

# Faculty of Engineering

## End Semester Examination May 2025

### EE3CO46 Power System Protection

<b>Programme</b>	:	B.Tech.	<b>Branch/Specialisation</b>	:	EE
<b>Duration</b>	:	3 hours	<b>Maximum Marks</b>	:	60

**Note:** All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.  
 Notations and symbols have their usual meaning.

#### Section 1 (Answer all question(s))

- |   | <b>Marks CO BL</b>  |
|---|---|
| <b>Q1.</b> Which among these is the most severe fault?  | 1    1    1   |
| <input type="radio"/> Single line to ground fault.<br><input type="radio"/> Line-to-line fault                  | <input type="radio"/> Double line to ground fault<br><input checked="" type="radio"/> Symmetrical fault               |
| <b>Q2.</b> What is the value of zero sequence impedance in line-to-line faults?                                 | 1    1    1   |
| <input type="radio"/> $Z_o = 1$<br><input type="radio"/> $Z_o = 3Z_n$   | <input checked="" type="radio"/> $Z_o = 0$<br><input type="radio"/> $Z_o = \infty$                                    |
| <b>Q3.</b> The voltage appearing across the contacts after the opening of the circuit breaker is called _____.  | 1    1    1   |
| <input type="radio"/> Arc voltage<br><input type="radio"/> Surge voltage  | <input checked="" type="radio"/> Recovery voltage<br><input type="radio"/> Break open voltage                         |
| <b>Q4.</b> In extra voltage lines, which of the following circuit breakers are most suitable?                   | 1    1    1   |
| <input checked="" type="radio"/> SF <sub>6</sub> circuit breakers<br><input type="radio"/> Oil circuit breakers | <input type="radio"/> Air circuit breakers<br><input type="radio"/> Vacuum circuit breakers                           |
| <b>Q5.</b> Which of the following is an instantaneous relay?  | 1    1    1   |
| <input type="radio"/> Induction type<br><input type="radio"/> Thermocouple type                                 | <input type="radio"/> Shaded pole type<br><input checked="" type="radio"/> Permanent magnet moving coil type          |
| <b>Q6.</b> Mho relay is normally used for the protection of:  | 1    1    1   |
| <input checked="" type="radio"/> Long transmission line<br><input type="radio"/> Short length lines             | <input type="radio"/> Medium length lines<br><input type="radio"/> No length criterion                                |
| <b>Q7.</b> The purpose of backup protection is-   | 1    1    1   |
| <input type="radio"/> To increase the speed<br><input type="radio"/> To leave no blind spot                     | <input type="radio"/> To increase the reach<br><input checked="" type="radio"/> To guard against failure of a primary |
| <b>Q8.</b> Pilot wire protection is for-  | 1    1    1   |
| <input type="radio"/> Overhead lines<br><input type="radio"/> Motors  | <input type="radio"/> Transformer<br><input checked="" type="radio"/> Cables  |
| <b>Q9.</b> Lightning arresters are-   | 1    1    1   |
| <input type="radio"/> Surge reflectors<br><input type="radio"/> Surge absorbers                                 | <input checked="" type="radio"/> Surge diverters<br><input type="radio"/> Surge attenuators                           |
| <b>Q10.</b> Which of the following is the protective device against lightning overvoltages?                     | 1    1    1   |
| <input type="radio"/> Rod gaps<br><input type="radio"/> Horn gaps   | <input type="radio"/> Surge absorbers<br><input checked="" type="radio"/> All of the above                            |

#### Section 2 (Answer all question(s))

**Marks CO BL**

**Q11.** Explain symmetrical and unsymmetrical faults in power system. Give example of symmetrical and unsymmetrical faults. 3 2 2

Rubric	Marks
What are symmetrical and unsymmetrical faults in power system?	2
Give example of symmetrical and unsymmetrical faults.	1

