



**Maratha Vidya Prasarak Samaj's**

**Rajarshi Shahu Maharaj Polytechnic, Nashik**

**Udoji Maratha Boarding Campus, Near Pumping Station, Gangapur Road, Nashik-13.**

**Affiliated to MSBTE Mumbai, Approved by AICTE New Delhi, DTE Mumbai & Govt. of Maharashtra, Mumbai.**

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***Subject: - Switchgear and Protection (22524)***



# SYLLABUS

<b>Chapter No.</b>	<b>Name of chapter</b>	<b>Marks With Option</b>
<b>1</b>	<b>Basics of Protection.</b>	<b>12</b>
<b>2</b>	<b>Circuit Interrupting Devices.</b>	<b>26</b>
<b>3</b>	<b>Protective Relays.</b>	<b>26</b>
<b>4</b>	<b>Protection of Alternator and Transformer.</b>	<b>20</b>
<b>5</b>	<b>Protection of Motor, Busbar and Transmission Line.</b>	<b>18</b>
<b>Total Marks :-</b>		<b>102</b>

# BOARD THEORY PAPER PATTERN

<b>Q.1</b>	<b>Attempt any FIVE</b>	<b>5*2=10</b>	
	a) <b>Basics of Protection.</b>		<b>CO-524.01</b>
	b) <b>Basics of Protection.</b>		<b>CO-524.01</b>
	c) <b>Circuit Interrupting Devices.</b>		<b>CO-524.02</b>
	d) <b>Protective Relays.</b>		<b>CO-524.03</b>
	e) <b>Protection of Alternator and Transformer.</b>		<b>CO-524.04</b>
	f) <b>Protection of Motor, Busbar and Transmission Line.</b>		<b>CO-524.05</b>
	g) <b>Protection of Motor, Busbar and Transmission Line.</b>		<b>CO-524.05</b>
<b>Q.2</b>	<b>Attempt any THREE</b>	<b>3*4=12</b>	
	a) <b>Basics of Protection.</b>		<b>CO-524.01</b>
	b) <b>Circuit Interrupting Devices.</b>		<b>CO-524.02</b>
	c) <b>Protective Relays.</b>		<b>CO-524.03</b>
	d) <b>Protection of Alternator and Transformer.</b>		<b>CO-524.04</b>
<b>Q.3</b>	<b>Attempt any THREE</b>	<b>3*4=12</b>	
	a) <b>Basics of Protection.</b>		<b>CO-524.01</b>
	b) <b>Circuit Interrupting Devices.</b>		<b>CO-524.02</b>
	c) <b>Protective Relays.</b>		<b>CO-524.03</b>
	d) <b>Protection of Alternator and Transformer.</b>		<b>CO-524.04</b>
<b>Q.4</b>	<b>Attempt any THREE</b>	<b>3*4=12</b>	
	a) <b>Circuit Interrupting Devices.</b>		<b>CO-524.02</b>
	b) <b>Protective Relays.</b>		<b>CO-524.03</b>
	c) <b>Protection of Alternator and Transformer.</b>		<b>CO-524.04</b>
	d) <b>Protection of Motor, Busbar and Transmission Line.</b>		<b>CO-524.05</b>
	e) <b>Protection of Motor, Busbar and Transmission Line.</b>		<b>CO-524.05</b>
<b>Q.5</b>	<b>Attempt any TWO</b>	<b>2*6=12</b>	
	a) <b>Circuit Interrupting Devices.</b>		<b>CO-524.02</b>
	b) <b>Protective Relays.</b>		<b>CO-524.03</b>
	c) <b>Protection of Alternator and Transformer.</b>		<b>CO-524.04</b>
<b>Q.6</b>	<b>Attempt any TWO</b>	<b>2*6=12</b>	
	a) <b>Circuit Interrupting Devices.</b>		<b>CO-524.02</b>
	b) <b>Protective Relays.</b>		<b>CO-524.03</b>
	c) <b>Protection of Motor, Busbar and Transmission Line.</b>		<b>CO-524.05</b>



# SAMPLE QUESTION PAPER

<b>Q.1</b>	<b>Attempt any Five of the following</b>	<b>08 Marks</b>	
a	Classify current limiting reactors based on location.		<b>CO-524.01</b>
b	Differentiate between symmetrical and unsymmetrical faults .(any two points)		<b>CO-524.01</b>
c	Define i) making capacity ii) short time rating of circuit breaker.		<b>CO-524.02</b>
d	State any two disadvantages of static relays.		<b>CO-524.03</b>
e	List any four faults occurs in alternator.		<b>CO-524.04</b>
f	State any four abnormalities in induction motor.		<b>CO-524.05</b>
g	List protection schemes used for the bus-bar.		<b>CO-524.05</b>
<b>Q.2</b>	<b>Attempt any Three of the following.</b>	<b>12 Marks</b>	
a	With the help of suitable diagram explain the importance of back-up protection.		<b>CO-524.01</b>
b	Define the following terms related to current interrupting devices: i) arc voltage, ii) re-striking voltage, iii) recovery voltage and iv) RRRV		<b>CO-524.02</b>
c	Explain PSM and TSM related to protective relays.		<b>CO-524.03</b>
d	A 220V/22kV three phase transformer is connected in star/ delta. The protective transformers on 220V side have current ratio of 400/5. Calculate the CT ratio on 22kV side.		<b>CO-524.04</b>
<b>Q.3</b>	<b>Attempt any Three of the following.</b>	<b>12 Marks</b>	
a	Two 11 KV, three phase 2500 KVA generators having reactance of 12% operate in parallel. The generators supply power to a transmission line through a 6000 KVA transformer of ratio 11/22 KV and having leakage reactance of 4%. Calculate fault KVA on H.T. side of transformer.		<b>CO-524.01</b>
b	Compare HRC fuse with MCCB on the following points.(i) size ii) cost (iii) reliability iv) applications c) With neat		<b>CO-524.02</b>
c	sketch explain working of directional over current relay		<b>CO-524.03</b>
d	The neutral point of a three phase 18MVA, 11kV alternator is earthed through a resistance of 4.5 $\Omega$ . The relay is set to operate when there is an out of balance current of 1.4A. The CTs have a ratio of 1000/5. What is the percentage of winding protected?		<b>CO-524.04</b>
<b>Q.4</b>	<b>Attempt any Three of the following.</b>	<b>12 Marks</b>	
a	Compare the MCCB with ELCB on any three points. State the application of the RCBO.		<b>CO-524.02</b>



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	b	Explain time-current characteristics of IDMT relay.	CO-524.03
	c	List four limitations of differential protection scheme for transformer.	CO-524.04
	d	Explain with sketch protection of 3-phase induction motor during single phasing.	CO-524.05
	e	Explain with neat sketch fault bus protection scheme.	CO-524.05
<b>Q.5</b>		<b>Attempt any Two of the following.</b>	<b>12 Marks</b>
	a	With the help of neat sketches explain the construction and working of vacuum CB.	CO-524.02
	b	With the help of block diagram explain the sequence of operation for microprocessor based over current protection.	CO-524.03
	c	A three phase transformer having line voltage ratio of 0.4 kV/11kV is connected Star / Delta and protective transformers on the 0.4 kV side have a current ratio of 500/5. Calculate the ratio of the protective transformers on 11 kV side. Draw a neat circuit diagram and indicate the given values at appropriate places.	CO-524.04
<b>Q.6</b>		<b>Attempt any Two of the following.</b>	<b>12 Marks</b>
	a	Explain with neat sketch pantograph type of isolator. State the sequence of operation of isolator, CB and earthing switch while opening and closing.	CO-524.02
	b	Explain any six quality requirements for better protective relaying.	CO-524.03
	c	With the help of neat sketch explain the operation of distance protection scheme for the transmission line.	CO-524.05



## CLASS TEST - I PAPER PATTERN

### Syllabus:-

Unit No.	Name of the Unit	Course Outcome (CO)
1	Basics of Protection.	CO-524.01
2	Circuit Interrupting Devices.	CO-524.02

