	Mansoura university Faculty of engineering Electric Engineering Dept.	
Course Title: Protection Systems	Course Code: EE2324	Year: 3ᵗʰ year
Date: May - 2014	Allowed Time: 3 Hrs	Total Marks: 90 Marks
Second Term	Final Term Exam	No. of Pages: 5
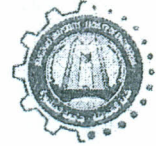
Remarks:
- Will you please answer each question at the beginning of a page in the answer sheet.
- You should make the required illustrations in an organized way and illustrating above them the required and necessary data.
- You should answer all questions as marks are distributed on them, and assuming any missing data.

Question Number   (1)   (16 Mark)

(a) The magnetization curves of a multi-ratio current transformer are shown in figure (3). Find the following according to AINSI and IEC standards for the full tap

   i-The knee point.

   ii-The name plate and the class of the transformer.   *(5 Mark)*

(b) A 2000/5 A ; Class 800 , CT. Determine the maximum permissible short circuit current and the burden of this CT and its equivalent IEC standard .   *(5 Mark)*

(c) With the help of neat drawing make in detail a comparison between the electromechanical, static and computerized relays.   *(3 Mark)*

(d) With the help of neat drawing explain the needs and the principle operation of a seal in relay.   *(3 Mark)*

Question Number   (2)   (17 Mark)

(a) With the help of neat drawing make in detail a comparison between the following protective relays , 51 , 51G , 50 and 67 from the connection , the setting rules , applications and drawbacks.   *(4 Mark)*

(b) For radial system shown in the figure (1), With the help of the time dial setting curves given in figure(4) , Calculate :
   I.   The CT's ratio at each bus and check it.   *(3 Mark)*
   II. The time-delay over-current relay settings at each bus.   *(3 Mark)*
   III. The Instantaneous Relay settings at each bus.   *(3 Mark)*

A   1   B   2

100 A   150 A

R_{ab} R_b

Min. Fault = 3000 A.   2000 A.   1000 A.
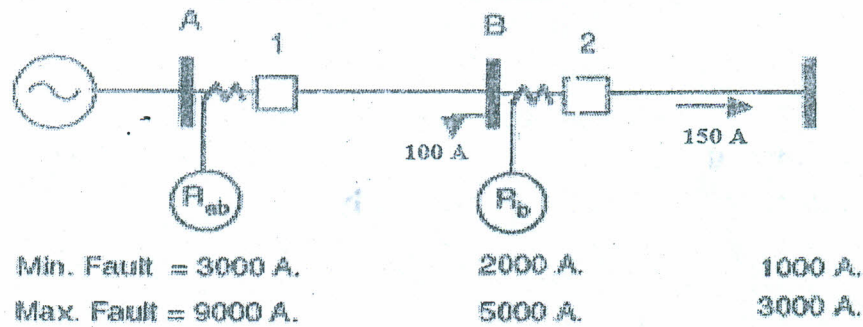
Max. Fault = 9000 A.   5000 A.   3000 A.

Figure (1)

(c) Compare between the sectionalizer and the recloser in distribution system and Autorecloser in a high voltage network.. Give a simple example to illustrate your answer.   *(4 Mark)*

Question Number (3) (12 Mark)

(a) Discuss the basic actions of primary and back-up protection.   *(2 Mark)*

(b) Explain the principle operation of the current limiting fuse.   *(2 Mark)*

(c) State the factors that affect on the relay time grading margin.   *(2 Mark)*

(d) For the system shown in Figure (2), the fault at F produces these differing responses at various times: (a) R4 B4 and R6 B6 operate; (b) R6 B6,R4,R3 B3 and R2 B2 operate; (c) R6 B6,R4 B4 and R1 B1 operate; (d) R6 B6,R5 B5 and R1 B1 operate. Analyze each of these responses for fault F and discuss the possible sequence of events that may have led to these operations. Also determine whether there was a loss of dependability or a loss of security in each of these cases.   *(6 Mark)*
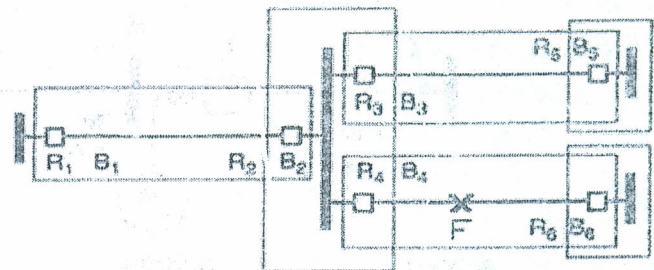

Figure (2)

Question Number (4) (10 Marks)

(a) Explain the following schemes used in circuit breaker   *(5 Marks)*

   I. Relay with break type contacts

   II. Relay with make type contacts

(b) 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 N_v turns with impedance of $2+j15$ Ω the other flux is generated by current signals $I = 100 \sin(wt+60)$ through N_i turns.   *(5 Marks)*

Question Number (5) (20 Marks)

(a) What do you mean by loss of excitation (LOE)? How the protection against loss of excitation is provided in generators? *(5 Marks)*

(b) The neutral point of a 11 kV alternator is earthed through a resistance of 12 Ω, the relay is set to operate when there is out of balance current of 0.8 A. The CTs have a ratio of 2000/5. What percentage of the winding is protected against earth faults? What must be the minimum value of earthing resistance required to give 90% of protection to each phase? *(5 Marks)*

(c) Draw the one-line diagram showing a 7500 hp motor connected to a 4 kV bus. Assume the following bus and motor parameters: *(10 Marks)*

Phase-to-phase bus fault = 20000 A

Three-phase bus fault = 25000 A

Minimum ground fault = 1200 A

Motor efficiency = 0.9

Power factor = 0.8 lagging

Motor locked rotor current = 5500 A

Motor starting time = 2.5 s.

