

Dr. O. L. Dahi

29/11/2022 (8)

Roll No.: 18.....

# National Institute of Technology, Hamirpur (HP)

Name of the Examination: B.Tech. End Semester Nov./Dec., 2022

Branch : Electrical Engineering Semester : Fifth  
Course Name : PROTECTION AND Course Code : EED-311  
SWITCHGEAR

Time: 3 Hours

Maximum Marks: 50

Note: Attempt all the questions. Marks allotted for each question are given in bracket. Assume missing data if any suitably.

1. (a) Define per unit quantity and state advantages of PU system. Differentiate between single line diagram and impedance diagram and their applications. (5)  
(b) A 3-phase, 500 KVA, 11 KV/0.4KV transformer is connected in delta-star. The protection transformer on LV side have turns ratio of 500/5. What will be the CT ratio on the HV side of the transformer? (5)
2. (a) A 100 MVA, 33 kV, 3-phase generator has a subtransient reactance of 15%. The generator is connected to the motors through a transmission line and transformers. The motors have rated inputs of 30 MVA, 20 MVA and 50 MVA at 30 kV with 20% subtransient reactance. The 3-phase transformers are rated at 110 MVA, 32 kV & 110 kV,  $\Delta/Y$  with leakage reactance 8%. The line has a reactance of 50 ohms. Selecting the generator rating as the base quantities in the generator circuit, determine the base quantities in other parts of the system and evaluate the corresponding p.u. values. Also draw the single line diagram and reactance diagram for this system. (5)  
(b) State the features of bus-bar protection and explain the differential protection of bus bar. (5)
3. (a) Draw and explain the scheme of protection against phase to phase fault in stator of an alternator. (5)  
(b) State the tripping and blocking criteria of distance relays. State the operating characteristics of impedance relay on R-X plane and state application of this relay. (5)
4. (a) Draw the circuit and explain the working and application of harmonic restraint relay installed in power transformers. (5)  
(b) Briefly explain the implementation of microprocessor based over current relay with the help of a schematic diagram and flow chart. (5)
5. (a) Explain the operating principle of a SF<sub>6</sub> circuit breaker. State the advantages of SF<sub>6</sub> circuit breaker over other types of circuit breakers and also state its suitability. (5)  
(c) In a 132 KV system, the reactance and capacitance upto the location of the circuit breaker is 3 Ohms and 0.015 micro farad, respectively. Calculate: (i) the frequency of transient oscillations (ii) The maximum value of restriking voltage across the circuit breaker contacts (iii) The maximum value of RRRV. (5)