UNIT- 1 INTRODUCTION

TWO MARKS Q& A

1) **State the type of Fault (Apr/May 2017, Nov/Dec 2017)**

   There are two types of faults namely :

   a) Symmetrical Fault : The fault which gives rise to equal fault currents in all the lines with displacement of 120^0 between them. Eg: 3 – phase Fault

   b) Unsymmetrical fault : The fault which gives rise to unequal fault currents in all the lines with unequal displacement between them.

   Ex: i) Single Line to ground Fault

   ii) Line to Line Fault

   iii) Double line to ground Fault

2) **Give the difference between circuit breaker and switch (Apr/May 2017)**

S.I. NO	CIRCUIT BREAKER	SWITCH
1	It is a device which is used to make or break the circuit either manually or automatically during normal and upnormal condition	It is used to isolate the circuit manually. It doesnot perform the automatic operation

3) **What are the effects of short circuit faults on power system, if the fault remain uncleared? (Nov/Dec 2018, Apr/May 2019)**

   a) It affects the reliability of the power system

   b) Damage the Electrical Apparatus

   c) If fault persist for long time damage the insulation of machines

4) **How Protective relays are classified based on their functions? (Nov/Dec 2018)**

   a) Electromagnetic Type relays

   b) Indcution Type Relays

   i) Non-Directional over Current Relay ii) Directional Over current Relay iii) Reverse power relay

   c) Distance Relays

   i) Impedance Relay ii) Reactance relay iii) Mho Relay

5) **Define Protected Zone (Apr/May 2019)**

A protective zone is the separate zone which is established around each system Components. Protective Zones is a protective relaying scheme, the circuit breakers are placed at the appropriate points such that any element of the entire power system can be disconnected for repairing work, usual operation and maintenance requirements and also under abnormal conditions like short circuits.

6) **What is Primary Protection?(Nov/Dec 2017)**

It is the protection scheme which is designed to protect the electrical apparatus of the power system. If fault occurs on any line it will be cleared by its relay and circuit breaker. This forms the Primary or main protection and serves as a first line of defence

7) **Why protection scheme is needed for power system? (Apr/May 2018)**

a) It affects the reliability of the power system

b) Damage the Electrical Apparatus

c) If fault persist for long time damage the insulation of machines

Hence the protection scheme is needed for power system

8) **Write down the importance of symmetrical components for fault current calculation Apr/May 2018)**

The method of **symmetrical components** is used to simplify fault analysis by converting a three-phase unbalanced system into two sets of balanced phasors and a set of single-phase phasors, or symmetrical components. These sets of phasors are called the positive-, negative-, and zero-sequence components.

9) **What is the difference between primary and back-up Protection? (Nov/Dec 2016)**

(*i*) Primary Protection.

It is the protection scheme which is designed to protect the component parts of the power system. If a fault occurs on any line, it will be cleared by its relay and circuit breaker. This forms the primary or main protection and serves as the first line of defence.

(*ii*) Back-up protection.

Sometimes faults are not cleared by primary relay system because of trouble within the relay, wiring system or breaker. Under such conditions, back-up protection does the required job

10) **What do you mean by dead spot in zones of protection?(Nov/Dec 2016)**

The circuit which remains unprotected in protective zones of a power system is called as a dead spot of power system. This is not normally happened in any any eletrical network. All the circuit should be protected

UNIT -2

ELECTROMAGNETIC RELAYS

1) **Why a shading ring is provided in an induction disc relay (Apr/May 2017)**

The purpose of shading ring in induction type over current relay is to neutralize the effects of pilot wire capacitance currents and of inherent lack of balance between two current transformer

2) **What are the difficulties of differential protection? (Apr/May 2017 Nov/Dec 2018)**

➔ In a power transformer, the voltage rating of the two windings is different. Due to this the difference in current may flow through the relay operating coil though there is no fault in the system. **To compensate for this difficulty, the current ratios of C.T.s on each side are different**

➔ Another one difficulty is there is an inherent phase difference between the voltages induced in high voltage winding and low voltage winding.

➔ To compensate for this, the C.T. connections should be such that the resultant currents fed into the pilot wires from either sides are displaced in phase by an angle equal to the phase shift between the primary and secondary currents.

3) **Differentiate time graded system and current graded system used in overcurrent protection. (Nov/Dec 2018)**

Time Graded System

In this scheme of Time Graded Overcurrent Protection, time discrimination is incorporated. In other words, the time setting of relays is so graded that in the event of fault, the smallest possible part of the system is isolated.

