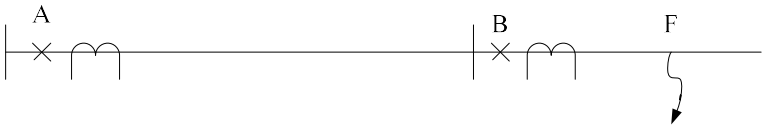
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER: VI**
BRANCH: EEE **SESSION: SP/2024**

SUBJECT: EE401 SWITCHGEAR & PROTECTION

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Justify the following two statements with proper reasoning. Statement I - During normal conditions the magnitude of the current flow depends on the loads and the impedances of network elements. A severe three-phase ground fault occurred, and it disconnects the load, the magnitude of the current increases. Statement II - Arc interruption in AC circuit breaker is difficult because of poor power factor occurring during a fault.	[5]	1	4
Q.1(b)	A circuit breaker interrupts the magnetizing current of a 100 MVA transformer at 220 kV. The magnetizing current is 5% of the full load current. Determine the maximum voltage which may appear across the gap of the breaker when the magnetizing current is interrupted at 53% of its peak value. The stray capacitance is 2500 μF. The inductance is 30 H.	[5]	2	3
Q.2(a)	An earth fault develops at point F on the feeder as shown in figure given below, and the fault current is 16000 A. The IDMT relay at point A and B are fed via 800/5 A CTs. The relay at B has a plug setting of 125% and time multiplier setting of 0.2. The circuit breaker takes 0.20 s to clear the fault, and the relay error in each case is 0.15 s. For plug setting of 200% of the relay A, determine the minimum TMS on that relay for it not to operate before the circuit breaker at B has cleared the fault. At TMS = 1, operating time at various PSM are: PSM - 2 4 5 8 10 16 20 Operating time in (sec) - 10 6 4.8 4.5 3 2.5 2.4 	[5]	2	3
Q.2(b)	The differential protection scheme suffers from some issues, what are those issues and how they affect the operation of the protection scheme? Write the name of schemes used to overcome these issues and hence explain the percentage biased differential protection scheme.	[5]	3	4,1
Q.3(a)	In merz-price protection scheme the CTs used in both ends of the equipment to be protected should be identical and having same turns ratio. Is the condition true for application of the scheme in transformer protection? Justify your answer. There is inherent phase-shift in the Y-Δ wound transformers, while applying the merz-price how this phase shift will affect the protection scheme? To overcome this effect what will you do?	[5]	3	5
Q.3(b)	A three-phase, 11 kV/132 kV, Δ-Y connected power transformer is protected by differential protection. The CTs on the LV side have a current ratio of 500/5. What must be the current ratio of the CTs on the HV side and draw the complete connection diagram.	[5]	3	3

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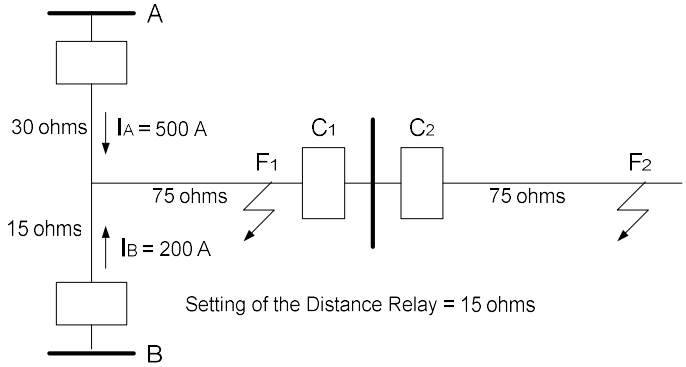
Q.4(a)	In restricted earth fault protection by differential scheme why the term "restricted" is used? A neutral point of a 50 MVA, 11 kV generator is grounded through a resistance of 5 Ω, the relay is set to operate when, there is an out of balance current of 1.5 A. The CTs have a ratio of 1000/5. What percentage of the winding is protected against a ground fault and what should be the minimum value of the grounding resistance to protect 90% of the winding?	[5]	3	3
Q.4(b)	In context of induction motor protection give answer to following questions: i. Write down the voltage and power rating of induction motor above which differential protection scheme is used for its protection. ii. Write the name of two basic protections provided to each motor. iii. To protect the motor from the effect of stalling which relays will you use? iv. An induction motor is supplied through a three-phase, 50 Hz, 11kV supply, due to some external fault two phases are out of order. For this condition will the motor remain running? If yes then, what will happen if motor has no protection against such situation?	[5]	1,5	2
Q.5(a)	In the figure shown below distance protection for a section of a power system is shown. The I zone setting at A and B is 150 ohms.  (i) What will be the impedance seen by the relay at A for a fault at F1? Will the relay at A operate before the circuit breaker at B has tripped? (ii) If the circuit breaker C_2 fails for a fault at F_2, will the fault be cleared by relays at A and B?	[5]	4,5	3
Q.5(b)	With proper labelling draw the schematic diagram of carrier current protection scheme for transmission line. What is the function of line trap and coupling capacitor in this scheme?	[5]	4,5	3

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