**Reg. No.** ☐☐☐☐☐☐☐☐☐☐☐☐☐

## B. E / B. TECH.DEGREE EXAMINATION, MAY 2023
Seventh Semester
### EE18701 –PROTECTION AND SWITCHGEAR
*(Electrical and Electronics Engineering)*
**(Regulation 2018 /Regulation2018A)**

**TIME:3 HOURS**                                                                 **MAX. MARKS: 100**

| | |
|---|---|
| **CO1** | Interpret the faults in power system and essential qualities of protection |
| **CO2** | Understand the operation of various electromagnetic relays. |
| **CO3** | Analyze the protection schemes for power system apparatus. |
| **CO4** | Synthesize various relays using static comparators and microcontroller. |
| **CO5** | Analyze the circuit breaker arcing phenomenon and understand the functioning of various types of circuit breakers |

### PART- A(10x2=20Marks)
(Answer all Questions)

| | | CO | RBT LEVEL |
|---|---|---|---|
| 1. | Why protection scheme is needed for Power System? | 1 | 2 |
| 2. | Categorize the IEEE standards for power system protection. | 1 | 2 |
| 3. | Write the Universal torque equation of relays. | 2 | 1 |
| 4. | Why is an under frequency relay required in a power system? | 2 | 4 |
| 5. | Justify, why secondary of transformer should not be opened? | 3 | 4 |
| 6. | What are the advantages of carrier aided protection of transmission lines? | 3 | 2 |
| 7. | In what way the static relays are meritorious than electromagnetic relays? | 4 | 2 |
| 8. | List out the general characteristics of numerical protection. | 4 | 1 |
| 9. | The oil circuit breakers are not suitable for heavy current interruption at low voltages. Justify. | 5 | 2 |
| 10. | A circuit breaker is rated as 1500 A, 1000 MVA, 3 second, 3-phase oil circuit breaker. Find making current. | 5 | 2 |

### PART- B (5x 14=70Marks)

| | | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|---|
| 11. (a) | | Why neutral grounding is provided and compare different types of neutral grounding in power system protection. | (14) | 1 | 4 |
| | | **(OR)** | | | |
| (b) | (i) | What do you understand by zones of protection? Discuss various zones of protection for a modern power system. | (7) | 1 | 4 |
| | (ii) | Analyze the essential qualities of a protective relaying system. | (7) | 1 | 4 |
| 12. (a) | | What are the different inverse-time characteristics of over current relays and mention how these characteristics can be achieved in practice for an electromagnetic relay? | (14) | 2 | 4 |

**(OR)**

**(b)** Explain the operation of i) Negative sequence relay — **(7)** 2 4

ii) Under frequency relay with necessary phasor diagrams — **(7)** 2 4

**13. (a) (i)** Explain with the neat diagram the application of Merz-price circulating current principle for protection of Transformer — **(7)** 3 3

**(ii)** Illustrate with a neat sketch. Explain the protection schemes for motors. — **(7)** 3 3

**(OR)**

**(b) (i)** The neutral point of a three-phase 20 MVA, 11 kV alternator is earthed through a resistance of 5 ohms, the relay is set to operate when there is an out of balance current of 1.5 A. The CTs have a ratio of 1000/5. What is the percentage of winding protected? Also, calculate the earthling resistance required to protect 90% of the winding. — **(7)** 3 3

**(ii)** A 3-phase transformer rated for 33 kV/6.6 kV is connected in star/delta and the protecting CT on the low voltage side have a ratio of 400/5. Determine the ratio of CT on the high voltage side. — **(7)** 3 3

**14. (a)** With the help of block diagram, examine the operation of the numerical relay. — **(14)** 4 4

**(OR)**

**(b)** Develop an application of Artificial Intelligence to power system protection. — **(14)** 4 4

**15. (a)** Describe construction, operating principle and application of vacuum circuit breaker. For what voltage range is it recommended. — **(14)** 5 4)

**(OR)**

**(b)** For a 132 kV system, the reactance and capacitance up to the location of the circuit breaker is 3 Ω and 0.015 respectively. Determine the following
(a) The frequency of transient oscillation
(b) The maximum value of restriking voltage across the contacts of the circuit breaker.
(c) The maximum value of RRRV — **(14)** 5 4

## PART- C (1x 10=10Marks)
(Q.No.16 is compulsory)

| | Marks | CO | RBT LEVEL |
|---|---|---|---|
| **16.** Explain the principle of operation with R-X diagram based on universal torque equation for the following types of distance relays:<br>i) Impedance relay ii) Reactance relay | (10) | 2 | 4 |

**\*\*\*\*\*\*\*\*\***