Manipal Institute of Technology, Manipal

Reg. No.

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING) **END SEMESTER EXAMINATIONS, NOVEMBER 2015**

SUBJECT: SWITCHGEAR AND PROTECTION [ELE 401]

REVISED CREDIT SYSTEM

26 November 2015

MAX. MARKS: 50

Instructions to Candidates:

- Answer ANY FIVE FULL questions.
- Missing data may be suitably assumed.
- Graph sheets shall be supplied, if required.
- 1A. Discuss the effects of the following on the re-striking voltage: (i) power factor (ii) armature reaction (iii) system neutral connection (iv) line reactance drop.
- 1B. What is resistance switching? Derive the expression for critical resistance in terms of system inductance and capacitance which gives no transient oscillation.
- 1C. A 3 phase, 50 Hz, 100 MVA, 132 kV transformer has a magnetizing current of 5% of its rated current. The inductive reactance of line up to and including magnetising reactance per phase is 9.425 k Ω . The capacitance of line to earth is 2300 pF. The transformer is operating on no load. It is desired to disconnect the transformer from the supply by opening the circuit breaker associated with it. The instantaneous value of magnetizing current at the instant of disconnection is 55% of its peak value. Calculate the maximum RMS voltage that appears across the breaker contacts during the operation.
- 2A. With the help of a neat sketch explain the working of a cross jet explosion pot. State its 3 merits and demerits. 2B. Explain the construction and working of Puffer type SF6 circuit breaker with the aid of sketches before and during arc extinction. 4 3 2C. Draw and explain the layout of a typical laboratory type circuit breaker testing station. 3A. A single line to ground fault occurs in an isolated star connected alternator on no-load. Draw the phasor diagram indicating voltages and charging currents under healthy and faulty conditions. Show that the current in faulty phase is three times that of the healthy charging current. 4 3B. Explain the following terms with respective to fuse: (i)Minimum fusing current, (ii) Prospective current (iii) cut-off current (iv) arcing time Δ 3C. Discuss backup protection scheme of a radial feeder using fuses. 2
- 4A. With the help of neat diagram, explain the construction and working of induction type directional power relay. 4 2
- 4B. Discuss the drawbacks of non-overlapping protection zones of a power system.



Time: 3 Hours



3

4

3

4C. An over current relay with rated current of 5 A is connected to the secondary of a current transformer having a ratio of 400/5 A. The relay is set to an operating current of 125%. The operating time characteristic at rated time setting is shown below:

Plug Setting Multiplier	2	4	6	8	10	12	14
Time of operation in seconds	9	5.8	4.2	3.5	3	2.8	2.5

Determine the time of operation when the fault current is (i) 1500 A, TMS = 0.6 (ii) 4300 A, TMS = 0.8

- 5A. With a neat figure, explain the time graded over current protection for radial feeder using (i) definite time relays (ii) Inverse time relays.
- 5B. A 13.2 kV, 3 phase, 200 MVA alternator has reactance of 0.3 per unit. It is equipped with a circulating current differential protection, set to operate at a minimum current of 600 A. Determine the ohmic value of grounding resistance that can protect 90% of the winding.

2

4

4

2

4

4

5C. A transmission line is divided into three sections with primary impedances as follows: Section-1: (2.5 + j 5) Ω, Section-2: (3.5 + j 7) Ω and Section-3: (3.2 + j 6) Ω C.T: 400/1 A; P.T: 132 kV/110 V

First zone covers 80% of the first line section, second zone covers first line section and 30% of second line section and third zone covers first and second line section and 20% of the third line section.

Obtain the 3-Zone settings for

- (i) impedance relay
- (ii) reactance relay and

(iii) mho relay with a characteristic angle of 30°

Also plot the corresponding characteristics on R-X plane.

- 6A. Sketch and explain the components of carrier protection scheme at any one end of the protected zone. How trip signal is generated only for an internal fault?
- 6B. With the help of a relevant block diagram and flow chart, explain the working of a microprocessor based non directional definite time over current relay.4
- 6C. Show how impedance relay characteristics can be realized using
 - (i) Amplitude comparator (ii) Phase comparator