

Sixth Semester B.E. Degree Examination, July/August 2002**Electrical & Electronics Engineering
Switchgear & Protection**

Time: 3 hrs.]

[Max.Marks : 100

Note: Answer any FIVE full questions.

1. (a) With a neat sketch explain the time current and 'cut-off' characteristics of HRC fuse. Explain the use of these characteristics in electrical power system. (10 Marks)
(b) Explain the problems involved in interruption of low inductive currents and capacitive circuits. (10 Marks)
2. (a) Explain the arc interruption methods used in high voltage circuit breakers. (10 Marks)
(b) In a short circuit test the breaking current is symmetrical and the restriking transient had a natural frequency of 16kHz. Determine the rate of rise of restriking voltage, if the power factor is 0.4 and the system is 132kV 3 phase grounded one. Recovery voltage is 0.95 of full line value. (10 Marks)
3. (a) Define 'circuit breaker' as applied to electrical power circuits. With a neat sketch explain the working of a vacuum circuit breaker. (10 Marks)
(b) Describe the short circuit tests to be carried out on circuit breaker. (10 Marks)
4. (a) Enumerate the properties of SF₆ gas which render its use in high voltage circuit breakers. With the help of a neat sketch explain briefly working of any one type of SF₆ breaker. (10 Marks)
(b) State and explain briefly the characteristics of good protective relaying. (10 Marks)
5. (a) With a neat sketch explain the working principle of induction disc relay. (10 Marks)
(b) With the aid of a neat diagram explain Buch-helz relay operation for protection of a transformer. (10 Marks)
6. (a) With a neat sketch and vector diagrams explain how a negative phase sequence relay is employed for protection of electrical power system. (10 Marks)
(b) With a neat diagram explain any one method of protecting large size generator rotor against earth faults. (10 Marks)
7. (a) A 3 phase transformer rated for 33kv/6.6kv is connected star/delta and the protecting current transformers on the low voltage side have a ratio of 400/5. Determine the ratio of the current transformers on H.V Side. Draw the connection diagram showing how the relay operates under fault conditions. (10 Marks)

- (b) An alternator rated 10kv protected by balanced circulating current system has its neutral grounded through a resistance of 10 ohms. The protective relay is set to operate when there is an out of balance current of 1.8 amperes in the pilot wires which are connected to the secondary of current transformers with ratio 1000/5.

Determine

- i) The percentage winding which remains unprotected.
- ii) The minimum value of the earthing resistance required to protect 80% of the winding.
(10 Marks)

8. Write short notes on.

- i) Arc quenching in air blast circuit breakers.
- ii) Minimum oil circuit breaker.
- iii) Primary and back up protection in electrical power system.
- iv) Operating principle of distance relay.

(4 × 5=20 Marks)

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Sixth Semester B.E. Degree Examination, July/August 2005

Electrical & Electronics Engineering
Switchgear and Protection

Time: 3 hrs.]

[Max.Marks : 100

- Note:** 1. Answer any FIVE full questions.
 2. Any missing data may be suitably assumed.

1. (a) Define the following terms as applied to circuit breakers.
 - i) Restriking voltage ii) RRRV iii) Recovery voltage. (6 Marks)
- (b) Describe principle of resistance switching and derive an expression for value of critical resistance R_c where L and C are inductance and capacitance per phase of system respectively upto circuit breaker location point. (10 Marks)
- (c) In a 220 KV system, the reactance and capacitance upto the location of circuit breaker is 6 ohms and $0.02\mu f$ respectively. Calculate value of critical resistance for suppressing transient oscillations. (4 Marks)
2. (a) With a neat diagram explain operation of vacuum circuit breakers. State the advantages of vacuum circuit breakers. (10 Marks)
- (b) Describe principle of operation of DC circuit breakers. (6 Marks)
- (c) In a 132 KV system, the inductance and capacitance per phase upto location of circuit breaker is 10H and $0.02\mu f$ respectively. Circuit breaker interrupts a magnetizing current of 15 Amp (rms) due to current chopping. Determine the maximum voltage which appears across contacts of circuit breaker. (4 Marks)
3. (a) With a neat sketch explain synthetic testing (parallel current injection method) of circuit breakers. (8 Marks)
- (b) Define the following with reference to protection system.
 - i) Sensitivity ii) Reliability iii) Selectivity (6 Marks)
- (c) Explain principle of operation of directional over current relay with neat sketch. (6 Marks)
4. (a) Describe principles of differential protection. (5 Marks)
- (b) With neat diagram explain brief zones of protection in typical power system. (5 Marks)
- (c) Explain differential scheme for bus bar protection. What can be drawback of the scheme and how this can be overcome. (10 Marks)

