ETAP PowerStation - Full suite for
power system analysis and design
Transmission 2000 - Loadflow, Short Circuit, Dynamic Stability, and Relay
Coordination (Academic Version Available)
EDSA - Loadflow, Short Circuit, Relaying, AC and DC systems
(mostly industrial, auto, shipboard)

VIII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OFPROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	1	-	-	-	-	1	2	2
CO2	2	2	1	1	-	1	1	-	-	-	-	1	2	2
CO3	2	2	1	1	-	1	1	-	-	-	-	1	2	2
CO4	2	2	1	1	-	1	1	-	-	-	-	1	2	2
AVG	2	2	1	1	-	1	1					2	2	2

IX. QUESTION BANK:

UNIT I

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Brief discuss the different methods of arc interruption in case of circuit breakers?	Knowledge	2
2	In a short circuit test on 220 kV, 3-phase system with breaker gave the results as: P.f of the fault is 0.6 and recovery voltage is 0.85 times the full line voltage. The breaking current is symmetrical and restriking transient has a natural frequency of 10kHZ. Calculate the RRR V for i) Grounded fault and ii) Ungrounded fault	Derive	3
3	What is meant by circuit breaker? Discuss the phenomenon of arc formation in a CB.	Knowledge	2
4	Explain the concepts of recovery voltage and restriking voltages?	Knowledge	2
5	Discuss the air blast circuit breakers' ratings and its advantages	Knowledge	2
6	Explain the types of SF6 circuit breakers with neat diagrams?	Knowledge	2
7	List out the merits and limitations of air blast circuit breaker?	Knowledge	2

8	Explain the properties of SF6 gas and how it is used for circuit breakers?	Knowledge	2
9	Explain the concept of resistance switching of a circuit breaker with an equivalent circuit?	Applying	2
10	In a short circuit test on a CB, the following readings were obtained on single frequency transient. i) Time to reach the peak restriking voltage is 50μ sec. ii) The peak restriking voltage is 100kV. Find the average RRRV and iii) Frequency of oscillations	Derive	4
11	Describe the principle of operation of air blast circuit breakers?	Knowledge	2
12	Compare the operation of vacuum circuit breaker with SF6 circuit breaker?	Knowledge	2

UNIT II

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	What is an impedance relay? Discuss its principle of operation. Show its characteristics R-X diagram. List out its merits for transmission line protection.	Derive	4
2	Explain the hinged armature type relay with neat sketch?	Knowledge	2
3	Explain about the principle of operation of biased differential relay with necessary equations?	Applying	3
4	Explain about MHO relay and OFF SET MHO relays with their characteristics?	Applying	3
5	Discuss the operating principle of an impedance relay and the draw its Characteristics on R-X plane?	Knowledge	2
6	Explain functions of induction disc relay with neat diagram?	Knowledge	2
7	Explain the operation of induction cup relay with neat diagram?	Knowledge	2
8	What are the various types of over current relay? Discuss the IDMT relays characteristics	Knowledge	2

UNIT III

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain the restricted earth fault protection by differential system in the protection of an alternator winding?	Understanding	2
2	A 11 kV, 100 MVA alternator is grounded through a resistance of 10 ohms. The current transformers have a ratio of 1000/5. The relay is set to operate when there is an	Solving	3

	out of balance current of 0.5 A. Find the percentage of generator winding protected by percentage differential protection?		
3	Discuss the various faults occurred in the transformer and write the protection scheme for each fault?	Knowledge	3
4	Explain the protection device for a transformer that gives protection from internal Faults.	Applying	3
5	A 3 phase, 11/33KV star delta connected power transformer is protected by differential protection. The CTs on the LV side have a current ratio of 300/5. What must be the ratio of CTs on the HV side? Draw the connection diagram?	Applying, Solving	5
6	Explain how the rotor of an alternator will be protected by field ground fault protection?	Knowledge	3
7	Describe the stator protection of alternator by percentage differential protection with neat sketch?	Knowledge	3
8	plain how the transformer is protected from overheating problem?	Knowledge	3
9	Explain how the transformer is protected from overheating problem?	Knowledge	3
10	A 3ϕ, transformer having line voltage ratio 0.4/11 kV is connected in star delta and protective transformer on the 400 V side have a CT ratio of 500/5. What must be the ratio of the protective transformers on the 11kV side?	Applying, Solving	4
11	Explain transverse percentage differential protection for multi winding generators	Knowledge	3
12	A Star connected 3-ϕ, 25MVA, 11kV generator has a per phase reactance of 12%. It is protected by merz-price circulating current principle which is set to operate for fault current not less than 170 A. Find the value of earth resistance to be provided in order to ensure that only 12% of the generator winding remains unprotected.	Applying, Solving	5
13	Explain the protection against magnetizing inrush current of a transformer?	Knowledge	3
14	Draw and explain the connection of current transformer secondaries for differential protection of star delta connected power transformer?	Knowledge	3

UNIT IV

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain the differences between grounded and un grounded neutral systems?	Solving	4
2	Explaineffects of Ungrounded Neutral on system performance?	Solving	4

3	What are the different methods of Neutral Grounding?	Solving	4
4	Explain Solid Grounding method? Write its merits and demerits?	Applying	4
5	Explain Resistance Grounding method? Write its merits and demerits?	Applying	4
6	Explain Reactance - Arcing Grounds method? Write its merits and demerits?	Solving	4
7	What are the different Grounding Practices?		

