Mid-Semester Examination

EE486: Power System Protection

Date: 24.09.2019

Full Marks: 30

Q1) In a percentage differential scheme, the two CTs have a nominal ratio 1000:5. The CT errors for maximum through fault current are as follows:

	CT_1	CT_2
Ration error	5 %	7 %
Phase angle error	2 %	-5 %

Determine the percentage biasing required for the scheme to remain stable during through fault conditions. Also, determine the spill current considering a through fault current of 1000 A. [5]

Q2) Derive the equation and draw the locus of power swing on X-R plane. Explain the impact of power swing on impedance, reactance and mho relay. [5]

Q3) Consider a protection system shown in Fig. 1. Identify the primary relays for backup relay R_1. Now assuming that pu impedance of all transmission lines is α pu ohm/km, determine the settings of zone-1, zone-2, and zone-3 of relay R_1. [5]

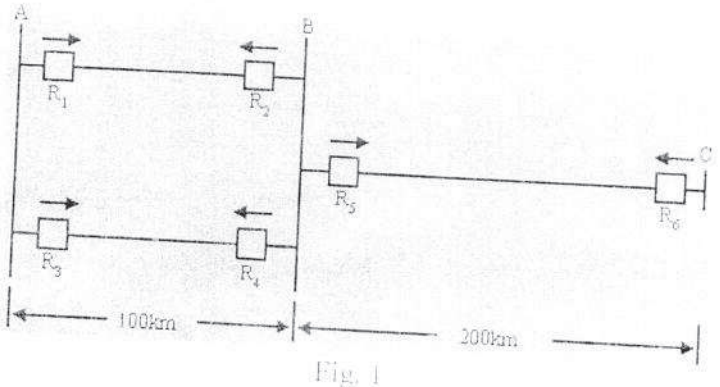

Fig. 1

Q4) Explain stability margin of a SMIB system using power swing curve. How it affects the speed and accuracy of the relay operation. [5]

Q5) If a 500:5 class C CT is connected to a meter as shown in Fig. 2 and secondary current in CT 4.5 A find out the primary current, voltage developed across the meter and percentage ration error. [5]

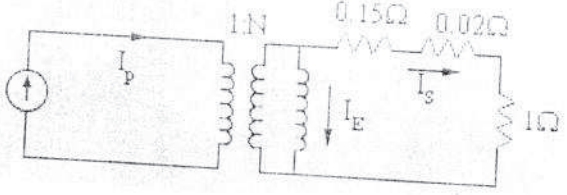

Fig. 2

Q6) For the radial system shown in Fig. 3 (Next page), 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. 5 (Appendix). [5]

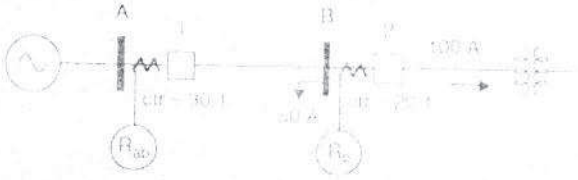

Fig. 3

Appendix

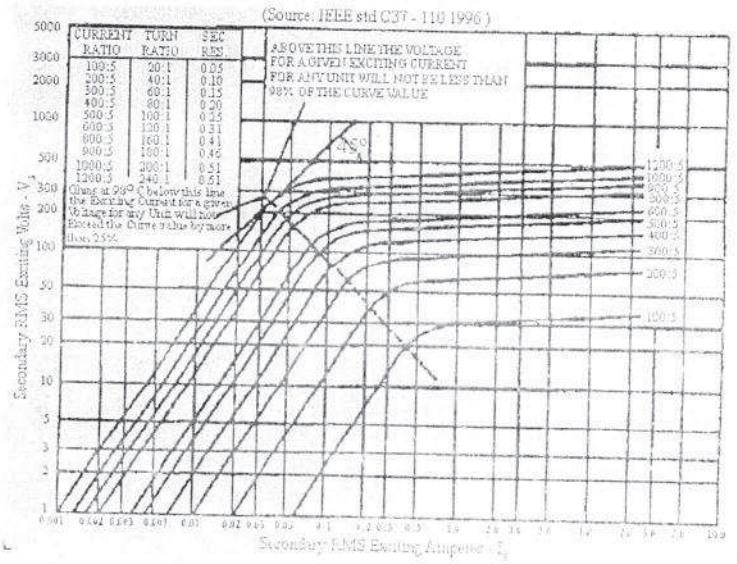

Fig. 4: Typical excitation curves for multi-ratio C type CTs

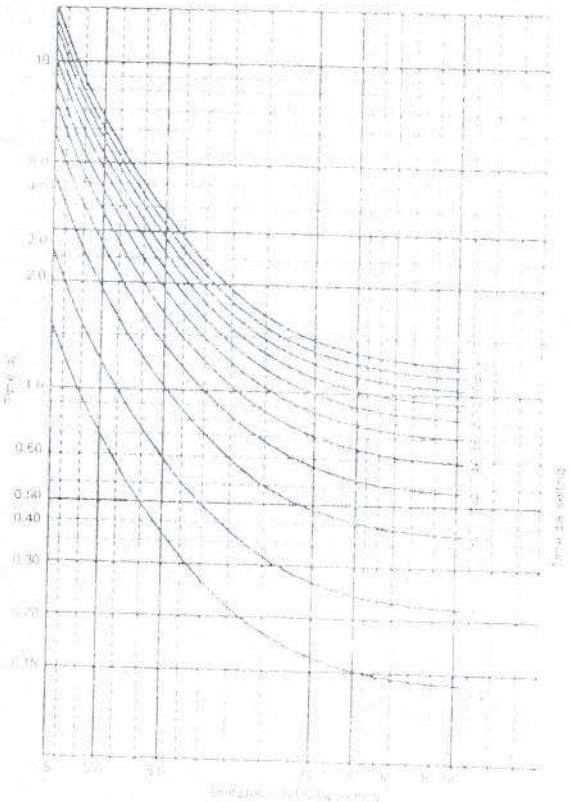

Fig. 5