Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **B. Tech**
REL6D001

7th Semester Regular/Back Examination 2024-25
ELECTRIC POWER SYSTEM PROTECTION
BRANCH: EEE
Max Marks: 100
Time: 3 Hours
Q.CODE: R099

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right-hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) An overcurrent relay having current setting of 125% is connected to a supply circuit through a current transformer of 400/5 A. Then what is the pick-up current?

b) The currents in a 3-phase unbalanced system are: I_R = (12 + j 6) A; IY = (12 – j 12) A; IB = (–15 + j 10) A. The phase sequence is RYB. What is the zero phase sequence component in R-phase? Briefly explain.

c) What is the main purpose of oil in oil circuit breakers? Briefly explain.

d) Briefly state the importance of anti-aliasing filter in a digital relay.

e) Define the terms: (a) burden (b) operating time of a relay.

f) What is reach defined with respect to a relay? Differentiate between underreach and overreach.

g) Define bias in a biased differential relay.

h) What is the ideal scheme of protection for overhead lines out of time-graded overcurrent protection, distance protection, and differential protection? Briefly explain.

i) What is RRRV? Briefly explain.

j) A transformer is rated at 11 kV/0.4 kV, 500 kVA, 5% reactance. Determine the short circuit MVA of the transformer when connected to an infinite bus.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) In a short circuit test on a 132 kV 3-phase system, the breaker gave the following results: p.f. of the fault 0.4, recovery voltage 0.95 of full line value; the breaking current is symmetrical and the restriking transient had a natural frequency of 16 kHZ. Determine the rate of rise of restriking voltage. Assume that the fault is grounded.

b) The line currents in amperes in phases a, b, and c respectively are 500 + j150, 100 – j600 and – 300 + j600 referred to the same reference vector. Find the symmetrical component of currents.

c) Explain the duality between an amplitude and a phase comparator.

d) A 6.6 kV, 5 MVA star connected alternator has a reactance of 1.5 ohm per phase and negligible resistance. Merz-Price protection scheme is used which operates when the out of balance current exceeds 25% of the full load current. The neutral of the generator is grounded through a resistance of 8 ohms. Determine the proportion of the winding which remains unprotected against earth fault. Show that the effects of the alternator reactance can be ignored.

e) Draw the block diagram of a numerical relay and explain its working principle.

f) Write a short note on Air Brake circuit breaker.

g) Explain -Static distance Protection.

h) Explain clearly the basic principle of operation of a differential relay. Explain the working of this type of relay for an internal fault.

i) Explain the process of 'current chopping' in SF_6 breakers.

j) Explain -Numerical Over-current protection.

k) Explain how arc is initiated and sustained in a circuit breaker when the circuit breaker contacts separate.

l) Write a short note on Minimum Oil Circuit Breaker.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 What is Universal Torque Equation? Using this equation derive the following characteristics: **(1+5 +5+5)**
(i) impedance relay; (ii) reactance relay; (iii) mho relay.
Draw the characteristics and indicate clearly the zones of operation and no-operation.

Q4 Explain the terms (i) restriking voltage; (ii) recovery voltage; and (iii) RRRV. Derive an expression for the restriking voltage in terms of system voltage, inductance and capacitance, across a C.B. contact when a 3-phase fault takes place. Assume the neutral of the system to be solidly grounded. **(2+2+2 +10)**

Q5 **a)** Explain Numerical distance Protection of a Transmission Line. **(8+8)**

b) Explain Numerical Transformer Differential Protection

Q6 **a)** Develop an equivalent network showing the interconnection of sequence networks to simulate a Line-to-ground fault. **(6)**

b) A 25 MVA, 13.2 kV alternator with solidly grounded neutral has a subtransient reactance of 0.25 p.u. The negative and zero sequence reactances are 0.35 and 0.1 p.u. respectively. A single line to ground fault occurs at the terminals of an unloaded alternator; determine the fault current and the line-to-line voltages. Neglect resistance. **(10)**