Date: _____

Name: _____ Partners Approval: _____

Name _____ Partners Approval: _____

EE 114 Power Engineering - I
Assignment 05

- **Question 1:** A straight wire of length 0.5 m moves at right angle to its length at 40 m/sec in a uniform magnetic flux of density 2 Wb/m^2. The field is directed perpendicular to the conductor. Calculate the e.m.f. induced in the conductor when the direction of motion is a) perpendicular to the field, b) induced at 30^o to the direction of field.

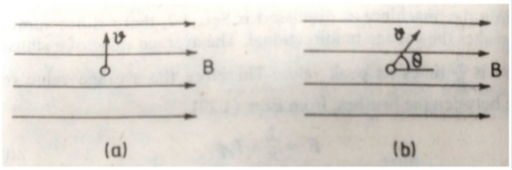

Figure 1

- **Question 2:** A square coil of 0.1 m side with 200 turns is rotated at a speed of 1000 rpm around an axis perpendicular to a uniform field of flux density 0.5 Wb/m^2. Calculate the induced e.m.f. at the instant when the plane of the coil is a) at right angle to the field, b) at 30^o to the field and c) in the plane of the field.

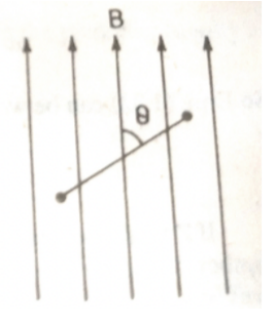

Figure 2

- **Question 3:** A circular coil of 100 turns with a mean diameter of 0.3 m is rotated about a vertical axis in the earth's field at 900 rpm. Calculate the instantaneous value of the e.m.f. induced in the coil when the plane is (a) perpendicular to, (b) inclined at 30^o to, (c) coincident with the magnetic meridian. Given H=15 A/m.

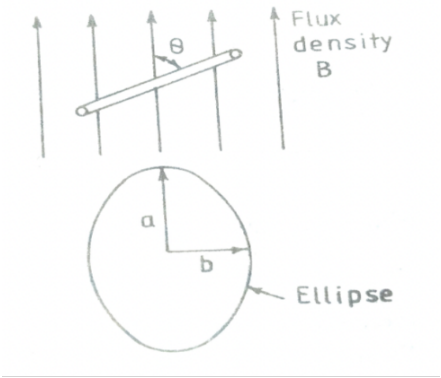

Figure 3

- **Question 4:** The simple loop is rotating in a uniform magnetic field shown in Figure 4 has the following characteristics:
  B =1.0 T to the right r = 0.1 m
  l =0.3 m $w_m = 377\ rad/sec$
  (a) Calculate the voltage $e_{tot}(t)$ induced in this rotating loop. (b) What is the frequency of the voltage produced in this loop? (c) Suppose that a 10 Ω resistor is connected as a load across the terminals of the loop. Calculate the current that would flow through the resistor. (d) Calculate the magnitude and direction of the induced torque on the loop for the conditions in (c). (e) Calculate the instantaneous and average electric power being generated by the loop for the conditions in (c). (f) Calculate the mechanical power being consumed by the loop for the conditions in (c). How does this number compare to the amount of electric power being generated by the loop?

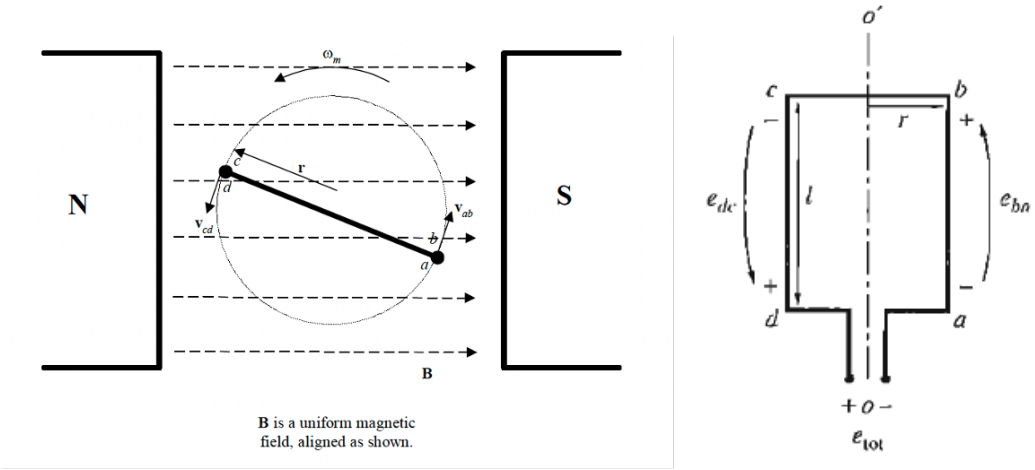

Figure 4: Front view and Coil view

- **Question 5:** If the AC power system is having a frequency of 133 Hz, which is produced by 4-pole generator. Calculate the speed to the shaft.