Q.1	Attempt any FOUR	4*2=8Marks	Course Outcome (CO)
a)	Basics of Protection.		CO-524.01
b)	Basics of Protection.		CO-524.01
c)	Basics of Protection.		CO-524.01
d)	Circuit Interrupting Devices.		CO-524.02
e)	Circuit Interrupting Devices.		CO-524.02
f)	Circuit Interrupting Devices.		CO-524.02
Q.2	Attempt any THREE	3*4=12 Marks	
a)	Basics of Protection.		CO-524.01
b)	Circuit Interrupting Devices.		CO-524.02
c)	Circuit Interrupting Devices.		CO-524.02
d)	Circuit Interrupting Devices.		CO-524.02
e)	Circuit Interrupting Devices.		CO-524.02

## SAMPLE CLASS TEST - I PAPER

Q.1	Attempt any FOUR <span style="float: right;">4*2=8Marks</span>	Course Outcome (CO)
a.	State any four causes of faults in power system.	CO-524.01
b.	State the function of current limiting reactor.	CO-524.01
c.	State the difference between normal and abnormal conditions in power system.	CO-524.01
d.	List any two advantages and two disadvantages of vacuum circuit breaker.	CO-524.02
e.	State the factors to be considered while selecting MCCB for motor protection.	CO-524.02
f.	State the need of insulation coordination	CO-524.02
Q.2	Attempt any THREE <span style="float: right;">3*4=12 Marks</span>	
a.	Two 11kV, 3 phase, 5000kVA generators each having reactance of 20% operate in parallel. The generators supply power to transmission line through 3000kVA transformer of ratio 22kV/33kV having leakage reactance of 6%. Calculate Fault kVA on H.T. side of transformer.	CO-524.01
b.	Compare HRC fuse and Circuit breakers as interrupting devices on any four points.	CO-524.02
c.	Describe with neat sketch the arc extinction in SF <sub>6</sub> circuit breaker.	CO-524.02
d.	Define following terms related to CB: i) Rated normal current ii) Rated breaking current iii) Short time rating iv) Symmetrical breaking current	CO-524.02
e.	With the help of neat sketch explain the working of ELCB.	CO-524.02

## CLASS TEST - II PAPER PATTERN

### Syllabus:-

Unit No.	Name of the Unit	Course Outcome (CO)
1	Protective Relays.	CO-524.03
2	Protection of Alternator and Transformer.	CO-524.04
3	Protection of Motor, Busbar and Transmission Line.	CO-524.05

Q.1	Attempt any FOUR	4*2=8Marks	Course Outcome (CO)
a)	Protective Relays.		CO-524.03
b)	Protective Relays.		CO-524.03
c)	Protective Relays.		CO-524.03
d)	Protection of Alternator and Transformer.		CO-524.04
e)	Protection of Alternator and Transformer.		CO-524.04
f)	Protection of Motor, Busbar and Transmission Line.		CO-524.05
Q.2	Attempt any THREE	3*4=12 Marks	
a)	Protective Relays.		CO-524.03
b)	Protective Relays.		CO-524.03
c)	Protection of Alternator and Transformer.		CO-524.04
d)	Protection of Alternator and Transformer.		CO-524.04
e)	Protection of Motor, Busbar and Transmission Line.		CO-524.05



## SAMPLE CLASS TEST - II PAPER

Q.1	Attempt any FOUR <span style="float: right;">4*2=8Marks</span>	Course Outcome (CO)
a)	Define the terms related to Protective Relay : (i) Selectivity (ii) Sensitivity	CO-524.03
b)	State the principle of distance relaying.	CO-524.03
c)	State any four advantages of static over current relay over electromagnetic relay.	CO-524.03
d)	State the need of over voltage relay in power system.	CO-524.04
e)	List any four faults occurring in alternators.	CO-524.04
f)	State the difference between short circuit and overload.	CO-524.05
Q.2	Attempt any THREE <span style="float: right;">3*4=12 Marks</span>	
a)	With a neat sketch explain solenoid type over current relay.	CO-524.03
b)	State any four salient features of microprocessor based protection relay. Draw block diagram of microprocessor based over current relay.	CO-524.03
c)	Explain the conditions for setting up negative phase sequence currents in an alternator. Draw the protective scheme to detect them and operate the CB.	CO-524.04
d)	A three phase 66/11 kV, star-delta connected transformer is protected by Merz-Price protection. The CTs on LT side have a ratio of 420/5. Find the ratios of the CTs on the HT side. Draw the neat labelled connection diagram of the complete scheme.	CO-524.04
e)	Describe with neat diagram, the time graded over current protection of transmission line. State its drawbacks.	CO-524.05



# **COURSE OUTCOME (CO)**

**COURSE: - SWITCHGEAR AND PROTECTION (22524)**

**PROGRAMME: - ELECTRICAL ENGINEERING.**

<b>CO. NO</b>	<b>Course Outcome</b>
<b>CO-524.01</b>	Identify various types of faults in power system.
<b>CO-524.02</b>	Select suitable switchgear for different application.
<b>CO-524.03</b>	Test the performance of different protective relays.
<b>CO-524.04</b>	Maintain protection systems for alternator and transformer.
<b>CO-524.05</b>	Maintain protection systems for motors and transmission lines

# 1. Basics of Protection.

Position in Question Paper

Total Marks-12

Q.1. a) 2-Marks.

Q.2. a) 4-Marks.

Q.4. a) 6-Marks.

## Descriptive Question

1. State any four abnormal conditions which can develop in power system and state its effect on power system.
2. State the necessity of current limiting reactors in power system and classify the reactors on the basis of their location.
3. Two 11 KV, 3 phase, 3000 KVA generators having reactance of 15% operates in parallel. The generator supply power to a transmission line through a 6000 KVA transformer of ratio 11/22 KV and having leakage reactance of 5%. Calculate fault current and faults KVA on H.T. side of a transformer.

Fig. No. 1 shows single line diagram of three phase system. The percentage reactance of each alternator is based on its own capacity. Find short circuit current that will flow into a complete three phase short circuit at 'A'

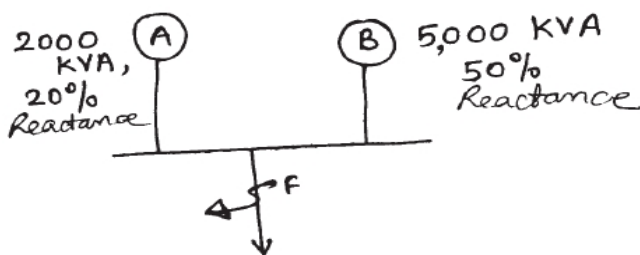


Fig. No. 1

4. List any eight essential features of effective protective system.
5. Draw diagram of a) Bus bar reactor b) Generator reactor c) Feeder reactor.



## MCQ Question

(Total number of Question=Marks\*3=12\*3=36)

Note: Correct answer is marked with **bold**.

