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MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING) END SEMESTER EXAMINATIONS, DECEMBER 2020

	SWITHGEAR AND PROTECTION [ELE 4101] REVISED CREDIT SYSTEM		
Time:	3 Hours Date: 23 DECEMBER 2020	Max. Marks: {	50
Instru	 ctions to Candidates: Answer ALL the questions. Missing data may be suitably assumed. 		
1A.	Discuss the effect of the following on the re-striking voltage:		
	i) power factor ii) armature reaction iii) system neutral connect	ion.	03
1B.	What is resistance switching ? Derive the expression for critical resis of system inductance & capacitance which gives no transient oscillat	tance in terms tion.	03
1C.	 A 50 Hz, 3Φ, 132 kV alternator with an isolated neutral has inductance of 1.6 mH per phase & is connected to bus bar through circuit breaker. The capacitance to earth between the alternator & circuit breaker is 0.003 µF. The fault current has asymmetry to the extent of 30% with a power factor of 0.2 lagging. Assuming the armature reaction affects induced emf to an extent of 12% determine the following: i. First peak value of restriking voltage ii. Natural frequency of oscillations of restriking voltage 		
	iv. Resistance required across breaker to damp out oscillation	IS.	04
2A.	Discuss the major problem associated with development of HVDC circuit breakers, suggest & describe a suitable method to overcome this problem.		03
2B.	With neat connection & timing diagrams, explain the synthetic method of testing o circuit breaker.		04
2C.	Under what circumstances, can 'effective' neutral grounding be used? Draw the phasor diagram for the effectively grounded system undergoing a line-to-ground fault. Why doesn't arcing ground phenomenon occur here?		03
3A.	Explain the following terms as applied to a H.R.C. fuse. (i) Prosp (ii) Cut – off current (iii) Pre-arcing time and (iv) Fusing factor	ective current	04
3B.	Describe the operation of (i) Shaded pole type and (ii) Induction converted with neat sketches.	up type relays	03
3C.	An alternator stator winding protected by a percentage differential in fig.3C. The relay has a 0.15 amp minimum pick up and a 12% resistance ground fault has occurred as shown near the grounded the generator winding while the generator is carrying load. The curre each end of the generator winding are shown in the figure. Assuming 400/5 ampere ratio and no inaccuracies, will the relay trip the gener this fault condition?	relay is shown slope. A high neutral end of ents flowing at that CTs have rator CB under	03



Fig.3C

- **4A.** Draw and explain the construction and working of Buchholz relay. Against which faults Buchholz relay gives the protection? State its advantages.
- **4B.** Obtain three zone relay settings (referred to secondary of CT and PT) for distance protection of transmission line if mho relay units with a characteristic angle of 53° is used for the protection of zones 1, 2, and 3 from the following data.
 - CT ratio: 500/1 A
 - PT ratio: 220 KV /110V
 - Impedance of line 1: $(3+j 6.1) \Omega$
 - Impedance of line 2: $(4 + j 7.8) \Omega$
 - Impedance of line 3: $(3.5 + j 7) \Omega$
 - Zone 1 covers 80% of line 1
 - Zone 2 covers up to 40 % of line 2
 - Zone 3 covers up to 20% of line3.

If a fault with fault arc impedance of $(2 + j 0.5) \Omega$ occurs at 70 % of line 1, which zone relay will operate to clear the fault?

- **4C.** With the help of neat diagrams describe the basic principle of operation of a voltage differential (wire pilot) protection of overhead transmission line and hence explain the translay scheme of wire pilot protection.
- **5A.** Describe the causes, and consequences of following abnormal operating conditions on the operation of 3 phase induction motor. Indicate (description not necessary) the type/s of protection normally used to protect the induction motor against each of these conditions.
 - i. Supply under voltage
 - ii. Stalling
 - iii. Stator winding faults
 - iv. Unbalanced supply.
- **5B.** With the help of relevant phasor diagrams illustrate how an amplitude comparator be used as a phase comparator. **03**
- **5C.** With the help of relevant block diagram and flow chart, describe the working of a numerical (microcontroller based) IDMT 3 second over current relay. **03**

03

04

03

04