UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

MAIN EXAMINATION MAY 2014

TITLE OF PAPER:	FUNDAMENTAL OF **ELECTRICAL POWER ENGINEERING**
COURSE CODE:	**EE351**
TIME ALLOWED:	**THREE** HOURS

INSTRUCTIONS:

1. Answer **all five** questions
2. Marks for different sections are shown in the right-hand margin.

This paper has 3 pages including this page.

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Question 1

a) State three kinds of accidents which appear too frequently among electrical students and technicians, and then for each kind stated, write down one rule for safe practice and to avoid the accident. (6 marks)

b) With reference to facility charges and tariffs structure and without quoting figures, explain how electricity is priced in Swaziland. (10 marks)

c) State three main applications of high-voltage direct current transmission. (3 marks)

Question 2

a) An unbalanced delta-connected load shown in Figure 2a is connected to a balanced 400-V three phase source, sequence *abc*. The impedances (in ohms) are

$\widehat{Z_{ab}} = 5 + j8.66; \quad \widehat{Z_{bc}} = 5 - j8.66; \quad \widehat{Z_{ca}} = 5 + j8.66$

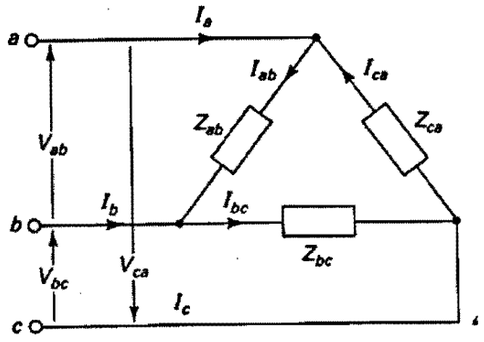

Figure 2a

Determine

i) the phase currents, (4 marks)

ii) line currents, and (6 marks)

iii) the total power dissipated in the load. (3 marks)

b) Figure 2b shows a single-line diagram of a 13.8kV primary feeder supplying power to a load at the end of the feeder. A shunt capacitor bank is located at the load bus. Assume that the voltage at the sending end of the feeder is 5% above rated and the load is **wye**-connected with $R_{load} = 20\ \Omega$ per phase in parallel with load $jX_{load} = j40\ \Omega$ per phase. With the shunt capacitor bank out of service. Calculate the following:

i. the line current (4 marks)

ii. the voltage drop across the line (3 marks)

iii. the three phase load voltage (3 marks)

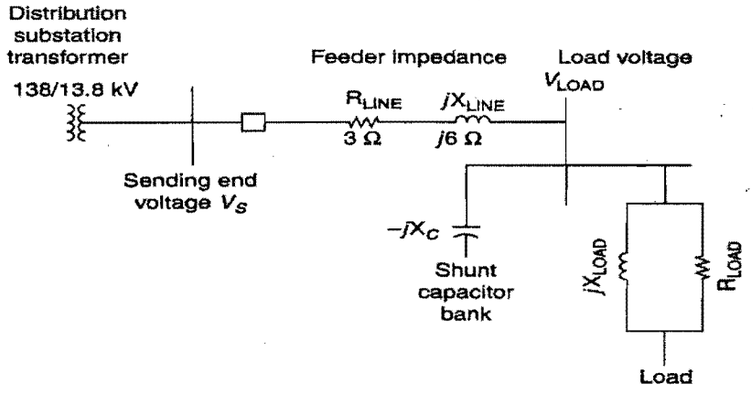

Figure 2b

Question 3

a) A balanced load of (4 + j3) ohm per phase is connected in wye (star) to a balanced 400-V three phase source, sequence *abc*.

Determine

i. the phase currents, (4 marks)
ii. the phase voltages, and (4 marks)
iii. the reactive power per phase . (3 marks)

b) A three-phase, 11- kV, 50-Hz, 20-MVA, delta –connected, cylindrical rotor synchronous generator has a synchronous reactance of 2 ohm per phase and armature resistance of 0.1 ohm per phase. Determine the phasor representation of the armature current per phase and the power angle when it delivers rated load at 11kV and 0.8 leading power factor. (8 marks)

Question 4

a) State three basic functions of a power transmission system. (3 marks)

b) State three types of induction motors and how the excitation of induction motors is provided. (6 marks)

c) Sketch a circuit model of an induction motor referred to stator and then properly label the voltages, currents, and all circuit components. (12 marks)

Question 5

A single phase two-winding 400/230-V, 50 -Hz, 15-kVA transformer is used as step down transformer. The load which is connected to the 230-V secondary absorbs 12 kVA at 0.85 power factor lagging when the load voltage is 220-V. Assume that the transformer is ideal and calculate the following:

a. The voltage across the 400-V winding. (5 marks)
b. The load impedance. (6 marks)
c. The load impedance referred to the 400-V winding. (3 marks)
d. The real and reactive power supplied to the 400-V winding. (4 marks)