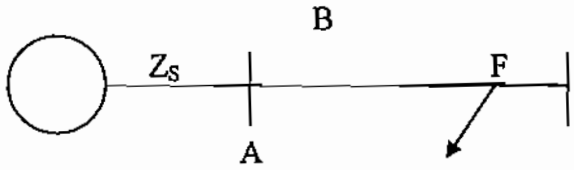
EEL 451 (POWER SYSTEM PROTECTION)
MAJOR EXAMINATION - 2008

Time : 02 Hours F.M. : 80

1. (a) For a three phase 13.8kV system shown find the impedance seen by a A-E relay at A for a LG fault in phase A at F (80% of the line from A). Z_{s1}=j5, Z_{s0}=j10, Z_{AB1} = 4+j40, Z_{AB0}=10+j90



(b) In a 220 kV system, the reactance and capacitance up to the location of CB is 8 Ω and 0.025 μF respectively. Determine the critical value of the resistance which will give no transient oscillation and the value of the resistance which will give a damped frequency of oscillation, one-fourth of the natural frequency of oscillation

(c) Explain the operating characteristics of a reactance type distance relay from the basic mathematical equation [6 + 4 +5]

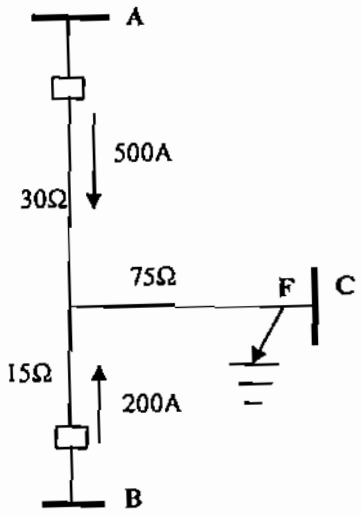
2. (a) Explain with suitable mathematical derivation the CT saturation for a fault current having a decaying dc component

(b) With a neat circuit diagram explain the operating characteristic of directional relay

(c) Discuss a protection scheme for parallel feeders.

(d) The figure shows distance protection for a section of a power system. The 1st Zone setting at A and B is 150 Ohms. Discuss the tripping sequence of the relays for a fault at F.

[7+5+3+5]



3. (a) Explain with suitable example why the CT ratios have to be identical for the bus bar differential scheme

(b) A 13.8 kV , 150 MVA, star connected alternator has a synchronous reactance of 1.68 p.u. per phase and a negligible resistance. It is protected by a Merz – Price balanced current system which operates when out of balance current exceeds 10% of the full load current. If the neutral point of the alternator is earthed through a resistance of 2.5 ohm, determine the portion of the winding is remain un-protected against the earth fault.

(c) Explain Transverse Differential protection Scheme. Where it is used ? [4 + 7 + 4]

4. (a) Explain what happens if there is the loss of excitation in an alternator. What is the scheme employed for the protection against sueh an event?
(b) How loss of prime mover is is detected?
(c) Explain the operation of a cosine type phase comparator with the realization of it using an electronic circuit.
(d) How a MHO relay is synthesized using amplitude comparator [3+2+5+5]

5. (a) Explain sampling theorem
(b) Explain Mann and Morrison method. What is the use of this method?
(c) In brief explain the differential equation algorithm for distance protection of a single phase transmission line
(d) Draw Impedance, Reactance and Mho characteristics to protect 100% of a line having impedance of 2.5 + j6 ohm. [2 + 4 + 6 + 3]