- The main function of a fuse is to
  - protect the line
  - open the circuit
  - protect the appliance
  - prevent excessive currents**
- On which of the following routine tests are conducted ?
  - Oil circuit breakers
  - Air blast circuit breakers
  - Minimum oil circuit breakers
  - All of the above**
- SF<sub>6</sub> gas
  - is yellow in colour
  - is lighter than air
  - is nontoxic**
  - has pungent smell
- The arcing contacts in a circuit breaker are made of
  - copper tungsten alloy**
  - porcelain
  - electrolytic copper
  - aluminium alloy
- Which of the following medium is employed for extinction of arc in air circuit breaker ?
  - Water
  - Oil
  - Air**
  - SF
- With which of the following, a circuit breaker must be equipped for remote operation ?
  - Inverse time trip
  - Time-delay trip
  - Shunt trip**
  - None of the above
- Fault diverters are basically
  - fuses
  - relays
  - fast switches**
  - circuit breakers
- A thermal protection switch can protect against
  - short-circuit
  - temperature
  - overload**
  - over voltage
- Arc in a circuit behaves as
  - a capacitive reactance
  - an inductive reactance
  - a resistance increasing with voltage rise across the arc
  - a resistance decreasing with voltage rise across the arc**

10. Thermal circuit breaker has
- (a) **delayed trip action**
  - (b) instantaneous trip action
  - (c) both of the above
  - (d) none of the above
11. Relays can be designed to respond to changes in
- (a) resistance, reactance or impedance
  - (b) voltage and current
  - (c) light intensity
  - (d) **all**
12. Overload relays are of.....type.
- (a) induction
  - (b) solid state
  - (c) thermal
  - (d) **all above**
13. Thermal overload relays are used to protect the motor against over current due to
- (a) short-circuits
  - (b) **heavy loads**
  - (c) grounds
  - (d) all of the
14. Magnetic circuit breaker has\_\_\_\_\_ trip action.
- (a) delayed
  - (b) **instantaneous**
  - (c) both of the above
  - (d) none of the
15. D.C. shunt relays are made of
- (a) few turns of thin wire
  - (b) few turns of thick wire
  - (c) **many turns of thin wire**
  - (d) many turns of thick wire
16. The relay operating speed depends upon
- (a) the spring tension
  - (b) the rate of flux built up
  - (c) armature core air gap
  - (d) **all of the above**
17. In order that current should flow without causing excessive heating or voltage drop, the relay contacts should
- (a) have low contact resistance
  - (b) be clean and smooth
  - (c) be of sufficient size and proper shape
  - (d) **have all above properties**
18. Circuit breakers usually operate under
- (a) **transient state of short-circuit current**
  - (b) sub-transient state of short-circuit current
  - (c) steady state of short-circuit current
  - (d) after D.C. component has ceased
19. Circuit breakers are essentially
- (a) **current carrying contacts called electrodes**
  - (b) arc extinguishers

- (c) circuits to break the system  
(d) transformers to isolate the two systems
20. The current zero interruption, in oil and air blast circuit breakers, is achieved by  
(a) lengthening of the gap  
(b) cooling and blast effect  
**(c) both (a) and (b)**  
(d) deionizing the oil with forced air
21. Air blast circuit breaker is used for  
(a) over currents  
(b) short duty  
(c) intermittant duty  
**(d) repeated duty**
22. An efficient and a well designed protective relaying should have  
(a) good selectivity and reliability  
(b) economy and simplicity  
(c) high speed and selectivity  
**(d) all of the above**
23. Burden of a protective relay is the power  
(a) required to operate the circuit breaker  
**(b) absorbed by the circuit of relay**  
(c) developed by the relay circuit  
(d) none of the above
24. Directional relays are based on flow of  
(a) **power**  
(b) current  
(c) voltage wave  
(d) all of the above
25. A differential relay measures the vector difference between  
(a) two currents  
(b) two voltages  
**(c) two or more similar electrical quantities**  
(d) none of the above
26. A transmission line is protected by  
(a) inrush protection  
(b) distance protection  
(c) time graded and current graded over current protection  
**(d) both (b) and (c)**
27. Large internal faults are protected by  
**(a) merz price percentage differential protection**  
(b) mho and ohm relays  
(c) horn gaps and temperature relays



- (d) earth fault and positive sequence relays
28. When a transmission line is energized, the wave that propagates on it is  
(a) current wave only  
(b) voltage wave only  
(c) **both (a) and (b)**  
(d) power factor wave only
29. Protective relays are devices that detect abnormal conditions in electrical circuits by measuring  
(a) current during abnormal condition  
(b) voltage during abnormal condition  
(c) **constantly the electrical quantities which differ during normal and abnormal conditions**  
(d) none of the above
30. The voltage appearing across the contacts after opening of the circuit breaker is called voltage.  
(a) **recovery**  
(b) surge  
(c) operating  
(d) arc
31. Ionization in circuit breaker is facilitated by  
(a) high temperature  
(b) increase of mean free path  
(c) increasing field strength  
(d) **all of the above**
32. In a circuit breaker the basic problem is to  
(a) maintain the arc  
(b) extinguish the arc  
(c) **transmit large power**  
(d) emit the ionizing electrons
33. Overheating of relay contacts or contact burn out is due to  
(a) slow making and breaking of load circuit  
(b) contacts  
(c) foreign matter on the contact surface  
(d) too low contact pressure  
(e) **all of the above**
34. Interruption of large currents by relay requires  
(a) arc suppressing blow out coils  
(b) wide separation of the opened contacts  
(c) high speed opening of contacts  
(d) **all of the above**



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35. Shunt capacitance is neglected while considering

(a) **short transmission line**

(b) medium transmission line

(c) long transmission line

(d) medium and long transmission lines



## 2. Circuit Interrupting Devices.

Position in Question Paper

Total Marks-26

Q.1. a) 2-Marks.

Q.1. b) 2-Marks.

Q.2. a) 4-Marks.

Q.3. a) 4-Marks.

Q.3. c) 4-Marks.

Q.3. d) 4-Marks.

Q.4. a) 6-Marks.

### Descriptive Question

1. Compare HRC Fuse and circuit breakers as interrupting devices.
2. State the sequence of operation of isolator, circuit breaker and earthing Switches:  
(a) while closing the circuit (b) while opening the circuit.
3. Describe current zero method for arc extinction in circuit breaker operation.
4. What is ELCB? Describe its working.
5. Define the term insulation co-ordination. Draw the volt-time curve of an apparatus used in power system.
6. Define following terms related to C.B.:
  - a) Rated normal current
  - b) Short time rating
7. State any eight properties of SF<sub>6</sub> gas which is suitable for arc quenching.
8. Describe the working principle, construction and advantages of vacuum circuit breaker with neat diagram.
9. Define (a) Arcing time (b) Recovery time (c) Arcing voltage (d) Rate of rise of restriking voltage.
10. Draw a neat labeled constructional diagram of vertical type break isolator.
11. Explain basic principle of lightning arrester and enlist different types of lightning.
12. Give any four differences between equipment earthing and neutral earthing.
13. Whether MCB is operated for earth fault? Give reason.
14. Compare HRC fuse and kit.kat fuse on any four point.



## MCQ Question

(Total number of Question=Marks\*3=26\*3=78)

Note: Correct answer is marked with **bold**.

- The arc voltage produced in A.C. circuit breaker is always  
(a) **in phase with the arc current** (c) leading the arc current by  $90^\circ$   
(b) lagging the arc current by  $90^\circ$  (d) none of the above
- The time of closing the cycle, in modern circuit breakers is  
(a) **0.003 sec** (c) 0.01 sec  
(b) 0.001 sec (d) 0.10 sec
- Insulation resistance of high voltage circuit breakers is more than  
(a) 1 mega ohms (c) **100 mega ohms**  
(b) 10 mega ohms (d) 500 mega ohms
- H.R.C. fuses provide best protection against  
(a) overload (c) open-circuits  
(b) reverse current (d) **short-circuits**
- The ground wire should not be smaller than No \_\_\_\_\_ copper.  
(a) 2 (c) 6  
(b) 4 (d) **10**
- The delay fuses are used for the protection of \_\_\_\_\_ .  
(a) **motors** (c) fluorescent lamps  
(b) power outlet circuits (d) light circuits
- Which of the following is the least expensive protection for overcurrent in low voltage system ?  
(a) **Rewireable fuse** (c) Oil circuit breaker  
(b) Isolator (d) Air break circuit breaker
- Resistance grounding is used for voltage between  
(a) 33kV to 66kV (c) **3.3kV and 11kV**  
(b) 11kV to 33kV (d) none of the above
- The contacts of high voltage switches used in power system are submerged in oil. The main purpose of the oil is to  
(a) lubricate the contacts (d) all of the above  
(b) insulate the contacts from switch body  
(c) extinguish the arc



