Registration No.: .....

Bhartiya Skill Development University Jaipur

School of Electrical Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, 3rd Semester,
End – Sem. Examination

Course Code: ELE1301 **Time: 2 Hours**
Course Name: Automation and Control **Max. Marks: 50**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries four marks. Answer all questions from section C, each question carries six marks. Scientific calculator is allowed.

Section – A

10X01 = 10 Marks

1. A set amount of each of the inputs to the process is received in a grouped form in:
   (a) Continuous process (b) Batch process
   (c) Individual control (d) Centralized Control

2. Full form of SMPS is:
   (a) Switch Mode Power Supply (b) Starter Mode Power Supply
   (c) Standard Mode Power Supply (d) None of these

3. The time required to make a single scan of PLC program:
   (a) 1 ms to 150 ms (b) 1 ms to 20 ms
   (c) 1 ms to 100 ms (d) None of these

4. The_____ mode is used to operate or monitor the user program without energizing any outputs.
   (a) Run mode (b) Program mode
   (c)Test mode (d) None of these

5. Opcodes are used in_____ Logic.
   (a) Statement logic (b) Boolean algebra
   (c) Flowchart (d) Mnemonics Logic

6. The _____ are drawn as horizontal lines and connect the rails to the logic expressions.
   (a) Rungs (b) Logic Expressions
   (c) Comments (d) Address Notation

7. Derivative controller is also known as: -
   (a) Reset controller (b) Rate controller
   (c) Both (a) and (b) (d) None of these

8. Full form of PID controller is: -
   (a) Proportional, Integral and Derivative (b) Preset, Integral and Derivative
   (c) Program, Integral and Derivative (d) None of these

9. Full form of SCADA is: -
   (a) Supervisory Control and Data Acquisition
   (b) Super Central and Data Acquisition
   (c) Super Control and Device Acquisition
   (d) None of these

10. Forward accelerating quadrant with positive speed and torque is: -
   (a) Quadrant I
   (b) Quadrant III
   (c) Quadrant II
   (d) Quadrant IV

Section – B

04X04 = 16 Marks

1. Explain the following: -
   (i) Manual Controlling
   (ii) Pneumatic Controlling
   (iii) Hard wired Controlling
   (iv) Logic gate Controlling
2. Explain the Rack Installation.
3. Explain the Human Machine Interface.
4. Explain the PID Controller.

Section – C

04X06 = 24 Marks

1. Explain the advantages of PLC in detail.
2. Explain Fault diagnosis technique and Troubleshooting.
3. Explain Ladder Logic Basic Gate functions with truth table and Ladder Logic Diagram.
4. Explain the VFD with drive operations.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, IIIrd Semester,
End-Sem. Examination

Course Code: ELE1301 **Time: 2 Hours**
Course Name: Automation & Control **Max. Marks: 50**

ANSWER-SHEET

Section – A

1. A set amount of each of the inputs to the process is received in a grouped form: -
   (a) Batch process
2. Full form of SMPS is: -
   (a) Switch Mode Power Supply
3. The time required to make a single scan of PLC program: -
   (b) 1 ms to 20 ms
4. The_____mode is used to operate or monitor the user program without energizing any outputs.
   (c)Test mode
5. Opcodes are used in_____Logic.
   (d) Mnemonics Logic
6. The _____ are drawn as horizontal lines and connect the rails to the logic expressions.
   (a) Rungs
7. Derivative controller is also known as: -
   (b) Rate controller
8. Full form of PID controller is: -
   (a) Proportional, Derivative and Integral
9. Full form of SCADA is: -
   (a) Supervisory Control and Data Acquisition
10. Forward accelerating quadrant with positive speed and positive torque is: -

    (a) Quadrant I

Section – B

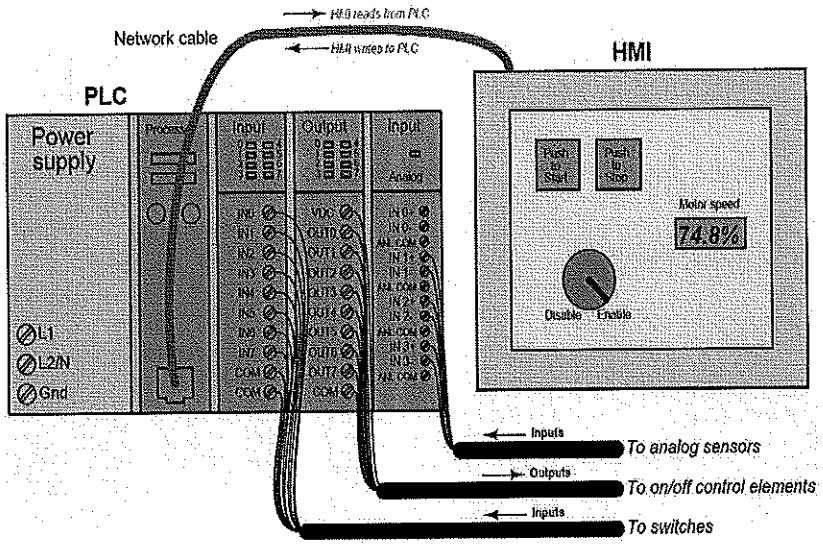
1. **(a) Manual Controlling**: In manual control system, the process operator observes the process condition and controls the system by doing manual adjustments. Heron of Alexandria, a Greek mathematician, invented the first automatic door, which could open the gates to the city using a series of ropes and pulleys.
   (b) Pneumatic Controlling: A pneumatic system is a collection of interconnected components using compressed air to do work for automated equipment. in this case the use of a gaseous media under pressure to generate, transmit and control power; typically using compressed gas such as air at a pressure of 60 to 120 pounds per square inch (PSI). Hydraulics is another form of fluid power, which uses a liquid media such as oil but at a much higher pressure with a typical range of 800 to 5000 PSI. EX. Hydraulic gates.

(c)Hard wire controlling: Hard-wired means the electrical cable is physically connected or wired into the household wiring. Ex. Hard wired counter, timer etc.

(d)Electric logic gate controlling: A logic gate is an idealized or physical device implementing a Boolean function that, performs a logical operation on one or more binary inputs and produces a single binary output.

2. **Rack Installation:**
   - The rack mounting type of PLC is similar to the modular concept, but is implemented differently. Whereas each module in a modular PLC connects to the base unit directly, a rack mounting PLC keeps each module separate.
   - All extra modules are connected through a network, and modules are held in organized racks. This approach allows for larger systems to be built without becoming overly cluttered and complicated. Modules are well organized on the rack and can be removed and reinserted as needed.
   - The commercial unit is an industry-standard example of the rack mounting PLC type. There are essentially no limits on the number of modules that can be added to this system, each mounted on a standard rack chassis. This setup allows large, scalable automation solutions to be built and is common in factories.

3. **Human Machine Interface (HMI)**
   - PLCs are built to input various signal types (discrete, analog), execute control algorithms on those signals, and then output signals in response to control processes. By itself, a PLC generally lacks the capability of displaying those signal values and algorithm variables to human operators.
   - In order for operators to monitor and adjust parameters inside the PLC's memory, we need a different sort of interface allowing certain variables to be read and written without compromising the integrity of the PLC by exposing too much information or allowing any unqualified person to alter the program itself.
   - One solution to this problem is a dedicated computer display programmed to provide selective access to certain variable's in the PLC's memory, generally referred to as Human-Machine Interface, or HMI.



- Most industrial HMI panels come equipped with touch-sensitive screens, allowing operators to press their fingertips on displayed objects to change screens, view details on portions of the process, etc.

4. Proportional Derivative Integral Controller (PID)

- It is a combination of Proportional, Derivative and an Integral controller the output (also called the actuating signal) is equal to the summation of proportional, derivative and integral of the error signal. Now let us analyse proportional, derivative and integral controller mathematically. As we know in a proportional, derivative and integral controller output is directly proportional to the summation of proportional of error signal, derivative of error signal and integration of the error signal, writing this

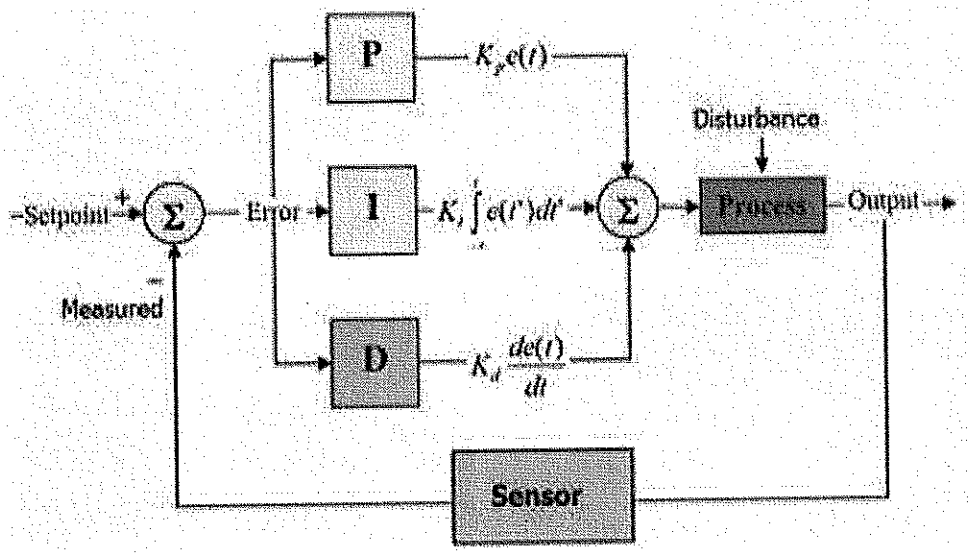
$$A(t) \propto \frac{de(t)}{dt} + A(t) \propto e(t) + A(t) \propto \int_0^t e(t)dt$$

mathematically we have,

- Removing the sign of proportionality we have,

$$A(t) = K_d \frac{de(t)}{dt} + K_p e(t) + K_i \int_0^t e(t)dt$$

- Where, K_d, K_i and k_p proportional constant, integral constant and derivative constant respectively.



Section – C

1. **Advantages of PLC:**
   1) **Increased Reliability:** Once a program has been written and tested, it can be easily downloaded to PLC. Since all the logic is contained in the PLC's memory there is no change of making a logic wiring error.
   2) **More flexibility:** It is easier to create and change a program in a PLC than to wire and rewire the circuit. With a PLC the relationship between the input and output are determined by the user program instead of manner in which they are interconnected.
   3) **Lower cost:** PLC were originally designed to replace relay control logic, and the cost saving have so significant that relay control is becoming obsolete except for power applications.
   4) **Communication capability:** A PLC can communicate with other controllers such as Human machine Interface, Supervision control, Data gathering, Monitoring devices and process parameters.
   5) **Faster Response time:** PLCs are designed for high-speed and real-time applications. The PLC operates in real time, which means that an event taking place in the field will result in the execution of an operation or output. Machines that process thousands of items per second and objects that spend only a fraction of second in front of a sensor require the PLC's quick-response capability.
   6) **Easier to troubleshoot:** PLC's have resident Diagnostics and override functions that allow user to easily trace and correct software and hardware problems. To find and fix problems user can display the control program on a monitor and watch it in real time as it executes.

2. **Fault diagnosis technique and Troubleshooting**

   The 5 Step Troubleshooting Approach consists of the following:

   1. Preparation

- Before you begin to troubleshoot any piece of equipment, you must be familiar with your organization's safety rules and procedures for working on electrical equipment. These rules and procedures govern the methods you can use to troubleshoot electrical equipment (including your lockout/ tagout procedures, testing procedures etc.) and must be followed while troubleshooting.

2. Observation

- Most faults provide obvious clues as to their cause. Through careful observation and a little bit of reasoning, most faults can be identified as to the actual component with very little testing.

3. Define Problem Area

- Starting with the whole circuit as the problem area, take each noted observation and ask yourself "what does this tell me about the circuit operation?" If an observation indicates that a section of the circuit appears to be operating properly, you can then eliminate it from the problem area. As you eliminate each part of the circuit from the problem area, make sure to identify them on your schematic. This will help you keep track of all your information.

4. Identify Possible Causes

- Once the problem area(s) have been defined, it is necessary to identify all the possible causes of the malfunction. This typically involves every component in the problem area(s).

5. Determine Most Probable Cause

- Once the list of possible causes has been made, it is then necessary to prioritize each item as to the probability of it being the cause of the malfunction.

6. Test and Repair

- Testing electrical equipment can be hazardous. The electrical energy contained in many circuits can be enough to injure or kill. Make sure you follow all your companies safety precautions, rules and procedures while troubleshooting.