Select and set the phase and ground relays using the time–current characteristic of the three relays shown in figure (4).

Question Number (6) (15 Marks)

(a) What are the drawbacks of the differential protection scheme? How can solve it? *(5 Marks)*

(b) A single-phase transformer is rated at 66/110 kV, 100 MVA. It has an over load capability of 120%. It is to be protected by a percentage differential relay, with input taps of 3.0, 4.0, 4.5, 4.8, 4.9, 5.0, 5.1, 5.2, 5.5 A secondary. The transformer has an under load tap changer (ULTC) with a turns ratio of $-$ 5 % to $+$ 5 % in steps of 5/8%. Specify the CTs, the pickup setting and the percentage differential slope for the relay? The available slopes are 10, 20, 30 and 40 %. What is the level of fault current, for an unloaded transformer, for which the differential relay will not operate? *(10 Marks)*

With our Best Wishes

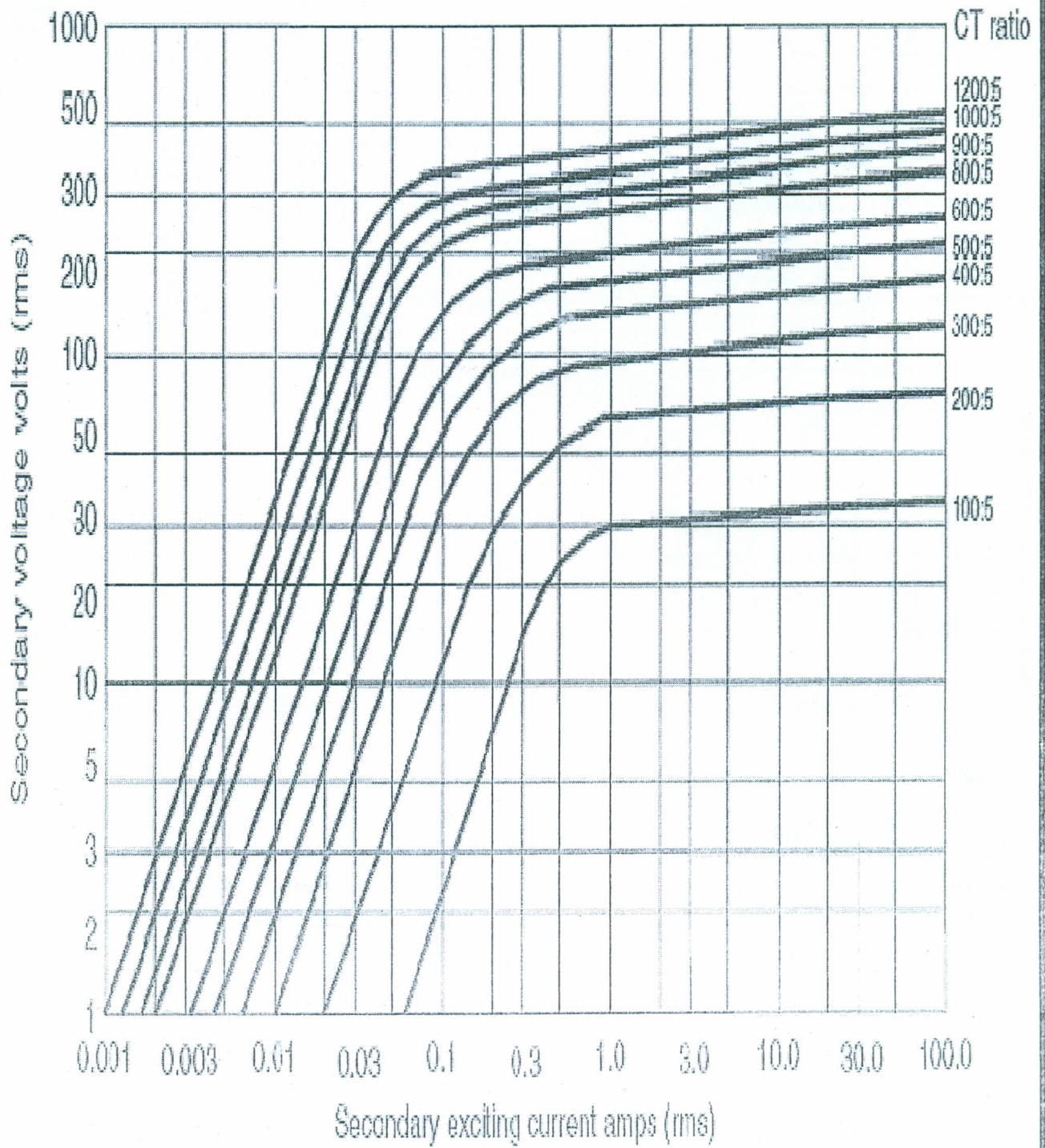Prof. Dr Gabr Abdelsalam   Dr. Ahmed Y. Hatata

Figure (3) The magnetization curves of a multi-ratio current