



U.S.N

P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belagavi)
Sixth Semester B.E. - Electrical and Electronics Engineering
Semester End Examination; August - 2023
Switchgear and Protection

Time: 3 hrs

Max. Marks: 100

Course Outcomes
The Students will be able to:
CO1: Select a fuse and/or a circuit breaker for a given application.
CO2: Distinguish between various types of circuit breakers and analyze the operation principles of circuit breakers and its arc extinction.
CO3: Compare the characteristic of different relays and selection criteria
CO4: Understand and analyze the different protection scheme for Generator
CO5: Understand and analyze the different protection scheme for Transformers and Induction motors.
Note: I) PART - A is compulsory. Two marks for each question.
II) PART - B: Answer any Two sub questions (from a, b, c) for a Maximum of 18 marks from each unit.

Q. No.	Questions	Marks	BLs	COs	POs
I : PART - A		10			
1 a.	A current of 6 A fuses a lead fuse wire of diameter 0.0195 inches. What current will fuse a wire of 0.0392 inch?	2	L2	CO1	PO2
b.	Mention the chemical properties of SF ₆ gas.	2	L1	CO2	PO1
c.	What is the role of TMS in relays?	2	L2	CO3	PO2
d.	The occurrence of short-circuiting between the stator winding is quite rare. Why so?	2	L2	CO4	PO2
e.	Name the two basic requirements that are to be fulfilled by differential relay.	2	L2	CO4	PO2
II : PART - B		90			
UNIT - I		18			
2 a.	Draw the layout of switchgear involving Circuit-breaker, Isolator, Earthing switch, Lightning arrester, Current transformer, and potential transformer. Discuss the functions of each.	9	L2	CO1	PO2
b.	A 50 cycles per second, 3 phase alternator with grounded neutral has inductance of 1.6 mH per phase and is connected to bus bar through a circuit breaker. The capacitance to earth between the alternator and circuit breaker is 0.003 μF per phase. The circuit breaker opens when r.m.s. value of current is 7500 A. Determine the following:	9	L1	CO2	PO2
	i) Maximum rate of rise of restriking voltage				
	ii) Time for maximum rate of rise of restriking voltage				
	iii) Frequency of oscillations				

- c. Explain Slepian's theory of arc interruption and discusses its limitations. How does energy balance theory explain the process of arc interruption? 9 L1 CO2 PO2

UNIT - II**18**

- 3 a. With neat sketch, explain the construction and working of vacuum circuit breaker. What are the advantages and disadvantages of the above? 9 L2 CO2 PO2
- b. Discuss the operating principle of SF₆ circuit breaker. What are its advantages over other types of circuit breakers? For what voltage range is it recommended? 9 L2 CO2 PO2
- c. With a neat figure, explain the construction and working of an axial flow air blast circuit breaker. 9 L2 CO2 PO2

UNIT - III**18**

- 4 a. i) Discuss the essential qualities of a protective relay. 6 L2 CO3 PO2
ii) Explain the concept of primary and back up protection. 3 L2 CO3 PO2
- b. With a neat sketch, explain the construction and operation of induction type Directional over current relay. 9 L2 CO3 PO2
- c. With the help of relevant equation and characteristic, explain the operating principle of a simple impedance relay. 9 L2 CO3 PO2

UNIT - IV**18**

- 5 a. Draw and explain Merz-price protection of alternator stator windings. State its advantages. 9 L2 CO4 PO2
- b. With neat sketch circuit diagram and vector diagrams, explain construction and working of negative sequence relay. 9 L2 CO4 PO2
- c. A star connected three phase, 10 MVA, 6.6 kV alternator is protected by Merz-price circulating current principle using 1000/5 amperes CT. The star point of the alternator is earthed through a resistance of 0.75 Ω. If the minimum operating current for the relay is 0.5 A, Calculate the percentage of each phase of the stator winding which is unprotected against earth-faults, When the machine is operating at normal voltage. 9 L3 CO4 PO2

UNIT - V**18**

- 6 a. What is phasing? Explain how 3-phase induction motor is protected from single phasing with the help of neat sketch. 9 L2 CO4 PO2
- b. Describe the harmonic restraint relay provided to protect power transformers against magnetizing inrush currents. 9 L2 CO4 PO2
- c. With the help of a neat sketch, explain the working of a Buchholz relay for transformer protection. 9 L2 CO5 PO2