3. Ladder Logic Basic Gate functions

(1) Ladder Logic NOT Function

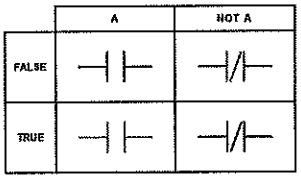
- The result of the NOT function is basically the opposite state of an event that occurs.
- So if PLC input A is FALSE the result will be TRUE. And vise versa when PLC input A is TRUE the result will be FALSE.
- The NOT Function is sometimes referred to as reverse logic. Check out the truth table below....

A	NOT A
FALSE	TRUE
TRUE	FALSE

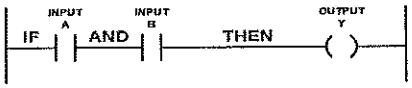
- If we translate a NOT function into a ladder logic diagram we express, it symbolically in the form of a normally closed (NC) contact.

(2) Ladder Logic AND Function

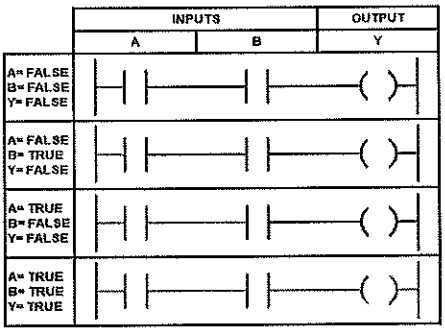
- The AND function examines multiple PLC inputs and has one resulting output.
- If we translate an AND function into a ladder diagram we can express, it symbolically in the form of two normally open (NO) contacts (PLC inputs A and B) and a relay coil (PLC output Y).



- They are all connected in line, just like a series connection in an electric circuit.
- Check out the truth table -

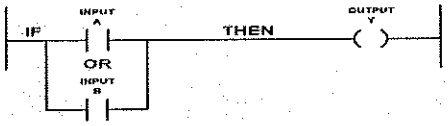


INPUTS		OUTPUT
A	B	Y
FALSE	FALSE	FALSE
FALSE	TRUE	FALSE
TRUE	FALSE	FALSE
TRUE	TRUE	TRUE

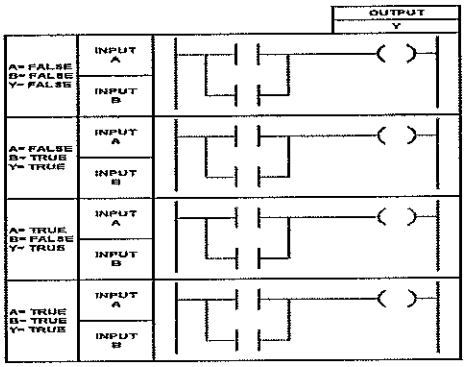


(3) Ladder Logic OR Function

- The OR function examines multiple PLC inputs and has one resulting output.
- If we translate an OR function into a ladder diagram we can express it symbolically in the form of two normally open (NO) contacts (PLC inputs A and B) and a relay coil (PLC output Y).
- The inputs are placed in the rung in what is known as a branch. This is the equivalent of a parallel connection in an electric circuit.
- Check out the truth table-



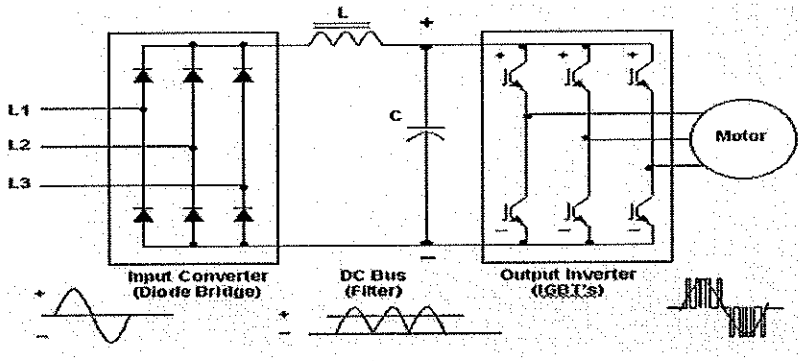
INPUTS		OUTPUT
A	B	Y
FALSE	FALSE	FALSE
FALSE	TRUE	TRUE
TRUE	FALSE	TRUE
TRUE	TRUE	TRUE



4. Variable-frequency drive

"A variable-frequency drive (VFD) or adjustable-frequency drive (AFD), variable-voltage/variable-frequency (VVVF) drive, variable speed drive (VSD), AC drive, micro drive or inverter drive is a type of adjustable-speed drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage."

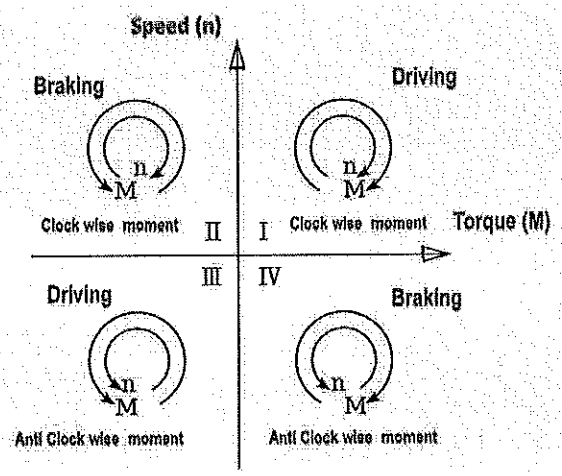
- VFDs are used in applications ranging from small appliances to large compressors. About 25% of the world's electrical energy is consumed by electric motors in industrial applications, which can be more efficient when using VFDs in centrifugal load service.
- The VFD controller is a solid-state power electronics conversion system consisting of three distinct sub-systems: a rectifier bridge converter, a direct current (DC) link, and an inverter.
- Most drives are AC-AC drives in that they convert AC line input to AC inverter output. However, in some applications such as common DC bus or solar applications, drives are configured as DC-AC drives.



Drive operation

Drive applications can be categorized as follows:

- Quadrant I - Driving or motoring, forward accelerating quadrant with positive speed and torque
- Quadrant II - Generating or braking, forward braking-decelerating quadrant with positive speed and negative torque
- Quadrant III - Driving or motoring, reverse accelerating quadrant with negative speed and torque
- Quadrant IV - Generating or braking, reverse braking-decelerating quadrant with negative speed and positive torque.



Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, 3rd Semester,
End – Sem. Examination

Course Code: ELE 1302 **Time: 2 Hours**
Course Name: Electrical Machine Design Developer **Max. Marks: 50**
Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries four marks. Answer all questions from section C, each question carries six marks. Scientific calculator is allowed.

Section – A

10X01 = 10 Marks

1. To reduce eddy current losses:
   (a) Laminated core is preferred (b) Silicon is added in core
   (c) Heat sink is used (d) None of the above
2. Class H insulating material can bear temperature up to:
   (a) 120^0 C (b) 90^0 C (c) 180^0 C (d) 150^0 C
3. Percentage differential relay is used for the protection of:
   (a) Transformer (b) Alternator (c) Motor (d) Both (a) & (b)
4. Which statement is true for DC series motor?
   (a) It should never run on no load
   (b) Flux value is constant
   (c) Its coil resistance is very high
   (d) Torque is inversely proportional to the armature current value
5. Unit of flux is:
   (a) Weber (b) Ampere-turns (c) Henry/Meter (d) None of these
6. Transformer is a:
   (a) Static device (b) Constant frequency device
   (c) Constant power device (d) All of these
7. Armature reaction is:
   (a) Effect of armature flux on main flux (b) Effect of improper size of poles
   (c) Effect of frequency (d) None of these
8. Fleming left hand rule is used for:
   (a) Generator (b) Motor (c) Transformer (d) None of these
9. Number of parallel path in LAP winding
   (a) 2 (b) 8 (c) Equal to number of poles (d) None of these
10. Brushes are always placed on
    (a) GNA (b) MNA (c) Can connected at anywhere (d) None of these

Section – B

04X04 = 16 Marks

1. A 4 pole 1200 rpm DC lap wound generator has 1520 conductors. If flux per pole is 0.01 wb, calculate the value of generated emf.
2. Why single phase induction motor is not self-started? Explain any 2 methods to make it self-start.
3. Differentiate between WAVE winding and LAP winding.
4. The stator of a machine has a smooth surface but its rotor has open type of slots with slots width W_s = tooth width, W_t = 12 mm, and the length of air gap L_g = 2 mm. Find the effective length of air gap if the Carter's coefficient = $1/(1+5L_g/W_s)$. There are no radial ducts.

Section – C

04X06 = 24 Marks

1. Explain limitation in designing of machines.
2. Explain classification of DC generator in detail.
3. Explain the construction & working principle of Buchholz relay.
4. Explain classification of insulating materials and applications of insulating materials.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, End-Sem. Examination

B. Voc. Program, Summer Semester (2019-20)

Course Code: ELE1302 **Time: 2 hour**

Course Name: Electrical Machine Design Developer **Max Marks: 50**

Section-A

A.1 (a)

A.2 (c)

A.3 (d)

A.4 (a)

A.5 (a)

A.6 (d)

A.7 (a)

A.8 (b)

A.9 (c)

A.10 (b)

Section-B

Ans. 1

Given, Number of poles=6
Z=1520
Φ=0.01 wb per pole
N=1200 rpm
No. of parallel path for LAP winding=No. of poles=6
Generated emf is given by, $E_g=(\varphi ZNP)/(60*A)$
$E_g= (0.01*1520*1200*6)/(60*6) = 304$ volts

Ans. 2

In induction machine a rotating magnetic field is required to produce torque. A rotating magnetic field can produce if we have balanced three phase supply and each phase is electrically spaced 120^0 to each other or we have required minimum two phase. But in single phase induction motor there is single phase supply to the stator of motor, a single phase supply cannot produce a rotating magnetic field but it produces a pulsating magnetic field which does not rotate. Due to this pulsating magnetic field torque cannot produce so motor is not self-starting. There are different methods for induction motor to make it self-start:

(a) Split phase induction motor:

BSDU

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

A split phase induction motor consists of two main parts i.e., one is stator and other is rotor. On stator two windings are provided one is Main winding & other is Auxiliary winding. Both windings are 90^0 electrical apart & are connected in parallel across the single phase AC supply with centrifugal switch. Auxiliary winding has a high resistance and low reactance so there will be 90^0 phase shift occurs and a rotating magnetic field is developed and torque is generated to rotate the rotor. Once rotor starts rotating the centrifugal switch gets open and rotor continuously rotates.

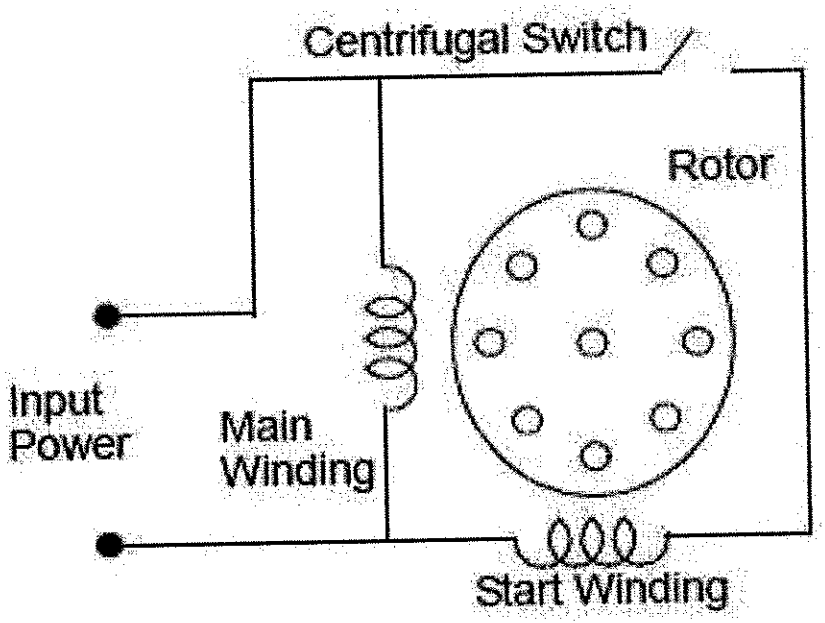
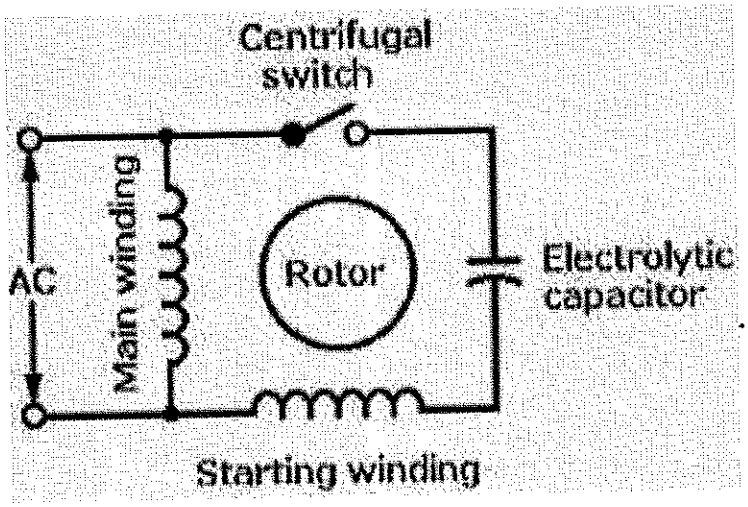


