Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 27-05-2025 **Time:** 09:30 am – 12:30 pm

School: SOE	**Program:** B. Tech -EEE	
Course Code : EEE3003	**Course Name:** Switchgear & Protection	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4
Marks	16	40	24	20

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

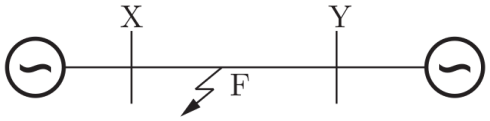
Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

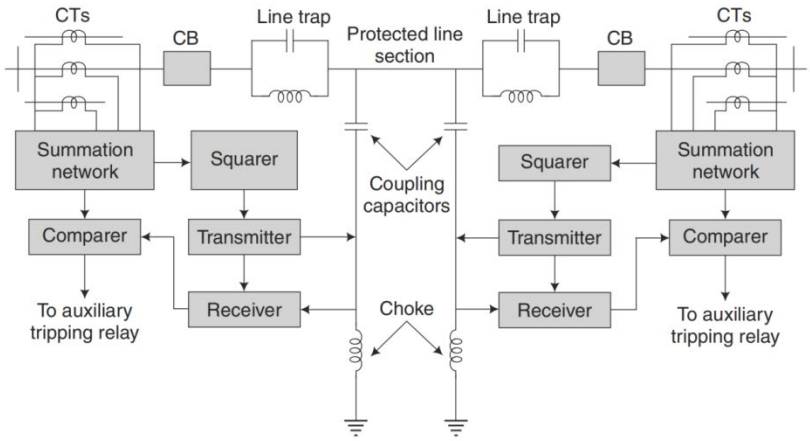
1.	Name two types of fuses	**2 Marks**	**L1**	**CO1**
2.	What is the primary function of a fuse in an electrical circuit?	**2 Marks**	**L1**	**CO1**
3.	List any two key components of a protection system.	**2 Marks**	**L1**	**CO1**
4.	What is an interlocking system.	**2 Marks**	**L1**	**CO1**
5.	What is the purpose of using reactors in a power system.	**2 Marks**	**L1**	**CO1**
6.	Outline any two reasons behind the need for a protection system.	**2 Marks**	**L1**	**CO1**
7.	List any two reasons behind nature and causes of fault in an electrical circuit?	**2 Marks**	**L1**	**CO1**
8.	Recite the importance of Mho Relay.	**2 Marks**	**L1**	**CO3**
9.	List any two control compensation devices.	**2 Marks**	**L1**	**CO1**
10.	Define the concept of Pick up current.	**2 Marks**	**L1**	**CO3**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	The Plug Setting Multiplier (PSM) is a concept used in protective relaying to determine the sensitivity of a relay to detect faults. It is a numerical value that is multiplied by the relay's current setting to	**10 Marks**	**L2**	**CO3**

		establish the threshold at which the relay will trip and initiate protective actions. Explain the calculation process of PSM (Plug Setting Multiplier) and its importance in determining the operational parameters of a relay. Offer instances to demonstrate the utilization of PSM in protective relaying methods.			
	b.	A Power system supplied by two Synchronous generators at the two buses X and Y respectively has been shown below. The Transmission line XY has positive sequence impedance of Z_1 Ohms and zero sequence impedance of Z_0 Ohms. An Single Line to Ground fault with zero fault impedance occurs at the centre of the transmission line in Phase R. Bus voltage at X and line current from X to F for the phase 'R', are given by Va Volts and Ia amperes, respectively. Impedance relay has been installed for the protection of transmission line at bus X. Explain how relay operate for Single Line to Ground as shown in the figure below.  	**10 Marks**	**L2**	**CO3**
Or					
12.	**a.**	During a review meeting, Mr. Arjun was asked to justify the use of a 3-zone distance relay rather than a simpler overcurrent relay system. The panel was particularly interested in how this approach improves system reliability and selectivity during fault conditions. Explain to Mr. Arjun, the advantages of 3-zone distance protection over conventional overcurrent protection?	**10 Marks**	**L2**	**CO3**
	b.	While analyzing fault scenarios in a meshed distribution system, Farooq realized that fault current could come from more than one direction. To prevent false tripping, his mentor suggested configuring the relays with directional sensing. Help Farooq put contrast on how directional relays distinguish the direction of fault current and ensure selective coordination?	**10 Marks**	**L2**	**CO3**
13.	**a.**	While monitoring generator performance, engineer named Harish observed fluctuations in terminal voltage and current during an unbalanced load condition. His team leader recommended checking for negative sequence protection and loss of excitation. Could you help Mr. Rahul put contrast on what negative sequence relaying and loss of excitation relaying are, and how they can affect a generator if not properly protected?	**10 Marks**	**L2**	**CO4**
	b.	While monitoring transformer operations, Ajay noticed a rapid rise in temperature and oil pressure. The plant engineer informed him that a special type of relay could have prevented the escalation. Help Ajay Rahul identify the relay and explain why it is crucial for transformer fault detection?	**10 Marks**	**L2**	**CO4**
Or					

