Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.Tech (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: SWITCHGEAR AND PROTECTION [ELE 401]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 23, November 2016** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer any **FIVE** questions.
- Missing data may be suitable assumed.
- Graph sheets shall be supplied, if required.

1A. With the help of relevant circuit diagram and waveforms, explain the problems faced by a circuit breaker when it tries to disconnect a transmission line under no load. ***(04)***

1B. A 50 Hz, 13.8 kV, 3 phase synchronous generator with grounded neutral has an inductance of 15 mH/phase and line capacitance to ground of 0.05 μF. When a three phase to ground fault occurs, the power factor is 0.45 with 8% asymmetry in breaking current and 6% reduction in voltage due to armature reaction. Under this condition calculate the following :

(i) Maximum value of restriking voltage and the time at which it occurs
(ii) Maximum value of RRRV
(iii) Time at which the restriking voltage is 25% of the first peak value. ***(04)***

1C. Write a brief technical note on resistance switching with respect to circuit breakers. ***(02)***

2A. With the help of neat sketches of contacts in closed position and open position, describe the construction and principle of operation of single pressure puffer type SF_6 Circuit breaker. ***(04)***

2B. Give reasons for the following with respect to auto-reclosure of circuit breakers:

(i) Auto-reclosure feature is normally provided only for circuit breakers protecting transmission lines
(ii) In case of distribution lines, auto-reclosure is attempted more than once and with sufficient time delay
(iii) In case of EHV lines, though auto-reclosure is rapid, dead time delay is necessary before auto-reclosure is attempted. ***(03)***

2C. With the help of a relevant circuit schematic, describe the method of direct testing of a circuit breaker for its making capacity. ***(03)***

3A. Compare the following:
(i) Fusing current and cut-off current
(ii) Isolator and Earthing switch
(iii) Circuit breaker backup and Relay backup ***(03)***

3B. Show that charging current of healthy phases during single line to ground fault is three times of normal charging current if the neutral is isolated from earth. Hence derive an expression for inductance of arc suppression coil. ***(03)***

3C. A 5 A relay is connected to the secondary of a CT of ratio 300/5 A. The relay operating time is given by $t = \frac{0.15}{PSM^{0.03} - 1} * TMS$. If the actual operating time is 1.26 second for a time multiplier setting of 0.4 when the fault current is 1700 A. Determine the current plug setting of the relay. ***(04)***

4A. Discuss the problems associated with differential protection of a transformer. With a neat sketch, explain the construction and working of Buchholz relay for transformer protection. ***(04)***

4B. What are the consequences of failure of prime mover on the operation of alternator and prime mover? Describe the protection scheme used. Mention the commonly used setting for the operation of this relay. What is the criterion for selecting this setting? ***(03)***

4C. A 400 V, 10 kVA, 3 phase alternator has its synchronous impedance of (2 +j 8) Ω per phase with negligible resistance. The differential protection system is set to operate on earth fault currents of more than 20% of rated current 200 A. Find the neutral earthing resistance, which gives earth fault protection to 90% of stator winding. ***(03)***

5A. With the help of a neat sketch, explain the Translay scheme of wire pilot protection. ***(03)***

5B. A transmission line with an impedance of (10+j 25) Ω per phase is installed with CT and PT of ratio 3500/5 A and 110 kV/110 V respectively for the purpose of protection of 100% length of the line. Obtain the settings for i) Reactance relay ii) Mho relay with a characteristic angle of 40^0 and iii) Impedance relay.
If a ground fault occurs at 95% length of the line with a fault impedance of (0.8+j1) Ω, determine whether the above mentioned relays operate to clear the fault. ***(04)***

5C. Describe the protection scheme to protect Induction Motor against unbalanced supply. ***(03)***

6A. Discuss the merits and demerits of static relays. ***(02)***

6B. With the help of flow chart and relevant block diagram of necessary hardware, explain the working of a microprocessor based impedance relay. ***(04)***

6C. With the help of relevant diagrams and phasor diagrams, prove the duality between amplitude and phase comparators. ***(04)***