Current Graded System

In this scheme of Current Graded Overcurrent Protection, Current discrimination is incorporated. In other words, the current setting of relays is so graded that in the event of fault, the smallest possible part of the system is isolated.

4) **What is the significance of PSM and TSM? (Nov/Dec 2016)**

   PSM

   It is the ratio of fault current in relay coil to the pick-up current ie.,

   $$PSM = \frac{Fault\,Current\,relay\,coil}{Pick-up\,current}$$

   TSM

   A relay is generally provided with control to adjust the time of operation. This adjustmet is known as time setting multiplier

5) **Write the torque equation of unversal relay. (Nov/Dec 2017)**

   The universal torque equation is

   $$T = K_1 I^2 + K_2 V^2 + K_3 V I \cos(\theta - t)$$

6) **Give the principle of negative sequence relay (Nov/Dec 2017)**

   The negative sequence relays are also called phase unbalance relays because these relays are provide protection against negative sequence component of unbalanced currents existing due to unbalanced loads or phase to phase

7) **Mention the principle of operation of distance relay.(Apr/May 2018)**

   There is another group of relays in which the operation is governed by the ratio of applied voltage to current in the protected circuit. Such relays are called **distance** or **impedance** relays.

8) **What is meant by differential relay?**

   A differential relay is defined as the relay that operates when the phasor difference of two or more similar electrical quantities exceeds a predetermined value.Thus a current differential relay operates on the result of comparison between the phase angle and magnitudes of the currents entering and leaving the system to be Protected

9) **What is an under frequency relay?**

   An under frequency relay is one which operates when the frequency of the system (usually an alternator or transformer) falls below a certain value.

10) **What are the various faults to which a turbo alternator is likely to be subjected?**

➔ Failure of steam supply;

➔ failure of speed; overcurrent;

➔ over voltage;

➔ unbalanced loading;

➔ stator winding fault .

11) **Define the term pilot with reference to power line protection.**

Pilot wires refers to the wires that connect the CT"s placed at the ends of a power transmission line as part of its protection scheme. The resistance of the pilot wires is usually less than 500 ohms.

12) **What are the features of directional relay?**

➔ High speed operation;

➔ high sensitivity;

➔ ability to operate at low voltages;

➔ adequate short-time thermal ratio;

➔ burden must not be excessive.

1. **What is the cause of over speed and how alternators are protected from it? [apr/may 2018]**

   Sudden loss of all or major part of the load causes over-speeding in alternators. Modern alternators are provided with mechanical centrifugal devices mounted on their driving shafts to trip the main valve of the prime mover when a dangerous over -speed occurs.

2. **What are the protection methods used for transmission line? [apr/may 2018]**

   The common methods of line protection are :

   (***i***) Time-graded overcurrent protection

   (***ii***) Differential protection

   (***iii***) Distance protection

3. **What is over fluxing? How it affect the transformer? [NOV/DEC 2016]**

   The flux density in the transformer core is proportional to the ratio of voltage to the frequency ie.,V/F. In the generator transformer unit, if full excitation is applied before generator reaches its synchronous speed, due to high V/f, the over fluxing of core may result. Higher core flux means more core loss and overheating of the core. The V/f relay called **volts/hertz relay** is provided to give the protection against over fluxing operation.

4. **Write two protection scheme used for protection of bus bar.[NOV/DEC 2016 & 2017]**

   Bus bars in the generating stations and sub-stations form important link between the incoming and outgoing circuits. If a fault occurs on a busbar, considerable damage and disruption of supply will occur unless some form of quick acting automatic protection is provided to isolate the faulty bus bar.

   The two most commonly used schemes for busbar protection are :

   (***i***) **Differential protection** (***ii***) **Fault bus protection**

5. **Which type protection scheme is preferred for EHV and UHV power line? [NOV/DEC 2018]**

   Distance type of Protection scheme is preferred for EHV and UHV power line. The types of distance protections are

   i) Impedance Type Relay ii) Reactance Type Relay iii) Mho Relay

6. **In the events of faults in generator winding, field excitation is to be suppressed as early as possible why? [NOV/DEC 2018]**

   When a fault occurs in an alternator winding even though the generator circuit breaker is tripped, the fault continues to fed because EMF is induced in the generator itself. Hence the field circuit breaker is opened and stored energy in the field winding is discharged through another resistor. **This method is known as field suppression.**

7. **Why secondary of Transformer should not be opened? [NOV/DEC 2017]**

   If the secondary of CT is open, then there will be no current flowing on secondary side. To counter the mmf of primary, there will be no secondary mmf (because of no current on sec). Hence there will be large amount of mmf present in the current transformer. Due to this large voltage will be developed across the secondary terminals will lead to the insulation failure and will saturate the core also. Hence the Secondary of C.T should not be open circuited

8. **What is the need for instrument transformer? [APR/MAY 2017]**

   In heavy currents and high voltage circuits, the measurements can not be done with the help of low range meters. In such case the specially designed transformer which is called as **Instrument Transformers** are used to measure the high voltage and high currents.