10. In Railway applications \_\_\_\_\_ circuit breaker is used.
- (a) SFe (c) minimum oil  
(b) bulk oil (d) air break A
11. To protect most of the electrical equipment handling low power, the types of relays used are
- (a) thermocouple (c) **both (a) and (b)**  
(b) electronic and bimetallic (d) none of the above
12. Wave trap is used to trap waves of
- (a) power frequencies  
(b) **higher frequencies entering generator or transformer units**  
(c) either of the above  
(d) none of the above
13. Ungrounded neutral transmission system is not recommended because of system
- (a) insulation being overstressed due to over voltages  
(b) insulation overstress may lead to failure and subsequent phase to phase faults  
(c) being inadequately protected against ground fault  
(d) **all of the above**
14. The reflection co-efficient at the open circuited end of a transmission line.
- (a) zero  
(b) infinity  
(c) **unity**  
(d) none of the above
15. For the protection of power station buildings against direct strokes the requirements are
- (a) interception  
(b) interception and conduction  
(c) **interception, conduction and dissipation**  
(d) interception, conduction, dissipation and reflection
16. The line insulation is the insulation level of the station equipment.
- (a) less than (c) more than  
(b) same as (d) **not directly related**
17. The interaction between a transmission line and communication line is minimized by
- (a) transposing transmission as well as communication lines  
(b) increasing the height of the trans-mission line tower

- (c) increasing the distance between the two lines  
**(d) all of the above**
18. When a wave propagates on a transmission line, it suffers reflection several times at  
(a) tapping  
(b) load end  
(c) sending end  
**(d) sending and other end**
19. Which of the following statements is incorrect?  
**(a) Station batteries are used to operate relay only**  
(b) The lightning arresters are basically surge diverters  
(c) An impedance relay has maximum fault current when fault occurs near the relay  
(d) A high speed relay has an operation of 1 to 2 cycles
20. Discrimination between main and back up protection is provided by the use of relays which are  
(a) fact  
(b) sensitive  
(c) **slow**  
(d) none of the above
21. Induction cup relay is operated due to changes in  
(a) current  
(b) voltage  
(c) impedance  
**(d) all of the above**
22. A.C. network analyser is used to solve problems of  
(a) load flow  
(b) load flow and short-circuit  
(c) load flow and stability  
**(d) load flow, short-circuit and stability**
23. Which of the following statements is incorrect ?  
**(a) Lightning arrestors are used before the switchgear**  
(b) Shunt reactors are used as compensation reactors  
(c) The peak short current is  $(1.8 \times V^2)$  times the A.C. component  
(d) The MVA at fault is equal to base MVA divided by per unit equivalent fault reactance
24. Short-circuit currents are due to  
(a) single phase to ground faults  
(b) phase to phase faults  
(c) two phase to ground faults  
**(d) any of these**
25. To reduce short circuit fault currents are used.  
**(a) reactors**  
(b) resistors  
(c) capacitors  
(d) none of the above



26. Bus coupler is very essential in arrangement
- (a) single bus
  - (b) double bus, double breaker
  - (c) **main and transfer bus**
  - (d) all of the above
27. For cost and safety, the outdoor substations are installed for voltages above
- (a) 11 kV
  - (b) **33 kV**
  - (c) 60kV
  - (d) 110kV
28. The short circuit in any winding of the transformer is the result of
- (a) mechanical vibration
  - (b) insulation failure
  - (c) loose connection
  - (d) **impulse voltage**
29. relays are used for phase faults on long line.
- (a) **Impedance**
  - (b) Reactance
  - (c) Either of the above
  - (d) None of the above
30. For which of the following protection from negative sequence currents is provided ?
- (a) Generators
  - (b) Motors
  - (c) Transmission line
  - (d) **Transformers**
31. relay is preferred for phase fault on short transmission line.
- (a) Induction type
  - (b) **Reactance**
  - (c) Impedance
  - (d) None of the above
32. Distance relays are generally
- (a) split-phase relays
  - (b) reactance relays
  - (c) impedance relays
  - (d) **none of the above**
33. For which of the following ratings of the transformer differential protection is recommended ?
- (a) above 30 kVA.
  - (b) **equal to and above 5 MVA**
  - (c) equal to and above 25 MVA
  - (d) none of the above
34. A is used to measure the stator % winding temperature of the generator.
- (a) thermocouple
  - (b) pyrometer
  - (c) **resistance thermometer**
  - (d) thermometer A
35. The under voltage relay can be used for
- (a) generators
  - (b) busbars
  - (c) transformers
  - (d) **all of the above**
36. The relay with inverse time characteristic will operate within
- (a) 1.5 sec
  - (b) **5 to 10 sec**
  - (c) 5 to 20 sec
  - (d) 20 to 30 sec

37. The single phasing relays are used for the protection of
- (a) single phase motors only
  - (b) two phase motors only
  - (c) two single phase motors running in parallel
  - (d) three phase motors**
38. 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
39. Which of the following parameter can be neglected for a short line ?
- (a) Inductance
  - (b) Capacitance**
  - (c) Resistance
  - (d) Reactance
40. Series reactors should have
- (a) low resistance**
  - (b) high resistance
  - (c) low impedance
  - (d) high impedance
41. Which of the following circuit breakers has high reliability and minimum maintenance ?
- (a) Air blast circuit breakers
  - (b) Circuit breaker with SF<sub>6</sub> gas**
  - (c) Vacuum circuit breakers
  - (d) Oil circuit breakers
42. Arc in a circuit breaker is interrupted at
- (a) zero current**
  - (b) maximum current
  - (c) minimum voltage
  - (d) maximum voltage
43. transmission line has reflection coefficient as one.
- (a) Open circuit**
  - (b) Short-circuit
  - (c) Long
  - (d) None of the above
44. What will be the reflection co-efficient of the wave of load connected to transmission line if surge impedance of the line is equal to load ?
- (a) Zero**
  - (b) Unity
  - (c) Infinity
  - (d) None of the above
45. The inverse definite mean time relays are used for over current and earth fault protection of transformer against
- (a) eavy loads
  - (b) internal short-circuits**
  - (c) external short-circuits
  - (d) all of the above
46. Over voltage protection is recommended for
- (a) hydro-electric generators
  - (b) steam turbine generators
  - (c) gas turbine generators
  - (d) all of the above**



47. Air blast circuit breakers for 400 kV power system are designed to operate in
- (a) 100 microsecond
  - (b) **50 millisecond**
  - (c) 0.5 sec
  - (d) 0.1 sec
48. Overfluxing protection is recommended for
- (a) distribution transformer
  - (b) **generator transformer of the power plant**
  - (c) auto-transformer of the power plant
  - (d) station transformer of the power plant
49. Series capacitors are used to
- (a) **compensate for line inductive reactance**
  - (b) compensate for line capacitive reactance
  - (c) improve line voltage
  - (d) none of the above
50. Admittance relay is \_\_\_\_\_ relay.
- (a) impedance
  - (b) **directional**
  - (c) non-directional
  - (d) none of the above
51. The material used for fuse must have
- (a) **low melting point and high specific resistance**
  - (b) low melting point and -low specific resistance
  - (c) high melting point and low specific resistance
  - (d) low melting point and any specific resistance
52. If the fault occurs near the impedance relay, the VII ratio will be
- (a) constant for all distances
  - (b) **lower than that of if fault occurs away from the relay**
  - (c) higher than that of if fault occurs away from the relay
  - (d) none of the above
53. The torque produced in induction type relay (shaded pole structure) is
- (a) inversely proportional to the current
  - (b) **inversely proportional to the square of the current**
  - (c) proportional to the current
  - (d) proportional to square of the current



