Uva Wellassa University, Sri Lanka
End Semester Examination – June/July 2010
SCT 369-2 Electric Power and Machines

Time: Two (02) hours

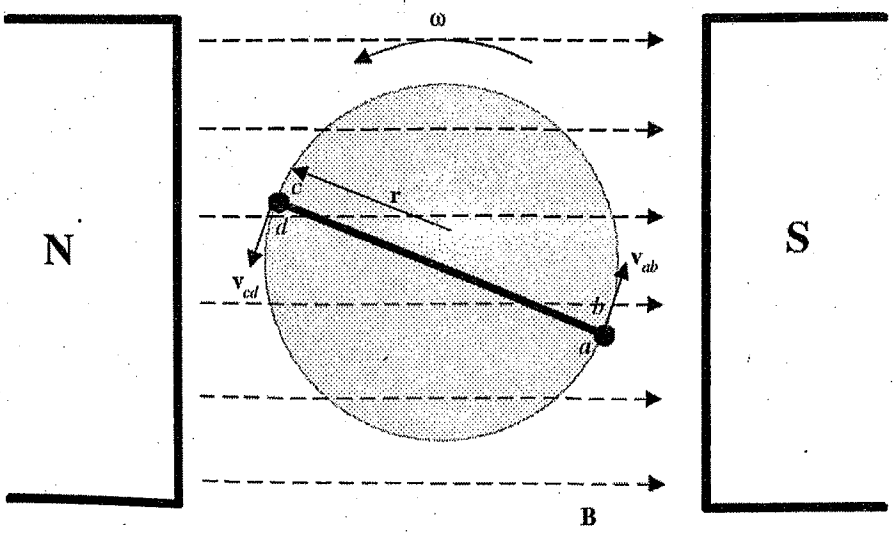
Total 04 Questions
Answer **all** questions
All questions carry equal marks

01)

The simple loop is rotating in a uniform magnetic field shown in Figure 1 has the following characteristics:

B = 0.5 T to the right $r = 0.1$ m

$l = 0.5$ m $\omega = 103$ rad/s



B= Magnetic flux density
ω= Angular Velocity of the loop

Figure 1

I. Prove that voltage induced in loop is $E_{ind} = 2rlB\omega Sin(\omega t)$.

(15 marks)

II. Calculate the voltage e (t) induced in this rotating loop.

(10 marks)

15

III. Suppose that a 5 Ω resistor is connected as a load across the terminals of the loop. Calculate the current that would flow through the resistor.

(10 marks)

IV. Prove that induced torque in the loop is $T(t) = 2rilBSin(\omega t)$

(15 marks)

V. Calculate the magnitude and direction of the induced torque on the loop.

(15 marks)

VI. Calculate the electric power being generated by the loop.

(15 marks)

VII. Calculate the mechanical power being consumed by the loop for the above conditions. How does this number compare to the amount of electric power being generated by the loop?

(20marks)

02)

I. What is armature reaction and explain how it can be minimized in a real DC Machine.

(15 marks)

II. Explain the difference between the Lap winding and Wave winding.

(15 marks)

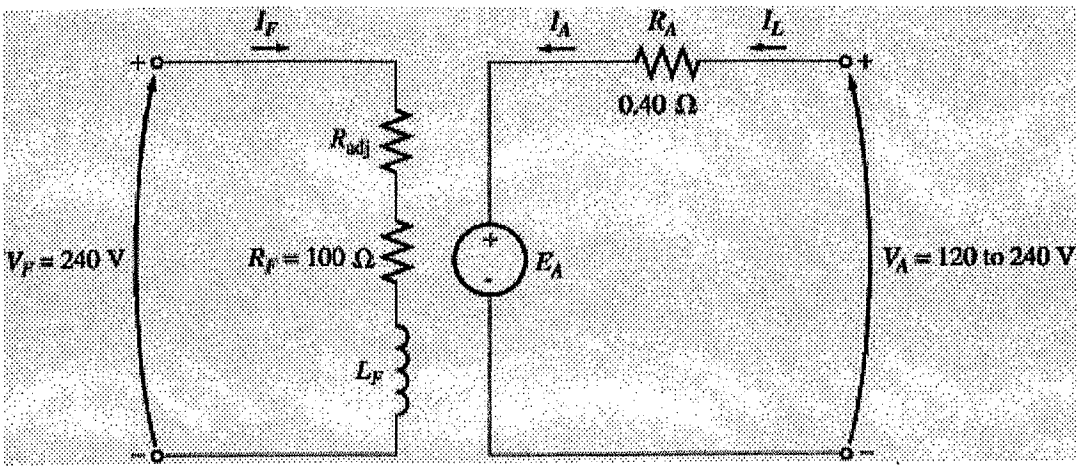
III. What are the common speed control methods used by a Separately Excited DC Motor.

