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B. Tech

CPEE 5402

Seventh Semester Examination – 2007

POWER SYSTEM PROTECTION

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory
and any **five** from the rest.

The figures in the right-hand margin
indicate marks.

1. Answer the following questions : 2×10
- (a) Give graphical proof of the theorem of duality.
 - (b) Explain the statement that all numerical relays have the same hardware but what distinguishes the relay is the underlying software.

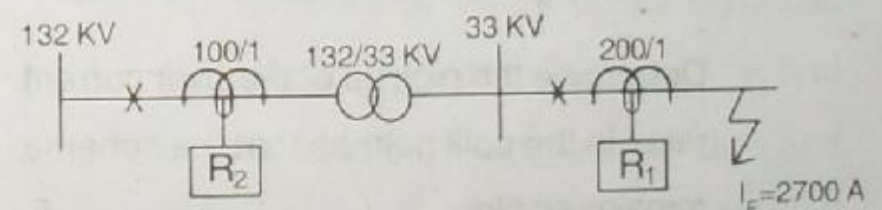
P.T.O.

- (c) What do you mean by a digital filter? Explain.
- (d) What are the various abnormal operating conditions to which a modern turbo-alternator is likely to be subjected?
- (e) What do you mean by tripping carrier and blocking carrier? Which one is more robust?
- (f) Arc resistance is a function of spark-over distance, wind velocity and time. Explain.
- (g) Why does a busbar differential scheme have a tendency to operate for external faults?
- (h) Why does the percentage differential relay fail to detect "high resistance winding" to "core" faults?
- (i) In what way is distance protection superior to overcurrent protection for the protection of transmission lines?
- (j) Why IDMT relays are widely used for over current protection?

2. (a) Discuss the terms TMS and PSM in connection with protective relays. 1.5+1.5
- (b) It is given that fault current level at 33 KV side is 2,700 A, CT ratio at 33 KV side is 200 : 1 and 132 KV side is 100 : 1.
- If both the relays R_1 and R_2 are set for 100% plug setting, determine the operation time for both the relays when the time grading margin of 0.6 second is given and TMS for relay R_1 is 0.15. 7

PSM	2	3	5	7	10	12	15	20
Time in seconds	10	9	7.0	3.8	3.5	3.1	2.5	2.1

(For Time multiplier of one)



3. (a) In connection with Feeder Protection, discuss the Time-graded Protection. 4

(b) Describe a suitable protective system for a ring main formed by a power station and four substations, and explain clearly its working, when a fault occurs. Explain the special features that a protective relay should possess in this case and also indicate the limitations of the system. 6

4. (a) In a simple differential scheme, the two CTs have a nominal ratio of 100 : 1. The CT errors for a "through fault" current of 1000 A are as follows :

	CT ₁	CT ₂
Ratio error	5%	+ 6%
Phase angle error	2%	- 4%

Determine the pick up of the over current relay in the spill path so that the scheme remains stable. 5

(b) Design the differential protection for a three phase, 50 Hz transformer with the following nameplate ratings : 5

MVA 250

15.75 KV / 400 KV

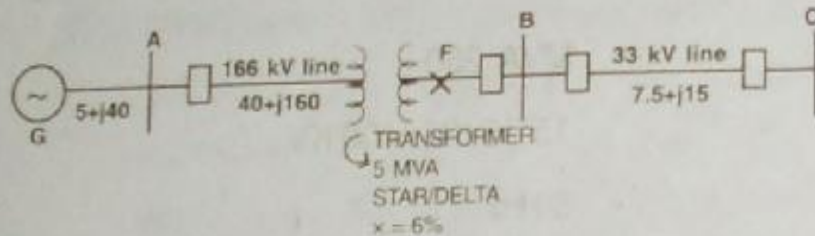
50 Hz

Delta – Star.

5. (a) Draw the schematic of three-stepped distance protection of Double-End-Fed lines and explain the principle of working. 5

(b) The transmission line section AB and BC are to be protected by Mho distance relays. The system is shown in figure. If the CT ratio is 300/5A and PT ratio is 166 KV/110 V and a 3 phase short circuit fault of zero impedance occurs at F, find the impedance seen by the relay and determine the setting of the relay for high

speed protection of the line AB, when the relay is located at end A. 5



6. (a) Discuss about Generator Rotor faults and draw a scheme for protection against rotor faults. 5

(b) An 11 KV, 100 MVA alternator is provided with differential protection. The percentage of winding to be protected against phase to ground fault is 85%. The relay is set to operate when there is 20% out of balance current. Determine the value of the resistance to be placed in the neutral to ground connection. 5

7. (a) Discuss about Synthesis of Mho Relay using static phase comparator. 6

(b) Define the following terms in connection with protective relays : 4

(i) Burden

(ii) Pick up

(iii) Reset

(iv) Operating time.

8. (a) Develop the differential equation algorithm for distance protection of a transmission line. 7

(b) Explain the principle of carrier current pilot relaying in connection with the protection of transmission line. 3

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