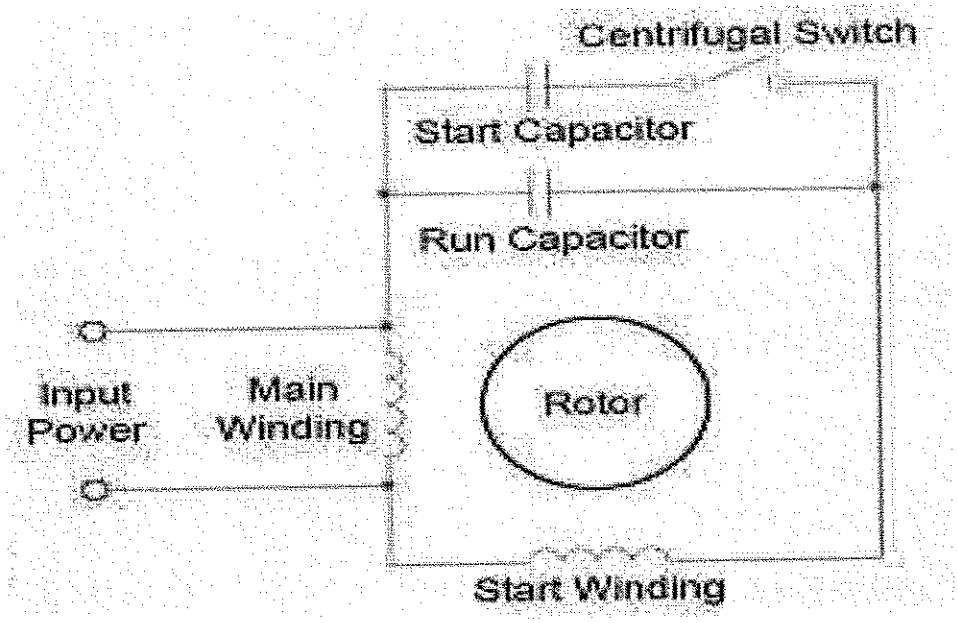
Fig. Circuit diagram of split phase induction motor

(b) Capacitor start motor:
In this motor, capacitor is connected in series with the start winding with centrifugal switch. Here, due to capacitor current leads 90^0 from voltage and creates phase shift. Hence the rotor feels force and starts rotating. This motor has high starting torque, about 1.5 times the full load torque.



(c) Capacitor start & Capacitor run motor:
In this motor, two capacitors are connected in parallel, one with centrifugal switch and other with starting winding. Through this method power factor of induction motor also gets improved. The operation is similar to that of capacitor start motor. This motor is used against heavy loads. Starting torque is about 2 to 2.5 times of its full load current.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY



Ans. 3

Basis For Comparison	**Lap Winding**	**Wave Winding**
Definition	The coil is lap back to the succeeding coil.	The coil of the winding form the wave shape.
Connection	The end of the armature coil is connected to an adjacent segment on the commutators.	The end of the armature coil is connected to commutator segments some distance apart.
Parallel Path	The numbers of parallel path are equal to the total of number poles.	The number of parallel paths is equal to two.
Other Name	Parallel Winding or Mulitiple Winding	Two-circuit or Series Winding.
EMF	Less	More
Number of Brushes	Equal to the number of parallel paths.	Two
Types	Simplex and Duplex lap winding.	Progressive and Retrogressive wave winding
Efficiency	Less	High
Additional Coil	Equalizer Ring	Dummy coil
Winding Cost	High (because more conductor is required)	Low
Uses	In low voltage, high current machines.	In high voltage, low current machines.

Ans. 4

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Solution. Carter's co-efficient for slots

$$K_{cs} = \frac{1}{1+5\times 2/12} = 0.545$$

Slot pitch $y_s = W_s + W_t = 24$ mm.

From Eqn. 3.12, gap contraction for slots

$$K_{sg} = \frac{y_s}{y_s - K_{cs}W_s} = \frac{24}{24 - 0.545\times 12} = 1.37.$$

Since there are no ducts, gap contraction factor for ducts, $K_{gd} = 1$.

From Eqn. 3.26, total gap contraction factor $K_g = K_{gs} = 1.37 \times 1 = 1.37$.

∴ Effective gap length (see Eqn. 3.36) $l_{gs} = K_g l_g = 1.37 \times 2 = 2.74$ mm.

Section-C

Ans. 1

(3)

* 3.) Insulation :- The insulating materials used in a M/c should be able its withstand the electrical, mechanical and thermal stresses which are produced in the machine.
→ The type of insulation is decided by the maximum operating temperature of the machine parts where it is put.
→ The size of insulation is not only decided by the maximum voltage stress but also by the mechanical stresses produced.

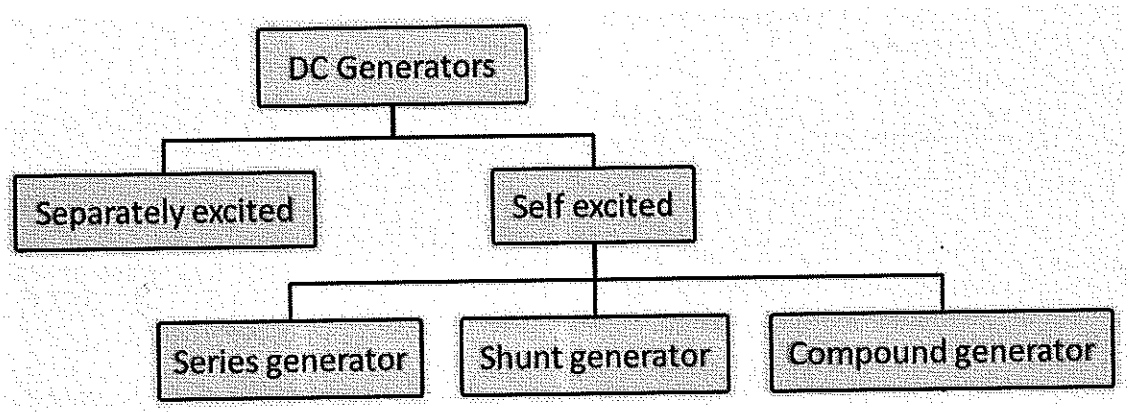
4.) Efficiency :- The η of a machine should be as high as possible to reduce the operating costs. In order to design a highly efficient M/c, the magnetic and electric loadings used should be small and this requires the use of large amount of material. Therefore, the capital cost of a M/c designed for high η is high while its running cost is low.

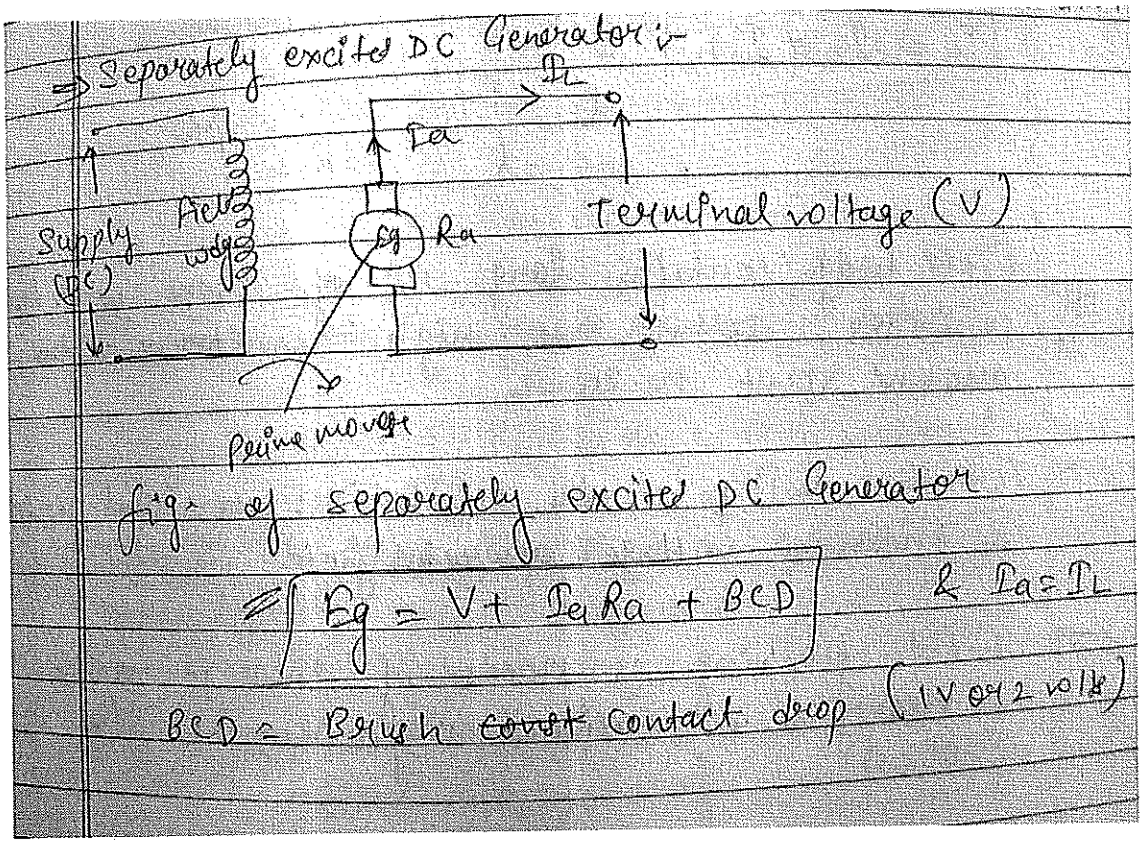
5.) Commutation :- The problem of commutation is important to know in the case of commutator M/c as commutation conditions limit the maximum O/P that can be taken from a machine.

6.) Standard specifications :- These specifications are the biggest strain on the design because both the manufacturer as well as the consumer cannot get away from them without satisfying them.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Ans. 2 Flowchart of DC generators drawn below:

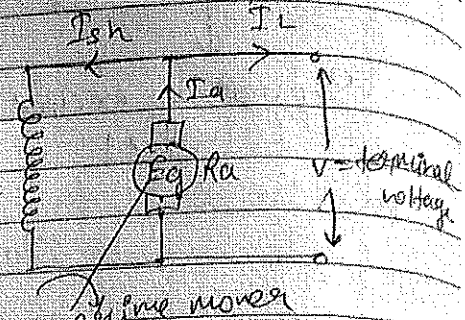




BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Self excitation :-

1. Shunt Generator :-



$$E_g = V + I_a R_a + BCD$$

$$I_a = I_L + I_{sh}$$ &

$$I_{sh} = \frac{V}{R_{sh}}$$

* Field wdg. contains large no. of turns with thin conductor, which has high resistance value around 50 Ω to 250 Ω.

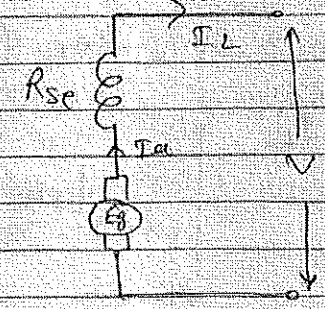
* Terminal voltage is the excitation on shunt field & known as voltage operated field.

⇒ Field flashing is need if there is zero or nearly zero residual magnetism in the field.

2. Series excitation generator :-

* This is called current operated field.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY



$$E_g = V + I_a(R_a + R_{se}) + BCD$$

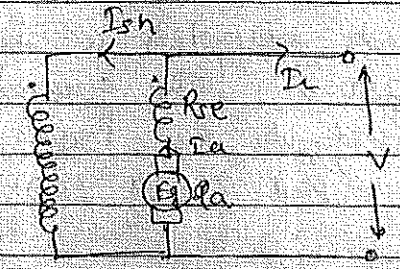
$$I_a = I_L$$

R_{se} is of thick conductor & generally it is having less no. of turns. (R_{se} ↓) (R_{se} lies b/w 1Ω to 2Ω) (R_a lies b/w 0.00Ω to 1Ω to 2Ω)

3. Compound excitation Generator :-

3.1 Cumulative compound Generator :- [Long shunt]

Current flowing in both wdg (series & shunt) is same in direction both the flux will add up & the net flux is +ve known as Commulatively compound generator.