(15 marks)

IV. Draw the equivalent circuit of a Separately Excited DC Motor with standard notation.

(15 marks)

V. Following figure shows the equivalent circuit of the Separately Excited DC Motor.



VI. What is the no-load speed of this separately excited motor when $R_{adj} = 175\ \Omega$ and

(a) $V_A = 120$ V

(b) $V_A = 180$ V

(c) $V_A = 240$ V

(40 marks)

03)

I. Explain how a rotating magnetic field is generated in an AC machine.

(20 marks)

II. Explain how induction torque is generated in an induction motor.

(20 marks)

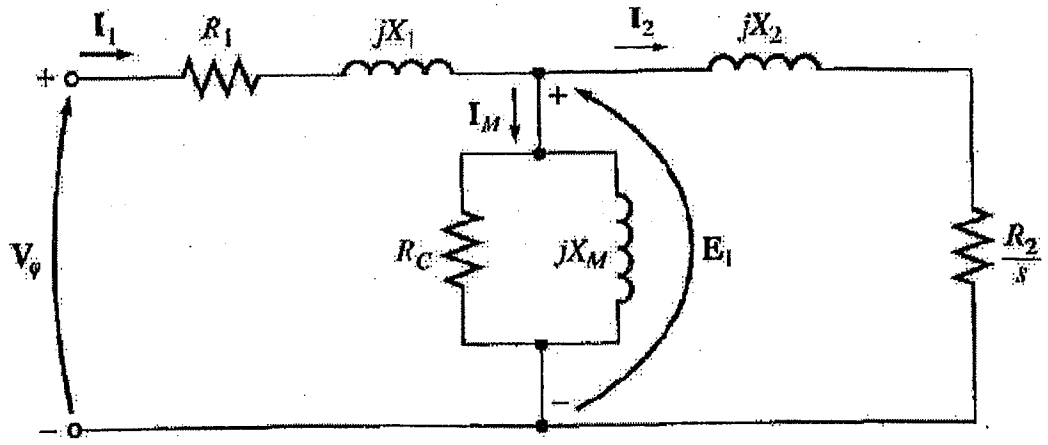
III. Draw the transformer model of an induction motor and in standard notation and name each component of the model.

(25 marks)

IV. A 460V, 25hp, 60Hz, 4 pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator circuit.

$R_1 = 0.641\ \Omega$ $R_2 = 0.332\ \Omega$
$X_1 = 1.106\ \Omega$ $X_2 = 0.464\ \Omega$ $X_m = 26.3\ \Omega$

15



The total rotational losses are 1100W and are assumed to be constant. The core loss is lumped in with the rotational losses. For a rotor slip of 2.2% at the rated voltage and rated frequency, find the motor's

(a) Speed

(5 marks)

(b) Stator Current

(5 marks)

(c) Power Factor

(5 marks)

(d) Converted power(P_{conv}) and output power (P_{out})

(5 marks)

(e) The induced torque τ_{ind}

(5 marks)

(f) The load torque τ_{load}

(5 marks)

(g) The overall machine efficiency

(5 marks)

04)

I. What are the main differences between an ideal transformer and a real transformer?

(20 marks)