9. **What are the limitations of buchholz relay? [APR/MAY 2017]**

   i)Only fault below the oil level are detected.

   ii) Mercury switch setting should be very accurate, otherwise even for vibration, there can be a false operation.

iii) The relay is of slow operating type, which is unsatisfactory.

10. **What are the problems associated with bus zone differential protection? [APR/MAY 2017]**

Large number of circuits, different current levels for different circuits for external faults Saturation of C.T cores due to D.C component and A.C component in short circuit. This saturation introduces ratio-error. It split bus or sensationalizing bus is existing, it makes the bus protection all the more difficult.

11. **What are the causes of bus zone faults?**

a) Failure of support insulator resulting in earth fault

b) Flash over across support insulator during over voltage

c) Heavily polluted insulator causing flash over

d) Earthquake, mechanical damage etc.

UNIT – 4 STATIC AND NUMERICAL PROTECTION

Two Marks Q& A

1) **Define Sampling Theorem (Apr/May 2017)**

   It states that in order to preserve the information contained in a signal of frequency it must be sampled at a frequency at least equal to or greater than twice the signal frequency. ω sampling,min ≥ 2ω signal

2) **Write about numerical Transformer Protection. (Apr/May 2017)**

   In numerical differential protection of Transformer the following algorithm is follwed:

   ➜ Read percentage bias B and minimum pick-up Ip.u

   ➜ Read Ip samples-----> Estimate phasors, Ip using any technique

   ➜ Read Is samples-----> Estimate phasors, Is using any technique

   ➜ Compute Spill Current $I_{spill} = I_P - I_S$

   ➜ Compute circulating current $I_{Circulating} = \dfrac{(I_p + I_s)}{2}$

   ➜ If Ispill > (Bicirculating + Ip.u) then trip else restrain

3) **What is Static Relay? (Apr/May 2019, Nov/Dec 2017)**

   A static relay refers to a relay in which measurement or comparison of electrical quantities is done in a static network which is designed to give an output signal, when a threshold condition is passed, which operates a tripping device

4) **List the merits of Numerical Relays. (Apr/May 2019)**

   ➜ Compact size

   ➜ Digital Protection makes the circuit simpler

   ➜ Flexibility

   ➜ Reliability

   ➜ Multifunction capability

   ➜ Low burden

   ➜ Sensitivity

   ➜ Speed & Fast resetting

5) **Write Two applications of Static Relay. (Nov/Dec 2016)**

➔ Used in Ultra high speed Protection schemes of EHV – AC lines utlising distance Protection

➔ Overcurrent Schemes

➔ Earth fault Protection schemes

6) **State the difference between conventional relay and Numerical relay(Nov/Dec 2016)**

S.I.No	Feature	Electromechanical Relay	Numerical Relay
1	Size	Bigger	Compact
2	Multiple function	Not Possible	Possible
3	Speed of operation	Slow	Fast
4	Burden on Transducer	Very High	Extremely Low
5	Maintenance	Frequent Maintenance required	Maintenance free relays

7) **Define Comparator**

Comparator is a part of a static relay which receives two inputs to be compared and gives output based on comparison. Types are amplitude comparator, phase comparator, Hybrid comparator

8) **What is phase comparator? (Nov/Dec 2017)**

The Phase comparator is a comparator which compares the phase difference between of two input signals. It checks whether the phase is within the limit or not.

9) **List out the general characteristics of numerical protection (Apr/May 2018)**

➔ Reliability

➔ Self Diagnosis

➔ Event and disturbance records

➔ Integration of digital systems

➔ Adaptive Protection. Etc.,

10) In what way the static relays are meritorious than electromagnetic relays? (Nov/Dec 2018)

➔ Static relay burden is less than Electromagnetic type of relays.

➔ Hence error is less.Less weight and requires less space.

➔ Arc less switching and no acoustical noise.

➔ Long life.

➔ More accurate compared to electromechanical relay.

➔ Low electromagnetic Interference and Less power consumption.

