



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

**FIRST YEAR SECOND SEMESTER EXAMINATION FOR MASTER OF
TECHNOLOGY**

EET 630 – POWER SYSTEM PROTECTION

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a. Healthy electrical systems call for their continuous surveillance to scale size abnormal conditions.
 - i. Explain any two outcomes of unhealthy electrical energy transmission. (4marks)
 - ii. Outline advantages enjoined to reactors controls with respect to protection of electrical systems. (3marks)
- b. Explain what constitutes a balanced symmetric fault in an electrical power system. (2marks)
- c. ..
 - i. Explain the reach with respect to protective relays.
 - ii. Discuss the negative effects of ... parameters to power system networks. (7marks)
- d. A distance relay is set to operate with a reach of 0.85 per unit. If a protected transmission line of 150km long had a complex fault parameter of $(0.1 + \dots/km)$, determine the distance reach in kilometres. (5marks)
- e. A power distribution system equipped with a distant carrier protection and a three-phase circuit rated at 11kv and 800A voltage and current respectively with a breaking capacity of KA. If the impedance between the circuit breaker and the protected section of the line was $0.3 + \dots$ hms, and the fault occurred at a distance of 30km from the circuit breaker, determine the ...

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a. With the aid of sequence networks, analyse the behaviour of currents and voltages during a balanced symmetrical fault. (3marks)
- b. Derive sequentially the expressions for fault currents and voltages in terms of impedances and system parameters. (8marks)
- c. An electrical system of 13.8Kv nominal voltage is connected to a synchronous generator rated at 100MVA with $[0.1 \dots]$ Per unit impedance on the 100MVA base. If the system was subjected to a balanced symmetrical fault through an impedance of $\dots = 0.05 + \dots$ Per unit determine the fault magnitude and angle at the point of fault. (9marks)

QUESTION THREE (20 MARKS)

A distance carrier aided protection was employed to protect transmission network lines from faults. The protection relay-to fault distance setting was provided at 80% of the line length, and set with a reach of 0.85 per unit.

- a. Calculate the maximum fault distance of the distant carrier aided protection. (4marks)
- b. Determine the reach of the distant relay in kilometres. (8marks)
- c. Discuss any four limitation and potential challenges associated with the distance carrier aided protection. (8marks)

QUESTION FOUR (20 MARKS)

- a. A power system is required to maintain stability and meet the demand of its clients. If the system consists of multiple generators transmission lines and loads. Discuss the role of computational techniques in the system operation and control. (5marks)
- b. Figure 2. Shows a generator supplying a load. If a load of 4mw requires the generation to be increased by 6mw and the incremental cost at the plant bus was required to be ks. 30/mwh, determine the incremental cost the receiving end. (6marks)