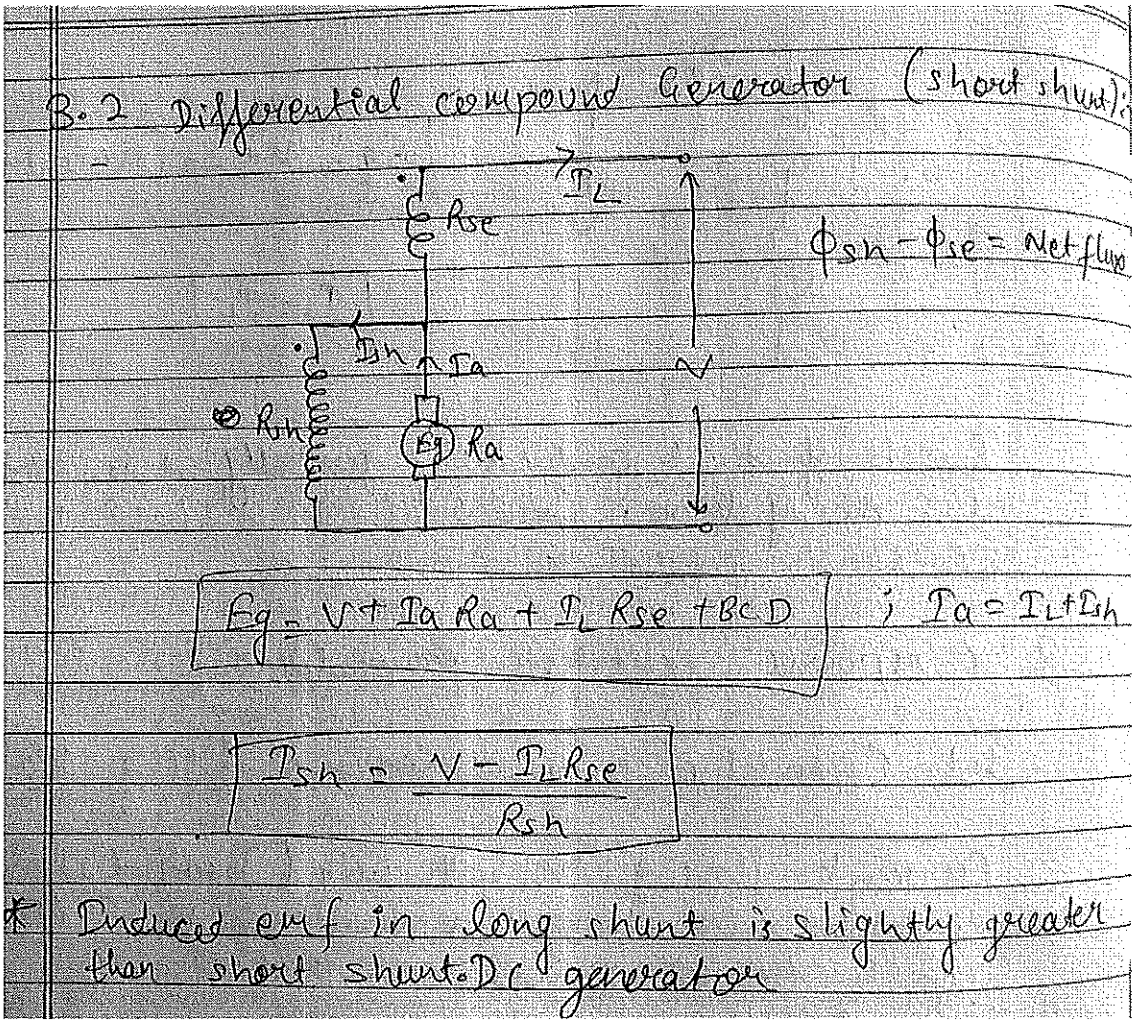
$\phi_{sh} + \phi_{se}$ = +ve

$$E_g = V + I_a(R_a + R_{se}) + BCD$$

$I_a = I_L + I_{sh}$ & $I_{sh} = \frac{V}{R_{sh}}$

→ used in arc welding.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY



Ans. 3 Buchholz relay is used for the protection purpose of transformer. Construction and operation principle is explained below:

Construction:

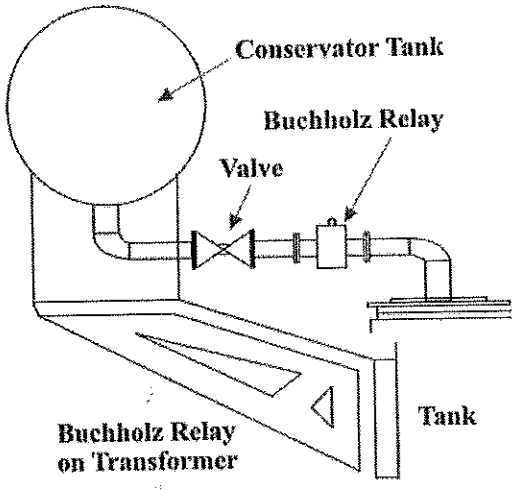
Buchholz relay in a transformer is an oil container housing the connecting pipe from the main tank to the conservator tank. It has mainly two elements. The upper element consists of a float. The float is attached to a hinge in such a way that it can move up and down depending upon the oil level in the Buchholz relay Container.

One mercury switch is fixed on the float. The alignment of the mercury switch hence depends upon the position of the float. The lower element consists of a baffle plate and a mercury switch. This plate is fitted on a hinge just in front of the inlet (main tank side) of Buchholz relay in a transformer in such a way that when oil enters in the relay from that inlet in high pressure the alignment of the baffle plate along with the mercury switch attached to it, will change.

In addition to these main elements, a **Buchholz relay** has gas release pockets on top. The electrical leads from both mercury switches are taken out through a moulded terminal block.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Principle:

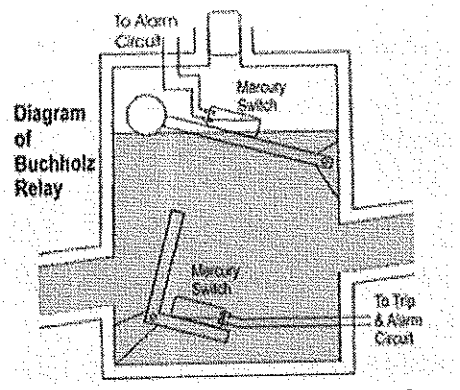


The Buchholz relay working principle of is very simple. Buchholz relay function is based on very simple mechanical phenomenon. It is mechanically actuated. Whenever there will be a minor internal fault in the transformer such as an insulation fault between turns, breakdown of core of the transformer, core heating, the insulating transformer oil will be decomposed in different hydrocarbon gases, CO2 and CO. The gases produced due to the decomposition of transformer insulating oil will accumulate in the upper part the Buchholz container which causes fall of oil level in it.

Fall of oil level means lowering the position of the float and thereby tilting the mercury switch. The contacts of this mercury switch are closed and an alarm circuit energized. Sometimes due to oil leakage on the main tank air bubbles may be accumulated in the upper part of the Buchholz container which may also cause a fall of oil level in it and the alarm circuit will be energized. By collecting the accumulated gases from the gas release pockets on the top of the relay and by analyzing them one can predict the type of fault in the transformer.

More severe types of faults, such as short circuit between phases or to earth and faults in the tap changing equipment, are accompanied by a surge of oil which strikes the baffle plate and causes the mercury switch of the lower element to close.

This switch energized the trip circuit of the circuit breakers associated with the transformer and immediately isolate the faulty transformer from the rest of the electrical power system by inter tripping



the circuit breakers associated with both LV and HV sides of the transformer. This is how Buchholz relay functions.

Ans. 4

S. No.	Class	Temperature range	Examples
1	Y	90^{0}C	Cotton, silk, paper, wood, etc.
2	A	105^{0}C	Materials of class Y impregnated by natural resins cellulose esters, insulating oils, etc
3	E	120^{0}C	Synthetic resins enamles, cotton and paper lamination with formaldehyde banding, etc
4	B	130^{0}C	Mica, glass, fiber, asbestos
5	F	155^{0}C	Materials of class B with bonding materials of higher stability
6	H	180^{0}C	Glass, fiber and asbestos materials
7	C	Above 180^{0}C	Mica, ceramics, glass, quartz with Silicon resins

BSDU

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Class Y: This insulation consists of materials or combination of materials such as cotton, silk and paper without impregnation. Its temperature range is 90^0C.
Class A: This insulation consists of materials or combination of materials such as cotton, silk and paper with suitably impregnated or clotted in a dielectric liquid such as oil. It can sustain up to 105^0C.
Class E: This insulation consists of materials or combination of materials such as synthetic resins, enamels, cotton and copper laminator. It can withstand up to temperature of 120^0C.
Class B: This insulation consists of materials or combination of materials such as mica glass fiber, asbestos etc. with suitable bonding substances. It can sustain up to 130^0C.
Class F: This insulation consists of materials or combination of materials such as mica, glass, fiber, asbestos with suitable bonding substances as well as other materials. Class F is of high thermal stability than class B. It can withstand up to temperature of 155^0C.
Class H: This insulation consists of materials or combination of materials such as glass, fiber, asbestos materials. It can withstand up to a temperature of 180^0C.
Class C: This insulation consists of materials or combination of materials such as Mica, ceramics, glass, quartz with Silicon resins. It can withstand up to temperature of above 180^0C

Applications of Insulating Materials :-

(i) Insulating materials for wires :- Enamel, cotton, Rayon Silk & fibrous glass

ii) Insulating materials for laminations :- Insuline, Oxide & Varnish

iii) Insulating materials for M/c :-
1.> Class A Materials :- cotton & oiled Cambric Tapes ; Tough fibrous Materials, Nylon & Terylene.
2.> Class B materials :- fibrous glass tape, Asbestos tapes Mica

iv) Insulating materials for Transformers :-
→ fibrous (class A) materials are use for both air-cooled & oil cooled x-formers.
→ cotton or oiled cambric used for taping the coils
→ Synthetic-resin-bonded paper used for insulation b/w core & coils
→ High grade manilla paper tape is usually employed for insulating the conductors
→ Pressboard is employed as spacers, packing b/w coils barriers b/w coils & tank etc.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

Session: 2019-20 (Summer Semester)

B. Voc. Program, 3rd Semester,

End – Sem. Examination

Course Code: ELE 1303 **Time: 2 Hours**

Course Name: Electrical Circuit Analysis **Max. Marks: 50**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries four marks. Answer all questions from section C, each question carries six marks. Scientific calculator is allowed.

Section – A

10X01 = 10 Marks

1. Kirchhoff s current law states that:
   (a) net current flow at the junction is positive
   (b) Algebraic sum of the currents meeting at the junction is zero
   (c) no current can leave the junction without some current entering it.
   (d) total sum of currents meeting at the junction is zero

2. Kirchhoffs current law is applicable to only:
   (a) junction in a network (b) closed loops in a network
   (c) electric circuits (d) electronic circuits

3. Thevenin resistance R^{th} is found:
   (a) by removing voltage sources along with their internal resistances
   (b) by short-circuiting the given two terminals
   (c) between any two 'open' terminals
   (d) between same open terminals as for E^{th}

4. An ideal voltage source should have:
   (a) large value of e.m.f. (b) small value of e.m.f.
   (c) zero source resistance (d) infinite source resistance

5. Which of the following is non-linear circuit parameter?
   (a) Inductance (b) Condenser
   (c) Wire wound resistor (d) Transistor

6. The circuit whose properties are same in either direction is known as:
   (a) unilateral circuit (b) bilateral circuit
   (c) irreversible circuit (d) reversible circuit

7. The number of independent loops for a network with n nodes and b branches is:
   (a) n-1 (b) b-n (c) b-n+1 (d) independent of the number of nodes

8. A network has seven nodes and five independent loops. The number of branches in the network is:
   (a) 13 (b) 12 (c) 11 (d) 10

9. A tree has:
   (a) A closed path (b) No closed path (c) none of these

10. The number of branches in a tree is--------- the number of branches in a graph.
    (a) less than (b) more than (c) equal to (d) None of these

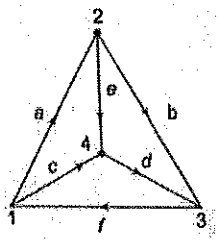
Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Section – B

04X04 = 16 Marks

1. Given phasor A = 6.34 + j 13.59 and phasor B = 16.38 – j 11.47 write down the A/B in (i) rectangular form and (ii) polar form.
2. Given phasor A = 6.34 + j 13.59 and phasor B = 16.38 – j 11.47 write down the (A+B)/ (A-B) in (i) rectangular form and (ii) polar form.
3. For the given graph shown in fig. draw the number of possible trees.



