

JK LAKSHMIPAT UNIVERSITY, JAIPUR
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November 2017

B. Tech. in Electrical Engineering, Semester V

Roll No.....

EE502: Power System Switchgear & Protection

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. A short-circuit is identified by: (a) no current flow (b) heavy current flow
(c) voltage drop (d) voltage rise
- ii. The fuse rating is expressed in terms of: (a) current (b) voltage (c) VAR
(d) kVA
- iii. In a substation current transformers are used for: (a) Measuring purpose
(b) Protection purpose connecting to relays (c) Both (a) and (b), (d) None of the above
- iv. The function of auxiliary relay is: (a) to carry high fault current (b) to sense the inception of fault
(c) to provide backup (d) none of the above
- v. In a Circuit breaker, the active recovery voltage depends on (a) power factor (b) armature reaction
(c) circuit conditions (d) all of the above
- vi. Current chopping phenomenon is related with:
(a) Resistance switching (b) capacitance switching (c) small inductive current
(d) asymmetrical current
- vii. Reverse power protection is applied for: (a) over speed (b) excitation failure (c) turbine failure
(d) stator earth fault
- viii. The magnetizing inrush current in a transformer is rich in the: (a) second harmonic component
(b) third harmonic component (c) fifth harmonic component (d) seventh harmonic component
- ix. The effect of CT saturation can be reduced by: (a) decrease the cross section of the CT core
(b) increasing the cross section of the CT core (c) changing the CT ratio (d) using identical CTs
- x. Numerical relays are useful for: (a) protection (b) measurement (c) control
(d) All of the above

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- i. Why faults occur in a power system?
- ii. Why is the backup protection used for an alternator?
- iii. Why busbar protection is needed?
- iv. What is the difficulty in the development of HVDC circuit breaker?

Q.3A Why is three overcurrent and one earth fault scheme of protection used for protection of distribution feeders containing transformer instead of two overcurrent and one earth-fault scheme? 05

Q.3B The current rating of a relay is 5 A. PSM = 2, TMS = 0.3, C.T. ratio = 400/5, fault current = 4000 A. Determine the operating time of the relay. At TMS = 1, operating time at various PSM are: 05

PSM :	2	4	5	8	10	20
Operating time in Sec. :	10	5	4	3	2.8	2.4

Q.4A What is a directional overcurrent relay? Discuss a protective scheme for parallel feeders. 05

Q.4B What is frame leakage protection? Discuss its working principle and field of application. 05

Q.5A Explain impedance relay characteristic on the R-X diagram. Discuss the range setting of three impedance relays placed at a particular location. Discuss why the first zone unit is not set for the protection of 100% of the line. 05

Q.5B An 11 kV, 100 MVA alternator is grounded through a resistance of 5 ohm. The CTs have a ratio 1000/5. The relay is set to operate when there is an out of balance current of 1 A. What percentage of the generator winding will be protected by the percentage differential scheme of protection? 05

Q.6A Describe with block diagram the construction and principle of operation of microprocessor based over current relays. 05

Q.6B Why is it difficult to interrupt a fault current with low lagging power factor compared to load current with high power factor? 05

OR

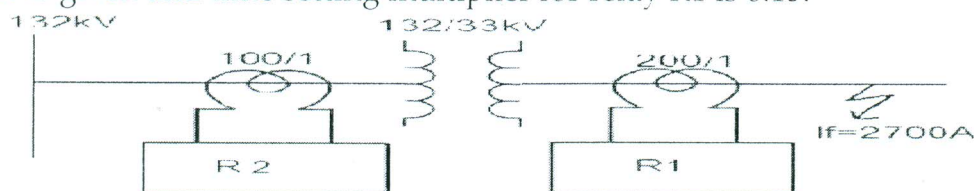
Q.6B What is adaptive relaying? Which feature of numerical relays make them suitable for adaptive relaying? 05

Q.7A Why are distance relays generally preferred to IDMT overcurrent relays for the protection of transmission lines? 05

Q.7B Explain why reactance relay is preferred for the protection of short lines against both, phase faults as well as ground faults. 05

OR

Q.7B With respect to the figures shown, R1 & R2 are set for 100% flux setting. Determine the time of operation of both relays when a time gradient margin of 0.6 sec is given and time setting multiplier for relay R1 is 0.15. 05



Q.8 In a 132 kV system, the reactance and capacitance up to the location of the circuit breaker is 5 ohm and 0.02 μF respectively. A resistance of 500 ohm is connected across the contacts of the circuit breaker. Determine the (a) natural frequency of oscillation, (b) damped frequency of oscillation and (c) critical value of resistance. 10

Q.9A What is meant by 3-zone protection? Give such scheme of protection for (i) short length lines (ii) medium length lines and (iii) long lines. 10

Q.9B Explain the terms (i) restriking voltage (ii) recovery voltage (iii) RRRV. 10
Derive an expression for the restriking voltage in term of system voltage, inductance and capacitance, across a CB contacts when a three phase fault occurs. Assume the neutral of the system to be solidly grounded.

OR

Q.9B Describe the construction, principle of operation and applications of Buchholz relay. Why is this form of protection an ideal protection scheme? 10