Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2023

SWITCHGEAR & PROTECTION [ELE 3252]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 27 May 2023** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. A 50 Hz, 11 kV, 3Φ alternator with earthed neutral has a reactance of 6 Ω/phase & is connected to a bus bar through a CB. The distributed capacitance up to CB between phase & neutral is 0.02 μf. Determine

i. Peak re-striking voltage across the contact of the breaker.
ii. Frequency of Oscillations
iii. The average rate of rise of re-striking voltage up to the first peak. ***(03)***

1B. Explain the phenomenon of current chopping with system current and voltage waveforms. What measures are taken to reduce it? ***(03)***

1C. In a short circuit test on a 3 pole 220 kV circuit Breaker, the following observations are made power factor of fault is 0.6, recovery voltage is 0.9 times full line value, the breaker circuit symmetrical and re-striking transient natural frequency is 14 kHz. Determine average RRRV. Assume fault is grounded. ***(04)***

2A. What are the requirements of the contact material for a vacuum circuit breaker? Justify with a suitable example, why is current chopping not a serious problem with such circuit breaker. ***(03)***

2B. An 11 kV, 400 MVA CB suddenly closes on to a fault. Determine:

i. The symmetrical breaking current
ii. The asymmetrical breaking current assuming 40% dc component.
iii. The peak making current as per IEC (Indian electrical commission)
iv. Short time rating ***(04)***

2C. With the help of a relevant one-line diagram of a power system, describe the role of isolators and earthing switch. Mention the sequence of operation of these equipment's along with the circuit breaker, while opening the circuit and closing the circuit. Justify the reason for having this sequence. ***(03)***

3A. With the help of a relevant diagram, highlight the significance of dividing the power system into protection zones. Justify the reason for overlapping adjacent zones of protection. What are the demerits of overlapping adjacent protection zones? Illustrate with an example. ***(03)***

3B. An electrical equipment needs to be protected against overload and short circuit faults using over current relay. The rated current of the equipment is 120A and 20% over load is permissible. The overcurrent relay is connected to protect this equipment through a 100 / 1 A CT. Select a suitable pick up current and thus an appropriate plug (current) setting for the relay. If for a fault current of 12 times the pickup current, the actual time of operation of the relay should be 1.1s, determine a suitable time multiplier setting (TMS), if the relay uses

i. IDMT 1.3 sec characteristics

ii. Extremely Inverse characteristics

iii. Very Inverse characteristics. ***(04)***

3C. With the help of a neat diagram, describe how Buchholz relay protects the transformer against incipient and short circuit faults. Why Buchholz relay alone is not used for the protection of transformer? Discuss. ***(03)***

4A. A 150MVA, 11kV, 3 phase, 50Hz alternator is protected by a current differential protection system. Synchronous reactance of the alternator winding is 40% per phase. The protective relay is set to operate when the out of balance current exceeds 15% of the full load current. Neutral of the alternator is grounded with a resistance of 2Ω. If a ground fault occurs in 'B' phase winding at 10% from the neutral end, will the relay operate? Justify your answer. If the relay does not operate, suggest a suitable grounding resistance to make the relay operate.

Neglect the resistance of the alternator winding. ***(03)***

4B. A transmission line is divided in to 3 section with primary impedances as follows:

Section-I:(2.5+j5) Ω, Section-2: (3.5+j7) Ω and Section-3:(3.2+J6) Ω

C.T:400/1 A; P.T: 132kV/110V

First zone covers 80% of 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

iii. Mho relay with a characteristics angle of 30^0 ***(04)***

4C. with the help of relevant diagram and wave forms explain the phasor comparison method of carrier pilot protection of transmission lines. ***(03)***

5A. What is the effect of single phasing operation of a 3 phase Induction Motor on its performance?

With the help of a neat connection diagram explain the working of single-phase preventer used to protect induction motor against single phasing. ***(04)***

5B. With the help of relevant diagram and phasor diagrams, prove the duality between amplitude and phase comparators. ***(03)***

5C. With the help of block diagram of static relay explain the working of each of its components. Discuss the merits and demerits of static relay. ***(03)***