Contd... 2

5. (a) Describe principle of 3 zones distance protection for transmission lines. (8 Marks)
- (b) Explain principles of operation of impedance relays. (6 Marks)
- (c) State different protective schemes provided for protection of generators. (6 Marks)
6. (a) Explain a protection scheme provided against stator internal faults of a generator. (10 Marks)
- (b) Describe protection of motors against unbalance and single phasing. (10 Marks)
7. (a) What are different types of faults that are encountered by power transformers in service. (6 Marks)
- (b) Describe harmonic restraint relay provided to protect power transformers against magnetizing inrush current. (8 Marks)
- (c) Briefly describe Buchholz relay protection for power transformer. (6 Marks)
8. Write short notes on :
- a) Testing of circuit breakers
 - b) principles of power system protection
 - c) Reactance relay
 - d) Carrier aided distance protection (4×5=20 Marks)

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Sixth Semester B.E. Degree Examination, January/February 2006

Electrical & Electronics Engineering
Switch Gear and Protection

Time: 3 hrs.)

(Max.Marks : 100)

Note: Answer any FIVE full questions.

1. (a) What are the basic functions of a circuit breaker? Discuss the theories of arc interruption with respect to a circuit breaker. (6 Marks)
- (b) Discuss the operating principle of SF_6 circuit breaker. What are its advantages over other types of circuit breakers? For what voltage range is it recommended? (8 Marks)
- (c) In a 132 kV system, the reactance per phase upto the location of the circuit breaker is 5Ω and capacitance to earth is $0.03\mu F$. Calculate maximum value of restriking voltage, maximum value of RRRV and the frequency of transient oscillation. (6 Marks)
2. (a) Explain the phenomenon of current chopping in a circuit breaker. What measures are taken to reduce it? (6 Marks)
- (b) What is resistance switching? Derive the expression for critical resistance in terms of system inductance and capacitance, which gives no transient oscillation. (8 Marks)
- (c) In a 132 kV system, the reactance and capacitance upto the location of circuit breaker is 5Ω and capacitance to earth is $0.02\mu F$, respectively. A resistance of 500Ω is connected across the contacts of the circuit breaker. Determine the natural frequency of oscillation, damped frequency of oscillation and critical resistance. (6 Marks)
3. (a) Mention the different types of tests that are performed on a circuit breaker. Explain the parallel current injection method of synthetic testing of a circuit breaker. (8 Marks)
- (b) A 11 kV generator connected through 5 cycle circuit breaker to transformer rated 8000 KVA with the reactances of and $X''_d = 9\%$, $X'_d = 5\%$ and $X_d = 100\%$. It is operating at no load and rated voltage, when 3 phase short circuit occurs between breaker and transformer. Find
 - i) Sustained short circuit current in breaker
 - ii) Initial RMS current in circuit breaker
 - iii) Maximum possible DC component of short circuit current in circuit breaker
 - iv) Momentary current rating of the breaker
 - v) Current to be interrupted
 - vi) Interrupting KVA.(12 Marks)

Contd... 2

4. (a) Define Fuse and explain the issues concerning material selection for fuse elements. (5 Marks)

(b) What are the considerations in selecting a fuse for protection of :

- i) Transformer ii) Motor iii) Capacitors
- iv) Heaters v) Lighting loads.

(5 Marks)

(c) Describe the construction and operation of HRC cartridge fuse. (10 Marks)

5. (a) With the aid of a schematic diagram, explain the construction and operation of a directional overcurrent relay. (6 Marks)

(b) Discuss the overcurrent protection schemes for

- i) Parallel feeders and ii) Ring mains.