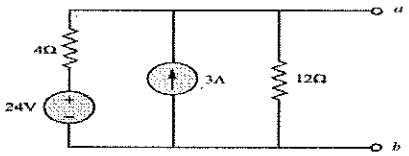
4. Draw the graph corresponding to the given incidence matrix

$$A=\begin{bmatrix} -1 & 0 & 0 & 0 & +1 & 0 & +1 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & -1 & +1 \\ 0 & 0 & -1 & -1 & 0 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 & -1 & +1 & 0 & 0 \\ +1 & +1 & +1 & +1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

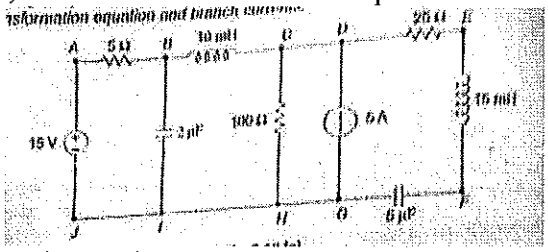
Section – C

04X06 = 24 Marks

1. Find the Norton equivalent for the circuit of Fig



2. For the electrical network shown in Fig. draw its topological graph and write its incidence matrix, tie set matrix, link current transformation equation and branch currents.

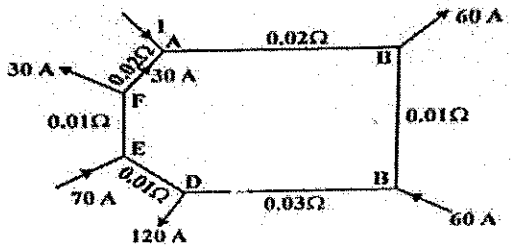


3. The driving point impedance of an LC network is given by:

$$Z(s)=\frac{2s^5+12s^3+16s}{s^4+4s^2+3}$$

Determine the Cauer form of the network.

4. Find the currents in all branches of the network, as shown in figure.



22/12/19

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Electrical Skills
Session: 2019-20 (Summer Semester)
B. Voc. / 3rd Semester,
End-Sem. Examination

Course Code: ELE-1303
Course Name: Electrical Circuit Analysis

Time: 2 Hours
Max. Marks: 50

Section – A

10X01 = 10 Marks

10 objective type questions, each question carries 01 mark.

1. Kirchhoff s current law states that
   (a) net current flow at the junction is positive
   (b) Algebraic sum of the currents meeting at the junction is zero
   (c) no current can leave the junction without some current entering it.
   (d) total sum of currents meeting at the junction is zero
2. Kirchhoffs current law is applicable to only
   (a) junction in a network
   (b) closed loops in a network
   (c) electric circuits
   (d) electronic circuits
3. Thevenin resistance R^{th} is found
   (a) by removing voltage sources along with their internal resistances
   (b) by short-circuiting the given two terminals
   (c) between any two 'open' terminals
   (d) between same open terminals as for E^{th}
4. An ideal voltage source should have
   (a) large value of e.m.f.
   (b) small value of e.m.f.
   (c) zero source resistance
   (d) infinite source resistance
5. Which of the following is non-linear circuit parameter ?
   (a) Inductance
   (b) Condenser
   (c) Wire wound resistor
   (d) Transistor
6. The circuit whose properties are same in either direction is known as
   (a) unilateral circuit
   (b) bilateral circuit
   (c) irreversible circuit
   (d) reversible circuit
7. The number of independent loops for a network with n nodes and b branches is
   (a) n-1
   (b) b-n
   (c) b-n+1
   (d) independent of the number of nodes
8. A network has seven nodes and five independent loops. The number of branches in the network is
   (a) 13
   (b) 12
   (c) 11
   (d) 10

9. A tree has
   (a) A closed path
   (b) <u>No closed path</u>
   (c) none
10. The number of branches in a tree is--------- the number of branches in a graph
   (a) <u>less than</u>
   (b) more than
   (c) equal to

Section – B

04X04 = 16 Marks

04 short answer type questions, each question carries 04 marks.

Q1 Given phasor A = 6.34 + j 13.59 and phasor B = 16.38 – j 11.47 write down the A/B in (i) rectangular form and (ii) polar form.

Ans:

$$A/B = (15\angle 65°/20\angle -35°) = 0.75\angle 100° = 0.75\,[\cos(100°) + j\sin(100°)]$$
$$= -0.13 + j0.74$$

Q2 Given phasor A = 6.34 + j 13.59 and phasor B = 16.38 – j 11.47 write down the (A+B)/(A-B) in (i) rectangular form and (ii) polar form.

Ans:

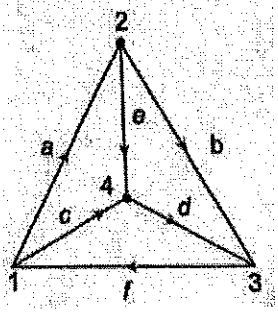
Expressing $(A - B)$ in polar form gives

$$(A - B) = (-10.04 + j\,25.06) = 27\angle 111.84°$$

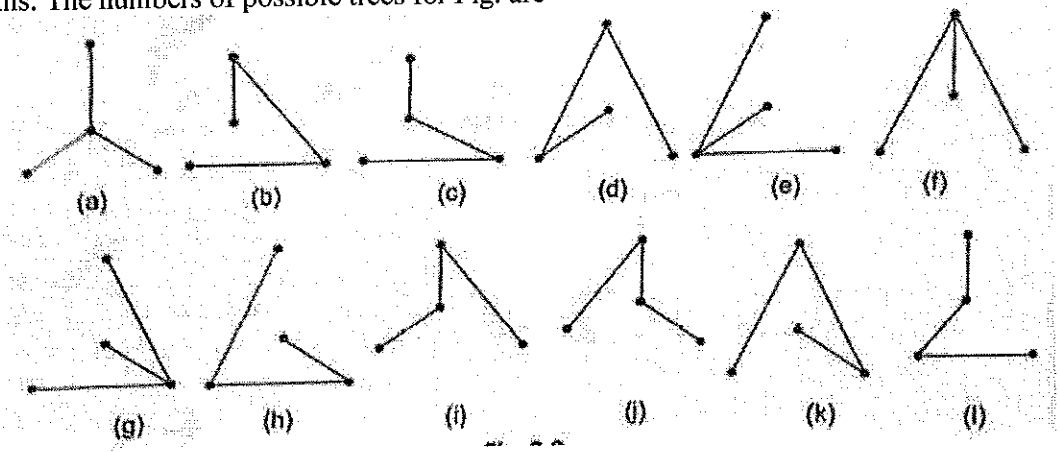
$$A + B = 6.34 + j\,13.59 + 16.38 - j\,11.47 = 22.72 + j\,2.12$$
$$= \sqrt{(22.72)^2 + (2.12)^2}\angle \tan^{-1}(2.12/22.72) = 22.82\angle 5.33°$$

Thus, $(A + B)/(A - B) = (22.8\angle 5.33°/27.0\angle 111.84°) = 0.85\angle -106.51°$
$= -0.24 - j0.81$

Q 3 For the given graph shown in fig. draw the number of possible trees



Ans: The numbers of possible trees for Fig. are



Q4 Draw the graph corresponding to the given incidence matrix

Ans:

$$A=\begin{vmatrix} -1 & 0 & 0 & 0 & +1 & 0 & +1 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & -1 & +1 \\ 0 & 0 & -1 & -1 & 0 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 & -1 & +1 & 0 & 0 \\ +1 & +1 & +1 & +1 & 0 & 0 & 0 & 0 \end{vmatrix}$$

Solution There are five rows and eight columns which indicate that there are five nodes and eight branches. Let us number the columns from a to h and rows as 1 to 5.

$$A=\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array}\begin{array}{c} \begin{array}{cccccccc} a & b & c & d & e & f & g & h \end{array} \\ \begin{vmatrix} -1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & -1 & 1 \\ 0 & 0 & -1 & -1 & 0 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \end{vmatrix} \end{array}$$

Mark the nodes corresponding to the rows 1, 2, 3, 4 and 5 as dots as shown in Fig. 2.13 (a). Examine each column of A and connect the nodes (unit entries) by a branch; label it after marking an arrow.

For example, examine the first column of A. There are two unit entries one in the first row and 2nd in the last row, hence connect branch a between node 1 and 5. The entry of A_{11} is –ve and that of A_{51} is +ve. Hence the orientation of the branch is away from node 5 and towards node 1 as per the convention. Proceeding in this manner we can complete the entire graph as shown in Fig. 2.13 (b).

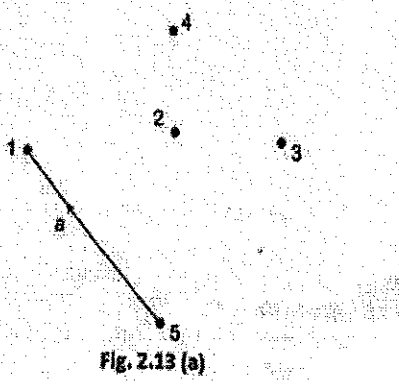


Fig. 2.13 (a)

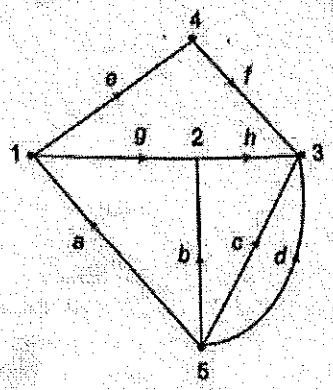


Fig. 2.13 (b)

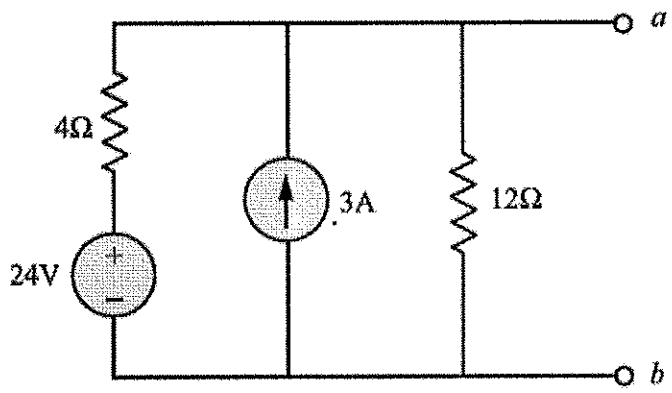
BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Section – C

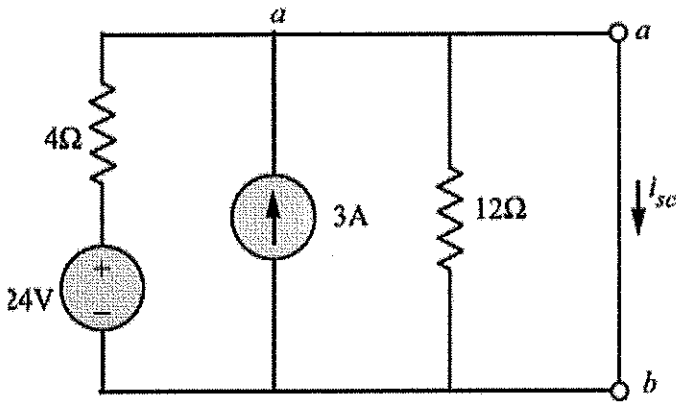
04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

Q1 Find the Norton equivalent for the circuit of Fig



Ans: As a first step, short the terminals a-b. This results in a circuit diagram as shown in Fig.

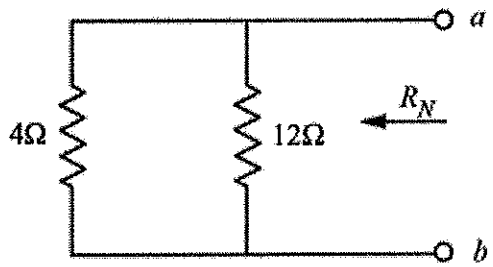


Applying KCL at node a, we get

$$\frac{0-24}{4} - 3 + i_{sc} = 0$$

$$\Rightarrow i_{sc} = 9\text{A}$$

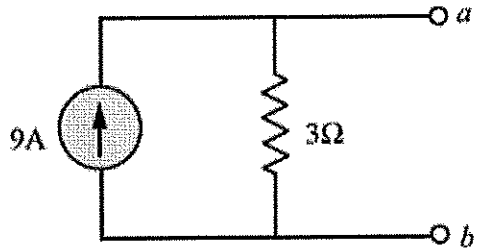
To find R_N, deactivate all the independent sources, resulting in a circuit diagram as shown



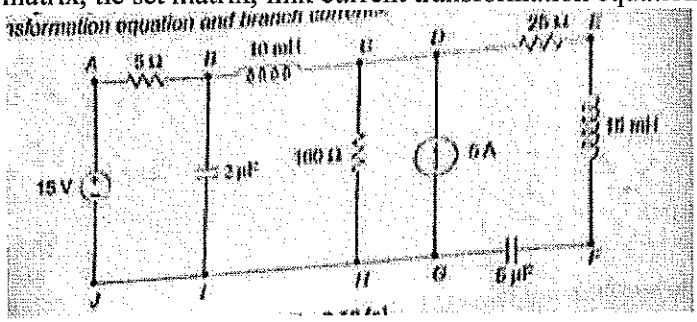
We find R_N in the same way as R_t in the Thevenin equivalent circuit.

$$R_N = \frac{4 \times 12}{4+12} = 3\ \Omega$$

Thus, we obtain Nortion equivalent circuit as shown in Fig.



