MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: SWITCHGEAR AND PROTECTION [ELE 4101]

REVISED CREDIT SYSTEM

Time: 3 Hours	Date: 16 November 2017	Max. Marks: 50

Instructions to Candidates:
- ❖ Answer **ALL** the questions.
- ❖ Missing data may be suitably assumed.

1A.	With the help of relevant diagrams and waveforms, discuss the problems faced by a circuit breaker when it disconnects an unloaded long transmission line.	*(03)*
1B.	With a neat figure, explain the construction and working of Air Break Circuit Breaker	*(03)*
1C.	A 3 phase, 11 kV, 50 Hz star-connected alternator is connected to a circuit breaker(CB). The inductive reactance upto the circuit breaker is 5 Ω per phase. The capacitance upto circuit breaker between phase and neutral is 0.01 μF. Determine the following:	
	i) Peak restriking voltage across the CB.	
	ii) Average rate of rise of restriking voltage.	
	iii) Frequency of restriking voltage transient.	
	iv) Time at which restriking voltage becomes 10 kV.	*(04)*
2A.	What is the significance of single-shot (EHV) auto-reclosing scheme? Explain.	*(03)*
2B.	With a neat diagram and phasor, explain how Peterson coil helps to reduce the arcing ground in neutral grounding system.	
	A 33 kV. 3 phase 50 Hz, overhead line 60 km long has a capacitance to ground of each line equal to 0.015 micro farad per km. Determine the inductance and KVA rating of the Peterson coil.	*(04)*
2C	With the help of relevant connection diagram and waveforms, explain the parallel current injection method of synthetic testing of circuit breakers.	*(03)*
3A.	Explain with suitable diagram the construction and working of Buchholz relay for transformer protection. Mention its advantages and disadvantages.	*(04)*
3B.	Describe the difficulties encountered in proving differential protection to a power transformer. Also, suggest remedies for each of the listed difficulties.	*(03)*
3C.	With the help of a neat diagram and phasor, explain the construction and working of Induction type directional power relay.	*(03)*
4A.	A 11 kV, 3 phase alternator has full load rated current of 200 A. Reactance of armature winding is 15%. The differential protection system is set to operate on earth fault current of more than 200A. Find the neutral earthing resistance, which gives earth fault protection to 90% of stator winding.	*(03)*

4B. With the help of a relevant diagram and suitable illustrations, explain the protection scheme for a ring main system using definite time overcurrent relays. Also, List the major limitations/demerits in general of over current protection (using overcurrent relay units) of overhead transmission lines. *(03)*

4C. Obtain three zone relay settings for distance protection of transmission line with reactance relays used for the protection of zones '1' and '2' and a mho relay with a characteristic angle of 50° for the third zone, using the following data.

- CT ratio: 3000/5 A
- PT ratio: 220 KV /110V
- Impedance of line 1: $(3+ j\, 5.6)\ \Omega$
- Impedance of line 2: $(4 + j\, 8)\ \Omega$
- Impedance of line 3: $(3.5 + j\, 7.5)\ \Omega$
- Zone 1 covers 80% of line 1
- Zone 2 covers line 1 plus 30% of line 2.
- Zone 3 covers line 1, line 2 plus 15% of line3.

Determine the actual reach of zone 1 and zone 2 relay units for a fault with fault arc impedance of $(1.8 + j\, 0.3)\ \Omega$. *(04)*

5A. Explain the following:

i. The basic principle of operation of a voltage differential (wire pilot) protection of overhead transmission line

ii. The translay scheme of wire pilot protection *(04)*

5B. Describe in brief the causes, consequences of the following abnormal operating conditions on the operation of 3 phase induction motor. Indicate the type of protection normally used to protect the induction motor against each of these conditions.

  i. Supply under voltage
  ii. Stalling
  iii. Phase reversal
  iv. Locked rotor *(03)*

5C. With the help of relevant block diagram and flow chart, describe the working of a numerical (microcontroller based) extremely inverse over current relay. *(03)*