(8 Marks)

(c) The current rating of a relay is 5A. PSM=1.5, TMS=0.4, CT ratio=400/5, fault current = 6000A. Determine the operating time of the relay for a TMS=0.4. At TMS=1, operating time at various PSM are :

PSM	2	4	5	8	10	20
Operating time(s)	10	5	4	3	2.8	2.4

(6 Marks)

6. (a) Explain the distance protection by

- i) Impedance relays and ii) Reactance relays.

(10 Marks)

(b) Discuss the protection of induction motors against phase fault, ground fault and abnormal conditions like single phasing, phase reversal and overloading. (10 Marks)

7. (a) Discuss the generator protection schemes against

- i) Stator faults
- ii) Rotor faults and
- iii) Abnormal running conditions.

(12 Marks)

(b) The neutral of a three-phase, 20MVA, 11kV alternator is earthed through a resistance of 5Ω . The relay is set to operate when there is an out of balance current of 1.5A. The CTs have a ratio of 1000/5. What percentage of winding is protected against an earth fault and what should be the minimum value of earthing resistance to protect 90% of the winding? (8 Marks)

8. Write explanatory notes on any FOUR of the following :

- (a) Construction and operation of vacuum circuit breakers
- (b) Operating mechanisms of circuit breakers
- (c) Construction and working of Buchholz's relay
- (d) Differential protection of transformers
- (e) Directional and phase comparison carrier protection schemes.

(4 × 5=20 Marks)

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NEW SCHEME

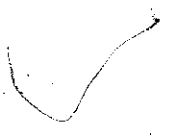
Sixth Semester B.E. Degree Examination, July 2006
Electrical and Electronics Engineering
Switchgear and Protection

Time: 3 hrs.]

[Max. Marks:100

Note: 1. Answer any FIVE questions.

- 1
 - a. Derive expressions for restriking voltage and RRRV in terms of system voltage, inductance voltage and capacitance. (08 Marks)
 - b. For a 132 kV system, the reactance and capacitance up to the location of the circuit breaker are 3Ω and $0.015 \mu\text{F}$ respectively. Calculate the following :
 - i) The frequency of transient oscillation,
 - ii) The maximum value of the restriking voltage across the contacts of the circuit breaker,
 - iii) The maximum value of RRRV. (06 Marks)
 - c. Explain the phenomenon of current chopping in a circuit breaker. (06 Marks)
- 2
 - a. With a neat sketch describe the working principle of an axial air blast type circuit breaker. (10 Marks)
 - b. Describe the working principle of SF_6 circuit breaker. What are its advantages over other types of circuit breakers? For what voltage range is it recommended? (10 Marks)
- 3
 - a. Explain the following with reference to circuit breakers :
 - i) Breaking capacity
 - ii) Making capacity
 - iii) Short-time capacity. (07 Marks)
 - b. With a neat sketch describe the working principle of a liquid fuse. (07 Marks)
 - c. What do you mean by discrimination? Discuss discrimination between
 - i) two fuses and
 - ii) a fuse and a over current relay. (06 Marks)
- 4
 - a. The current ratings of an over current relay is 5A. It has a PSM = 2, TSM = 0.3, C.T. ratio = 400/5, Fault current = 4000 A. Determine the time of operation of the relay assuming normal IDMT characteristics. (04 Marks)
 - b. Explain time graded and current graded system for a feeder. (08 Marks)
 - c. With a neat sketch explain the principle of operation of a non-directional over current relay. (08 Marks)
- 5
 - a. Explain the principle of working and operating characteristics of a percentage biased differential relay. (10 Marks)
 - b. Explain differential scheme of bus bar protection. What can be drawbacks of this scheme and how this can be overcome? (10 Marks)
- 6
 - a. Explain the working principle and characteristics of an impedance relay. (06 Marks)
 - b. Describe the three-zone distance protection of transmission lines. (08 Marks)
 - c. Explain the principle of DC arc extinction in circuit breaker. (06 Marks)
- 7
 - a. List the various abnormal operating conditions against which a modern large turbo-alternator has to be protected. (06 Marks)
 - b. Draw the connection diagram showing differential protection, negative sequence protection, over-current protection and earth fault protection of a Y-connected generator. (08 Marks)
 - c. List the various abnormal operating conditions against which a large induction motor has to be protected. (06 Marks)
- 8
 - a. Explain the working of Buchholz relay. (08 Marks)
 - b. Describe the harmonic restraint relay used to protect transformers. (08 Marks)
 - c. A 3-phase transformer rated for 33 KV/6.6 KV is connected star/delta and the protecting current transformer on the low voltage side have a ratio of 400/5. Determine the ratio of the CT on the HV side. (04 Marks)