Q2 For the electrical network shown in Fig. draw its topological graph and write its incidence matrix, tie set matrix, link current transformation equation and branch currents.



Ans:

Solution Voltage source is short circuited, current source is open circuited, the points which are electrically at same potential are combined to form a single node. The graph is shown in Fig. 2.18 (b).

Combining the simple nodes and arbitrarily selecting the branch current directions the oriented graph is shown in Fig. 2.18 (c). The simplified consists of three nodes. Let them be x, y and z and five branches 1, 2, 3, 4 and 5. The complete incidence matrix is given by

$$A = \begin{array}{c} \text{nodes} \downarrow \\ x \\ y \\ z \end{array} \begin{array}{c} \text{branches} \rightarrow \\ \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 1 & 0 & 1 & 0 & -1 \\ -1 & 1 & 0 & 1 & 0 \\ 0 & -1 & -1 & -1 & 1 \end{bmatrix} \end{array}$$

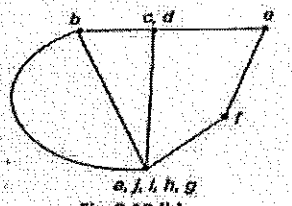


Fig. 2.18 (b)

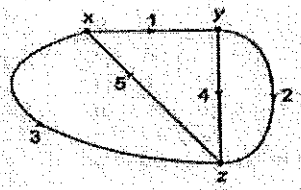


Fig. 2.18 (c)

Let us choose node z as the reference or datum node for writing the reduced incidence matrix A_1 or we can obtain A_1 by deleting the last row elements in A.

$$A_1 = \begin{array}{c} \text{nodes} \downarrow \\ x \\ y \end{array} \begin{array}{c} \text{branches} \rightarrow \\ \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 1 & 0 & 1 & 0 & -1 \\ -1 & 1 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

For writing the tie-set matrix, consider the tree in the graph in Fig. 2.18 (c).
No. of nodes $n = 3$
No. of branches $= 5$
No. of tree branches or twigs $= n - 1 = 2$
No. of link branches $l = b - (n - 1) = 5 - (3 - 1) = 3$
The tree shown in Fig. 2.18 (d) consists of two branches 4 and 5 shown with solid lines and the link branches of the tree are 1, 2 and 3 shown with dashed lines. The tie-set matrix or fundamental loop matrix is given by

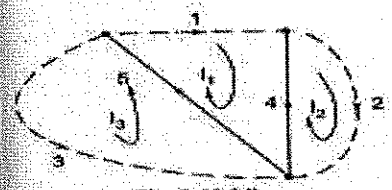


Fig. 2.18 (d)

$$B = \begin{array}{c} \text{loop} \\ \text{i} \\ I_1 \\ I_2 \\ I_3 \end{array} \begin{array}{c} \text{branches} \longrightarrow \\ \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & -1 & 0 \\ 0 & 0 & 1 & 0 & 1 \end{bmatrix} \end{array}$$

To obtain the link current transformation equation and thereby branch currents the transpose of B should be calculated.

$$B^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

The equation $[I_b] = [B^T]\,[I_l]$

$$\begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \\ i_5 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

The branch currents are given by

$$i_1 = I_1$$
$$i_2 = I_2$$
$$i_3 = I_3$$
$$i_4 = I_1 - I_2$$
$$i_5 = I_1 + I_3$$

Q3 The driving point impedance of an LC network is given by

$$Z(s) = \frac{2s^6 + 12s^3 + 16s}{s^4 + 4s^2 + 3}$$

Determine the Cauer form of the network

Ans:

Solution By taking continued fraction expansion, we get

$$s^4 + 4s^2 + 3\overline{)2s^5 + 12s^3 + 16s}\,(2s = I_1$$
$$\underline{2s^5 + 8s^3 + 6s}$$
$$4s^3 + 10s\overline{)s^4 + 4s^2 + 3}\,(\tfrac{s}{4} = C_2$$
$$\underline{s^4 + \tfrac{5}{2}s^2}$$
$$\tfrac{3s^2}{2} + 3\overline{)4s^3 + 10s}\,(\tfrac{8}{3}s = I_3$$
$$\underline{4s^3 + 8s}$$
$$2s\overline{)\tfrac{3s^2}{2} + 3}\,(\tfrac{3}{4}s = C_1$$
$$\underline{\tfrac{3s^2}{2}}$$
$$3\overline{)2s}\,(\tfrac{2}{3}s = I_2$$
$$\underline{2s}$$
$$0$$

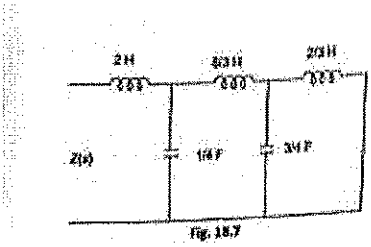


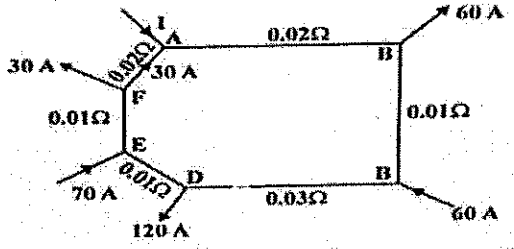
Fig. 18.7

Hence,

$$Z(s) = 2s + \cfrac{1}{\cfrac{1}{\frac{s}{4}} + \cfrac{1}{\frac{3}{s} + \cfrac{1}{\frac{3}{4}s + \cfrac{1}{\frac{2}{3}}}}}$$

The resulting network shown in Fig. 18.7 is called the first Cauer form.

Q4 Find the currents in all branches of the network, as shown in figure.



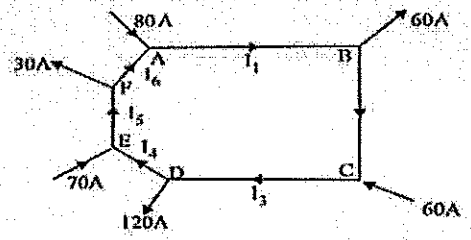
Sol. **The given circuit has 6 nodes. As, in any electrical circuit the total current in any section of the circuit must be zero. So for the given circuit. Sum of all current = 0**

$$\therefore \quad -I + 60 - 60 + 120 - 70 + 30 = 0$$

Because at node A, C, E currents are entering and at node B, D, F currents are leaving.

$$\therefore \quad I = 80\,A$$

So at node A, the 80 A current is entering. Now we apply the currents in the complete network as I_1, I_2, I_3, I_4, I_5 and I_6.



Now apply KCL at each node.

At node A

$$-80 - I_6 + I_1 = 0 \qquad \ldots(1)$$

At node B	$60 - I_1 + I_2 = 0$	...(2)
At node C	$-60 - I_2 + I_3 = 0$	...(3)
At node D	$120 - I_3 + I_4 = 0$	...(4)
At node E	$-70 - I_4 + I_5 = 0$	...(5)
At node F	$30 - I_5 + I_6 = 0$	...(6)

As given in the circuit $I_6 = 30\,A$ so

from equation (6) $I_5 = 30 + I_6 = 30 + 30 = 60\,A$ Ans.

from equation (1) $I_1 = I_6 + 80 = 30 + 80 = 110\,A$ Ans.

from equation (2) $I_2 = I_1 - 60 = 110 - 60 = 50\,A$ Ans.

from equation (3) $I_3 = I_2 + 60 = 50 + 60 = 110\,A$ Ans.

from equation (4) $I_4 = I_3 - 120 = 110 - 120 = -10\,A$ Ans.

from equation (5) $I_5 = I_4 + 70 = -10 + 70 = 60\,A$ Ans.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, 3rd Semester,
End – Sem. Examination

Course Code: ELE 1304 **Time: 2 Hours**
Course Name: Electrical Measuring Instruments **Max. Marks: 50**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries four marks. Answer all questions from section C, each question carries six marks. Scientific calculator is allowed.

Section – A

10X01 = 10 Marks.

1. Which of the following is not an integrating instrument?
   (a) Ampere-hour meter (b) Watt-hour meter
   (c) Voltmeter (d) All of the above

2. Change in output of sensor with change in input is:
   (a) Threshold (b) Slew rate
   (c) Sensitivity (d) None of the mentioned

3. Smallest change which a sensor can detect is:
   (a) Resolution (b) Accuracy
   (c) Precision (d) Scale

4. Which of the following essential features is possessed by an indicating instrument?
   (a) Deflecting device (b) Controlling device
   (c) Damping device (d) All of the above

5. It is the ability of the sensor to indicate the same output over a period of time for a constant input.
   (a) Stability (b) Resolution
   (c) Error (d) Impedance

6. Following acts as detector in Optical sensor:
   (a) Light emitting diode (b) Photo diode
   (c) Transistor (d) All of the above

7. A pointer of an instrument once deflected returns to zero position, when the current is removed due to
   (a) Action of gravity (b) Mass of the pointer
   (c) Controlling Torque (d) Damping Torques

8. An ammeter is convertible to a voltmeter by
   (a) Changing the scale
   (b) Putting a large resistance in parallel with the actual measuring part of the instrument
   (c) Putting a large resistance in series with the actual measuring part of the instrument
   (d) Simply installing the instrument in parallel with the circuit

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

9. Induction type instruments are generally used as:
   (a) Ammeter (b) Voltmeter
   (c) Wattmeter (d) All of these
10. In an energy meter braking torque is produced to:
   (a) Safe guard it against creep
   (b) Brake the instrument
   (c) Bring energy meter to stand still
   (d) Maintain steady speed and equal to driving torque

Section – B

04X04 = 16 Marks

1. Differentiate different types of fingerprint sensor technology. Explain the working of any one technology with diagram.
2. What is the difference between indoor and outdoor air pollution?
3. What is proximity sensor? What is the use of proximity sensor in the mobile phones?
4. Prove that the deflection torque is directly proportional to the current passing through the coil for PMMC instruments.

Section – C

04X06 = 24 Marks

1. Explain the terms resolution, sensitivity and accuracy.
2. Write difference between sensor and transducer.
3. Explain photoelectric smoke detector with diagram.
4. A permanent moving coil instrument has a coil of dimensions 10mm X 8mm. The flux density in the air gap is $0.15 Wb/m^2$. If the coil is wound for 100 turns, carrying a current of 5mA, then calculate the deflecting torque. Calculate the deflection if the spring constant is $0.2*10^{-6}$.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, III Semester,
End-Sem. Examination

Course Code: ELE 1304 **Time: 2 Hours**
Course Name: Electrical Measuring Instruments **Max. Marks: 50**

Answer Sheet

Section – A

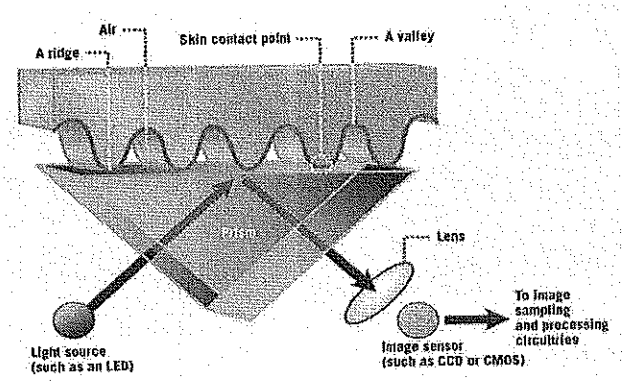
1. Which of the following is not an integrating instrument?
   (c) Voltmeter
2. Change in output of sensor with change in input is _____
   c) Sensitivity
3. Smallest change which a sensor can detect is _____
   a) Resolution
4. Which of the following essential features is possessed by an indicating instrument?
   (d) All of the above
5. It is the ability of the sensor to indicate the same output over a period of time for a constant input.
   (a) Stability
6. Following acts as detector in Optical sensor
   (b) Photo diode
7. A pointer of an instrument once deflected returns to zero position, when the current is removed due to
   (c) Controlling Torque
8. An ammeter is convertible to a voltmeter by
   (c)Putting a large resistance in series with the actual measuring part of the instrument
9. Induction type instruments are generally used as
   (d) All of these
10. In an energy meter braking torque is produced to
    (d)Maintain steady speed and equal to driving torque

