Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem Examination May-2023

EE3CO24 / EX3CO24 Power System Protection

Programme: B.Tech. Branch/Specialisation: EE/EX

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. _____ is a series type unbalanced fault that occurs in a power system. **1**

(a) Line to line fault (b) Double line to ground fault

(c) Single line to ground fault (d) Open conductor fault

ii. The most frequently occurring fault in the power system is- **1**

(a) Line to ground fault (b) Line to line fault

(c) Double line to ground fault (d) Three-phase fault

iii. For the protection of stator winding of an alternate against internal fault involving ground the relay used is a- **1**

(a) Biased differential relay (b) Directional over-current relay

(c) Plain impedance relay (d) Buchholz relay

iv. For the protection of a very long extra high-voltage lines, the protective relay used is- **1**

(a) Over currently with extremely inverse characteristics

(b) Percentage differential relay

(c) Reactance type distance relay

(d) Mho type distance relay

v. In Extra Voltage lines which of the following circuit breakers are most suitable. **1**

(a) SF_6 circuit breakers (b) Air circuit breakers

(c) Oil circuit breakers (d) Vacuum circuit breakers

vi. Breaking capacity of a circuit breaker is usually expressed in- **1**

(a) Volts (b) Amperes (c) MVA (d) MW

vii. The most important stator winding fault in an alternator is- **1**

(a) Fault between phase and ground (b) Fault between phases

(c) Inter turn fault in phases (d) None of these

P.T.O.

viii. Which protection system is used for earth fault in power transformer? **1**
(a) Merz prize protection
(b) Earth fault protection
(c) Merz prize protection and Earth fault protection both
(d) None of these

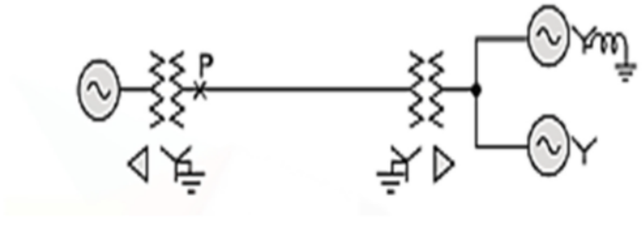
ix. A lightning arrester provides- **1**
(a) A low impedance path between line and ground, during operation
(b) A high impedance path between line and ground, during operation
(c) A low resistance path between line and ground, during operation
(d) A high resistance path between line and ground, during operation

x. Impulse ratios of insulators and lightning arresters should be- **1**
(a) Both low (b) High and low respectively
(c) Low and high respectively (d) Both high

Q.2 i. What do you understand by Per unit system? Explain the importance of Per unit system in power system. **3**

ii. Explain the necessity of current limiting reactors in power system and classify the reactor on the basis of their classification. **7**

OR iii. A 30 MVA, 13.8 kV, 3-phase alternator has a subtransient reactance of 15% and negative and zero sequence reactances of 15% and 5% respectively. The alternator supplies two motors over a transmission line having transformers at both ends as shown on the one-line diagram. The motors have rated inputs of 20 MVA and 10 MVA both 12.5 kV with 20% subtransient reactance and negative and zero sequence reactances are 20% and 5% respectively. Current limiting reactors of 2.0 ohms each are in the neutral of the alternator and the larger motor. The 3-phase transformers are both rated 35 MVA, 13.2 Δ-115Y kV with leakage reactance of 10%. Series reactance of the line is 80 ohms. The zero-sequence reactance of the line is 200 ohms. Evaluate the fault current when (a) L-G (b) L-L, and (c) L-L-G fault takes place at point P. Assume Vf = 120 kV. **7**



Q.3 i. Describe the construction, principle of operation and application of an- **4**
(a) Induction disc (b) Induction cup type of relay

ii. Find the time of operation of relay of rating 5 amps, 2.2sec IDMT and having a realy setting of 125% TMS=0.6. It is connected to a supply circuit through a C.T. 400/5 ratio. The fault current is 5000 amps. **6**

