INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR OF ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 3/SEMESTER 2

COURSE CODE: ELE3243

NAME: POWER SYSTEM II

DATE: 2025-04-23

TIME: 2:00-5:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Answer any two QUESTIONS FROM THIS SECTION

Question 1:

a) What is the impact of transmission losses on the optimal economic dispatch sol and how are they incorporated into the dispatch calculations? (6marks

b) How is the penalty factor method used to account for transmission losses in eco dispatch problems? (7marks

c) What is the role of the B-coefficients in modeling transmission losses for econo dispatch, and how are they determined? (7marks

Question 2:

a) What are unsymmetrical faults in power systems? List and briefly describe the main types of unsymmetrical faults. (6marks)

b) How are sequence networks used to analyze unsymmetrical faults? Explain the sequence network connections for a single line-to-ground fault. (7marks

c) Describe the process of calculating fault currents in an unsymmetrical fault usi symmetrical components. How do these currents affect system stability and equipment? (7marks

Question 3:

a) How does a fault affect the internal voltage of a synchronous machine, and wha factors influence the magnitude of this change? (6marks)

b) What is the relationship between the pre-fault, during-fault, and post-fault intern voltage of a loaded machine in transient stability analysis? (7marks)

c) How are equivalent circuit models used to analyze the internal voltage behavior synchronous machine under fault conditions? (7marks)

Question 4:

a) What is a sequence network in power systems, and why is it used for analyzing unbalanced faults? (6marks)
b) Explain the three types of sequence components in sequence networks: positive negative, and zero sequences. How do these components help in fault analysis? (7marks)
c) Describe how sequence networks are connected for different types of faults (e.g. single line-to-ground, line-to-line, and three-phase faults). What role do these networks play in determining fault currents? (7marks)

Section B Answer any Three QUESTIONS from this SECTION

Question 1:

a) Describe at least three techniques used to enhance the stability of power systems. (6
b) Explain the function of automatic voltage regulators (AVRs) and power system stabilizers (PSS) in improving stability. (7mark
c) Discuss the role of FACTS (Flexible AC Transmission Systems) devices in enhancing power system stability. (7mark

Question 2:

a) Define power system stability and explain its importance in electrical power networks. (7mark
b) Differentiate between steady-state, transient, and dynamic stability in power systems. (7mark
c) Discuss the impact of power system instability on grid operations and end-users.(6

Question 3:

a) Discuss the effect of increasing system inertia H on transient stability as analyzed u
the Equal Area Criterion. (6mark
b) Explain how fast-acting circuit breakers influence the critical clearing time and imp
system stability. (7mark
c) Discuss how the Equal Area Criterion helps in designing system improvements suc
FACTS devices, automatic voltage regulators (AVRs), and power system stabilizer
(PSS). (7mark

Question 4:

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a) Write the expression for the electrical power output of a synchronous generator connecte to an infinite bus: $Pe = P_{max} Sin\,\delta$ Explain how this equation helps in stability analys using the Equal Area Criterion. (6marks)

b) Illustrate and explain the areas A_1 (accelerating area) and A_2 (decelerating area) in a power-angle curve and their significance in transient stability. (7marks)

c) Derive the condition for stability based on the areas A_1 and A_2, and explain how a fault duration affects the critical clearing angle. (7marks)