Section – B

04X04 = 16 Marks

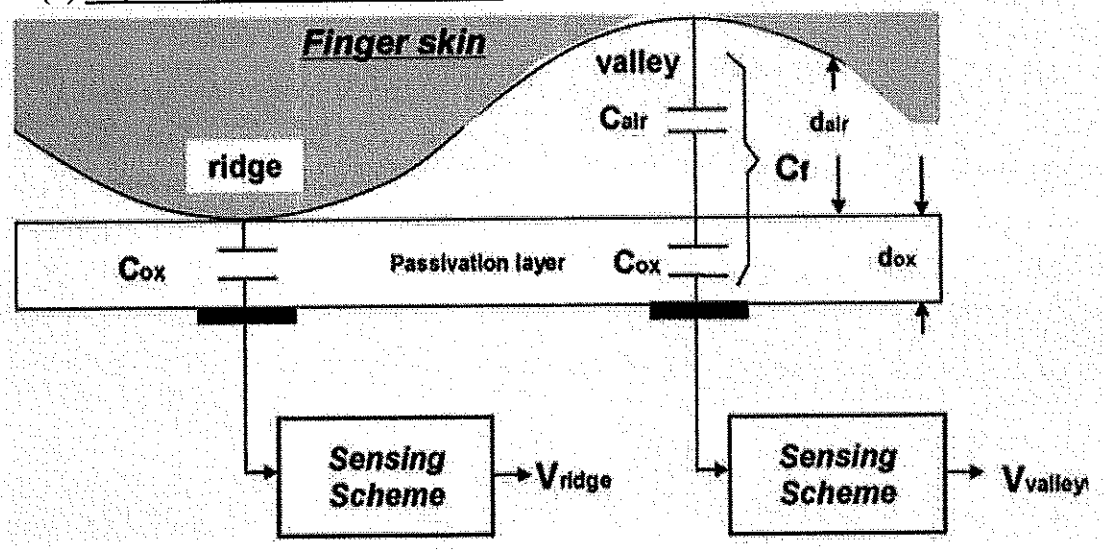
Ans-1 Different types of fingerprint sensor technology is as follows-

(a) Optical Fingerprint Scanners



An optical scanner involves the use of optics (light) to capture and scan fingerprints on a device. Essentially, the scanner works by capturing a digital photograph of the fingerprint and then using algorithms to find unique patterns of lines and ridges, spread across the different lighter and darker areas of the image. This digital photograph is a 2D depiction of the different patterns of ridges and lines present on the finger, and since it comprises of details in the darker sections of the image as well, the same is lit-up using a light source, typically an LED, to capture a detailed image. The quality of the image sensor plays a crucial role in getting a high-definition and detailed image of the fingerprint, which would make it easier to extract more data from the image, increasing security.

(b) Capacitive Fingerprint Scanners



Capacitive scanners capture different details of the fingerprint using just the electrical signals. For this, it uses a series of tiny capacitors circuits, arranged in an array, to store data of the captured fingerprints. During the process of enrolment, the change in fingerprint patterns (ridges and lines) causes a change in the registration process, as the charge would be different for a finger placed over the capacitive plate and different for the air gap between the ridges and lines. This change, in the charge of the capacitor, is further determined using an op-amp (Operational Amplifier), and then recorded with the help of an ADC (Analogue-to-Digital Converter).

(c) Ultrasonic Fingerprint Scanners

An ultrasonic scanner, utilizes a very high-frequency ultrasonic sound. Additionally, it also requires the use of a combination of an ultrasonic transmitter and an ultrasonic receiver. The process involves the use of an ultrasonic pulse, which is sent through the ultrasonic transmitter towards the finger resting on the scanner. As soon as this pulse strikes the finger, some part of it is transmitted, while some part is reflected back. This reflected pulse is then picked up by an ultrasonic receiver, which depending upon the intensity of the pulse, captures a 3D depiction of the fingerprint. This change in the intensity of pulse is caused due to the texture of the finger, which constitutes ridges and lines.

To be able to pick the change in intensity of the reflected ultrasonic pulse, the ultrasonic receiver takes into consideration the mechanical stress of the fingerprint on the scanner. The longer a finger stays on the scanner, the more details it can capture, and produce a detailed

3D depiction of the fingerprint. However, a drawback of this type of fingerprint scanning method is that it is not as fast as the other methods of fingerprint scanning. On the other hand, the scanner does a great job of allowing manufacturers to get rid of or minimize the bezels around the screen, which is only possible because the scanner can be easily implemented under the display.

Ans-2 Outdoor Environment Pollution

Outdoor air pollutants mainly consist of NOx, SO2, O3, CO, HC, and particulate matters (PM) of different particle sizes. In urban areas, these pollutants are mainly emitted from on-road and off-road vehicles, but there are also contributions from power plants, industrial boilers, incinerators, petrochemical plants, aircrafts, ships and so on, depending on the locations and prevailing winds. Comparatively, the contribution from cross border sources is less significant in urban areas due to its increased distance from the pollution sources. However, urban air quality is highly affected by city design. Densely distributed and deep street canyons (buildings with large building height to road width ratios) can block and weaken the approaching wind, thus reducing its air dispersion capability

Indoor Environment Pollution

There are many sources of indoor air pollution. Tobacco smoke, cooking and heating appliances, and vapors from building materials, paints, furniture, etc. cause pollution inside buildings. Radon is a natural radioactive gas released from the earth, and it can be found concentrated in basements in some parts of the United States. Every home will be different, there are some common indoor air pollutants that should be monitored –mold, asbestos, second-hand smoke, carbon monoxide, radon gas, nitrogen dioxide and airborne lead. There are also many anthropogenic sources (such as wooden construction materials, oil based paints, fragrant decorations, and indoor plants) emitting VOCs at a variety of concentrations. These VOCs (such as formaldehyde) may be carcinogenic, while some of them (such as turpenes) may react with ozone to form secondary fine suspended indoor particles

Ans-3: A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The proximity sensor detects when a user is holding the phone near their face during a call and turns off the display to prevent keypad presses and battery consumption from the display. The proximity/light sensor is located to the right of the earpiece.

Ans-4

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

The equation for the developed torque can be obtained from the basic law of the electromagnetic torque. The deflecting toque is given by,

$$T_d = NBAI$$

where T_d = deflecting torque in N-m
B = flux density in air gap, Wb/m^2
N = number of turns of the coil
A = effective coil area m^2
I = Current in the moving coil, amperes

$$\therefore \quad T_d = GI$$

where $G = NBA$ = constant

The controlling torque is provided by the springs and is proportional to the angular deflection of the pointer.

$$T_c = K\theta$$

where T_c = controlling torque
K = spring constant, Nm/rad or Nm/deg
θ = angular deflection

For the final steady state position,

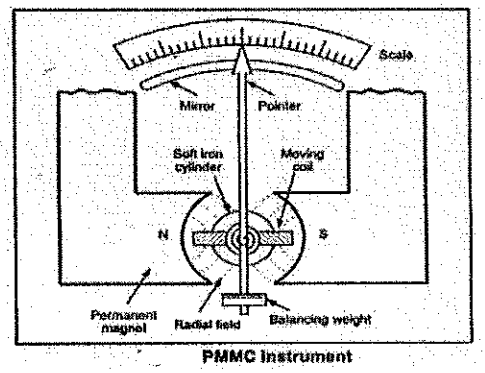
$$T_d = T_c$$

$$\therefore \quad GI = K\theta$$

$$\therefore \quad \theta = \left(\frac{G}{K}\right)I$$

or $$I = \left(\frac{K}{G}\right)\theta$$

Thus the deflection is directly proportional to the current passing through the coil. The pointer deflection can therefore be used to measure current.



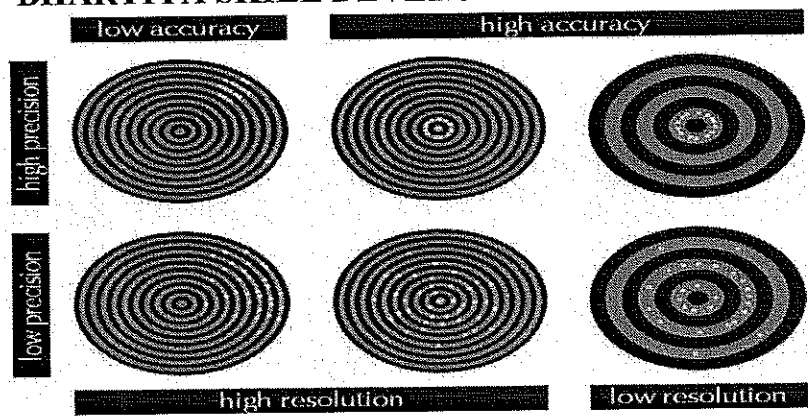
PMMC Instrument

Section-C

Ans-1

Resolution: is the minimal change of the input necessary to produce a detectable change at the output. In other words, the smallest to be distinguished magnitude from the measured value.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY



Sensitivity:

- The slope of the calibration curve y=f(x) g. An ideal sensor will have a large and constant sensitivity
- It is the ratio of change in output to change in input. If Y be the output quantity in response to input X, then sensitivity S can be expressed as

$$S = \frac{dY}{dX} = \frac{\Delta Y}{\Delta X}$$

Accuracy: is the capacity of a measuring instrument to give RESULTS close to the TRUE VALUE of the measured quantity.

- Accuracy is measured by the absolute and relative errors
- The measurement value (which is sometimes referred to simply as the measurement) is the value given by a measuring instrument and the true value is the actual value of the property being measured.

$$\text{ABSOLUTE ERROR} = \text{RESULT} - \text{TRUE VALUE}$$

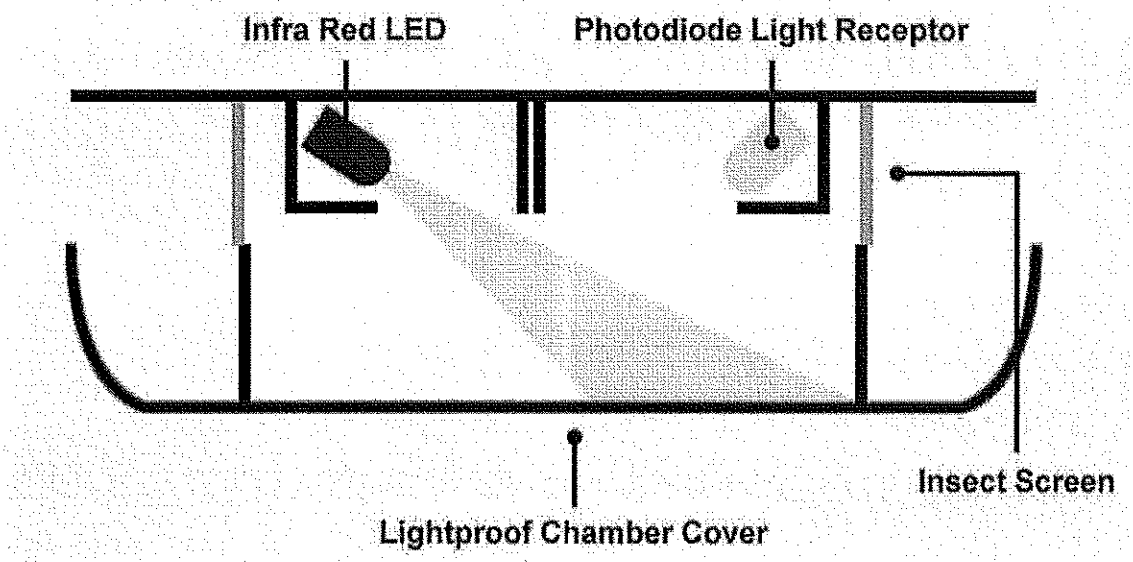
$$\text{RELATIVE ERROR} = \frac{\text{ABSOLUTE ERROR}}{\text{TRUE VALUE}}$$

Ans-2

Basis for Comparison	Sensor	Transducer
Definition	Senses the physical changes occurs in the surrounding and converting it into a readable quantity.	The transducer is a device which, when actuates transforms the energy from one form to another.
Components	Sensor itself	Sensor and signal conditioning
Function	Detects the changes and induces the corresponding electrical signals.	Conversion of one form of energy into another.
Examples	Proximity sensor, Magnetic sensor, Accelerometer sensor, Light sensor etc.	Thermistor, Potentiometer, Thermocouple, etc.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Ans-3



An optical smoke alarm (also called photo-electric smoke alarm) works using the light scatter principle. The alarm contains a pulsed Infra red LED which pulses a beam of light into the sensor chamber every 10 seconds to check for smoke particles. The device projects a continuous, focused beam of light onto a mirror. If nothing interferes with the beam en route and back, the sensor perceives no obstruction. But when a small amount of smoke enters the chamber, the light is refracted slightly, causing an alarm to sound. Smoke from a smoldering source may trigger the alarm even before flames appear. Photoelectric cell detection has saved many lives, buildings and properties.

