

B.E. Electrical (Electronics & Power) Engineering (Model Curriculum) Semester-VII
PCC-1 / FE104 - Power System Protection

P. Pages : 3

Time : Three Hours



GUG/S/25/14245

Max. Marks : 80

-
- Notes :
1. All questions carry equal marks.
 2. Due credit will be given to neatness and adequate dimensions.
 3. Assume suitable data wherever necessary.
 4. Illustrate your answers wherever necessary with the help of neat sketches.
 5. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
 6. Read the question paper carefully (Branch, Semester, Scheme) before attempting the questions.
 7. Every question has equal weightage.
 8. Use of programmable calculator is prohibited.
 9. Draw neat and proper diagram/sketches.
 10. Don't use red pen for writing the answers.
 11. Don't write any other comments except answers of questions.

1. a) A 50 Hz, 11 kV, 3 ϕ alternator with earthed neutral has a reactance of 5Ω /phase and is connected to busbar a circuit breaker, The capacitance to earth between the alternator and the circuit breaker is $0.02 \mu F$ /phase. Assuming the resistance of the generator to be negligible calculate the following. **8**
- a) Maximum voltage across the contacts of circuit breaker.
- b) Frequency of oscillations.
- c) The average rate of rise of restriking voltage up to first peak.
- d) Maximum RRRV
- b) Describe the constructional details of vacuum circuit breaker and explain its principle of operation and working. **8**

OR

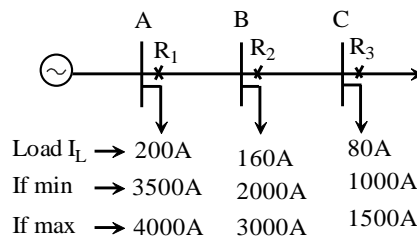
2. a) In a 220 kV system, the inductance and capacitance upto the location of the circuit Breaker are 0.35H and $0.0025 \mu f$. Determine. **8**
- i) The maximum value of restriking voltage.
- ii) The maximum value of RRRV.
- iii) The frequency of transient oscillation
- b) Explain in detail the constructional features, principle of working of SF₆ circuit breaker with a neat diagram **8**

3. a) Explain the following desirable properties of relays. 8
- Sensitivity
 - Speed
 - Selectivity
 - Discrimination.
- b) Justify the following statements. for 30° connections, the torque on the Relay is 1 2 max. Torque (0.5 Tmax) during faulty condition 8

OR

4. a) A radial feeder shown in fig is protected by IDMT relays. The maximum and minimum fault current and load current are indicated in the diagram. Compute the settings of the relay The relay characteristics are given by. 8

PSM	2	3.6	5	8	10	15	20
Time in (sec) for TMS = 1	10	6	3.9	3.15	2.8	2.2	2.1



- b) Explain the terms primary and backup protection. Give suitable examples. 8
5. a) Explain the principle of distance relays stating clearly the difference between impedance relay, reactance relay and MHO relay. 8
- b) Derive the equation for the impedance seen by relay during power swing. Is power swing a fault? Which relay is most suitable for it? 8

OR

6. a) A line section has an impedance of $2.8 + 5j\Omega$. Show this on R-X vector diagram if the relay is adjusted to just operate for a zero impedance short circuit at the end of the line section, show on the same R-X diagram the operating characteristics of:- 8
- An Impedance relay.
 - Reactance Relay.
 - mho Relay used for the purpose.
- Assume that the center of the mho relay operating characteristics lies on the line impedance vector.
- If the arcing short circuit occurs having an impedance of $1.5 + j0$ ohm anywhere along the line, find for each type of distance relay the maximum portion of the line that can be protected.
- b) With the help of suitable example, explain the effect of Infeed on the operation of the distance relay. 8

7. a) A three phase, 11 kV/132 kV, $\Delta - Y$ 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 how should they can be connected. 8
- b) What are the abnormal conditions in a large synchronous generator against which protection is necessary? 8

OR

8. a) An 220 kV, 100MVA generator is provided with differential scheme of protection. The percentage of the generator winding to be protected against phase to ground fault is 90% The relay is set to operate when there is 10% out of balance current. Determine the value of resistance to be placed in neutral to ground connection. 8
- b) Draw and explain bus bar differential protection. 8
9. a) Give the classification of static relay. Draw and explain the block diagram of a static relay indicating it's basic elements. 8
- b) Explain with a neat sketch microprocessor based Impedance Relay. 8

OR

10. a) What is digital message security? Explain in detail. 8
- b) Explain with a neat sketch – 8
- i) Phase comparator
- ii) Amplitude comparator