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NEW SCHEME

Sixth Semester B.E. Degree Examination, Dec. 06 / Jan. 07
Electrical and Electronics Engineering
Switchgear and Protection

Time: 3 hrs.]

[Max. Marks:100

Note : 1. Answer any FIVE full questions.
 2. Any missing data may be suitably assumed.

- 1 a. How interruption of capacitive currents takes place in AC circuit breakers? Explain. (10 Marks)
- b. From the following data of a 50Hz generator : e.m.f to neutral 7.5 kV (rms), reactance of generator and connected system 4Ω , distributed capacitance to neutral $0.01 \mu\text{F}$ resistance negligible. Find
 - i) The maximum voltage across the contacts of circuit breaker when it breaks a short-circuit current at zero current.
 - ii) The frequency of the transient oscillation and
 - iii) The average rate of rise of voltage up to the first peak of oscillation. (10 Marks)
- 2 a. Explain the working of air blast circuit breaker with reference to
 - i) Axial blast
 - ii) Cross blast. (10 Marks)
- b. Enumerate the properties of SF_6 gas which render its use in high voltage circuit breaker. With the help of a neat sketch explain anyone type of SF_6 breaker. (10 Marks)
- 3 a. Explain the construction, working, advantages and disadvantages of vacuum circuit breakers. (10 Marks)
- b. Write notes on :
 - i) Unit testing
 - ii) Synthetic testing (10 Marks)
- 4 a. Explain with neat sketch the construction and working of HRC fuse. Also explain its properties and characteristics. (10 Marks)
- b. State and explain briefly the characteristics of good relaying. (10 Marks)
- 5 a. Explain with the help of neat diagram, the construction and working of non directional induction type over current relay. Draw and explain its time-current characteristics. (10 Marks)
- b. Explain the working of percentage differential relay. (05 Marks)
- c. Write a note on Frame leakage protection. (05 Marks)
- 6 a. Explain the construction, working, torque equation and operating characteristics of reactance relay. (10 Marks)

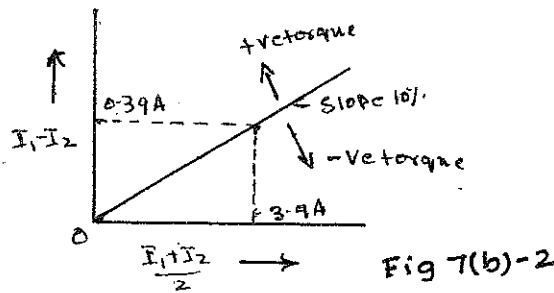
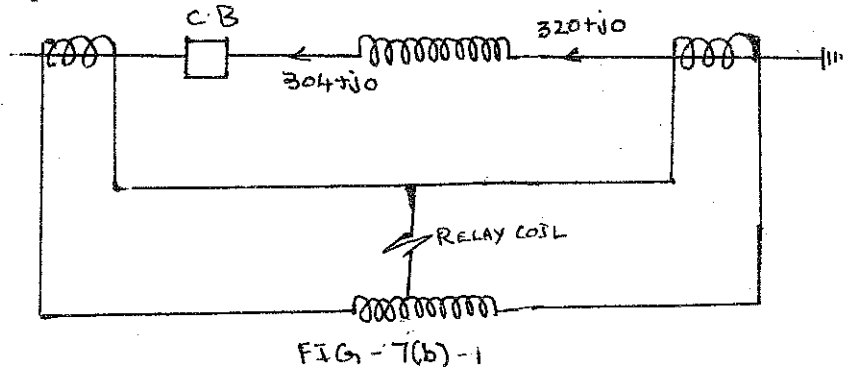
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- b. A line section has an impedance of $2.8 + j 5$ ohms. Show this on R-X diagram as impedance vector. If the relay is adjusted to just operate for a zero impedance short circuit at the end of the line section, show on the R-X diagram the operating characteristics of : i) an impedance relay ii) a reactance relay iii) A mho relay used for the purpose. Assume that the centre of the mho relay operating characteristics lies on the line impedance vector.