14.	**a.**	Carrier protection, also known as carrier current protection or pilot-wire protection, is a method used in electrical power systems to provide selective and high-speed protection for transmission lines and other critical equipment. It involves the transmission of a carrier signal over the power line itself, typically at a higher frequency than the power frequency, to communicate between relay devices installed at different locations along the line. In the diagram shown below, explain the role of line trap and also the concept behind communication at very high frequency through the power lines in the range of kHz to MHz.  	**10 Marks**	**L2**	**CO4**
	b.	Mr. Akshay was concerned that external faults or inrush currents might cause false trips in the differential protection system. His mentor assured him that modern relays can distinguish between inrush current and internal faults. Could you help Mr. Akshay identify the protection scheme to avoid nuisance tripping during transformer energization? Also explain the operating principle of the relay.	**10 Marks**	**L2**	**CO4**

15.	**a.**	National Thermal Power corporation employed an oil Circuit breaker at the terminals of a 3 Phase 50 Hz alternator which has rated voltage 20 kV connected to circuit breaker, inductance of 10 mH and Capacitance of 2 micro-Farad. After identifying the unknown parameters that could be computed from the given data, Solve for the unknown parameters.	**10 Marks**	**L3**	**CO2**
	b.	The phase to ground capacitance in a 132 kV transmission line commissioned between gulbarga to hubli is 0.01 microfarad. The value of line inductance is 6 Henry. Determine the voltage across the pole of a circuit breaker when a magnetizing current of 10A is abruptly stopped. The air blast circuit breaker is a three-phase device with a rating of 2500A, 1000MVA, operating at 33 kV for a duration of 3 seconds. After identifying the unknown parameters that could be computed from the given data, Solve for the unknown parameters.	**10 Marks**	**L3**	**CO2**
		Or			

16.	**a.**	SF_6 (Sulfur Hexafluoride) circuit breakers are widely used in electrical power systems due to their excellent insulating and arc-quenching properties. Some key applications include: High Voltage and Extra High Voltage (EHV) Power Systems used in 132 kV, 220 kV, 400 kV, and even up to 800 kV power transmission systems. Provides reliable and efficient protection in long-distance transmission lines, Gas-Insulated Substations (GIS), essential for compact, indoor, and space-constrained substations. Put Contrast about the concepts and properties of SF6 circuit breaker.	**10 Marks**	**L2**	**CO2**
	b.	A 3 phase, 50 Hz, $1\frac{1}{2}$ cycle Circuit breaker is interrupting a fault current. The fault current lags voltage by 72 degrees. If circuit breaker contacts get fully opened at voltage zero crossing, Solve for the breaker operating time.	**10 Marks**	**L3**	**CO2**
17.	**a.**	A 60 Hz 3 phase alternator located in NTPC Kaniha with grounded neutral has inductance of 2 mH per phase and is connected to busbar through a circuit breaker. The capacitance to earth between the alternator and the circuit breaker is 0.003 micro-farad per phase. The circuit breaker opens when a current of rms value of 8 kA is flowing through the contacts of the circuit breaker. After identifying the unknown parameters that could be computed from the given data, Solve for the unknown parameters.	**10 Marks**	**L2**	**CO2**
	b.	The phase to ground capacitance in a 220 kV transmission line commissioned between gulbarga to hubli is 0.05 microfarad. The value of line inductance is 3 Henry. Determine the voltage across the pole of a circuit breaker when a magnetizing current of 15 A is abruptly stopped. The SF6 breaker is a three-phase device with a rating of 2500A, 1000MVA, operating at 33 kV for a duration of 3 seconds. After identifying the unknown parameters that could be computed from the given data, Solve for the unknown parameters	**10 Marks**	**L2**	**CO2**
		Or			
18.	**a.**	A Circuit breaker, installed by Power Corporation of Texas Limited, meant for discontinuation of a 220/132 kV, 300 MVA, 60 Hz power transformer during no load condition. Determine the worst condition of overvoltage induced across the contacts of the circuit breaker. The no load current of transformer is 5% of the full load current of the trasnformer. The capacitance of the system is 8,000 pF/phase.	**10 Marks**	**L3**	**CO2**
	b.	Put contrast on the concepts of recovery voltage, active recovery voltage, restriking voltage and prospective voltage with mathematical equations wherever applicable.	**10 Marks**	**L3**	**CO2**