OR iii. Describe and define the following terms: **6**
(a) RRRV (b) Drop off/Pick up ratio
(c) Overreach

Q.4 Attempt any two:

i. Describe construction, operating principle and application of vacuum circuit breaker for what voltage range is it recommended. **5**

ii. Compare the performance and characteristics of minimum oil circuit breaker and air blast circuit breaker. **5**

iii. What is an HRC fuse? Compare an HRC fuse with a circuit breaker as interrupting device. **5**

Q.5 Attempt any two:

i. Discuss the protection of a three-phase alternator in the event of following: **5**
(a) Loss of prime mover (b) Loss of excitation

ii. What is a biased differential protection? Why it is used? Draw a neat circuit diagram of differential protection for Transformer and also explain its operation. **5**

iii. Explain protection for a parallel feeder fed from the following: **5**
(a) One end (b) Both the ends.

Q.6 i. Discuss the phenomenon of lightning arrester. Why it is needed? **4**

ii. Explain how surge absorbers provide protection to equipment from destructive effect of travelling waves. **6**

OR iii. Explain in detail the types of lightning arresters for outdoor applications. **6**

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Marking Scheme
EE_EX3CO24 Power System Protection

Q.1	i)	d. Open conductor fault	**1**
	ii)	a. line to ground fault	**1**
	iii)	a. Biased differential relay	**1**
	iv)	d. Mho type distance relay	**1**
	v)	a. SF_6 circuit breakers	**1**
	vi)	c. MVA	**1**
	vii)	a. Fault between phase and ground	**1**
	viii)	c. Merz prize protection and Earth fault protection both	**1**
	ix)	a. A low impedance path between line and ground, during operation	**1**
	x)	b. High and low respectively	**1**

Q.2 i. What do you understand by Per unit system. Explain the importance of Per unit system in power system.

Explanation **03 marks**
Define - 2 Marks
Importance -1 Marks

ii. **necessity of current limiting reactors** **03 marks**

Classification of reactors with neat diagram **04 marks**

OR iii. L-G Fault current **03 marks**
L-L Fault current **02 marks**
L-L-G fault current **02 marks**

Q.3 i.

Induction disc principle of operation **02 marks**
Induction cup type of relay operation **02 marks**

ii.

Operating current of relay **02 marks**
PSM **02 marks**

Time of operation of relay **02 marks**

OR iii. Describe and define the following terms (i) RRRV (ii) Drop off/Pick up ratio(iii) Over reach

Each with **02 Marks**

Q.4 i. Describe construction, operating principle and application of vacuum circuit breaker for what voltage range is it recommended. **5**

Construction **02marks**
Operating Principle **01marks**
Applications **02marks**

ii. Compare the performance and characteristics of minimum oil circuit breaker and air blast circuit breaker. **5**

Compression With at least 5 points **05 marks**

OR

i. Describe the construction, principle of operation ,application and advantages of a SF_6 circuit breaker. **5**

Construction **02marks**
Operating Principle **01marks**
Applications **02marks**

ii. What is an HRC fuse? Compare an HRC fuse with a circuit breaker as interrupting device. **5**

Statement **02 marks**
Compression **03 marks**

Q.5 i. Discuss the protection of a three-phase alternator in the event of following:(i) Loss of prime mover (ii) Loss of excitation. **5**
Each 2.5 Marks

ii. What is a biased differential protection? Why it is used. Draw a neat circuit diagram of differential. 1 Marks **5**
protection for Transformer 1 Marks

		and explain its operation. 3 Marks	
	iii.	Explain protection for a parallel feeder fed from (i) one end (ii) both the ends. Each 2.5 Marks	**5**
Q.6	i.	Discuss the phenomenon of lightning arrester. Why is it needed? Each 2 Marks	**4**
	ii.	Explain how surge absorbers provide protection to equipment from destructive effect of travelling waves. Explanation 6 Marks	**6**
OR	iii.	Explain in detail the types of lightning arresters for outdoor applications. At last, 2 in details each 1 Marks	**6**

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