If the arcing short circuit occurs having an impedance of $1.5 + j 0$ ohms anywhere along the line, find for each type of distance relay the maximum portion of the line that can be protected. (10 Marks)

- 7 a. Which are the various abnormal running conditions which may exist in a generator? What are the effects? How can it be minimized? (10 Marks)

- b. Fig.7(b)-1 shows percentage differential relay applied to the protection of an alternator winding. The relay has 10% slope of characteristics $(I_1 - I_2) / (I_1 + I_2) / 2$. A high resistance ground fault occurred near the grounded neutral end of the generator winding while generator is carrying load. As a consequence, the current in amperes at each end of the winding is shown in Fig.7(b)-2. Assuming CT ratio of 400/5 amperes, will the relay operate the trip of the breaker?



(10 Marks)

- 8 a. With neat sketch explain the construction and working principle of Buchholz relay. (08 Marks)
- b. Draw and explain the Merz-price protection scheme of star-delta transformer. (04 Marks)
- c. Explain the block diagram of phase comparison method of carrier current protection. (08 Marks)

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NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2007
Electrical and Electronics Engineering
Switch Gear and Protection

Time: 3 hrs.]

[Max. Marks:100

Note : Answer any FIVE full questions.

1.
 - a. Discuss the Recovery rate theory and energy balance theory of Arc interruption in a Circuit Breaker. (06 Marks)
 - b. Derive an expression for Restriking voltage and R R R V. (06 Marks)
 - c. A 50 Hz generator has emf to neutral 7.5 KV (rms). The reactance of generator and the connected system is 4Ω and distributed capacitance to neutral is $0.01\mu F$ with resistance negligible. Find, i) Maximum voltage across the circuit breaker contacts. ii) Frequency of oscillation, f_n iii) R R R V average upto first peak of oscillations. (08 Marks)
2.
 - a. With a neat sketch describe the working principle of an axial air blast type circuit breaker. (10 Marks)
 - b. Describe the working principle of SF6 circuit breaker. What are its advantages over other types of circuit breakers? For what voltage range is it recommended?(10 Marks)
3.
 - a. Explain the differences between fuse and a circuit breaker. (05 Marks)
 - b. Describe the construction and working principles of an H.R.C. fuse. (05 Marks)
 - c. What are the considerations in selecting a fuse for :
 i) Transformer protection ii) Motor protection iii) Capacitor protection
 iv) Heaters v) Lighting loads. (10 Marks)
4.
 - a. Explain in brief the basic requirements of protective relaying. (12 Marks)
 - b. The current ratings of an over current relay is 5A. It has a PSM = 2, TSM = 0.3, CT ratio = 400/5, fault current = 4000 A. Determine the time of operations of the relay assuming normal IDMT characteristics.
 At TSM = 1, the operating time at various PSM : (08 Marks)

PSM	2	4	5	8	10	20
Operating time in secs	10	5	4	3	2.8	2.4

5.
 - a. With a neat diagram, explain the working principle and operating characteristics of a percentage biased differential relay. (10 Marks)
 - b. Explain the differential scheme of bus bar protection. What are the draw backs of this scheme and how can you overcome them? (10 Marks)

Contd...2

- 6 a. Explain the construction, working, torque equation of reactance relay. (10 Marks)
b. Explain the full scheme of protecting a transmission line using an Impedance relay. (10 Marks)
- 7 a. Explain the working of gas operated Buchholz relay used for the protection of a transformer. State its limitations and advantages. (10 Marks)
b. A 3 phase power transformer having a line voltage ratio of 400v to 33kv is connected in Y - Δ . The CTs on 400v side have current ratio 1000/5. What must be the C.T. ratio on 33 kv side? (10 Marks)
- 8 Write short notes on :
a. Testing of circuit breakers.
b. Principles of power system protection.
c. Carrier aided distance protection.
d. Protection against inter - turn faults. (20 Marks)

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Sixth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Switchgear and Protection

Time: 3 hrs.