54. The steady state stability of the power system can be increased by
- (a) **connecting lines in parallel**
  - (b) connecting lines in series
  - (c) **using machines of high impedance**
  - (d) reducing the excitation of machines
  - (e) using machines of high impedance
55. The inductive interference between power and communication line can be minimized by
- (a) transposition of the power line
  - (b) transposition of the communication line
  - (c) **both (a) and (b)**
  - (d) increasing the distance between the conductors
56. The power loss is an important factor for the design of
- (a) **transmission line**
  - (b) motor
  - (c) generator
  - (d) feeder
57. A fuse is connected
- (a) **in series with circuit**
  - (b) in parallel with circuit
  - (c) either in series or in parallel with circuit
  - (d) none of the above
58. H.R.C. fuse, as compared to a rewirable fuse, has
- (a) **no ageing effect**
  - (b) high speed of operation
  - (c) high rupturing capacity
  - (d) all of the above
59. The fuse rating is expressed in terms of
- (a) **current**
  - (b) voltage
  - (c) VAR
  - (d) kV
60. The fuse blows off by
- (a) burning
  - (b) arcing
  - (c) **melting**
  - (d) none of the above
61. On which of the following effects of electric current a fuse operates ?
- (a) Photoelectric effect
  - (b) Electrostatic effect
  - (c) **Heating effect**
  - (d) Magnetic effect
62. An isolator is installed
- (a) to operate the relay of circuit breaker
  - (b) as a substitute for circuit breaker
  - (c) always independent of the position of circuit breaker
  - (d) **generally on both sides of a circuit breaker**



63. A 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
64. Protection by fuses is generally not used beyond
- (a) 20 A
  - (b) 50 A
  - (c) **100 A**
  - (d) 200 A
65. A fuse is never inserted in
- (a) **neutral wire**
  - (b) negative of D.C. circuit
  - (c) positive of D.C. circuit
  - (d) phase line
66. Oil switches are employed for
- (a) low currents circuits
  - (b) low voltages circuits
  - (c) **high voltages and large currents circuits**
  - (d) All circuit
67. A switchgear is device used for
- (a) interrupting an electrical circuit
  - (b) switching an electrical circuit 111.
  - (c) switching and controlling an electrical circuit
  - (d) **switching, controlling and protecting the electrical circuit and equipment**
68. The fuse wire, in D.C. circuits, is inserted in
- (a) negative circuit only
  - (b) positive circuit only
  - (c) **both (a) and (b)**
  - (d) either (a) or (b)
69. By which of the following methods major portion of the heat generated in a H.R.C. fuse is dissipated
- (a) Radiation
  - (b) Convection
  - (c) **Conduction**
  - (d) All of the above
70. A short-circuit is identified by
- (a) no current flow
  - (b) **heavy current flow**
  - (c) voltage drop
  - (d) voltage rise
71. The information to the circuit breaker under fault conditions is provided by
- (a) **relay**
  - (b) rewirable fuse
  - (c) H.R.C. only
  - (d) all of the above



72. To limit short-circuit current in a power system are used.
- (a) earth wires
  - (b) isolators
  - (c) H.R.C. fuses
  - (d) reactors**
73. A balanced 3-phase system consists of
- (a) zero sequence currents only
  - (b) positive sequence currents only**
  - (c) negative and zero sequence currents
  - (d) zero, negative and positive sequence currents
74. In a single bus-bar system there will be complete shut down when
- (a) fault occurs on the bus itself**
  - (b) fault occurs on neutral line
  - (c) two or more faults occur simultaneously
  - (d) fault occurs with respect to earthing

## 3. Protective Relays.

Position in Question Paper

Total Marks-26

Q.1. a) 2-Marks.

Q.1. b) 2-Marks.

Q.2. a) 4-Marks.

Q.3. a) 4-Marks.

Q.3. c) 4-Marks.

Q.3. d) 4-Marks.

Q.4. a) 6-Marks.

### Descriptive Question

1. Describe with the help of neat diagram the construction and operation of Induction type over current relay.
2. Explain how the plug setting and time setting can be done in induction relay.
3. State advantages and disadvantages of static relays over electromagnetic relays.
4. State salient features of microprocessor based protection relay. Draw block diagram of microprocessor based over current relay.
5. Define the following terms related to relay:
  - a) Relay time
  - b) pick up
  - c) Reset
  - d) Fault clearing time.
6. The current rating of an overcurrent relay is 5 Amp. Current setting is at 200%.  $T_{sm} = 0.4$ , CT ratio = 400/S. Fault current = 4000 Amp. Determine the operating time of the relay. Use the following table operating at various PSM at TMS = 1. **PSM 2 4 8 20 Relay time in Sec.**  
10 5 3 2
7. Describe restricted earth fault-protection scheme for 3 phase Delta/Star transformer with neat diagram.
8. What are fundamental requirements of protective relaying? What qualities relay must possess for satisfactory functioning.
9. Draw ckt. diagram of balanced beam type of relay labelled its different part.
10. Draw block diagram of microprocessor based over current relay.
11. Explain with neat diagram solenoid type over current relay.



## MCQ Question

(Total number of Question=Marks\*3=26\*3=78)

Note: Correct answer is marked with **bold**.

- Protective relays can be designed to respond to
  - Light intensity
  - Temperature
  - Resistance, reactance or impedance
  - All of the above**
- Protective relays are the devices that detect abnormal conditions in electrical circuits by measuring
  - Voltage
  - Current
  - Constantly the electrical quantities which differ during normal and abnormal conditions**
  - Note the above
- The protective relays is provided to
  - Provide additional safety to the circuit breaker in its operation
  - Close the contacts when the actuating quantity attains a certain predetermined**
  - Limit the arcing current during the circuit breaker operation
  - Earth any stray voltage
- For the protection of a very long extra high-voltage lines, the productive relay used is
  - Over currently with extremely inverse characteristics
  - Percentage differential relay
  - Reactance type distance relay
  - Mho type distance relay**
- Burden of a protective relay is the power
  - Required to operate the circuit breaker
  - Absorbed by the circuit of relay**
  - Developed by the relay circuit
  - None of the above
- Buchholz relay is
  - Located in the conservator tank
  - Located in the transformer tank itself
  - Connected in the pipe connecting main tank of transformer and conservator**
  - Installed in the circuit breaker
- Buchholz relays are used on
  - Air cooled Transformers
  - Instrument Transformers
  - Distribution transformers
  - Oil immersed power transformers of ratings above 500 kVA**
- Buchholz relay cannot be used on
  - Three-phase transformers
  - Air cooled transformers**
  - 500 KV transformers
  - D.1000 kV transformers
- Buchholz relay is a.....relay
  - Oil immersed
  - Arc quenching
  - Gas actuated**
  - None of the above



10. Buchholz relay can detect faults.....oil level in the transformer.
- Upper
  - Below**
  - Same
  - None of the above
11. Distance relays are generally
- Split phase relays
  - Reactance relays
  - Impedance relays
  - None of the above**
12. Three step time distance characteristic of distance relay can be had by
- Changing taps on voltage transformer
  - Separate measuring elements for zones 2 and 3
  - Switching resistance in relay restrain circuit at pre-set time interval by means of a timer element
  - Any of the above**
13. Distance protection scheme is preferred over graded time-lag over-current protection in HV and EHV lines because
- It is faster in operation**
  - It is simple
  - It is cheaper in cost
  - All of the above
14. In a three-step distance protection the reach of the three zones of the relay at the beginning of the first line typically extends into
- 100% of the first line, 50% of the second line and 20% of the third line
  - 80% of the first line, of 50% of the second line and 20% of the third line**
  - 80% of the first line, 50% of the second line and 10% of the third line
  - 50% of the first line, 50% of the second line and 20% of the third line
15. Which of the following relay is/are overload relays?
- Thermal
  - Electromagnetic
  - Induction
  - All of the above**
16. A Mho relay is a
- Voltage restrained directional relay**
  - Voltage restrained over current relay
  - Directional restrained over-current relay
  - Directional restrained over voltage relay
17. Mho relay is usually employed for the protection of
- Short lines only
  - Medium lines only
  - Long lines only**
  - Any line
18. Which of the following relay has inherent directional characteristic?
- Mho**
  - Reactance
  - Impedance
  - None of the above
19. For the protection of a very long extra high voltage line, the protective relay used is
- Over current with extremely inverse characteristics
  - Percentage differential relay
  - Reactance type distance relay
  - Mho type distance relay**



