	Mansoura university **Faculty of engineering** **Electric Engineering Dept.**	

Course Title: Protection systems	**Course Code: EE2423**	**Year: 4th year**
Date: 5 /6/ 2013	**Allowed Time: 3 Hrs**	**Total Marks: 110 Marks**
Second Term	**Final Term Exam**	**No. of Pages: 3**

Remarks: Answer All the following questions (assuming any missing data)

Question # 1 (20 Marks)

(a) Describe with net sketch the operation of plunger type relay, and drive its force relation? *(5 Marks)*

(b) Explain with the help of net diagram the construction and working of a solid-state time delay over current relay and its waveforms. *(5 Marks)*

(c) What will be the torque equation of an induction type two input signals relay, if one flux is generated by voltage signal of $v = 220\sin(wt)$ across Nv turns with impedance of 1+j10 Ω the other flux is generated by a current signals $i = 300\ \sin(wt+50)$ through Ni turns. *(10 Marks)*

Question # 2 (20 Marks):

(a) State the possible faults encountered in the oil immersed type reactor ? *(5 Mark)*

(b) Draw the one line diagram showing a 200 hp motor connected to 4 kV bus. Assume the following bus and motor parameters:

- phase to phase fault current = 15000 A
- three phase fault current = 25000A
- ground fault current = 1500A
- motor full load current = 25A
- motor locked rotor current =150A
- motor starting time = 1.5S

select and set the phase and ground relays using time current characteristics shown in figure 2. *(15 Marks)*

Question # 3 (20 Marks):

(a) What do you mean by Autorecloser and sectionalizer, what are the motivation of using them. *(5 Marks)*

(b) For the radial system shown in Figure (1), Calculate;

i. The CT's ratio at each bus. *(5 Marks)*

P.T.O

ii. The time-delay overcurrent relay settings at each bus using the relay characteristic given in figure (2). *(10 Marks)*

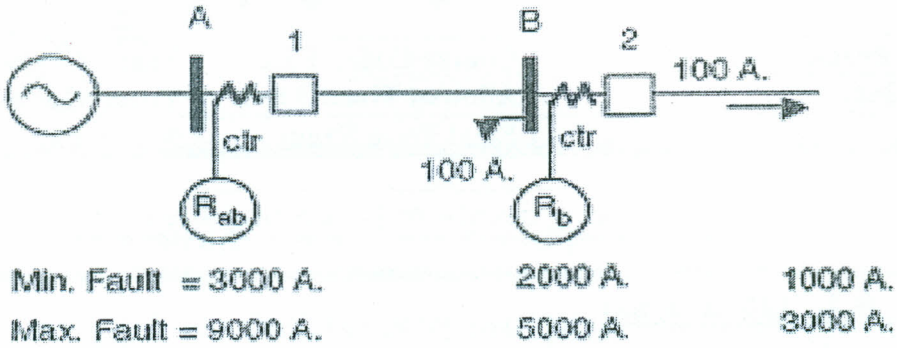

Figure (1)

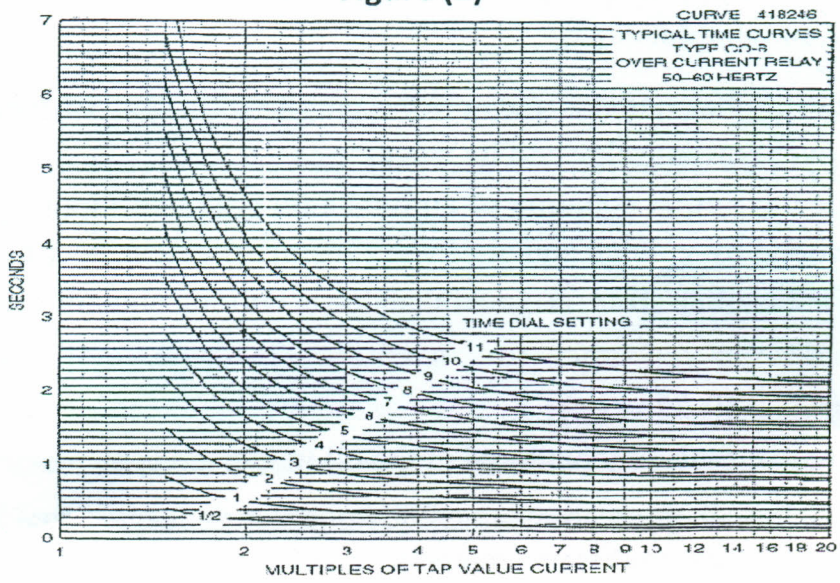

Figure (2)

Question # 4 (25 Marks):

(a) A current transformer has the following data; 20 VA, class 10 P 20,1 amp. Evaluate an equivalent ANSI/IEEE standard current transformer to this current transformer. *(5Marks)*

(b) Explain how to define the IEC and ANSII knee point for the protection CT? *(5 Marks)*

(c) The system nominal voltage is 220 kV, and the positive sequence impedances for the various elements are given in the figure . The angle of maximum torque τ is 80°.the maximum load at relay site is 300MVA.

For an impedance relay Rab in the system shown in the figure (3) determine the following:

P.T.O

i. The CT and PT ratio for this relay?
ii. The Rab relay side (secondary) zones setting? *(5Marks)*
iii. Draw the relay Rab characteristics considering 10% offset in zone 3? *(5 Marks)*
iv. The loadability limit for zone one of Rab relay, assuming a 0.85 power factor lag? *(5 Marks)*

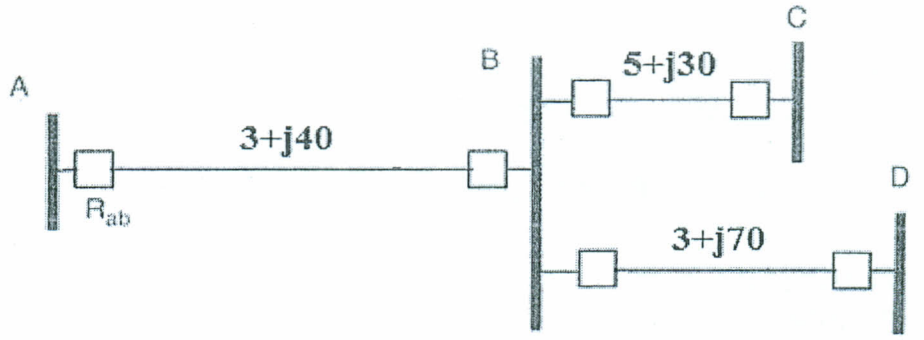

Figure (3)

Question # 5 (25 Mark)

(a) State the factors which are affecting the accuracy of distance relays. *(5 Marks)*

(b) A single phase transformer is rated at 110/69 kV, 100 MVA and. The 110 kV side has a tap changer with a range of 10%. Assume a maximum CT error of 5% in either of the two CTs.

i. Determine the CT ratios for a percentage differential relay to protect this transformer?
ii. If both relays windings are provided with taps for 3, 4, 4.3, 4.5, 4.8, 5, 5.2, 5.6, 5.7A, Determine the required slope of the relay characteristics?
iii. Draw the relay characteristics and what pickup current setting for the relay would you recommended? *(20 Mark)*

With Our Best Wishes

Dr/ Gabr M. Abdulsalam and Dr/A. Y. Hatata