King Fahd University of Petroleum & Minerals

Electrical Engineering Department

EE 360, Electric Energy Engineering

FINAL EXAM

First Semester (071)

Date	Tuesday, January 22, 2008
Time	7:30 AM to 10:00 AM
Location	Bldg. 10

Student Name	
ID #	
Section #	
Serial #	
Question # 1	**/20**
Question # 2	**/20**
Question # 3	**/20**
Question # 4	**/20**
Question # 5	**/20**
TOTAL	**/100**

Question # 1

A) A 25 KVA, 2400/240, 60 Hz single-phase distribution transformer was tested for open and short circuit test.

	Voltage (V)	Current (A)	Power (W)
Open Circuit	**240**	**3.2**	**165**
Short circuit	**55**	**10.4**	**375**

1) Calculate the equivalent circuit parameters referred to the primary side.

2) Draw the equivalent circuit referred to primary showing all variables and parameters.

3) Find the voltage regulation and efficiency of the transformer when it is delivering 75% of its full rating at 0.85 power factor lagging on the low voltage side.

4) Draw the phasor diagram.

B) Three single-phase transformers, each one is rated at 25 KVA, 2400/240, 60 Hz are now connected to form a three-phase transformer. Determine the rating and the line to line voltage ratio for each connection option in the table below by putting a Circle on the right choice

Three phase connection	**Y : Y**	**Y : △**	**△ : Y**	**△ : △**
Three phase rating (KVA)	a: 25	a: 75	a: 100	a: 50
	b: 50	b: 50	b: 125	b: 75
	c: 75	c: 25	c: 75	c: 125
Line to line voltage ratio	a: 4157/240	a: 4157/415.7	a: 2400/240	a: 2400/240
	b: 4157/415.7	b: 2400/415.7	b: 1386/415.7	b: 1386/138.6
	c: 2400/415.7	c: 4157/240	c: 2400/415.7	c: 4157/240

Question # 2

A 4-pole, 200 V, DC shunt generator supplies two loads: Load A consists of five motors each one draws 40 A, and Load B consists of seventy-five lighting lambs each lam consums 100 W. The generator shunt field resistance is 80 Ohm, and its armature resistance is 0.04 Ohm. If the rotational loss is 4300 W, find out the efficiency of this machine.

Question # 3

A three phase, 200 hp, 2400 V, 60 Hz, 4 pole, Y connected synchronous motor has a reactance of 12 Ω/phase and a negligible armature resistance. The motor draws 150 kW at a power angle of 18^0. Draw the equivalent circuit and Determine

a) The synchronous speed of the motor in rpm.
b) The excitation voltage E.
c) The line current and the motor power factor.
d) The pull-out torque.
e) if the excitation of the motor is changed to have minimum armature current while maintaining constant input power find the new armature current, the power factor and the excitation voltage.

Question # 4

A 3-phase, Y-connected, 440-V, 20 kW, 50 Hz, 1450 rpm wound rotor induction motor has the following parameters in ohms:

$R_1 = 0.25\ \Omega$ $X_1 = 1.0\ \Omega$ $X_m = 30\ \Omega$
$R_2 = 0.20\ \Omega$ $X_2 = 0.8\ \Omega$

Where R_2 and X2 are referred to the stator.

The total friction, windage and core losses may be assumed to be constant at 1000 W, independent of load. Determine:

(a) Draw the approximated equivalent circuit.
(b) The full-load developed torque
(c) The maximum developed torque and the corresponding speed.
(d) The starting torque.
(e) How much resistance must be inserted in the rotor circuit to bring the motor speed at maximum torque down to 1250 rpm?

Question # 5

A 140 km 220 kV transmission line has the following parameters expressed per unit length:

Series Resistance	r = 0.12 Ohms/km
Series Reactance	x= 0.88 Ohms/km
Shunt admittance	y= 4.1×10^{-6} S /Km.

The line delivers a load of 150 MVA at a voltage of 210 kV and 0.85 power factor lagging. Use the π model of the transmission line to calculate:

(i) The sending end voltage and current
(ii) The line sending end power factor
(iii) The line efficiency
(iv) The voltage regulation of the line.