11) List the electronic circuits commonly used in static relays.(Apr/May 2018 ,Nov/Dec 2018)

➔ Semiconductor devices (Ex: Diodes Transistors,Unifunction Transistors, Thyristors etc.,)

➔ Logic circuits

➔ Filter circuits

➔ Multivibrators

➔ Time delay circuits

➔ Level detectors and Analog circuits

UNIT -5

CIRCUIT BREAKERS – TWO MARKS Q&A

1. **What are the factors responsible for increase of arc resistance? [APR/MAY 2018]**

   The arc resistance depends upon the following factors :

   (i) Degree of ionization

   (ii) Length of the arc

   (iii) Cross-section of arc

2. **A circuit breaker is rated as 1500 A, 1000 MVA, 33 kV, 3 second, 3 phase oil circuit breaker. Find rated making current. [APR/MAY 2018]**

   (*i*) Rated normal current = 1500 A

   (*ii*) Breaking capacity = 1000 MVA

   iii) Voltage = 33 kV

   $Rated\,Making\,Current = 2.55 * Symmetrical\,Breaking\,current$

   $Symmetrical\,Breaking\,Current = \dfrac{1000\,x\,10^6}{\sqrt{(3)} * 33\,x\,10^3} = 17496\,(A)$

   $Rated\,Making\,Current = 2.55 * 17496 = 44614\,(A)$

3. **What is the difference between Re-striking voltage and Recovery voltage? [NOV/DEC 2016]**

S.I.No.	Recovery Voltage	Re striking Voltage
1.	It is the Power frequency System Voltage	It is the high frequency transient voltage.
2.	It appears in steady state condition	It appears during Transient Condition
3	The frequency of this voltage is having normal power frequency value	The frequency of this voltage is does not having normal power frequency value
4	It is the voltage that appear across breaker contacts after contact separation and extinction of arc	It may appear across the breaker contacts if its rate of rise is higher than rate of building of dielectric strength of the contact space

4. **State the difference between D.C and A.C circuit Breaking. [NOV/DEC 2016]**

S.I. No.	AC Circuit Breaking	DC Circuit Breaking
1	Current is reduced to zero twice in every cycle in AC circuits	It is Constant in DC circuits
2	Arc current can be reduced to zero when voltage is reduced to zero	Arc is continued and arc current is difficult to reduce unless the contacts are widely opened
3	The breaker can have higher rating for same capacity	The breakers can have lesser rating for same capacity due to larger arc currents
4	Arc Current naturally reduces to zero	Arc current is forced to zero
5	Smaller voltage appear across breaker contacts during arc interruption.	Larger voltage appear across the breaker contacts during arc interruption.

5. **Why the rate of rise of re striking voltage plays important role in circuit breaker operation? [NOV/DEC 2018]**

   The rate of rise of re-striking voltage (R.R.R.V.) decides whether the arc will re-strike or not. If R.R.R.V. is greater than the rate of rise of dielectric strength between the contacts, the arc will re-strike. However, the arc will fail to re-strike if R.R.R.V. is less than the rate of increase of dielectric strength between the contacts of the breaker. The rate of rise of re striking voltage plays important role in circuit breaker operation.

6. **Why oil circuit breakers are not suitable for heavy current interruption at low voltages? [NOV/DEC 2018]**

   (*i*) There is no special control over the arc other than the increase in length by separating the moving contacts. Therefore, for successful interruption, long arc length is necessary.

   (*ii*) These breakers have long and inconsistent arcing times.

(*iii*) These breakers do not permit high speed interruption. Due to these disadvantages, oil circuit breakers are not suitable for heavy current interruption at low voltages

7. **State the slepian theory for arc interruption. [NOV/DEC 2017]**

This theory states that is the rate at which the ions and the electrons combine to form or are replaced by the neutral molecules ie., the rate at which the gap recovers its dielectric strength is faster then the rate at which voltage stress rises, the arc will be extinguished

8. **Define re striking Voltage. [APR/MAY 2017]**

Re striking Voltage

It is the transient voltage appearing across the breaker contacts at the instant of arc being extinguished.

9. **What is rupturing or Breaking capacity? [NOV/DEC 2017]**

Breaking capacity or rupturing capacity is the current that a circuit breaker is able to interrupt without being destroyed or causing an electric arc with unacceptable duration. It is the product of breaking current and recovery voltage.

10. **What is meant by current chopping with respect to circuit breaking? [APR/ MAY 2016]**

When low inductive currents, such as magnetizing current of transformer, shunt reactors are interrupted by breaker, there is rapid deionization of contact space and may cause the interruption of current before its natural zero. This phenomenon is called current chopping