

Mid-Semester Examination
EE486: Power System Protection

- Q1) The performance of a distance relay was monitored over a period of 2 years. It was found that it operated 15 times, 12 were desired trips due to faults in its jurisdiction. It was found that relay failed to issue trip decision on 2 occasions. Compute dependability and security for the relay. [2]
- Q2) Design a CCVT for a 400 kV transmission line using the following data. Secondary resistive burden (3- ϕ) = 300VA. Core loss (3- ϕ) = 50W. Consider three choices of $V_2 = 3.3$ kV, 6.6 kV, and 11 kV. Take phase angle error $\beta = 40$ min. and standard VT secondary voltage = 110 V (L-L). [8]
- Q3) Derive the equation for fault current in (a) L-L fault and (b) L-L-G fault with fault impedance Z_f . [2+3]
- Q4) For the radial system shown in Fig. 1, calculate the instantaneous and time delay over current relay settings at each bus. Assume that the transformer must not be de-energized and that the relays at bus B are "looking into" a transformer differential and do not need to coordinate with it. Assume that any pickup tap is available, but use the relay characteristic of Fig. 3 (next page). [3+2]

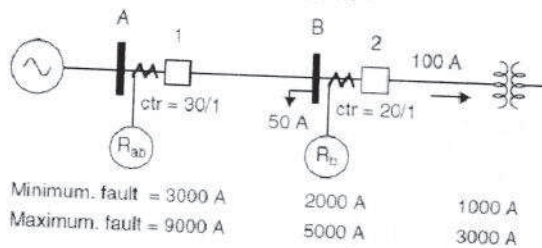


Fig. 1

- Q5) Considering the system given in Fig. 2, determine the coordination settings (TMS) for each relay considering IEC VI characteristics for one iteration, only. [10]

Table 1 : Fault Current seen by Primary - Back up Relay Pairs				
Remote Bus Fault at	Anti clockwise loop		Clockwise loop	
	Current seen by primary relay	Current seen by back up relay	Current seen by primary relay	Current seen by back up relay
F ₁	R ₂ (639A)	R ₁ (152A)	R ₆ (1365A)	R ₅ (272A)
F ₂	R ₁ (1652A)	R ₄ (391A)	R ₇ (868A)	R ₆ (240A)
F ₃	R ₄ (1097A)	R ₃ (140A)	R ₈ (1764A)	R ₇ (287A)
F ₄	R ₃ (937A)	R ₂ (142A)	R ₅ (553A)	R ₈ (197A)

For the relays in table 1, if the pick up values are as tabulated in table 2, find out the TMS.

Table 2 : Pick up Values of Relays								
Relay	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
Pick up setting (A)	60	80	60	160	80	160	128	100

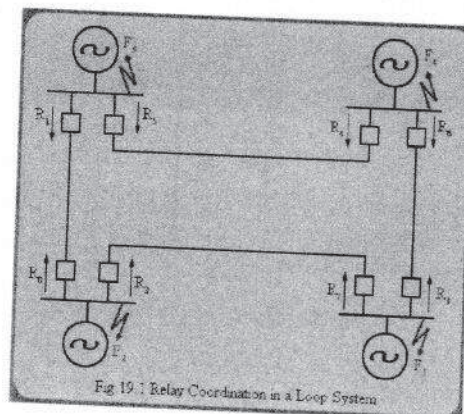


Fig. 2

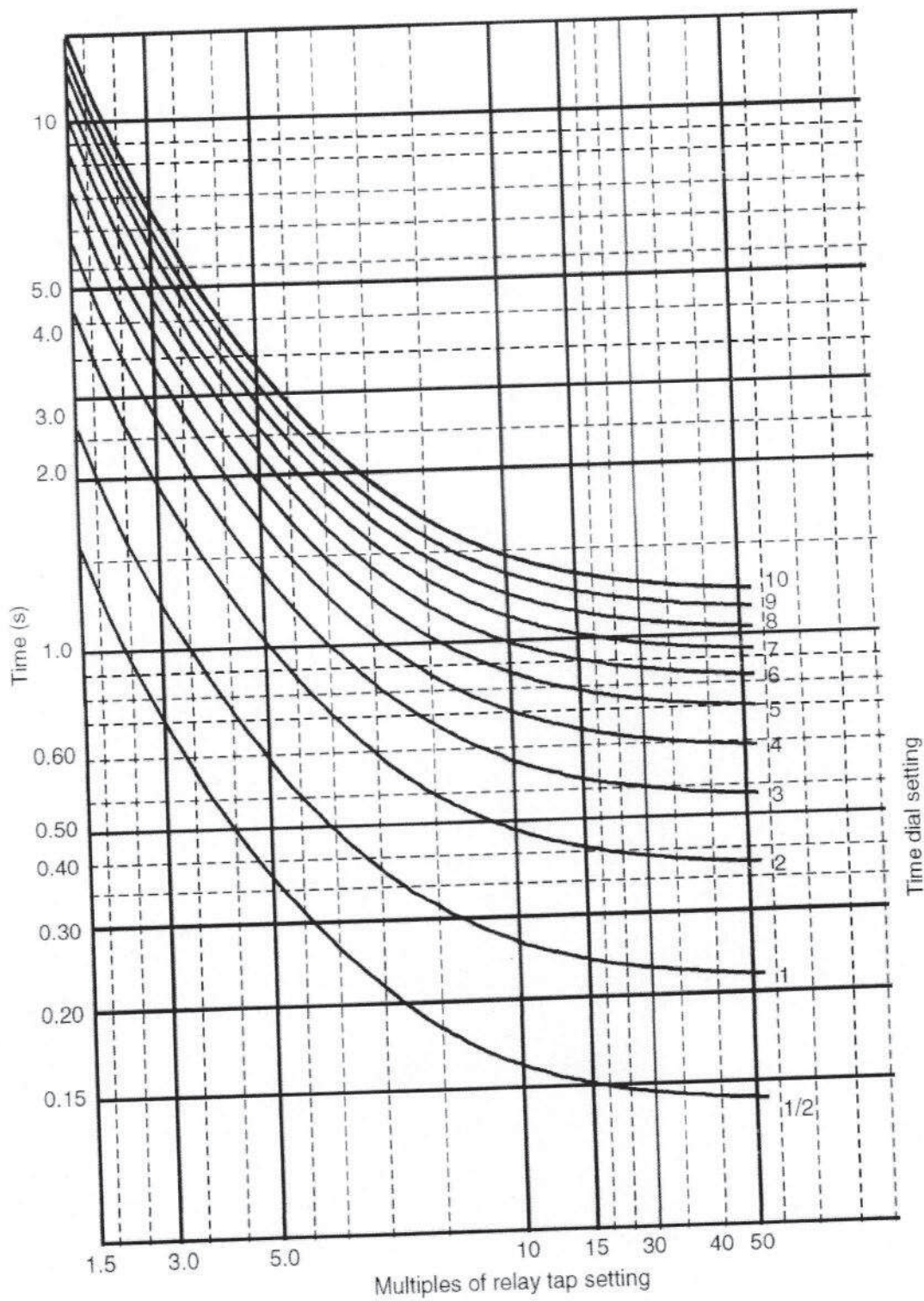


Fig. 3