MINOR – II Examination

ELL – 400 (Power System Protection)

Time : 1 Hour **Full Marks : 20**

1. (a) What is the protection scheme used for failure of insulations between few turns of stator winding of a turbo – generator? Discuss in brief . [2]

   (b) Is the unbalanced loading for a long time a threat to the armature winding of the generator? What is the protection used for this purpose. [2]

   (c) Why biasing is provided in the differential relay for the protection of the transformer and what are the biasing? Discuss in brief. [2]

   (d) If the two signals, $S_1 = 1 + j0$ and $S_2 = -\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}$, when fed to a comparator produces a trip signal, determine the type of comparator ? [2]

2. A 150 MVA, 132 / 11 kV, DY – 11 , 3-phase transformer is to be protected against short circuit. An Instantaneous OC Relay is used to protect it. The magnetizing inrush current is 10 times the rated current. The setting range of the OC realy is 400 – 2000 % of 1 Amp in steps of 50 %. CT Ratio is 1000 / 1 on the HV side. Suggest the setting of the relay. [2]

   If the transformer is protected by percentage bias differential relay, select the CTs (Assume the 1000 / 1 CT on HV side), bias setting of the relay and draw a neat sketch of all the connections. Assume any extra equipment as per justification. [4]

3. Find the impedance seen by a phase fault distance relay (from very basic, suitable mathematical derivation) connected to take care of Phase faults between phase B and phase C. The relay is to protect a line having positive sequence impedance Z_1. [3]

4. Realize a Reactance relay using Amplitude Comparator [3]

1a. For an A-G fault, the readings of the meter are

$V_A = 0.2 \angle -10°$ p.u., $V_B = 1 \angle -120°$, $V_C = 1 \angle +110°$

$I_A = 2.5 \angle -80°$; $I_B = 0.8 \angle -180°$, $I_C = 1.8 \angle +30°$

Find impedance seen by A-G distance relay ? $Z_1 = Z_2 = 0.8$ p.u.

$Z_0 = 1.2$ p.u.

b. How to set MHO relay for a line -

$Z_1 = 100 \angle 60°$

CTR = 1000 : 5

PTR = 110 kV / 110 V

$Z_1 = \frac{V_S - V_R}{I_S}$

$Z_1 = \frac{V_S}{I_S} = \frac{V_R}{I_R} \times \frac{CTR}{PTR}$

$Z = \frac{V_b - V_c}{I_b - I_c}$ $Z_2 = \frac{V_{a1} - V_{a2}}{I_{a1} - I_{a2}}$

$Z + jR$

$V_{a2} = V_{a1} + V_{a2} + V_0$

$V_{b2} = a^2 V_{a1} + a V_{a2} + V_0$

$V_{c2} = a V_{a1} + a^2 V_{a2} + V_0$

$V_b - V_c = a^2(V_{a1} - V_{a2}) - a(V_{a1} - V_{a2})$

$(a^2 - a)(V_{a1} - V_{a2})$

$Z + jR$

$Z \angle \theta$