Max. Marks:100

Note : 1. Answer any FIVE full questions.
 2. Any missing data may be suitably assumed.

1.
 - a. Explain clearly with figure the current interruption in a.c. circuit breaking. Hence define the terms Restriking voltage and Recovery voltage. (08 Marks)
 - b. Derive the expression for R.R.R.V. for circuit breaker. (08 Marks)
 - c. A 50 Hz generator has e.m.f. to neutral 7.5 kV (r.m.s). The reactance of the generator and the connected system is 4Ω and distributed capacitance to neutral is $0.01 \mu\text{F}$ with resistance negligible. Find i) Frequency of oscillations ii) R.R.R.V average upto first peak of oscillation. (04 Marks)
2.
 - a. With waveform explain clearly the interruption of capacitive currents. (06 Marks)
 - b. Explain clearly how the arc is formed and maintained between the contacts of circuit breaker. What are the different methods of arc quenching? Explain. (08 Marks)
 - c. With neat figure, explain Cross Blast type circuit breaker. (06 Marks)
3.
 - a. With neat figure, explain the construction and working of Non – puffer type SF₆ breaker. (08 Marks)
 - b. Explain clearly with neat figure minimum oil circuit breaker. (08 Marks)
 - c. Explain clearly the characteristics of fuse. (04 Marks)
4.
 - a. What is Relay? What are the essential qualities of relay? Explain. (06 Marks)
 - b. Derive the torque equation for Induction type relays. (04 Marks)
 - c. Explain clearly with neat figure the working of non – directional induction type over – current relay. Write the application of over – current relay in power system. (10 Marks)
5.
 - a. Explain clearly the differential protection scheme and what are the difficulties faced in differential protection scheme. (08 Marks)
 - b. With neat figure, explain Frame – leakage protection of bus – bar. (06 Marks)
 - c. Explain Transley relay with figure. (06 Marks)
6.
 - a. What are distance relays? Write the classification. (06 Marks)
 - b. Derive the torque equation for impedance relay and explain its operating characteristics on R – X diagram. Prove $Z = \text{constant}$. (08 Marks)
 - c. Explain with neat figure the Restricted Earth fault protection of generator. (06 Marks)
7.
 - a. Explain clearly the Merz – price protection scheme for protection of power transformer connected in star – delta fashion. (10 Marks)
 - b. A 3 – phase transformer having line voltage ratio of 0.4 kV/11 kV is connected in star – delta and protective transformers on the 400V side have a current ratio of 500/5. What must be the ratio of the protective transformers on the 11 kV side? Assume line current on 400V side is 500 Amperes. (10 Marks)
8. Write short notes on (any four)
 - a. Buchholz relay
 - b. Negative sequence relay.
 - c. Carrier current protection.
 - d. D.C. circuit breaking.
 - e. Resistance switching.

(20 Marks)



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EE63

Sixth Semester B.E. Degree Examination, June/July 08
Switch Gear and Protection

Time: 3 hrs.

Max. Marks:100

Note : Answer any FIVE full questions.