UNIT V

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain about the valve type and zinc oxide type lightning arresters?	Applying	3
2	Why is insulation coordination needed in a large power system? What is meant by basic impulse level of equipment?	Solving	3
3	Explain the resistance grounding with circuit diagram and phasor diagrams? List out its merits and demerits.	Solving	3
4	Explain the concept of arcing grounds in the power system and derive the necessary expressions.	Derive	4
5	Draw the volt time characteristics of impulse test wave and mark the flash over voltages?	Applying	3
6	Explain how the over voltages are generated in the power system?	Applying	3
7	what are the methods that are used to give protection against over voltages in the power system?	Applying	3

OBJECTIVE QUESTIONS:
FILL UP THE BANKS:
UNIT-I
1. In a circuit breaker the contact space is ionized by_____.
2. _____should be the value of fusing factor?
3. _____is the relation between the fusing current and the diameter of the wire.
4. The making and breaking currents of a 3 phase ac circuit breakers in power systems are respectively in _____form.
5. _____circuit breaker is preferred to be installed in extra high voltage AC system?

UNIT-II
1. _____ relay is preferred for phase fault on short transmission line.
2. The under voltage relay can be used for_____.
3. _____ is the purpose of back up protection.
4. The torque produced in induction type relay (shaded pole structure) is inversely proportional to the square of the _____.
5. Induction cup relay is operated due to changes in_____.
UNIT-III
1. Unbalancing of an alternator may occur due to _____.
2. Bias is used in the relay protection to _____.
3. A longitudinal differential protection on _____can detect inter-turn on the stator.
4. We need the biasing of differential relay biased to avoid mal operation when used for transformer protection due to _____.
5. A feeder, in a transmission system, feeds power to _____.

UNIT-IV

1. When the 3-phase system is not grounded and if Single Line to Ground fault occurs, the voltage of the other two healthy phases will_____.

2. Factors on which soil resistance depends_____.

3. Solid grounding is adopted for voltages below_____.

5

UNIT-V

1. Over voltage protection is recommended for_____.

2. Wave trap is used to trap waves of _____.

3. Ungrounded neutral transmission system is not recommended because of system_____.

4. For the protection of power station buildings against direct strokes the requirements are

   _____.

   5. Negative sequence currents is provided for _____.

MULTIPLE CHOICE QUESTIONS:

UNIT-1

 1. What is the average rate of rise of restriking voltage upto the first peak?

a. $525 * 10^3$kV / sec   b. $453 * 10^3$kV / sec   c. $582 * 10^3$ kV / sec d. $467 * 10^3$ kV / sec

Answer. b

2. Circuit breakers usually operate under

a. Steady short circuit current   b. Sub transient state of short circuit current

c. Transient state of short circuit current   d. None of these

Answer. B

3. What is the making capacity of the circuit breaker?

a. Less than the asymmetrical breaking capacity of the breaker

b. Greater than the asymmetrical breaking capacity of the breaker

c. Equal to the asymmetrical breaking capacity of the breaker

d. Equal to the symmetrical breaking capacity of the breaker

Answer. B

4. SF6 is which type of gas?

a. Electro positive   b. Electro negative   c. Both (a) and (b)   d. None of these

Answer. c

5. A three phase, 33 kV oil circuit breaker is rated 1200 A, 2000 MVA, 3s. What is its symmetrical breaking current?

a. 1200 A   b. 3600 A   c. 35 kA   d. 104.8 kA

Answer. c

UNIT.2

 1. What is the actuating quantity for the relays?

a. Magnitude   b. Frequency   c. Phase angle   d. All of these

Answer .d

2. The most efficient torque producing actuating structure for the induction type relays is

a. Shaded pole structure   b. Watt hour meter structure   c. Induction cup structure

d. Single induction loop structure

Answer. c

3. Plug setting of a electromagnetic relay can be altered by varying

a. Number of ampere turns   b. Air gap of magnetic path   c. Adjustable back stop

d. None of these

Answer .a

4. On what factor does the operating speed of the relay depend?

a. Rate of flux built up   b. Armature core air gap   c. spring tension   d. All of these

Answer. d

5. Admittance relay is _____ relay.
   (a) Impedance   (b) directional   (c) non-directional   (d) none of the above
   Answer. b

UNIT-3

1. Protective relays can be designed to respond to _____.

a. Light intensity, impedance   b. Temperature, resistance, reactance   c. Voltage and current   d. All of these

Answer. D

2. A thermal protection switch provides protection against what?

a. Overload   b. Temperature   c. Short circuit   d. Over voltage

Answer. d.

