International Islamic University Chittagong
Department of Electrical and Electronic Engineering
B. Sc. Engineering in EEE
Semester End Exam, Autumn 2023

Course Code: **EEE 4801**
Time: 2 hours 30 minutes

Course Title: **Power System protection**
Full Marks: 50

(i) The figures in the right-hand margin indicate full marks
(ii) Course Outcomes and Bloom's Levels are mentioned in additional Columns

CO	CO Statements
CO1	Reflect a basic understanding of switchgear, fuse, protective relay, static and numerical relay, circuit breaker, transformer and alternator protection, bus bar and line protection etc.
CO2	Develop the idea regarding the different types of protection system design
CO3	Demonstrate basic proficiency in building protective system

Bloom's Levels (BL) of the Questions						
Letter Symbols	C1	C2	C3	C4	C5	C6
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Part A

[Answer the questions from the followings]

1. a) "IIUC Substation-3 used VCB as a protective device at the high-tension side." Justify the statement according to its operation and reliability. **CO2** **C4** 5

1. b) In a short circuit test on a circuit breaker, the following readings were obtained single frequency transient: **CO3** **C3** 5
   i) Time to reach the peak re-striking voltage, 20u sec.
   ii) The peak re-striking voltage is 120kV.
   Determine the average RRRV and frequency of oscillations.

2. a) For IIUC substation, design a Buchholz relay based transformer protection scheme. **CO3** **C2** 5

2. b) Design the combined leakage and over load protection for a transformer. **CO2** **C3** 5

OR

2. a) What factors cause difficulty in applying circulating current principle to a power transformer? Design and depict a solution of that problem for a Star-Delta connected Transformer. **CO3** **C2** 5

2. b) A 3-phase, 33/6·6 kV, star/delta connected transformer is protected by Merz-Price circulating current system. If the CTs on the low-voltage side have a ratio of 1000/5, determine the ratio of CTs on the high voltage side. **CO2** **C3** 5

Part B

[Answer the questions from the followings]

3.	a)	For failure of prime mover what will happen for the following cases (*i*)Turbo-alternator at Raouzan thermal electric power plant. (*ii*)Hydro-generator sets at Kaptai hydroelectric power plant (*iii*) Diesel driven alternators at Feni lanka oil based power plant.	**CO3**	**C3**	5
3.	b)	A 100 MVA, 66 kV, 3-phase star-connected alternator is protected by the Merz-Price balance-current system, which operates when the out-of-balance current exceeds 15% of full-load current. Determine what portion of the alternating winding is unprotected if the star point is earthed through a resistance of 11 Ω. The reactance of the alternator is 5 Ω	**CO2**	**C3**	5
4.	a)	Write down the importance of Bus bar protection. Point out the requirements of protection of lines	**CO2**	**C3**	5
4.	b)	Design a time graded over current protection for PGCB grid substations of Chittagong zone.	**CO3**	**C5**	5
5.	a)	Define numerical relay. Design the basic structure or component of numerical relay.	**CO1** **CO3**	**C2** **C3**	5
5.	b)	Formulate an operating algorithm for Digital time over current relay.	**CO2**	**C3**	5

OR

5.	a)	Write down the types of lightning arresters. Design a lightning arrester with nonlinear resistor.	**CO1** **CO3**	**C2** **C3**	5
5.	b)	Suppose a line having neutral impedance of the line Z_n=100kΩ, carries a current of 500 kA (r.m.s) and the break occurs at the moment when current is maximum. Calculate the voltage across the breaker. If 250 kV is the peak value of line Voltage, calculate the maximum voltage the line may subject to at the time of break.	**CO2**	**C3**	5