Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKEUP EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: SWITCH GEAR AND PROTECTION [ELE 401]

REVISED CREDIT SYSTEM

Time: 3 Hours | 30 December 2015 | MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A. Describe the Dielectric recovery theory with respect to arc extinction in circuit breakers. ***3***

1B. What is current chopping? With the help of relevant sketch and waveforms, describe the consequences of such an operation on the circuit breaker. ***3***

1C. In a 132kV, 50Hz, 3 phase grounded neutral system, the inductance of each conductor is 16 mH and capacitance of conductor to ground up to the location of circuit breaker is 0.02 μF. For a ground fault with a symmetrical fault current and a power factor of 0.6, determine:

(i) average and maximum values of RRRV
(ii) natural frequency of oscillations
(iii) critical value of resistance
(iv) damped frequency of oscillations, if a resistance of 500 Ω is connected across the contacts of the circuit breaker. ***4***

2A. What are the difficulties encountered in the development of a HVDC circuit breaker? Suggest and explain a relevant method to overcome them. ***3***

2B. With neat connection and timing diagrams, explain the parallel current injection method of testing of circuit breaker. ***4***

2C. A 33 kV, 3 phase, 50 Hz, overhead 60 km line has a capacitance to ground of each line equal to 0.015 μF per km. Determine the inductance and KVA rating of Peterson coil. ***3***

3A. With a neat sketch, describe the construction and operation of a HRC cartridge fuse. Why tin joints are used along with silver for fuse element? ***4***

3B. What are Auto-reclosure circuit breakers? Explain the operation of single shot and double shot type of Auto-reclosure circuit breakers. ***3***

3C. A three phase 15 MVA, 33/11 kV, delta-star connected transformer is protected by differential protection scheme. The CT ratio on HV side is 100/5 A. Determine the CT ratio on LV side for reliable operation of the differential protection. Draw the diagram of the protection scheme. ***3***

4A. With the help of neat diagram, explain the differential current concept used for unit protection scheme. What are its drawbacks and explain how biased differential relay can be employed to overcome these drawbacks. ***4***

4B. What are the consequences of the loss of excitation of an alternator? Explain the protection scheme used to overcome this phenomenon with the aid of relay characteristic on R-X plane. ***3***

4C. With neat connection diagram, explain the use of bi-metal relay to detect single phasing of three phase induction motor. ***3***

5A. With a neat figure, explain the over current protection for ring mains feeder such that only faulty section is isolated without affecting reliability of other sections. ***4***

5B. A transmission line has an impedance of (2.2 +j 5.1) Ω per phase. The ratios of CT and PT used are 400/1 A and 132 kV/110 V respectively. Obtain the impedance relay setting. When fault occurs, the arc resistance across circuit breaker is 0.5 Ω. Determine the percentage length of line that can be protected without ignoring arc resistance. ***3***

5C. Draw and explain the contact timing diagram of 3-zone setting using impedance relays. ***3***

6A. With the aid of relevant connection diagram, explain the differential voltage protection using wired pilot scheme. ***4***

6B. With the help of a relevant block diagram, explain how the direction of fault current can be detected with respect to voltage in static relays. ***2***

6C. Derive the general expression for amplitude comparator in terms of input signals and constants of comparator. Show how an amplitude comparator can also be used for phase comparison. ***4***