20. Relay used for feeder protection is
- a) Under voltage relay
  - b) **Translay relay**
  - c) Thermal relay
  - d) Buchholz relay
21. Induction cup relay is operated due to changes in
- a) current
  - b) voltage
  - c) impedance
  - d) **all of the above**
22. A.C. network analyser is used to solve problems of
- a) load flow
  - b) load flow and short-circuit
  - c) load flow and stability
  - d) **load flow, short-circuit and stability**
23. Which of the following statements is incorrect ?
- a) **Lightning arrestors are used before the switchgear**
  - b) Shunt reactors are used as compensation reactors
  - c) The peak short current is  $(1.8 \times V^2)$  times the A.C. component
  - d) The MVA at fault is equal to base MVA divided by per unit equivalent fault reactance
24. Short-circuit currents are due to
- a) single phase to ground faults
  - b) phase to phase faults
  - c) two phase to ground faults
  - d) **any of these**
25. To reduce short circuit fault currents are used.
- a) **reactors**
  - b) resistors
  - c) capacitors
  - d) none of the above
26. Bus coupler is very essential in arrangement
- a) single bus
  - b) double bus, double breaker
  - c) **main and transfer bus**
  - d) all of the above
27. For cost and safety, the outdoor substations are installed for voltages above
- a) 11 kV
  - b) **33 kV**
  - c) 60kV
  - d) 110kV
28. The short circuit in any winding of the transformer is the result of
- a) mechanical vibration
  - b) insulation failure
  - c) loose connection
  - d) **impulse voltage**
29. relays are used for phase faults on long line.
- a) **Impedance**
  - b) Reactance
  - c) Either of the above
  - d) None of the above



30. For which of the following protection from negative sequence currents is provided ?
- a) Generators
  - b) Motors
  - c) Transmission line
  - d) Transformers**
31. relay is preferred for phase fault on short transmission line.
- a) Induction type
  - b) Reactance**
  - c) Impedance
  - d) None of the above
32. Distance relays are generally
- a) split-phase relays
  - b) reactance relays
  - c) impedance relays
  - d) none of the above**
33. For which of the following ratings of the transformer differential protection is recommended ?
- a) above 30 kVA.
  - b) equal to and above 5 MVA**
  - c) equal to and above 25 MVA
  - d) none of the above
34. A \_\_\_\_\_ is used to measure the stator % winding temperature of the generator.
- a) thermocouple
  - b) pyrometer
  - c) resistance thermometer**
  - d) thermometer A
35. The under voltage relay can be used for
- a) generators
  - b) busbars
  - c) transformers
  - d) all of the above**
36. The relay with inverse time characteristic will operate within
- a) 1.5 sec
  - b) 5 to 10 sec**
  - c) 5 to 20 sec
  - d) 20 to 30 sec
37. The single phasing relays are used for the protection of
- a) single phase motors only
  - b) two phase motors only
  - c) two single phase motors running in parallel
  - d) three phase motors**
38. Which of the following devices will receive voltage surge first travelling on the....
- a) Lightning arresters**
  - b) Relays
  - c) Step-down transformer
  - d) Switchgear
39. Which of the following parameter can be neglected for a short line ?
- a) Inductance
  - b) Capacitance**
  - c) Resistance
  - d) Reactance

40. Series reactors should have
- a) **low resistance**
  - b) high resistance
  - c) low impedance
  - d) high impedance
41. Which of the following circuit breakers has high reliability and minimum maintenance ?
- a) Air blast circuit breakers
  - b) **Circuit breaker with SF<sub>6</sub> gas**
  - c) Vacuum circuit breakers
  - d) Oil circuit breakers
42. Arc in a circuit breaker is interrupted at
- a) **zero current**
  - b) maximum current
  - c) minimum voltage
  - d) maximum voltage
43. transmission line has reflection coefficient as one.
- (c) **Open circuit**
  - (d) Short-circuit
  - (c) Long
  - (d) None of the above
44. What will be the reflection co-efficient of the wave of load connected to transmission
- a) **Zero**
  - b) Unity
  - c) Infinity
  - d) None of the above
45. The inverse definite mean time relays are used for over current and earth fault protection of transformer against
- a) eavy loads
  - b) **internal short-circuits**
  - c) external short-circuits
  - d) all of the above
46. Over voltage protection is recommended for
- a) hydro-electric generators
  - b) steam turbine generators
  - c) gas turbine generators
  - d) **all of the above**
47. Air blast circuit breakers for 400 kV power system are designed to operate in
- a) 100 microsecond
  - b) **50 millisecond**
  - c) 0.5 sec
  - d) 0.1 sec
48. Overfluxing protection is recommended for
- a) distribution transformer
  - b) **generator transformer of the power plant**
  - c) auto-transformer of the power plant
  - d) station transformer of the power plant
49. Series capacitors are used to
- a) **compensate for line inductive reactance**
  - b) compensate for line capacitive reactance





- c) improve line voltage  
d) none of the above
50. Admittance relay is \_\_\_\_\_ relay.  
a) impedance  
b) **directional**  
c) non-directional  
d) none of the above
51. The torque produced in shaded pole structure induction type relay is  
a) Proportional to the square of the current  
b) **Proportional to the current**  
c) Inversely proportional to the current  
d) Inversely proportional to the square of the current
52. The most efficient torque producing actuating structure for induction type relays is  
a) Shaded pole structure  
b) Watt hour meter structure  
c) **Induction type structure**  
d) Single induction loop structure
53. Admittance relay is.....relay  
a) Impedance  
b) **Directional**  
c) Nondirectional  
d) None of the above
54. If the fault occurs near the impedance relay, the V/I ratio will be  
a) Constant for all distances  
b) **Lower than that of if fault occurs away from the relay**  
c) Higher than that of if fault occurs away from the relay  
d) None of the above
55. The power loss is an important factor for the design of  
a) **Transmission line**  
b) Motor  
c) Generator  
d) Feeder
56. In an over current protection the setting of the earth fault relay is  
a) More than the phase fault relay  
b) Equal to the phase fault relay  
c) **Less than the phase fault relay**  
d) The two settings are unrelated to each other
58. Earth fault relays are  
a) **Directional relays**  
b) Nondirectional relays  
c) Short update Time relays  
d) None of the above
59. The earth fault in stator causes  
a) Arcing to core  
b) Severe heating in conductors and thereby damaging the insulation  
c) Open circuit in the stator  
d) **Both A and B**
60. Earth fault protection for an electric motor is provided by means of  
a) Instantaneous over-current relay  
b) Instantaneous relay having a setting of approximately 30% of motor rated current in the residual circuits of two CTs  
c) Ground wire  
d) **Both B and C**



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61. The magnitude of earth fault current for a given fault position within a winding depends upon

- a) The winding connections
- b) The method of neutral grounding
- c) Unmatched characteristics of CTs
- d) Both A and B**

## 4. Protection of Alternator and Transformer.

Position in Question Paper

Total Marks-20

Q.1. a) 2-Marks.

Q.2. a) 4-Marks.

Q.3. a) 4-Marks.

Q.3. d) 4-Marks.

Q.4. a) 6-Marks.

### Descriptive Question

1. State the common faults occurs in power transformer. Suggests the protection for these faults.
2. State the abnormalities and faults in alternator with necessary protection.
3. What are the difficulties in differential protection scheme used for transformer?
4. Draw a diagram of differential protection scheme for a star connected alternator and explain its working.
5. A 3 phase transformer of 220/11000 volts is connected in star/delta is protected by Merz price circulating current scheme. The protective transformer on 220 volt side have a current ratio of 600/S. What should be the ratio on 11000 volt side? Draw a neat diagram and indicate given values at appropriate places.
6. How negative phase sequence current is set up in an alternator? Draw protective scheme for same.
7. Draw neat labelled diagram of Buchholz relay.
8. State the specifications of CT and PT as a protective transformer.
9. Draw the circuit diagram of biased differential protection of  $\Delta/\lambda$  transformer.
10. List the difficulties experienced in differential relay in alternator protection. How are they overcome?
11. Give location of Buchholz relay and state application of it for transformer protection.
12. Draw the restricted earth fault protection scheme for 250 MVA delta/delta Transformer.
13. Draw ckt. Diagram for merz price protection scheme for star-star connected 3 $\phi$  phase power transformer.



