THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Engineering & Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR DEGREE IN BACHELOR OF ENGINEERING IN ELECTRICAL & ELECTRONIC ENGINEERING
[Institutional Based Programmes)

EEE 4406: POWER SYSTEMS I

END OF SEMESTER EXAMIANTION
SERIES: AUGUST 2012
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*

This paper consists of **FIVE** questions in **TWO** sections **I** & **II**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

SECTION I (COMPULSORY)

Question One (30 marks)

a) State any **THREE** advantages of per unit systems. **(3 marks)**

b) Show the conversion of one base to another using the per-unit system. **(3 marks)**

c) A portion of a power system consists of two generators in parallel connected to step up transformer that links them with a transmission line. The line is connected to a step down transformer which supplies a 25KVA @0.8p.f lagging motor for large water treatment plant. The ratings of these components are:
- Generators G1 10KVA, 2.5KV, 0.2 per unit
- Generators G2 20KVA, 2.5KV, 0.3 per unit
- Transformer T1 40KVA, 2.5/8KV, 0.1 per unit

- Transmission line (50 + j 200) ohms.

i) Draw a impedance diagram for the system expressing all values as per unit values.
ii) Calculate the actual amount of current flowing in the transmission une and the motor.
(14 marks)

d) (i) Draw a phasor diagram showing the voltage current relationship for a short transmission line.

(ii) A 10KM long, single-phase short transmission line has $0.5160^{o}\ \Omega$ per Km impendence. The line supplies a 316.8KW load at 0.8 power factor lagging. Determine the voltage regulation if the receiving-end voltage is 3.3KV. **(10 marks)**

SECTION II (Answer any TWO question from this section)

Question Two (20 marks)

a) A transmission-line cable consists of 19 strands of identical conductors, each 1.5mm in diameter. The length of the cable is 2km but, because of twist of the strands, the actual length of each conductor is increased by 5%. If the resistivity of copper is $1.72 \times 10^{-8}\ \Omega^{-}m$. Determine the resistance of the cable. **(3 marks)**

b) A double circuit, three phase, transposed transmission line is shown in figure 1. The radius of each conductor is 1.25cm. Calculate the inductance per kilometer per phase. **(10 marks)**

a

c) Determine the capacitance to neutral of the line of question 2(b) **(7 marks)**

Question Three (20 marks)

a) Explain the following with respect to transmission lines.
i) Surge Impendance Loading (SIL)
ii) Ferranti Effect **(4 marks)**

b) A balanced 3-phase, 50Hz load of 30MW is supplied by means of a transmission line. The series impendence of a single conductor is (20 +j52) Ω and the total phase-neutral admittance is 315 x 10-6 siemen. Using nominal T-method, calculate:

i) The ABCD constant of the line
ii) Sending end voltage
iii) Regulation of the line **(16 marks)**

Question Four (20 marks)

a) With the aid of circuit and waveform diagrams, describe the principle of operation and compare their output waveforms for the following three phase rectifiers.
   i) Half wave
   ii) Full wave
   iii) Show analytically the magnitude of the output voltage for EACH case. **(14 marks)**

b) (i) With the aid of a diagram, describe the traction substation used for electric trains.
(ii) Explain how the substation in b(i) above differs from the conventional substation.
(6 marks)

Question Five (20 marks)

a) Explain the following reactive compensation techniques
   i) Series compensation
   ii) Parallel compensation **(4 marks)**

b) A three phase 765KV, 60Hz, 300km, completely transposed line has the following positive sequence impendance and admittance.

$Z = 0.0165 + \int 0.3306 = 0.3310\ 87.14^{o}\ \Omega / km\ \ Y = \int 4.674 \times 10^{-6}\ S / KM$

Assuming a positive sequence operation, calculate using equivalent π the ABCD parameters of the line. **(16 marks)**