- 1 a. Define :
i) Fuse ii) Rated current of the fuse ii) Fusing current iv) Fusing factor of the fuse. (08 Marks)
b. With neat sketch, explain the HRC fuse and list its advantages and disadvantages. (08 Marks)
c. Define circuit breaker. How they are classified? (04 Marks)
- 2 a. Explain recovery rate theory related to current zero method of arc interruption. (06 Marks)
b. Derive an expression for restriking voltage and rate of rise of restriking voltage of circuit breaker. (07 Marks)
c. For a 132 kV system, the reactance and capacitance upto the location of the circuit breaker is 3Ω and $0.015 \mu\text{F}$ respectively. Calculate the following
i) The frequency of transient oscillation
ii) Maximum value of restriking voltage across the contacts of the circuit breaker and
iii) Maximum value of rate of rise of restriking voltage. (07 Marks)
- 3 a. By analyzing the resistance switching of circuit breaker, derive an expression for critical resistance. (08 Marks)
b. Explain how arc can be extinguished in the circuit breaker. (04 Marks)
c. In a 220 kV system, the reactance and capacitance upto the location of circuit breaker is 8Ω and $0.025 \mu\text{F}$ respectively. A resistance of 600Ω is connected across the contacts of the circuit breaker. Determine the :
i) Natural frequency of oscillation.
ii) Damped frequency of oscillation.
iii) Critical value of resistance, which will give no transient oscillation.
iv) The value of resistance which will give damped frequency of oscillation, one-fourth of the natural frequency of oscillation. (08 Marks)
- 4 a. With a neat sketch explain the operating principle of axial air blast circuit breaker. (06 Marks)
b. Sketch and explain the working principle of sulphur hexa-fluoride circuit breaker. (06 Marks)
c. Explain the procedure adopted in unit test and synthetic testing of circuit breaker. (08 Marks)
- 5 a. Explain making capacity, breaking capacity and short time rating of the circuit breaker. (06 Marks)
b. Define relay. Explain the fundamental requirements of relay. (06 Marks)
c. Define the following relay terminologies :
i) Operating force
ii) Pick-up level
iii) Reset level
iv) Burden. (08 Marks)

- 6 a. Explain with neat sketch the construction and operation of induction type non-directional over current relay. (07 Marks)
 b. Explain with neat sketch the impedance type distance relay. (06 Marks)
 c.

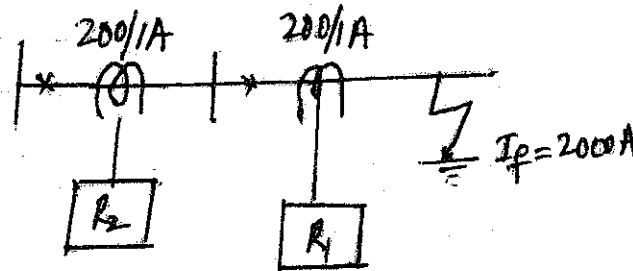


Fig.6(c)

Table

PSM	2	3.6	5	8	10	15	20
Time in Sec.	10	6	3.9	3.15	2.8	2.2	2.1

With reference to Fig.6(c) and tabular column the fault current is 2000A, for discrimination time grading margin between the relays is 0.5 sec, the plug setting multiplier of relay R₁ is 100%, the plug setting multiplier of relay R₂ is 125% and time multiplier setting of relay R₁ is 0.2. Determine the time of operation of the two relays.

(07 Marks)

- 7 a. With the help of neat sketch explain the working of Buchholz relay used for transformer protection. (10 Marks)
 b. Discuss the protection of an alternator against stator winding faults, field failure and rotor faults. (10 Marks)
- 8 Write short notes on :
 a. Primary and backup protection
 b. Current chopping
 c. Vacuum circuit breaker
 d. Negative sequence relay. (20 Marks)

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Sixth Semester B.E. Degree Examination, June-July 2009

Switch Gear and Protection

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. Mention the role of fuse, Isolator, Lad Breaking switch and Earthing switch in a power system network. (08 Marks)
- b. With a neat sketch describe the working of a liquid fuse. (06 Marks)
- c. Explain with neat sketch in brief the construction and working of a HRC fuse. (06 Marks)
- 2 a. Explain how arc is initiated and maintained in a circuit breaker, when its contact separate. (07 Marks)
- b. Discuss the factors on which Restriking voltage depends. (05 Marks)
- c. In a 220 kV system, the reactance and capacitance up to the location of circuit breaker is 8Ω and $0.025 \mu\text{f}$ respectively. A resistance of 600μ is connected across the contacts of the circuit breaker. Calculate the following.
 - i) Natural frequency of oscillation.
 - ii) Damped frequency of oscillation.
 - iii) Critical value of resistance which will give no transient oscillation.
 - iv) The value of resistance which will give damped frequency of oscillation, $1/4^{\text{th}}$ of the natural frequency of oscillation. (08 Marks)
- 3 a. Discuss the phenomenon of current chopping in circuit in circuit breaker. (10 Marks)
- b. With neat sketch explain the working of Air break circuit breaker. (10 Marks)
- 4 a. Discuss the properties of sulphur hexafluoride (Sf_6) gas that makes it superior for application in circuit breaker. (06 Marks)
- b. Explain the construction, working, advantages of vaccum circuit breaker. (10 Marks)
- c. Explain briefly synthetic testing of circuit breaker. (04 Marks)