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14. A 3 $\phi$  transformer having line voltage ratio of 0.4 kV/11 kV is connected Star/Delta and Protective transformers on the 0.4 kV side have a current ratio of 500/5. What must be ratio of the protective transformers on 11 kV side? Draw a neat circuit diagram and indicate the given values at appropriate places.
15. Suggest the type of protection for the following abnormalities/faults on alternator:  
(a) Thermal overloading (b) Stator winding faults (c) Earth faults on rotor winding



## MCQ Question

(Total number of Question=Marks\*3=20\*3=60)

Note: Correct answer is marked with **bold**.

- In an alternator one of the advantages of distributing the winding is to
  - a) Improve voltage waveform**
  - Reduce noise
  - Same on copper
  - Reduce harmonics
- In large generators protection provided against external faults is
  - Inter-turn fault protection
  - Sensitive earth fault protection
  - Biased differential protection
  - d) All of the above**
- Due to which of the following reasons, for aircraft alternators high frequency is used
  - a) To reduce the bulk**
  - To compensate for high speeds
  - To compensate for high altitudes
  - To free the systems from external disturbance
- The permissible duration for which a generator of rated frequency 50Hz can at 46 Hz is
  - One cycle
  - b) One second**
  - One minute
  - Zero
- In an alternator the voltage of field system is usually
  - More than 1000 V
  - Between 400 V and 600 V
  - c) Less than 200 V**
  - None of the above
- In an alternator field the effect of cross-magnetisation is to make the output
  - a) Non-sinusoidal**
  - True sinusoidal
  - Free from harmonics
  - None of the above
- When two alternators are running in exact synchronism, the synchronising power will be
  - Unity
  - b) Zero**
  - Sum of the output of two
  - None of the above
- The power factor of an alternator is determined by it
  - Excitation
  - Speed
  - Primemover
  - d) None of the above**
- If two alternators are running in parallel and the excitation of one of the alternators is increased, then
  - Power output will decrease
  - b) Wattless component will change**
  - Machine with excess excitation will burn
  - Both machines will start vibrating
- When an alternator is supplying unity power factor load, the armature reaction will produce
  - a) Distortion of the main field**
  - Magnetisation of the main field
  - Demagnetisation of the main field
  - None of the above
- Turbo-alternators are generally used to run at
  - 1500 r.p.m.
  - b) 3000 r.p.m.**
  - 5000 r.p.m.
  - 15000 r.p.m.



12. In case of turbo-alternators the rotor is usually made of
- a) Cast iron
  - b) Forged steel**
  - c) Laminated stainless steel
  - d) Manganese steel
13. The number of poles in turbo-alternators is usually
- a) 2**
  - b) 4
  - c) 12
  - d) 50
14. What kind of rotor is most suitable for turbo-alternators which are designed to run at high speed
- a) Salient pole type
  - b) Non-salient pole type**
  - c) Inversely proportional to its upper 3dB frequency
  - d) None of the above
15. For a given output steam turbo-alternators are much smaller in size than water turbine - alternators because
- a) Steam turbo-alternators are built with smaller capacities
  - b) Steam turbo-alternators have long rotors**
  - c) Steam turbo-alternators run at high speed
  - d) All of the above
16. Salient pole type alternators are generally used on
- a) Low voltage alternators**
  - b) Hydrogen cooled primemovers
  - c) High speed primemovers
  - d) Low and medium speed primemovers
17. The speed of a salient pole machine is nearly
- a) 500 r.p.m.**
  - b) 1000 r.p.m.
  - c) 1500 r.p.m.
  - d) 3000 r.p.m.
18. When the terminal voltage of an alternator falls on throwing of the load, it indicates that the load is purely
- a) Resistive
  - b) Capacitive
  - c) Inductive**
  - d) None of the above
19. Which of the following is a primemover
- a) Steam turbine**
  - b) Solar Energy
  - c) Electric heater
  - d) None of the above
20. In a large generator, dampers
- a) Reduce frequency fluctuations
  - b) Reduce voltage fluctuations
  - c) Increase stability**
  - d) None of the above
21. If the input to the prime mover of an alternator is kept constant but the excitation is changed then
- a) The power factor of the load remains constant
  - b) The reactive component of the output is changed**
  - c) The active component of the output is changed
  - d) None of the above



22. For the alternators operating in parallel, if the load shared by one of them is to be increased, its field excitation is
- To be weakened keeping input torque same
  - To be strengthened keeping input torque same
  - To be kept constant but input torque should be increased**
  - To be kept constant but input torque should be decreased
23. The power drawn by the prime-mover of an alternator, under no-load conditions, goes to
- Meet copper losses both in armature and rotor windings
  - Produce power in armature
  - Meet no-load losses**
  - Produce e.m.f. in armature winding
24. The regulation of an alternator is
- The increase in terminal voltage when load is thrown off**
  - The reduction in terminal voltage when alternator is loaded
  - The variation of terminal voltage under the condition of maximum and minimum
  - The change in terminal voltage from lagging power factor to leading power factor
25. Dirt accumulation in generators can cause
- Flashovers
  - Overheating
  - Poor voltage regulation
  - All of the above**
26. In order to reduce the harmonics in the e.m.f. generated in an alternator
- Winding is well distributed
  - Slots are skewed
  - Sailent pole tips are chamfered
  - All of the above**
27. Salient pole type rotors as compared to cylindrical pole type are
- Small in diameter as well as axial length
  - Large in diameter as well as axial length
  - Smaller in diameter and larger in axial length
  - Larger in diameter and smaller in axial length**
28. Which of the following relays come into operation in the event of the failure of prime-mover connected to the generator
- Buchholz relay
  - Reserve power relay**
  - All of the above
  - None of the above
29. .... plays an important role in overspeed protection of a generator
- Reserve power relay**
  - Differential protection
  - Over current relay
  - Alarm
30. In an alternator, the armature reaction influences
- Generated voltage per phase**
  - Waveform of voltage generated
  - Operating speed
  - Windage losses
31. For a machine on infinite bus active power can be varied by
- Changing field excitation
  - Changing of prime mover speed**
  - Both (a) and (b) above
  - None of the above



32. Squirrel-cage bars placed in the rotor pole faces of an alternator help reduce hunting
- Above synchronous speed only
  - Below synchronous speed only
  - Above and below synchronous speed both**
  - None of the above
33. The load sharing between two steam-driven alternators operating in parallel may be adjusted
- Field strengths of the alternators
  - Power factors of the alternators
  - Steam supply to their prime movers**
  - Speed of the alternators
34. Keeping its excitation constant, if steam supply of an alternator running in parallel with another identical alternator is increased, then
- It would over-run the other alternator
  - Its rotor will fall back in phase with respect to the other machine
  - It will supply greater portion of the load**
  - Its power factor would be decreased
35. Two identical alternators are running in parallel and carry equal loads. If excitation of one alternator is increased without changing its steam supply, then
- It will keep supplying almost the same load**
  - kVAR supplied by it would decrease
  - Its p.f. will increase
  - kVA supplied by it would decrease
36. It is never advisable to connect a stationary alternator to live bus-bars because it
- Is likely to run as synchronous motor
  - Will get short-circuited**
  - Will decrease bus-bar voltage through momentarily
  - Will disturb generated e.m.fs of other alternators connected in parallel
37. Under no-load condition, power drawn by the prime mover of an alternator goes to
- Produce induced e.m.f. armature winding
  - Meet no-load losses**
  - Produce power in the armature
  - Meet Cu losses both in armature and rotor windings
38. For proper parallel operation, a.c. polyphase alternators must have the same
- Speed
  - Voltage rating**
  - kVA rating
  - Excitation
39. Of the following conditions, the one which does not have to be met by alternators working in parallel is
- Terminal voltage of each machine must be the same
  - The machines must have the same phase rotation
  - The machines must operate at the same frequency
  - The machines must have equal things**
40. Three-phase alternators are invariably Y-connected because
- Magnetic losses are minimised
  - Less turns of wire are required**
  - Smaller conductors can be used





- d) Higher terminal voltage is obtained
41. The main disadvantage of using short-pitch winding in alternators is that it
- a) Reduces harmonics in the generated voltage
  - b) Reduces the total voltage around the armature coils
  - c) Produces asymmetry in the three phase windings
  - d) Increases Cu of end connections
42. At lagging loads, armature reaction in an alternator is
- a) Cross-magnetising
  - b) **Demagnetising**
  - c) Non-effective
  - d) Magnetising



## **5. Protection of Motor, Busbar and Transmission Line.**

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**Position in Question Paper**

**Total Marks-18**

Q.1. a) 2-Marks.