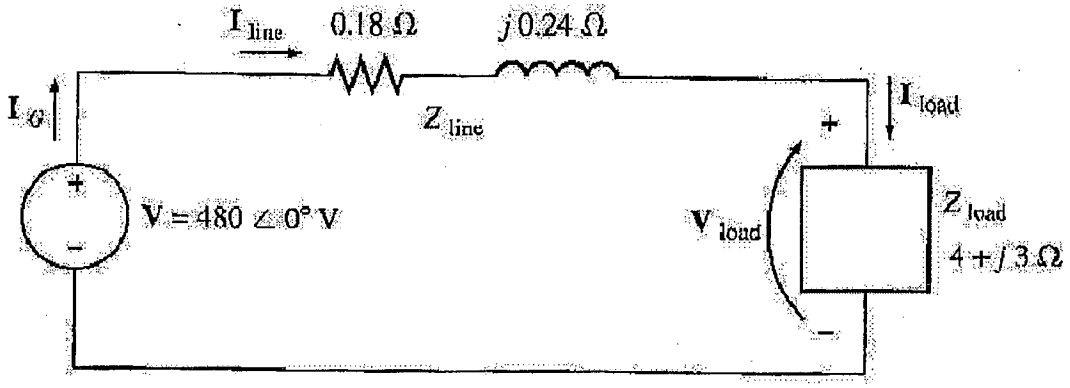
II. Draw the equivalent circuit model of a Transformer and explain how major power losses are modeled in the equivalent circuit.

(15 marks)

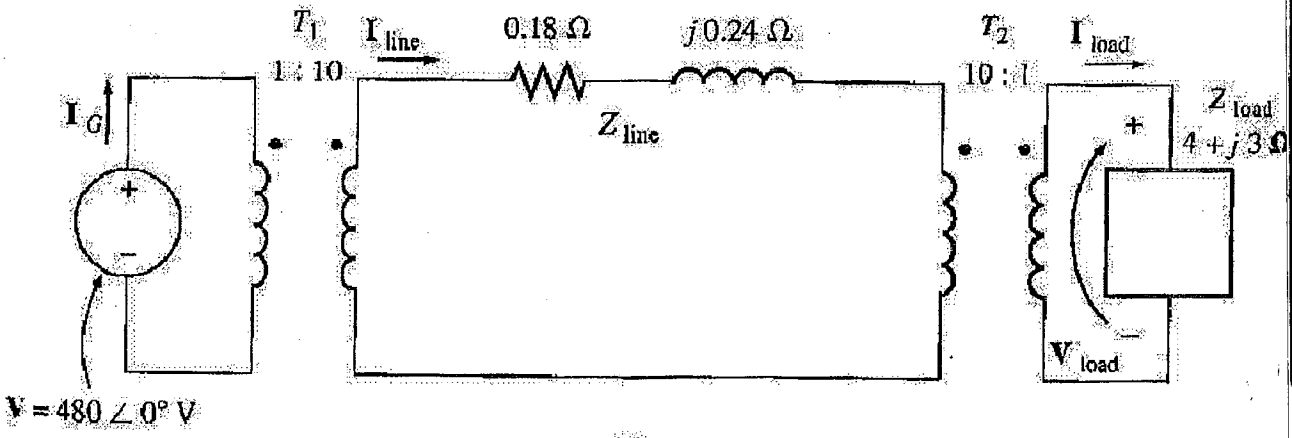
III. Explain the reason why even when the output of the transformer is open circuit, there still current flows in the primary winding.

(15 marks)

IV. A generator rated at 480V, 60 Hz is connected a transmission line with an impedance of 0.18+j0.24Ω. At the end of the transmission line there is a load of 4+j3Ω.



(a)



(b)

(a) If the power system is exactly as described above in Figure (a), what will the voltage at the load be? What will the transmission line losses be?

(20marks)

(b) Suppose a 1:10 step-up transformer is placed at the generator end of the transmission line and a 10:1 step-down transformer is placed at the load end of the line (Figure (b)). What will the load voltage be now? What will the transmission line losses be now?

(30marks)