PART – B

- 5 a. Discuss the various essential qualities of a protective relay. (08 Marks)
- b. With a neat sketch, explain the construction and working of directional type over current relay. (12 Marks)
- 6 a. With neat sketch, explain the working principle and operating characteristics of a percentage biased differential relay. (10 Marks)
- b. With neat sketch, explain the working principle and operating characteristics of a – Distance type Impedance relay. (10 Marks)
- 7 a. Discuss the important faults of an alternator. (10 Marks)
- b. A star connected, 3 – phase, 10 MVA, 6.6kV alternator is protected by Merz – Price circulating current principle using 1000/5 amperes current transformers. The star point of the alternator is earthed through a resistance of 7.5Ω . 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. (10 Marks)
- 8 a. With the help of a neat sketch, explain the working of a Buchholz relay for transformer protection. (10 Marks)
- b. In connection with 3 – phase Induction motor protection, what do you mean by single phasing and phase Rexersal? What is the effect of it and how it is protected? (10 Marks)

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Sixth Semester B.E. Degree Examination, Dec.09/Jan.10

Switch Gear and Protection

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

Part – A

- 1 a. With neat sketch explain the time current and cut-off characteristics of H.R.C fuse. What are the advantages and disadvantages of H.R.C fuse? (12 Marks)
- b. Explain the principle of D.C. circuit breaking. (08 Marks)
- 2 a. Explain the problems involved in interruption of low inductive and capacitive currents. (12 Marks)
- b. In a 220 kV system, the reactance and capacitance up to the location of circuit breaker is 8Ω and $0.025 \mu\text{F}$ respectively. A resistance of 600Ω is connected across the contacts of the circuit breaker. Determine the following:
 - i) Natural frequency of oscillation.
 - ii) Damped frequency of oscillation.
 - iii) Critical value of resistance which will give no transient oscillation.
 - iv) The value of resistance which will give damped frequency of oscillation, $\frac{1}{4}$ th of the natural frequency of oscillation. (08 Marks)
- 3 a. Explain the working of air blast circuit breaker with reference to i) Axial blast ii) Cross blast. (10 Marks)
- b. With neat sketch explain the construction and working of non-buffer type SF₆ breaker. (10 Marks)
- 4 a. With neat sketch explain construction and working of vacuum C.B. What are the advantages and disadvantages of the above? (10 Marks)
- b. With neat circuits, explain briefly the two types of synthetic test on circuit breaker. (10 Marks)

Part – B

- 5 a. What are the basic requirements of protective relaying? Explain briefly. (10 Marks)
- b. With the aid of neat sketch explain the operation of directional over current relay. (10 Marks)
- 6 a. Explain the principle of operation of, i) Percentage differential relay, ii) Voltage balance differential relay. (10 Marks)
- b. With the aid of neat diagram, explain Buchholz relay for protection of transformer. (10 Marks)
- 7 a. Draw and explain the Merz-Price protection of alternator stator windings. State its advantages. (10 Marks)
- b. The neutral point of a 11 kV alternator is earthed through a resistance of 12Ω , the relay is set to operate when there is out of balance current of 0.8 A. The C.T.S have a ratio of 200/5. What percentage of winding is protected against earth faults? What must be the minimum value of earthing resistance required to give 90% of protection to each phase? (10 Marks)
- 8 a. With the aid of neat circuit diagram, explain how protection for induction motor is given by, i) Single phase preventer ii) Ground fault protection. (12 Marks)
- b. A 11 kV/132 kV power transformer is connected in delta-star. The C.T.S on the low voltage side have turns ratio of 600/5. Find the suitable turns ratio for the C.T.S on high voltage side. (08 Marks)



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