



No. of pages: 2

No. of questions: 4

Allowed Tables and Charts: (None)

Answer all the following Questions

Question (1)

[25 Marks]

- (a) Introduce a directional algorithm using the negative sequence current components. Illustrate the algorithm with the aid of phasor diagram for an example of power network. [8 Marks]
- (b) State types of fault current limiter and explain an example of each type? [7 Marks]
- (c) For high impedance open conductor fault case in the distribution network as shown in Figure 1, derive the fault detection algorithm for identifying the faulty phase when the downed conductor is at either the load side or at the source side. Sketch the fall time of the down conductor to aid you for the algorithm derivation. [10 Marks]

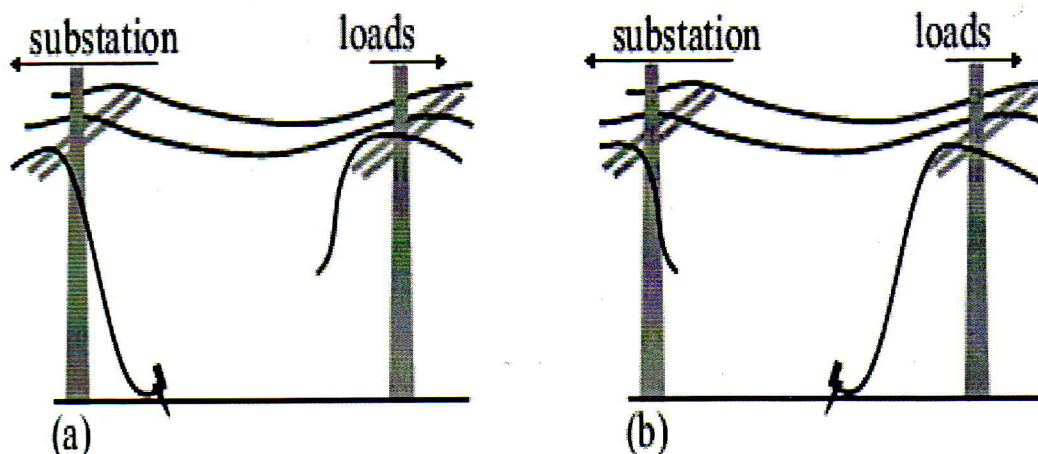


Figure 1. Down conductor: (a) source side, (b) load side.

Question (2)

[25 Marks]

- (a) After fault occurrence in the distribution network, introduce the control strategies utilized for multi-agent-based system restoration. [7 Marks]
- (b) Assume that there is a primary substation area contains: one primary substation, one backup primary substation and seven secondary substations installed on a feeder. If a fault occurred between secondary substations number 4 and 5: [10 Marks]
- Introduce a distributed agent-based decentralized control in order to implement an automated fault management process.
 - Explain the required agents. How many communication hops that will be utilized and compare with the centralized control.
- (c) Explain how the crowbar system used for protection of the doubly-feed induction generator (DFIG) in a wind farm. [8 Marks]

Question (3)

[28 Marks]

- (a) Declare an example of using DWT for extracting slop features of inrush currents for blocking the differential relay operation? **[7 Marks]**
- (b) Explain how the discrete computed active and reactive powers can be exploited to block distance protection system. **[7 Marks]**
- (c) Propose a power differential protection function with the aid of auto regression technique? **[7 Marks]**
- (d) Analytically, explain the impact of shunt FACTS devices on the distance protection of transmission lines. **[7 Marks]**

Question (4)

[22 Marks]

- (a) Derive an expression for fault location determination in distribution power systems using Apparent Impedance Approach. **[7 Marks]**
- (b) Present and define parameters of a frequency-based fault location algorithm for distribution network. **[5 Marks]**
- (c) Derive the traveling wave-based fault location using double end measurements. Present an improvement of the fault location equation to be independent of the travelling wave speed using: **[10 Marks]**
 - i- Three measuring points.
 - ii- Combining signal and double end travelling wave equations.

With our best wishes

This exam measures the following ILOs							
Skills	Knowledge & Understanding Skills		Intellectual Skills		Professional Skills	General skills	
	a1-1	a1-2	b3-1	b3-2	c1-1	d2-1	d7-2
Question Number	Q1-c, Q3	Q2-c	Q2	Q2, Q4	Q3	Q1, Q2	Q4