Q.1. b) 2-Marks.

Q.3. a) 4-Marks.

Q.3. d) 4-Marks.

Q.4. a) 6-Marks.

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### **Descriptive Question**

1. What are the requirements of transmission line protection?
2. What type of motor protection is used for high capacity induction motors? Describe the function of different relays used.
3. Which are most commonly used schemes for bus bar protection? Explain any one scheme in detail.
4. What are advantages of distance protection over other type of protection of feeder?  
Explain distance protection of transmission line.
5. Draw ckt. Diagram for biased differential protection used for transmission line protection.
6. Explain how pilot wire protection is given to transmission line.
7. Explain short circuit protection scheme for motor.
8. Explain with the help of sketches the working scheme for motor against  
A) Overload B)Phase failure
9. Describe with circuit diagram the working of single phase preventer.



## MCQ Question

(Total number of Question=Marks\*3=18\*3=54)

Note: Correct answer is marked with **bold**.

- Which of the following sections can be employed for bus-bars ?
  - Bars
  - Rods
  - Tubes
  - Any of the above**
- A bus-bar is rated by
  - Current only
  - Voltage only
  - Current , voltage and frequency
  - Current, voltage, frequency and short circuit current**
- The material used for bus-bar should have
  - Low resistivity
  - Low-cost
  - High Softening temperature
  - All of the above**
- Which of the following bus-bar schemes has the lowest cost?
  - Ring bus-bar scheme
  - Single bus-bar scheme**
  - Breaker and a half scheme
  - Main and transfer scheme
- Which of the following can be used for bus-bars?
  - Tubes
  - Rods
  - Bars
  - Any of the above**
- Due to which of the following reasons aluminium is being favoured as bus-bar material?
  - Low-density
  - Low-cost**
  - Ease of fabrication
  - None of the above
- Which of the following bar schemes is the most expensive?
  - Double bus-bar double breaker**
  - Ring bus-bar scheme
  - Single bus-bar scheme
  - Main and transfer scheme
- When an alternator connected to the bus-bar is shut down the bus-bar voltage will
  - Fall
  - Rise
  - Remain unchanged**
  - none of the above
- The bus-bar zone, the purpose of protection includes ....., .....and .....
  - Bus-bars, isolating switches, circuit breakers**
  - Transformers, relays, circuit breakers
  - Transformers, conductors and relays
  - None of the above
- If a voltage controlled bus is treated as a load bus, then which one of the following limits would be violated ?
  - Voltage**
  - Active power
  - Reactive power
  - Phase angle
- Single bus-bar arrangement
  - Is cheapest in initial as well as maintenance cost
  - Provide simple operation and relaying system
  - Has the drawback that there will be complete shut down when a fault occurs on the bus itself
  - All of the above**



12. In a single bus bar system there will be complete shutdown when
  - a) Fault occurs on the bus itself
  - b) Fault occurs on neutral line**
  - c) Two or more faults occur simultaneously
  - d) Fault occurs with respect to earthing
13. The main factor in favour of the use of aluminium as bus bar material is its
  - a) **Low-cost**
  - b) Low-density
  - c) Low melting point
  - d) High resistivity
14. Double bus bar arrangement makes use of two identical bus bus and has the advantages that
  - a) It does not require any bus coupler and permits switchover from one bus to another whenever desired
  - b) It provides maximum flexibility and reliability
  - c) Either bus bar may be taken up for maintenance
  - d) All of the above**
15. The voltage of a particular bus is regulated by controlling the
  - a) Active power of the bus
  - b) Reactive power of the bus
  - c) Phase angle
  - d) Phase angle and reactive power**
16. The voltage of a particular bus can be controlled by controlling the
  - a) Active power of the bus
  - b) Reactive power of the bus**
  - c) Phase angle
  - d) Both A and B
17. In a power system the maximum number of buses are
  - a) Generator buses
  - b) Load buses**
  - c) Slack buses
  - d) P-V buses
18. Load bus is specified by
  - a) P and V
  - b) P and  $\delta$
  - c) P and  $|V|$
  - d) P and Q**
19. At slacks bus, which one of the following combinations of variables is specified?
  - a)  $|V|$ ,  $\delta$**
  - b) P, Q
  - c) P,  $|V|$
  - d) Q,  $|V|$
20.  $Y_{BUS}$  as used in load flow study, and  $Z_{BUS}$  as used for short circuit study are:
  - a) The same
  - b) Inverse of each other
  - c) Are not related to each other
  - d) None of the above
21. Surge absorbers are used for protection against
  - a) High-voltage low-frequency oscillations
  - b) High-voltage high-frequency oscillations
  - c) Low-voltage high frequency oscillations
  - d) Low-voltage low-frequency oscillation**
22. Surge absorber..... the energy of travelling waves
  - a) Absorbs
  - b) Reflects
  - c) Diverts
  - d) Partly absorbs and partly diverts**



23. Surge modifiers are employed for
- a) Reducing the steepness of wave front
  - b) Reducing the current of wavefront
  - c) **Reducing the voltage of wavefront**
  - d) Modify the shape of the wave front
24. Switching over voltages are more hazards than lightning surges in case of
- a) Low-voltage system
  - b) 33KV system
  - c) **EHV and UHV system**
  - d) All of the above
25. The over voltage surge in power systems may be caused by
- a) Lightning
  - b) Resonance
  - c) Switching
  - d) **All of the above**
26. In a substation the following equipment is not installed
- a) **Exciters**
  - b) Series capacitors
  - c) Shunt reactors
  - d) Voltage transformers
27. With which of the following are step-up substations associated ?
- a) Concentrated load
  - b) Consumer location
  - c) Distributors
  - d) **Generating stations**
28. Which of the following equipment is used to limit short circuit current level in a Sub Station?
- a) Isolator
  - b) Lightning switch
  - c) Coupling capacitor
  - d) **Series reactor**
29. Most of the substations in the power system change .....of electric supply.
- a) Current level
  - b) **Voltage level**
  - c) Both A and B
  - d) None of the above
30. An ideal location for the substation would be at the .....of load.
- a) **Centre of gravity**
  - b) Load centre
  - c) Nearer to consumer
  - d) None of the above
31. Outdoor Sub Station requires .....space
- a) Less
  - b) **More**
  - c) Medium
  - d) Any of the above
32. Majority of distribution substations are of ..... type.
- a) Pole mounted
  - b) Indoor
  - c) **Outdoor**
  - d) All of the above
33. Power factor correction substations are generally located at the .....end of a transmission line
- a) Sending
  - b) **Receiving**
  - c) Both sending and receiving
  - d) None of the above
34. Underground sub stations are generally located in .....
- a) **Thickly polluted area**
  - b) Villages
  - c) Cities
  - d) Any of the above
35. An indoor Sub Station is .....expensive than outdoor Sub Station
- a) **More**
  - b) Less
  - c) Almost equal
  - d) None of the above