
DC GENERATOR AND MOTOR PRINCIPLES

SUPPLEMENTARY PROBLEMS

(Ronaldo D. Ebrada, PEE, ASEAN ENGR. RMP, MSME)

1. Calculate the average voltage generated in a moving conductor if it cuts 2.5×10^6 maxwells in $1/40$ sec ; $1/80$ sec. **Ans. 1V, 2V**
2. A six-pole DC generator has an armature winding with 504 conductors connected in six parallel paths. Calculate the generated voltage in this machine if each pole produces 1.65×10^6 maxwells and the armature speed is 1,800 rpm. **Ans. 250V**
3. The armature winding of the generator of Prob.2 is modified so that it has two parallel paths instead of six. At what speed should the machine be driven if it is to develop the same voltage as before the change, assuming all other conditions to remain unchanged? **Ans. 600 rpm**
4. Calculate the generated voltage by a four pole DC machine given the following particulars; number of slots = 55; number of conductors per slot = 4; flux per pole = 2.62×10^6 maxwells; speed = 1200 rpm; number of parallel paths in armature = 2. **Ans. 230V**
5. If the armature winding of Prob. 4 had four parallel paths, what would have been generated voltage? **Ans. 115V**
6. A four-pole generator, having wave-wound armature winding has 51 slots, each slot containing 20 conductors, what will be the voltage generated in the machine when driven at 1500 rpm assuming flux per pole to be 7.0 mWb? **Ans. 357V**
7. A four-pole machine generates 250V when operated at 1500 rpm. If the flux per pole is 1.85×10^6 maxwells, the number of armature slots is 45, and the armature winding has two parallel paths, calculate; a) total number of armature conductors; b) number of conductors in each slot. **Ans 270, 6**
8. How many total conductors per slot would be necessary in the armature of Prob. 7 if the winding had four parallel paths? **Ans. 540, 12**

9. The armature of a four-pole dc generator is lap-wound and generates 216V when running at 600 rpm. Armature has 144 slots, with 6 conductors per slot. If this armature is rewound, wave connected, find the emf generated with the same flux per pole but running at 500 rpm. **Ans. 360V**
10. The speed of the generator of Prob. 7 is decreased to 1350 rpm. a) what will be the generated voltage if the flux per pole is maintained at the same value i.e. 1.85×10^6 maxwells? b) To what value of flux per pole should the excitation be adjusted if the generated voltage is to remain the same i.e. 250 volts?
Ans. 225V, 2.056×10^6 maxwells
11. A 4-pole generator has a wave-wound armature with 792 conductors. The flux per pole is 0.0121 Wb. Determine the speed at which should be run to generate 240V on no-load. **Ans. 751.3 rpm**
12. When driven at 1000 rpm with a flux per pole of 0.02 Wb, a dc generator has an emf of 200 V. If the speed is increased to 1100 rpm, and at the same time the flux per pole is reduced to 0.019 Wb per pole, what is then the induced emf?
Ans. 209V
13. A 4-pole DC generator with duplex lap winding has 48 slots and four elements per slot. The flux per pole is 2.5×10^6 maxwells and it runs at 1500 rpm. What is the output voltage? *EE BP Oct. '98*
Ans. 60V
14. What is the frequency of the alternating voltage generated in the armature conductors of; a) six-pole 900 rpm machine?; b) an eight-pole 750 rpm machine?; c) a 10-pole 500 rpm machine? **Ans. 45 cps, 50 cps, 41.7 cps**
15. How many pole are there in a generator in which the armature frequency is 30 cps when operating at a speed of 600 rpm? **Ans. 6 poles**
16. At what speed is an armature rotating in a 12-pole machine if the frequency in the armature conductors is 50 cps? **Ans. 500 rpm**
17. Calculate the force exerted by each conductor, 6 in. long on the armature of a DC motor when it carries a current of 90A and lies in a field the density of which is 52,000 lines per square inch. **Ans. 2.48 lb**
18. What torque will the conductor of Prob. 17 develop if it lies on an armature the diameter of which is 9 in? **Ans. 0.93 lb-ft**

19. The armature of a DC motor has 31 slots with 16 conductors in each slot, only 68 percent of the conductors lie directly under the pole faces, where the flux density is uniform at 46,000 lines per square inch. If the armature core diameter is 7.25 in., its length 4.25 in., and the current in each conductor is 25 amp, calculate; a) the force exerted by the armature tending to produce rotation; b) the torque in pound-feet. **Ans. 158lb, 44.1 lb-ft**
20. Using the data of Prob 19. Calculate the torque that will be developed if the flux density is reduced by 5 percent while the current is increased to 40A. **Ans. 67 lb-ft**
21. What total current must the armature of a DC motor carry, given the following information; armature slots = 72; conductors per slot = 6; pole arcs over 70.5 percent of circumference; flux density = 58,000 lines per square inch; armature core length = 8 in; armature core diameter = 21 in; number of armature paths in parallel = 6; torque = 1050 lb-ft. **Ans. 575.73A**
22. What must be the total armature winding current in Prob. 21 if the torque increases to 1,200 lb-ft while the flux density drops by 4 percent? **Ans. 114.23 A**
23. The armature of a motor has 400 active conductors, the flux density in the field being 3000 gauss. The axial length of the armature is 20.32 cm. The current is 30 amperes. Determine the total force exerted in the armature. **Ans. 731.5 N-m**

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