Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Programme Name: B. Tech. EE + B. Tech. PSE **Semester : VI**
Course Name : Power System Protection and switchgear
Time : 03 Hrs. **Max. Marks: 100**

Instructions: All question are compulsory

SECTION A

S. No.		Marks	CO
Q 1	Explain the basic differential protection scheme, discuss its disadvantages	**4**	**CO2**
Q 2	Discuss the various types of faults, which can occur on an alternator and the protection to be used for each of such faults	**4**	**CO3**
Q 3	Explain the phenomena of arc formation in the circuit breaker	**4**	**CO5**
Q 4	Explain the terms " Restriking voltage" and "Recovery voltage"	**4**	**CO5**
Q5	Explain the principle of time grading and current grading in a simple radial system equipped with IDMT over current relays for the protection.	**4**	**CO2**
Q 6	Discuss the problems associated with the application of differential protection to power transformer.	**10**	**CO3**
Q 7	Discuss the suitable protection schemes for rotor earth fault	**10**	**CO2**
Q 8	An alternator has a 15% slope $(I_1 - I_2)$ vs. $(I_1 + I_2)/2$. A high resistance earth fault has protected has occurred nearer the grounded neutral end of the generator stator winding while generator is carrying load. The current flowing at neutral side and phase side of the generator are (0+ 360j) amperes and on phase side (0+ 300j) respectively. Assuming CT ratio of 500/5 A for differential protection. Analyze the protection scheme will the trip the generator circuit breaker	**10**	**CO2**

	under this fault condition.		
Q9	Explain with the help of block diagram, a negative phase sequence current protection for generators.	**10**	**CO3**
	SECTION-C		
Q 10	The neutral point of a three phase 20 MVA, 11 kV alternator is earthed through resistance of 5 ohm, the relay is set to operate out of balance of 1.5 A. The CT's have a ratio of 1000/5 A. What percentage of winding protected against the fault? Also calculate the earthing resistance required to protect 90 % of winding	**20**	**CO4**
Q11	a) Discuss the classification of circuit breakers based on different factors b) An 11kV 500MVA, circuit breaker suddenly closes on a fault. Determine (i) Symmetrical breaking current (ii) Asymmetrical breaking current assuming 50% DC component (iii) Peak making current as per IES specifications (iv) Short time current rating.	**8+12 =20**	**CO5**

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SECTION A

S. No.		Marks	CO
Q 1	Explain the abnormal operating conditions of power transformers	**4**	**CO3**
Q 2	Which type of protection is selected for various abnormal condition of three phase induction motors?	**4**	**CO4**
Q 3	Explain the following terms related to circuit breaker. i) Making current capacity of breaker ii) Breaking current capacity of breaker	**4**	**CO5**
Q 4	Write a short note on a) Magnetic inrush current problems of the transformer b) Frame leakage protection	**4**	**CO2**
Q5	Distinguish between the terms " Over load" and "Over current"	**4**	**CO1**
Q 6	Discuss the problems associated with the application of differential protection to power transformer	**10**	**CO3**
Q 7	Discuss, in brief, the abnormal conditions in a large alternators against which the protection is necessary	**10**	**CO3**
Q 8	A three phase, power transformer having a line voltage of 400 V and 33 kV connected in star delta. The CT ratio on 400 v side 1000/5.What must CT ratio on HV side. Assume the current on transformer 400 V side is 1000A.	**10**	**CO2**

Q9	Discuss the reasons for arc formation in the circuit breaker and enlist the methods of arc extinction	**10**	**CO5**
	SECTION-C		
Q 10	A three phase, star connected 125 MVA, 13.8 kV alternator has a synchronous reactance of 1.4 per unit per phase and negligible resistence. It is protected by a Mertz- Price balanced current system which operates when out of balance current exceeds 10% of full load current. If the neutral point is earthed through a resistence of 2 ohm, determine what portion of winding remains protected against earth fault **OR** **a)** Explain the current circulating protection of Busbar. **b)** A100 MVA delta-star connected, 11/220 kV transformer is to be protected by percentage differential relay scheme. CT's ratio are as below: HV side 300/1 and LV side CT ratio 300/1. Calculate **i)** Full load HV and LV side CT's **ii)** Draw a relay schematic arrangement and & the ratio of the additional auxiliary CT's required.	**20**	**CO2**
Q11	a) An alternator is connected to through circuit breaker. Derive an expression for for the recovery voltage in terms across the breaker terminal for short circuit conditions b) In a short circuit test on a circuit breaker, the following reading were observed on a single frequency transient time to reach peak recovery voltage 40 μ sec and peak striking voltage 100kV. Determine the average RRRV and the frequency of oscillations.	**8+ 12= 20**	**CO5**