Bachelor of Electrical Engineering, 2018

(4th Year, *1st* Semester).

Power System Protection and Switchgear

Time: Three Hours

Full Marks: 100

(50 marks for each part)
Use a separate Answer-Script for each Part

PART-I.

Answer *any three* questions from this part.
Two marks are reserved for neat and well organised answer

1. Justify
   a) Isolators are always used with circuit breakers and their operations are interlocked. 6
   b) Successful autoreclosure improves the stability of power system but an unsuccessful autoreclosure is detrimental to system stability. 6
   c) Air blast circuit breakers are prone to current chopping problem. 4

2. a) Explain with necessary derivations how restriking transients can be damped by connecting a resistance across the contacts of a circuit breaker. 8
   b) A 3-phase fault with maximum asymmetry in one phase occurs on a 3 Ph. 11kV, 50Hz feeder. If the rms value of symmetrical fault current is 7000 A, and the making capacity is 18kA, determine, (i) the doubling factor (ii) the time constant of the circuit (iii))the asymmetric breaking capacity assuming that the circuit breaker contacts just open after 3 cycles from the initiation of fault. 5
   c) Discuss the role of main and arcing contacts in air circuit breaker. 3

3. a) Draw and explain dynamic characteristic of arc. 4
   b) Explain how the arc in vacuum is different from that in air. 4
   b) Explain the terms restriking voltage and RRRV. Explain the significance of RRRV in respect of quenching of arc. 8

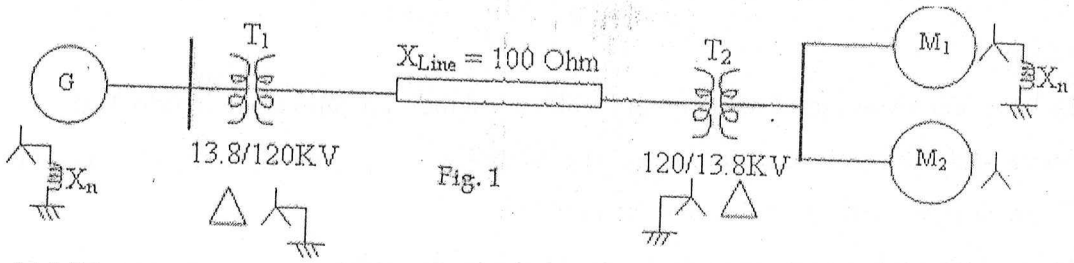
4. a) Describe the effect of different operating conditions on active recovery voltage in a circuit 8

breaker.

b) Derive the necessary equation to determine the fault current for a line to line fault. Draw the necessary sequence network for the simulation of the fault. 8

5. a) Explain why zero sequence reactance of transmission line is more than its positive or negative sequence reactances. 4

b) The alternator of a power system supplies two motors over a transmission line having transformers as shown in Fig. 1. The positive and zero sequence reactances of the line are 100Ω and 250 Ω respectively. Calculate fault current if there is a single line to ground fault at the HV terminal of the generator transformer. Particulars of system components are as given below: 12



G: 24 MVA, 13.8KV , X_1= 20%, X_2=15%, X_0= 5% X_n=2.5ohm
T_1= T_2=28MVA, X=10%
M_1: 16 MVA, 13.8 KV , X_1=25%, X_2=20%, X_0= 5%,
M_2: 8 MVA, 13.8 KV , X_1=25%, X_2=20%, X_0= 5%, X_n=2.5ohm

Ref: Ex/EE/T/412/2018

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PART-II

Answer ***any three*** questions from this part.
Two marks are reserved for neat and well organised answer

1. (a) With the help of necessary diagram explain why and how a power system is divided into a number of small zones for the purpose of proper protective relaying. What do you understand by primary relaying and back up relaying? Discuss about desirable properties of a good relaying system. 4+2+2=8

(b) (i) What do you mean by the term "reset value" and "pick up value" of an overcurrent relay? 2+2+4=8
(ii)What should be the ideal value of "reset to pick up ratio" of a relay? Justify your answer.
(iii) Which one among induction type overcurrent relay and the attraction type overcurrent relay performs better from the point of view of the above ratio? Justify your answer.

2. (a) What do you understand by an IDMTL type overcurrent relay? Draw characteristics of attraction type overcurrent relay and IDMTL type overcurrent relay. Which one would perform better for feeder protection? Justify your answer. 3+2+2=7

(b) What do you understand by cross polarization in relay. Draw the connection diagram and phasor diagramof 30^0 power relay. (2+5=7)

(c) Explain the terms PSM and TMS with a suitable example. 2

3. (a) What do you understand by universal relay torque equation of four pole induction cup type relay? Write the equation and explain each terms of it. (2+2=4)

(b) Derive torque equation of mho relay from universal relay torque equation with proper justification. Explain how directional feature of mho relay is utilized in power system feeder protection. (4+2)=6

(c) An IDMTL relay with PSM =18, is carrying a fault current of 135A in CT secondary. The rated current CT secondary current is 5A. Calculate plug setting of the relay. This relay is acting as a backup relay with DTM of 0.2 sec where the actual time of operation of the primary relay is 0.52 sec. Also calculate TMS of the relay. (3+3=6)

PSM	2	6	10	12	18	20
Time	10	3.8	3	2.8	2.4	2.2

4. (a) Distinguish between ordinary differential relay and biased differential relay. 2

(b) Explain how differential relay is employed for stator winding inter-phase and inter-turn fault protection of an alternator. 3+3=6

(c) Explain the principle of 3-step 3-zone distance protection. 4+4=8
Show the corresponding trip control circuit using reactance relay alongwith mho relay. Also mention how directional feature is incorporated in it.

5. (a) Write a short note on carrier current relaying. 6

(b) Explain operation of Restricted Earth Fault Relay with the help of a suitable example. 4+2=6
How is it different from ordinary Earth Fault Relay?

(c) Discuss how effect of arc resistance on performance of impedance relay may be overcome by using mho relay. 4