field windings). Remember that core losses, mechanical losses, etc. are being ignored since the problem-statement does not mention anything about them.

1. What are the main assumptions you have tacitly made in solving Problem 15? ALL LOSSES EXCEPT COPPER LOSSES ARE ZERO
2. How would you define the efficiency of a DC Generator? AS PER DISCUSSION IN CLASS
3. How would you define the efficiency of a DC Motor? AS PER DISCUSSION IN CLASS
4. In the context of DC Machines, briefly explain the role played by a) Rotor, b) Armature, c) Yoke, d) Stator, e) Bushes, f) Commutator, g) Field Windings, and h) Armature Windings. AS PER DISCUSSION IN CLASS
5. What is the main difference between a lap-wound armature and a wave-wound armature? AS PER DISCUSSION IN CLASS
6. Why the rotor in a DC Machine is built using laminations (instead of solid construction)? AS PER DISCUSSION IN CLASS
7. What is the essential difference between self-excited DC Motors and Separately-Excited DC Motors? AS PER DISCUSSION IN CLASS
8. Briefly discuss the torque vs. load characteristics of DC Motor vis-à-vis the type of field excitation. AS PER DISCUSSION IN CLASS
9. Briefly discuss the speed vs. load characteristics of DC Motor vis-à-vis the type of field excitation. AS PER DISCUSSION IN CLASS
10. Briefly discuss the torque vs. speed characteristics of DC Motor vis-à-vis the type of field excitation. AS PER DISCUSSION IN CLASS
11. Briefly discuss the various methods of speed control in a DC Motor. AS PER DISCUSSION IN CLASS