THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

YR 1 SEM II

EEE 2514: POWER SYSTEM ANALYSIS II

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

This paper consists of **FIVE** questions

- *Answer Booklet*

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Marks are indicated for each part of the question

This paper consists of **TWO** printed pages

Question One

a) State and briefly explain any **FOUR** inequality constraints under which a modern power system operates (6 marks)

b) Briefly explain the term 'incremental fuel rate' and 'incremental efficiency'. Hence, discuss why merit order scheduling, though seemingly an attractive solution to the economic dispatch problem is not practical (6 marks)

c) Give **FOUR** reasons why it is important to keep strict limits on power system frequency variations (4 marks)

d) Explain how tie-line loads can be used for frequency regulation in a large interconnected power system (5 marks)

e) Discuss the **THREE** main difficulties associated with reactive power transmission (9 marks)

Question Two

a) With the aid of a block diagram, describe the components of the automatic control system used for load dispatching (10 marks)

b) Two generating stations A and B have full load capacities of 600MW and 350 MW respectively. The interconnector connecting the two stations has a motor-generator (plant C) near station A of full load capacity 100MW. Percent changes of speeds of A, B and C are 5, 4 MW respectively. Determine the load taken by set C and indicate the direction in which the energy is flowing (10 marks)

Question Three

a) Give any **TWO** definitions of the concept of 'voltage stability' of a power system (4 marks)

b) Briefly explain the relationship between voltage stability and rotor angle stability (4 marks)

c) The fuel inputs to two plants are given by:

(i) $F_1 = 0.013P^2_1 + 22P_1 + 35$

(ii) $F_2 = 0.02P^2_2 + 25P_2 + 30$

The minimum and maximum loads on each unit are as follows:

Unit 1: Minimum load 5MW and maximum load 200MW.
Unit 2: Minimum load 15MW and maximum load 80MW.

Determine the incremental fuel cost and the allocation of load between units for minimum costs when the loads are

(i) 150 MW
(ii) 220 MW (12 marks)

Question Four

a) Show that formulation of the economic dispatch problem neglecting losses indicates that the condition for optimum generation of a power system consisting of three generating units is

$$\frac{dF_1}{dP_1} = \frac{dF_2}{dP_2} = \frac{dF_3}{dP_3} = \lambda$$

.

Where F_n is the fuel input to the *n*th unit and, Pn is the generation of the *n*th and λ is the Lagrangian multiplier (10 marks)

b) The voltage stability problem of a power system is associated with reactive power transfer. Show that the reactive power flow depends mainly on the difference between the voltage magnitudes at the sending and receiving ends and that is flows from the higher voltage end to lower voltage end. (10 marks)