THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
Department of Electrical & Electronic Engineering

EEE 3352: Electromechanics and Electrical Machines

Assignment 4: Induced Voltages in Rotating Machines (*Due Monday 08 June 2015*)

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1. What voltage is induced in a single conductor in a slot in the rotor of a machine 1.8 m long, 0.4 m radius, 1800 rev/min, when cutting a flux density of 0.8 T?

2. An 8-pole rotating machine has 496 lap coils having two turns. The flux per pole is 0.02 Wb. With the machine running at 900 rev/min, calculate

   (a) the rms voltage, with a pair of diametrically placed brushes per pole pair for single phase working
   (b) the dc voltage appearing across quadrature brushes when running as a commutator machine.

3. An 6-pole dc machine has a total of 800 armature conductors, a pole face area of 400 cm^2 and an average flux density of 0.8 T. Ignoring all losses, what voltage would be induced if it is driven at 750 rev/min, given that it is
   (a) lap wound?
   (b) wave wound?

   Calculate the driving torque and the output current in each case if the prime mover supplies 40 kW.

Assignment 5: DC Generators. (*Due Tuesday 09 June 2015*)

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1. A separately excited generator has the magnetisation characteristic which gives a no-load voltage of 131 V when driven at 5000 rpm with field excitation of 2000 ampere-turns. The total armature circuit resistance is 0.08 Ω. Determine the
   (a) terminal voltage
   (b) power output
   (b) the electromagnetic power
   (c) electromagnetic torque input

   required if the generator supplies a load current of 120 A**.**

2. The magnetic characteristic obtained for a dc generator at 1200 rpm is as follows.

Field current (A)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	5.5
Generated emf (V)	120	240	360	480	540	600	660	696	738	744

   The generator is shunt excited and is driven at 1000 rpm. If its field resistance is 120 Ω, what is its no-load generated voltage? If the load resistance is 4 Ω and the armature resistance is 1 Ω, find the terminal voltage and load current.

Assignment 6: DC Motors. (*Due Wednesday 10 June 2015*)

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1. A 100-V shunt motor has an armature resistance of 0.4 Ω and a field resistance of 100 Ω while being driven at 1200 rpm, the armature taking a current of 25 A and the load torque being maintained constant. If it is desired to raise the speed to 1600 rpm, what resistance must be inserted in the shunt field circuit, assuming a linear magnetisation curve?

2. A dc series motor operates at 750 rpm with a line current of 80 A from the 230-V mains. Its armature-circuit resistance is 0.14 Ω ⋅ and its field resistance is 0.11 Ω. Assuming that the flux corresponding to a current of 20 A is 40 % of that corresponding to a current of 80 A, find the motor speed at a line current of 20 A at 230 V.

A Zulu
04/06/2015

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ASSIGNMENT 7: THREE PHASE POWER SYSTEMS (*Due Friday 11 June 2015*)

1.
Three similar coils, each of resistance 10 Ω and reactance 10 Ω, are connected
(a) in star
(b) in delta
across a 400-V, 3-phase supply. Find in each case,
(i) the line current; and
(ii) the sum of the readings of the two wattmeters connected to measure the power.

2.
(a) A balanced 3-phase load has power factor of 0.447 lagging. Two wattmeters are connected to measure the power input to this load which is known to be 20 kW. Find the readings of the instruments.

(b) Each of the two wattmeters connected to measure the power input to a 3-phase circuit reads 10 kW on balanced load when the power factor is unity. What does each instrument read when the power factor falls to

(i) 0.866 lagging;
(ii) 0.5 lagging,
the total three phase power remaining unaltered?

3.
Three coils, each having a resistance of 20 Ω and a reactance of 15 Ω, are connected in star to a 415-V, 3-phase, 50-Hz supply. Calculate the
(a) line current;
(b) active power supplied; and
(c) power factor.

If three identical capacitors are connected in delta to the same supply so as to form a parallel network with the above coils, calculate the

(d) capacitance of each capacitor to obtain a resultant power factor of 0.95 lagging and
(e) the line current taken by the combined circuits.

A Zulu
04/06/2015