- **Question 6:** A nonmagnetic rotor as shown in Fig. 5 having two coils is placed in a uniform magnetic field of magnitude B_o. The coil sides are of radius R and are uniformly spaced

around the rotor surface. The first coil is carrying a current I_1 and the second coil is carrying a current I_2.
Assuming that the rotor is 0.32 m long, R = 0.13 m, and $B_0 = 0.87$ T, find the θ-directed torque as a function of rotor position α for (a) $I_1 = 0A$ and $I_2 = 8A$ (b) $I_1 = 5A$ and $I_2 = 0A$ (c) $I_1 = 8A$ and $I_2 = 8A$

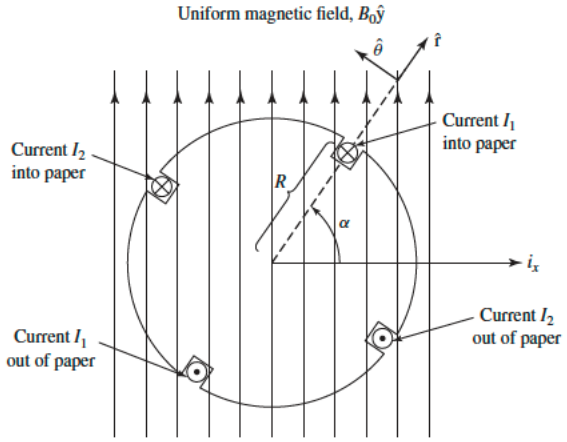

Figure 5

- **Question 7:** An inductor has an inductance which is found experimentally to be of the form

$$L = 2L_o/(1 + x/x_o)$$

where L_o= 70 mH, x_o = 1.20 mm, and x is the displacement of a movable element. Its winding resistance is measured and found to equal 135 $m\Omega$.
a) The displacement x is held constant at 1.30 mm, and the current is increased from 0 to 7.0 A. Find the resultant magnetic stored energy in the inductor.
b) The current is then held constant at 7.0 A, and the displacement is increased to 2.5 mm. Find the corresponding change in magnetic stored energy.

- **Question 8:** An RL circuit is connected to a battery, as shown in Fig. 6. Switch S is initially closed and is opened at time t = 0.
a. Find the inductor current $i_L(t)$ for $t \geq 0$. (Hint: Note that while the switch is closed, the diode is reverse-biased and can be assumed to be an open circuit. Immediately after the switch is opened, the diode becomes forward-biased and can be assumed to be a short circuit.)
b. What are the initial and final ($t = \infty$) values of the stored energy in the inductor? What is the energy stored in the inductor as a function of time?
c. What is the power dissipated in the resistor as a function of time? What is the total energy dissipated in the resistor?

- **Question 9:** A 45-kVA, $120V/280V$ single-phase transformer is to be connected as a $280V/400V$ autotransformer. Determine the voltage ratings of the high- and low-voltage windings for this connection and the kVA rating of the autotransformer connection.

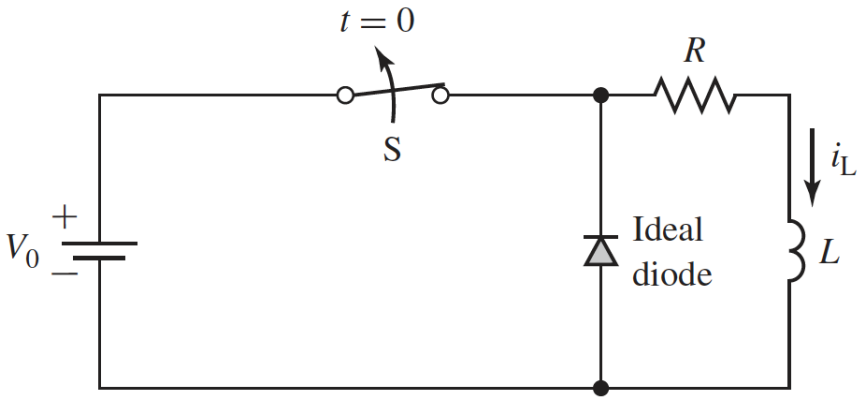

Figure 6