

ELL 400: Power System Protection
Indian Institute of Technology Delhi
Minor 1, Max Marks: 20, Time: 1 Hour
 Date: 06th February 2018

1. A system consisting of three buses and fed at single end is as shown in Figure 1.

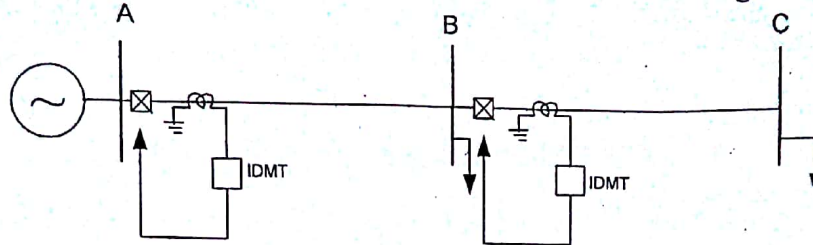


Figure 1

IDMT type relays are installed at both the buses. The CT ratio at bus B is 100:5 and that at bus A is 200:5. For both the relays, the operating characteristic is given as:

$$t_{op} = \frac{0.14(TMS)}{PSM^{0.02} - 1} \text{ sec}$$

The TMS for both the relays can be chosen between the range: 0.5, 1, 2, 3, 4, 5, 6.

The plug setting for both the relays is the continuous rating of CT secondary windings. The relation between the maximum fault current and the distance from the fed end (i.e., Bus A) is given as

$$I_{fault} = 50 - 0.1x, \text{ kA}$$

Where, x is the distance measured from feeding end in km. The total distance of the feeder is 200 km (from Bus A to Bus C), bus B being located at halfway.

By ignoring CB delays and relay overshoot time and with selective time interval of 0.5 sec, find out:

- (a) TMS for relay A, (4 Marks)
- (b) Time in seconds that relay A takes to provide trip signal for fault taking place near bus B in zone B-C, (2 Marks)
- (c) Time in seconds that relay A takes to provide trip signal for fault taking place near bus A in zone A-B. (2 Marks)

2. For a single phase transformer installed on a single end fed feeder, the percentage differential scheme is such that the through fault characteristics is given as

$$I_{spill} = 0.08x^2 + 0.1x$$

Where, $x = \frac{I_1 + I_2}{2}$ and I_1, I_2 indicate the currents in the circulating circuit.

Also, the percentage bias characteristic is given as

$$I_{spill} = 2 + 0.5x$$

Calculate the stability ratio of the differential scheme when

- (a) Bias is in place, (b) without bias, where pick-up of relay is set at 2 A.

(6 Marks)

3. Draw the phasor diagram of a electromechanical type directional relay. If MTA of this relay is 20 degrees

i. Define the range of trip zone with V_{pc} as a reference phasor (2 Marks)

ii. If resistance of pressure coil is 100 Ohm, what is its inductance for 50 Hz? (2 Marks)

4. What would be the choice for phase fault relay excitation quantities fed to a directional overcurrent relay for *phase b* for 30° and 60° connections? (2 Marks)

-----ALL THE BEST!-----