Step 1 - Smoke Enters the Optical Chamber

When a fire breaks out smoke will enter the optical chamber through the opening vents. Smoke alarms from quality manufacturers have the chamber protected with insect screens to stop bugs entering and causing false alarms.

Step 2 - Infra Red Light is Scattered

As the smoke enters the optical chamber, its particles cause the Infra-red light to be scattered onto the photodiode light receptor.

Step 3 - The Alarm Sounds

Once the scattered light hits the photodiode light receptor a signal is sent to the integrated circuit which causes the alarm to sound alerting the occupants to the fire.

Ans-4

Sol.: The deflecting torque is given by,

$$T_d = NBAI = 100 \times 0.15 \times (A) \times 5 \times 10^{-3}\ \text{Nm}$$

Now $A = \text{area} = 10 \times 8 = 80\ \text{mm}^2 = 80 \times 10^{-6}\ \text{m}^2$

$\therefore$ $T_d = 100 \times 0.15 \times 80 \times 10^{-6} \times 5 \times 10^{-3} = 6 \times 10^{-6}\ \text{Nm}$

Now $T_d = T_c = K\theta$

$\therefore$ $6 \times 10^{-6} = 0.2 \times 10^{-6} \times \theta$

$\therefore$ $\theta = \dfrac{6 \times 10^{-6}}{0.2 \times 10^{-6}} = 30\ \text{degrees}$

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

Session: 2019-20 (Summer Semester)

B. Voc. Program, 3rd Semester,

End – Sem. Examination

Course Code: ELE 1305 **Time: 2 Hours**

Course Name: Introduction to Power System **Max. Marks: 50**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries four marks. Answer all questions from section C, each question carries six marks. Scientific calculator is allowed.

Section – A

10X01 = 10 Marks

1. The thermal efficiency of a steam power station is.....

   (a) 38% (b) 28% (c) 40% (d) 45%

2. The amount of electrical energy that can be generated by a hydroelectric power plant depends upon _____

   (a) Head of water (b) Quantity of water

   (c) Specific weight of water (d) Efficiency of Alternator

3. Nuclear fuel in reactor lasts for _____

   (a) more than 5 months (b) few weeks

   (c) few days (d) more than 5 years

4. Corona loss can be reduced by the use of hollow conductor because:

   (a) The current density is reduced

   (b) The eddy current in the conductor is eliminated

   (c) For a given cross section, the radius of the conductor is increased

   (d) of better ventilation in the conductor

5. On what factors does the skin effect depend upon?

   (a) Cross section of the conductors (b) Supply frequency.

   (c) Permeability of the conductor (d) All of these.

6. A _____ distribution system is more reliable than the _____ distribution system.

   (a) parallel, radial (b) parallel, ring

   (c) radial, parallel (d) ring, parallel

7. Bulk oil circuit breaker is suitable for voltages up to:

   (a) 4 kV (b) 25 kV (c) 10 kV (d) 36 kV

8. For a EHV equipment for maintenance first it should be isolated and connected to ground because:

   (a) to provide low impedance
   (b) to discharge the charging capacitance to ground
   (c) protection for operating personnel
   (d) both (b) and (c)

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

9. Current transformers are:
   (a) series connected type of instrument transformers
   (b) parallel connected type of instrument transformers
   (c) series-parallel connected type of instrument transformers
   (d) parallel connected normal transformers
10. Moisture content in the soil ..... the earth soil resistance.
    (a) increase (b) decrease (c) does not affect (d) none of the above

Section – B

04X04 = 16 Marks

1 Why is a moderator necessary in a nuclear reactor? What materials are suitable as moderator materials in a reactor?

2 Classify different distribution system. Explain any one in detail

3 Explain the generation and properties of corona on transmission line .

4 Explain the terms isolator, current transformer, potential transformer and lightning arrester.

Section – C

04X06 = 24 Marks

1 Explain operating principle and construction features of the relay.

2 Compare grounding and earthing of a system.

3 Write a comparison between HVDC and HVAC transmission system.

4 Draw and explain the layout of thermal power plant .

Answer Key ELE 1305 Set – A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

Session: 2019-20 (Summer Semester)

B. Voc. Program, III Semester,

End-Sem. Examination

Course Code: ELE 1305 **Time: 2 Hours**

Course Name: Introduction to Power System **Max. Marks: 50**

Section – A

10X01 = 10 Marks

10 objective type questions, each question carries 01 mark.

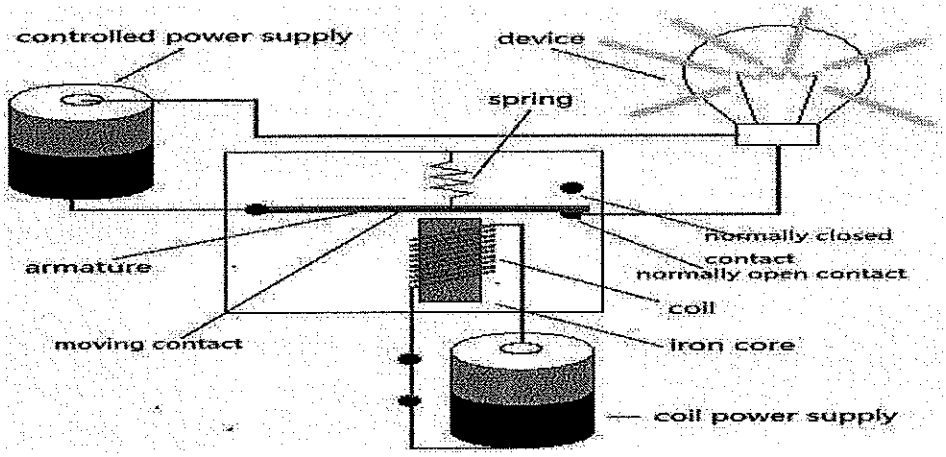
1.	The thermal efficiency of a steam power station is..... b.28%
2.	The amount of electrical energy that can be generated by a hydroelectric power plant depends upon _____ b) Quantity of water Explanation: Potential energy of large quantity of stored water is used by hydroelectric power plant to generate electrical energy. Head of water is important to get kinetic energy from that potential energy. Efficiency of alternator represents that what percentage of input mechanical power it can convert into electrical power.
3.	Nuclear fuel in reactor lasts for _____ Answer: d more than 5 years Explanation: Very small amount of nuclear fuel can produce very high amount of energy. Nuclear fuel may remain in a reactor for more than 5 years.
4.	Corona loss can be reduced by the use of hollow conductor because **Ans: C**
5.	On what factors does the skin effect depend upon? **d. All of these.**
6.	A _____ distribution system is more reliable than the _____ distribution system. Answer: a) parallel, radial Explanation: A parallel distribution system has two end feeding and an alternative of parallel line, so in case there is a fault, the isolator can isolate the faulty part and let the healthy system operate.
7.	Bulk oil circuit breaker is suitable for voltages upto d) 36 kV
8.	For a EHV equipment for maintenance first it should be isolated and connected to ground because **(d) both (B) and (C)**
9.	Current transformers are _____ Answer: a Explanation: Current transformer (CT) is a series connected type of instrument transformer. They are designed to present negligible load to the supply which is being measured and also have an accurate current ratio and phase relationship to enable accurate secondary connected metering.
10.	Moisture content in the soil .....the earth soil resistance. (b) decrease

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Section – C

04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

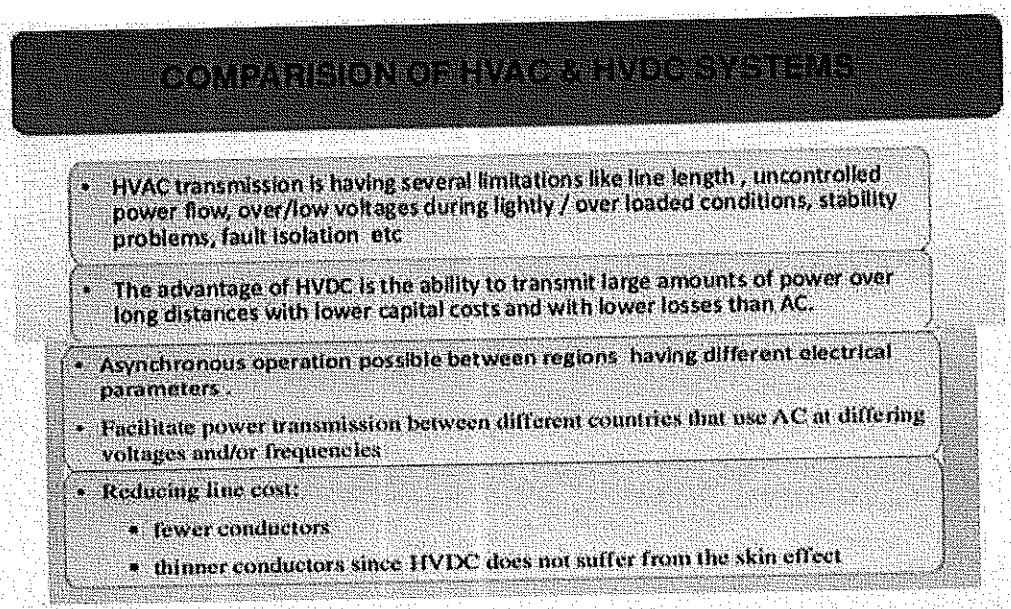
1	Explain operating principle and construction features of the relay.
	Relay Definition: The relay is the device that open or closes the contacts to cause the operation of the other electric control. It detects the intolerable or undesirable condition with an assigned area and gives the commands to the circuit breaker to disconnect the affected area. Thus protects the system from damage. Working Principle of Relay It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energizes the electromagnetic field which produces the temporary magnetic field. This magnetic field moves the relay armature for opening or closing the connections. The small power relay has only one contacts, and the high power relay has two contacts for opening the switch. 
2	Compare grounding and earthing of a system.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Comparison Chart

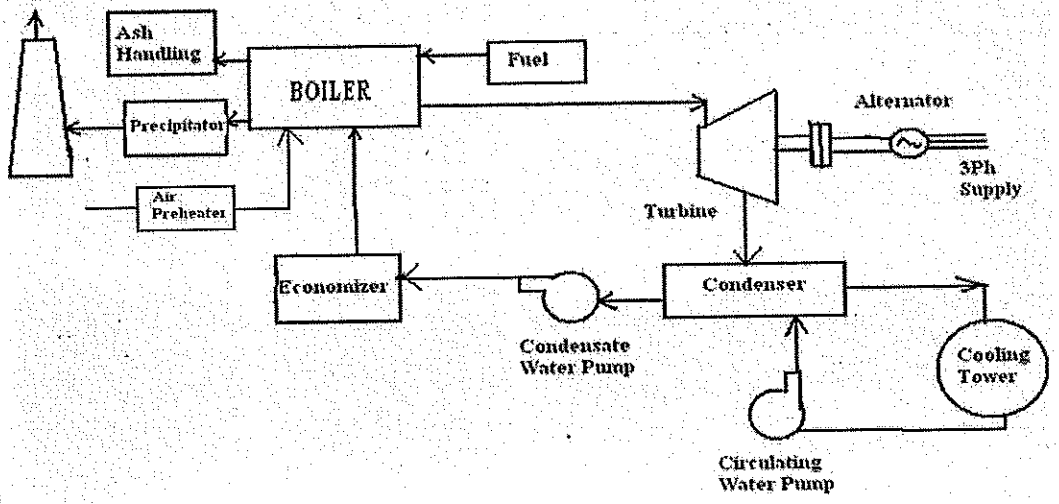
Basis For Comparison	Grounding	Earthing
Definition	The current carrying part is connected to ground.	The body of the equipment is connected to ground.
Location	Between the neutral of the equipment and ground	Between the equipment body and earth pit which is placed under the earth surface.
Symbol		
Zero Potential	Does not have	Have
Protection	Protect the power system equipment.	Protect the human from electric shock.
Application	Provide the return path to the current.	It discharges the electrical energy to the earth.

3 Write a comparison between HVDC and HVAC transmission system.



- Lesser Corona Loss than HVAC at same voltage and conductor diameter and less Radio interference.
- Direction of power flow can be changed very quickly
- HVDC has greater reliability. i.e. bipolar dc is more reliable than 3 phase HVAC
- DC requires less insulation.
- An optimized DC link has smaller towers than an optimized AC link of equal capacity.

4 Draw and explain the layout of thermal power plant .



MAIN EQUIPMENTS
Coal handling plant
Pulverizing plant
Boiler
Turbine
Condenser
Cooling towers and ponds
Feed water heater
Economizer
Air preheater