**Q12. (a)** Explain the symmetrical component of the power system in short. Explain L-L fault with fault impedance  $Z_F$ . 7 3 3

Rubric	Marks
Explain the symmetrical component of the power system in short.	2
Explanation about the L-L fault with fault impedance $Z_F$	5

**(OR)**

- (b)** A balanced star-connected load takes 100A from a balanced 3-phase, 4-wire supply. If the fuses in the Y and B phases are removed. Find the symmetrical components of the line currents.
- (i) Before the fuses are removed
  - (ii) After the fuses are removed

Rubric	Marks
(i) Before the fuses are removed. the symmetrical components <b>before</b> the fuse removal are: $I_1 = 100 \text{ A}$ , $I_2 = 0 \text{ A}$ , $I_0 = 0 \text{ A}$	3
(ii) After the fuses are removed the symmetrical components <b>after</b> the fuse removal are: $I_0 = 100/3 \text{ A}$ , $I_1 = 100/3 \text{ A}$ , $I_2 = 100/3 \text{ A}$	4

### Section 3 (Answer all question(s))

Marks CO BL

4 2 2

**Q13.** Explain the following terms-

- (a) Restriking voltage
- (b) Recovery voltage

Rubric	Marks
Explanation of Restriking Voltage	2
Explanation of Recovery Voltage	2

**Q14. (a)** Explain the principle of arc extinction in air-blast circuit breaker. Write different methods of arc quenching. 6 3 3

Rubric	Marks
Explain the principle of arc extinction in air-blast circuit breaker	3
Write different methods of arc quenching.	3

**(OR)**

- (b)** Explain the concept of current chopping and resistance switching in circuit breakers.

Rubric	Marks
Explanation about the current chopping in circuit breakers.	3
Explanation about the resistance switching in circuit breakers.	3

### Section 4 (Answer all question(s))

Marks CO BL

**Q15.** Explain the basic principle of operation of a percentage differential relay.

3 2 2

Rubric	Marks
The basic principle of operation of a percentage differential relay.	3

**Q16. (a)** Explain the working of induction-type directional overcurrent relay with a suitable diagram. Also, support the answer with suitable mathematical relationships.

7 3 1

Rubric	Marks
Explanation about the working of induction-type directional overcurrent relay	2
Diagram. of induction-type directional overcurrent relay	2
Also, support the answer with suitable mathematical relationships.	3

(OR)

**(b)** Explain static relays with a suitable block diagram. Also, classify the static relays.

Rubric	Marks
Static Relay block diagram	2
Explanation about static relays	3
classify the static relays.	2

### Section 5 (Answer all question(s))

**Q17.** What are the various abnormal conditions in synchronous generators? Explain any one.

Marks CO BL  
4 2 2

Rubric	Marks
What are the various abnormal conditions in synchronous generators?	2
Explain anyone.	2

**Q18. (a)** Discuss the different transformer faults. What are the various protection schemes available for transformers?

6 3 3

Rubric	Marks
Discuss the different transformer faults.	4
What are the various protection schemes available for transformers?	2

(OR)

**(b)** A 3-phase transformer having a line-voltage ratio of 400V/11kV is connected in star-delta and protective transformers on the 400 V side have a current ratio of 500/5. What must be the ratio of the protective transformers on the 11 kV side.

Rubric	Marks
The required CT ratio for the 11 kV side is 100/5.	6

### Section 6 (Answer any 2 question(s))

Marks CO BL

**Q19.** What are the different types of lightning arrestors? Describe them in detail.

5 2 1

Rubric	Marks
What are the different types of lightning arrestors?	2
Describe them in detail.	3

**Q20.** Explain the phenomena of lightning and protection against lightning.

5 2 2

Rubric	Marks
lightning	2
protection against lightning	3

**Q21.** Explain the differential protection scheme for the protection of the bus bar.

5 2 2

Rubric	Marks
Explain the differential protection scheme for the protection of the bus bar.	5

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