*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/M.TECH (EE)/SEM-2/MTEE-201/2010**

**2010**

# PROJECTION OF POWER SYSTEM AND DEVICES

*Time Allotted* : 3 Hours Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer Question No. 1 which is compulsory and any *four* from the remaining. 5 × 14 = 70

1. Answer the following questions in few lines/word : 7 × 2

   a) Why is it necessary to suppress the field immediately after disconnection of faulty alternator from the system ?

   b) Why are voltage differential protection of bus bars superior to circulating current protection ?

   c) What is pole stipping phenomenon in case of an alternator ?

   d) What is blinder and what is its function ?

   e) What is the principle of out of step blocking relay ?

   f) Why directional feature provided for impedance relay cannot be used for reactance relay ?

   g) What is field suppression ?

2. a) What is the effect of prolonged unbalance fault on a generator ? Discuss the protection scheme used to cope with the effect. 2 + 5

b) A three-phase 50 MVA, 11 kV star connected alternator has a synchronous reactance of 2·0 ohm per phase and resistance of 0·70 ohm per phase. It is being protected by Merz-Price balanced current system. Determine what portionn of the winding remains unprotected if the neutral of the alternator is earthed through a resistance of 5 ohm. Assume that the relay operates when the out of balance current exceeds 25% of the load current. 7

3. a) The system shown in figure is fed by two generators $G_1$ and $G_2$ ; $G_1$ at the bus $A$ and $G_2$ at 70% distance from $A$ in section $AB$. The currents $I_A$ and $I_B$ supplied by them respectively are equal. The reactance of the transformer is 10%. The line voltages and impedances are shown in figure. Find the setting for the impedance relays for first, second and third zones adjusting the first zone to reach 80%, second zone to reach 50%. CTs and PTs have ratios 400/5 V and 166000/110 V respectively. 10

dia

b) Draw impedance, reactance and MHO characteristics to protect the 100 per cent of the line having ( 2·5 + $j$6 ) ohm impedance. A fault may occur at any point on the line through arc resistance of 2 ohm. Determine the maximum percentage of the line section which can be protected by each type of relay. 4

4. a) What will happen to a generator if there is —

i) sudden loss of excitation ?

ii) sudden failure of prime-mover ?

iii) loss of load ?

Discuss in brief the protection schemes that are needed to cope with the effect. 3 + 3 + 3

b) What type of protection scheme is used for a generator rotor earth fault ? 5

5. a) Give the differences between 'protective' and 'measuring' current transformers. 3

b) Give the basic principle of static distance relay and compare it with that of electromagnetic distance relay. 6

c) Show with a simple diagram, how a static impedance relay can be realised by amplitude comparator. 5

6. a) Describe with block diagram the principle of operation of a microprocessor based harmonic restraint percentage differential relay scheme for protection of a power transformer. 11

b) Why is harmonic restraint required ? 3

7. a) Explain briefly the process of current chopping in $SF_6$ breakers. 4

b) Differentiate between type tests and routine tests. What different tests are carried out to prove the ability of circuit breaker ? 5

c) Give the principle of operation of a DC circuit breaker. 5

8. a) Explain what is meant by short circuit capacity of a bus or fault level of a bus. 4

b) Discuss the double bus bar arrangement of bus bar layout in a substation or a power station switchyard using single line diagram showing incoming, outgoing feeders and switchgears.

What are its merits over single bus bar system ? 10