Information Technology University, Lahore

Electrical Machines

BSEE-19 Fall 2021

Assignment No. 3

CLO-2

Issue Date: Monday Nov. 1, 2021

Due Date: Tuesday Nov. 9, 2021 (Upload on Google classroom before 5:00 pm)

CLO1: Understand fundamental theories and laws on magnetics & magnetically coupled circuits.

CLO2: Understand the operation of Transformers, synchronous machines, induction motors and DC machines.

CLO3: Perform the equivalent circuit Analysis of transformers, AC Machines and DC machines.

Carefully Read Instructions

1. Please review the University Plagiarism Policy.
2. Late submission will not be accepted.
3. Assignment should be upload as pdf file.
4. The name of file should be your Roll Number as BSEEXXXX.
5. Handwriting must be very neat and legible. You may lose points otherwise.
6. Please submit your own work only.
7. Please show all steps for full credit.

Question no.1 Figure 1.1 shows a one-line diagram of a power system consisting of a three-phase 480-V 60-Hz generator supplying two loads through a transmission line with a pair of transformers at either end.

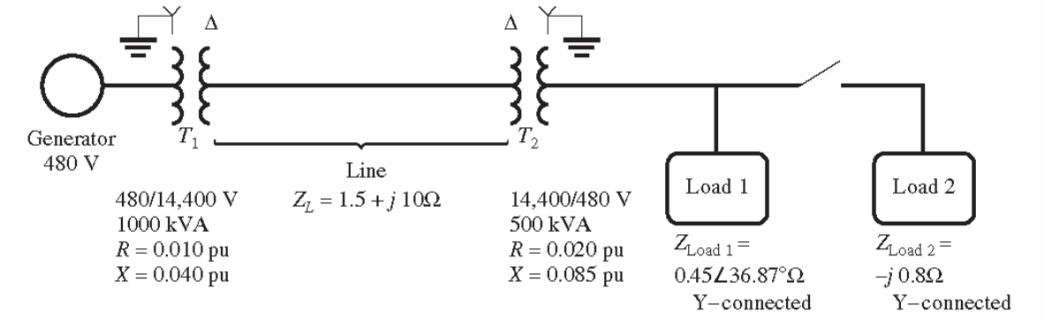

Figure1.1

a) Sketch the per-phase equivalent circuit of this power system.

b) With the switch opened, find the real power P, reactive power Q, and apparent power S supplied by the generator. What is the power factor of the generator?
c) With the switch closed, find the real power P, reactive power Q, and apparent power S supplied by the generator. What is the power factor of the generator?
d) What are the transmission losses (transformer plus transmission line losses) in this system with the switch open? With the switch closed? What is the effect of adding Load 2 to the system?

Question no 2 The following information is given about the simple rotating loop shown in Figure 1.2.

B = 0.4 T	V_B = 48V
l = 0.5 m	R = 0.4 Ω
r = 0.25 m	ω = 500 rad/s

a) Is this machine operating as a motor or a generator? Explain.
b) What is the current i flowing into or out of the machine? What is the power flowing into or out of the machine?
c) If the speed of the rotor were changed to 550 rad/s, what would happen to the current flow into or out of the machine?
d) If the speed of the rotor were changed to 450 rad/s, what would happen to the current flow into or out of the machine?

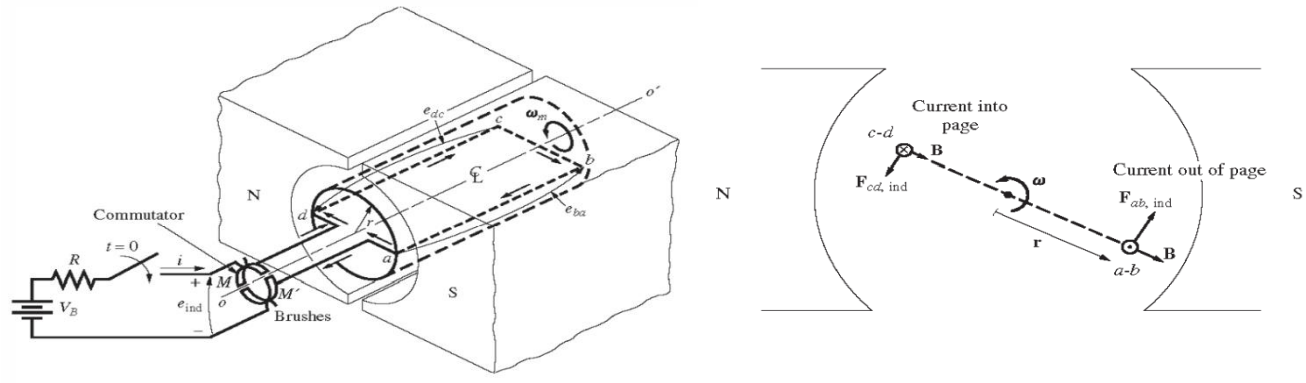

Figure 1.2

Question no 3

1. An eight-pole, 25-kW, 120-V dc generator has a duplex lap-wound armature which has 64 coils with 10 turns per coil. Its rated speed is 3600 r/min.
    a) How much flux per pole is required to produce the rated voltage in this generator at no-load conditions?
    b) What is the current per path in the armature of this generator at the rated load?

c) What is the induced torque in this machine at the rated load?
d) How many brushes must this motor have? How wide must each one be?
e) If the resistance of this winding is 0.011 Ω per turn, what is the armature resistance R_A of this machine?

2. A dc machine has 8 poles and a rated current of 120 A. How much current will flow in each path at rated conditions if the armature is
   a) simplex lap-wound
   b) duplex lap-wound
   c) simplex wave-wound?

Question no 4

1. Figure 1.3 shows a small two-pole dc motor with eight rotor coils and 10 turns per coil. The flux per pole in this machine is 0.006 Wb.

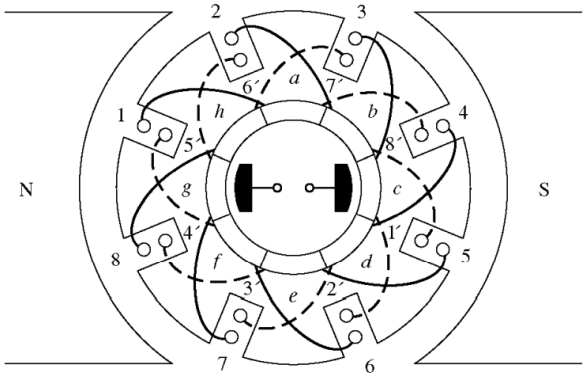

Figure 1.3

   a) If this motor is connected to a 12-V dc car battery, what will the no-load speed of the motor be?
   b) If the positive terminal of the battery is connected to the rightmost brush on the motor, which way will it rotate?
   c) If this motor is loaded down so that it consumes 600 W from the battery, what will the induced torque of the motor be? (Ignore any internal resistance in the motor.)

2. How many parallel current paths will there be in the armature of a 20-pole machine if the armature is
   a) simplex lap-wound
   b) duplex wave-wound
   c) triplex lap-wound
   d) quadruplex wave-wound