3. What does protective relay provide?

a. Provide additional safety to the circuit breaker in its operation.

b. Close the contacts when the actuating quantity attains a certain predetermined value.

c. Limit the arcing current during the circuit breaker operation.

d. Earth or ground any stray voltage.

Answer. b

4. Large internal faults are protected by

   a. Merz-price percentage differential b. Mho and ohm relays
   c. Horn gaps and temperature relays   d. Earth fault and positive sequence relays
   Answer. a

5. A three phase transformer having a line voltage ratio of 400/33000 V is connected in the star-delta. The CTs on the 400V side have a CT ratio of 1000/5. What will be the current through the pilot wire?
   a) $5\sqrt{3}$ A   b) $5/\sqrt{3}$ A   c) 5 A   d) 1/5 A
   Answer. a

UNIT-IV

1. Generally grounding is provided for

a. only for the safety of the equipment

b. only for the safety of the operating personnel

c. both (A) and (B)

d. none of the above

Answer .c

2. Ground resistance should be designed such that

a. grounding resistance should be as low as possible

b. grounding resistance should be as high as possible

c. grounding resistance should be always zero

d. none of the above

Answer .b

3. The objective of earthing or grounding is

a. to provide as low resistance possible to the ground

b. to provide as high resistance possible to the ground

c. to provide flow of positive, negative and zero sequence currents

d. none of the above

4. Earth wire or ground wire is made of

a. copper   b. aluminium   c. iron   d. galvanized steel

Answer.d

5. Average resistance of human body is

a. 500 ohms   b. 1000 ohms   c. 1500 ohms   d. 2000 ohms

Answer .b.

UNIT-V

1. Per cent bias for a generator protection lies between

a) 5 to 40   b) 40 to 45   c) 45 to 20   d) None of the above

Answer. a

2. Fault diverters are basically

(a) fuses   (b) relay   (c) fast switches   (d) circuit breakers

Answer. c

3. Which of the following devices will receive voltage surge first travelling on the transmission line?

(a) Lightning arresters   (b) Relays (c) Step-down transformer   (d) Switchgear

Answer. a

4. To limit short-circuit current in a power system are used.

(a) Earth wires (b) isolators (c) H.R.C. fuses   (d) reactors

Answer. d.

5. Fuse in a motor circuit provides protection against

(a) overload   (b) short-circuit and overload   (c) open circuit, short-circuit and overload

(d) none of the above

Answer.b.

GATE:

1. A negative sequence relay is commonly used to protect (2011)

a. An alternator   b. A transformer   c. A transmission line   d. A busbar

2. In a biased differential relay the bias is defined as a ratio of (2005)

a. Number of turns of restraining and operating coil

b. Operating coil current and restraining coil current

c. Fault current and operating coil current

d. Fault current and restraining coil current

3. The transmission line distance protection relay having the property of being inherently directional is (2006)

a.   impedance relay   b. MHO relay   c. OHM relay   d. reactance relay

4. A -phase transformer rated for 33kv/11kv is connected in delta/star as shown in figure. The current transformers on low and high voltage sides have a ratio of 500/5. Find the currents and , if the fault current is 300 A as shown in figure (2015)

a. i $1/1\sqrt{3}$ A, i $2 = 0$ A   b. i $1 = 0$ A, i $2 = 0$ A   c. .i $1 = 0$ A, i $2 = $ A $1\sqrt{3}$ d. i $1 = 1/1\sqrt{3}$ /A, i $2 = 1/1\sqrt{3}$ A

5. Consider a stator winding of an alternator with an internal high resistance ground fault. The currents under the fault condition are as shown in the figure. The winding is protected using a differential current scheme with current transformers of ratio 400/5400/5 AA as shown. The current through the operating coil is   (2011)

a. 0.1875 A   b. 0.2 A   c. 0.375 A   d. 60 kA

X.WEBITES:
1. https://nptel.ac.in/courses/108/101/108101039/.
2. https://www.vidyarthiplus.com/vp/Thread-EE2402-EE6702-Protection-Switchgear-Hand-Written-Lecture-Notes-All-Units-Lavanya-Edition#.XeYD7YMzbIU

XI. EXPERT DETAILS:
1. Dr. A.Jayalakshmi, Professor, JNTUH
2**.** Dr. Suryakalaavthi,, Professor, JNTUH

XII. JOURNALS:
1. IEEE Transactions on Industry and General Applications.
2. Springer Protection and Control of Modern Power Systems.

XIII. LIST OF TOPICS FOR STUDENTS SEMINARS:
1. Circuit breakers.
2. Electromagnetic and Static Relays.
3. Generator protection
4. Transmission line protection

XIV. CASE STUDIES/SMALL PROJECTS:
1. Microprocessor based relay protection.
2. Transformer protection.