

**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. The father of PLC is:
(a) Aristotle
(b) Richard E. "Dick" Morley
(c) Michael Faraday
(d) Archimedes
2. The function of Relay is:
(a) Programming
(b) Convert 230 VAC to 24VDC
(c) Protection
(d) None of these
3. Full form of the HMI is:
(a) Human Machine Instrument
(b) Human Machine Interface
(c) Human Motor Interface
(d) None of these
4. Numbers of Contactors required to make star-delta starter:
(a) One
(b) Two
(c) Three
(d) Four
5. Full form of the VFD is:
(a) Variable Frequency Device
(b) Variable Frequency Drive
(c) Voltage Frequency Device
(d) All of these
6. Full form of IED is:
(a) Intelligent energy drive
(b) Intelligent Electronic Devices
(c) Instrument Electronic Devices
(d) None of these
7. Integral controller is also known as:
(a) Reset controller
(b) Rate controller
(c) Both (a) and (b)
(d) None of these
8. Full form of PD controller is:
(a) Proportional and Derivative
(b) Preset and Derivative
(c) Program and Derivative
(d) None of these
9. SCADA systems were first used in:
(a) 1968
(b) 1960
(c) 1965
(d) None of these
10. Third Generation SCADA system is:
(a) Monolithic SCADA systems
(b) Distributed SCADA systems
(c) Networked SCADA systems
(d) None of these



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Section – B

04X04 = 16 Marks

1. What is Distributive control system? Explain with diagram.
2. Explain the electrical maintenance of PLC system.
3. What are the applications of Human Machine Interface?
4. Explain the Drives operations in all quadrant.

Section – C

04X06 = 24 Marks

1. Differentiate between PLC and computer in Software and hardware.
2. Explain the Modes of operation of PLC.
3. Explain the types of PLC programming.
4. Explain the applications of SCADA in
 - (a) Manufacturing Industries
 - (b) Waste Water Treatment and Distribution Plants
 - (c) SCADA in Power System



Answer Key ELE 1301 (Set – B)

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School of Electrical Skills

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Course Name: Automation & Control

Max. Marks: 50

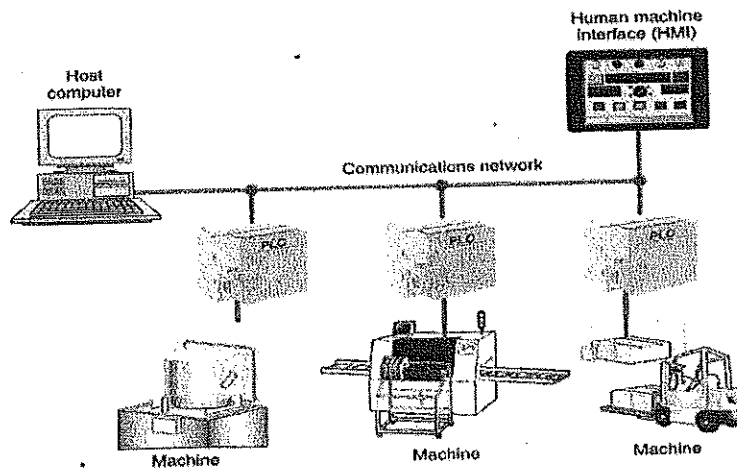
ANSWER-SHEET

Section – A

1. The father of PLC is: -
(b) Richard E. “Dick” Morley
2. The function of Relay is: --
(c) Protection
3. Full form of the HMI is: -
(b) Human Machine Interface
4. Numbers of Contactors required to make star-delta starter: -
(a) Three
5. Full form of the VFD is: -
(b) Variable Frequency Drive
6. Full form of IED is: -
(b) Intelligent Electronic Devices
7. Integral controller is also known as: -
(a) Reset controller
8. Full form of PD controller is: -
(a) Proportional and Derivative
9. SCADA systems were first used in: -
(b) 1960
10. Third Generation SCADA system is: -
(b) Networked SCADA systems

Section – B

1. **Distributive control system(DCS):** This is a network based system. Distributive control involves two or more PLCs communicating with each other to accomplish the complete control task. Each PLC controls different processes locally and the PLC are constantly exchanging information through communication link.



2. **Electrical maintenance**

All electrical systems require periodic maintenance in addition to non-scheduled maintenance caused by unpredictable events such as storms, accidents, and equipment failure. Certain maintenance activities are common to all systems, regardless of type. These activities should always be performed on the cycle applicable for the system. These activities are defined as follows:

- Clean conductors, terminals, and connectors of all corrosion. Tighten terminals and connectors including breaker, transformer, and contactor connectors.
- Check the equipment grounding system including conduit end bushing connections, bonds, equipment grounding conductors, enclosure grounding connections, and pole grounding connections.
- Check the grounding electrode, grounding electrode conductor, and associated connections.
- Check conductor insulation for damage, and repair if necessary.
- Replace deteriorated or missing conductor and terminal identification markings.

3. **Applications of HMI**

- The HMI is used throughout various industries including manufacturing plants, vending machines, food and beverage, pharmaceuticals, and utilities etc.

- HMIs along with PLCs are typically the backbone of the production line in these industries. The integration of the HMI into manufacturing has vastly improved operations. The HMI allows for supervisory control and data acquisition in the entire system, so parameter changes are feasible as the operator's choosing.
- For example, in metals manufacturing, an HMI might control how metal is cut and folded, and how fast to do so. HMIs are used in bottling processes to control all aspects of the manufacturing line, such as speed, efficiency, error detection and error correction. Utility companies may use HMIs to monitor water distribution and waste water treatment.

4. Drive operation

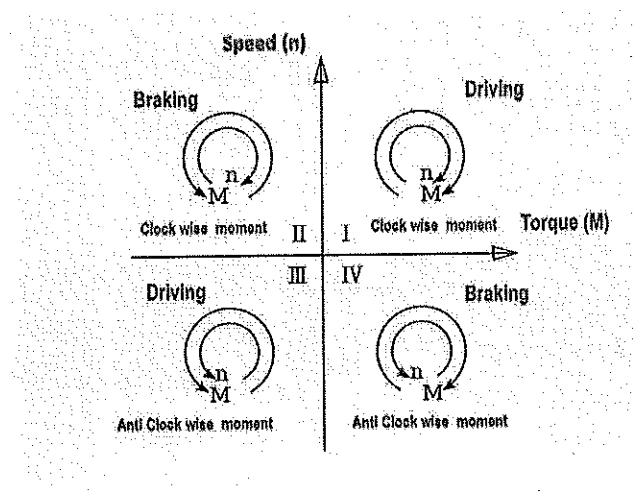
Drive applications can be categorized as follows:

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.



Section – C

1. Comparison between PLC and Computer:

The architecture of a PLC is basically the same as that of a personal computer. A personal computer (PC) can be made to operate as a programmable logic controller if you provide some way for the computer to receive information from devices such as pushbuttons or switches. We also need a program to process the inputs and decide the



means of turning load devices off and on. However, PLC is a specially designed computer to operate in an industrial environment. The main difference between computer and PLC are list below on two sections hardware and software.

Hardware:

- The PLC comes with its program language built into its memory and has no the permanently attached keyboard CD drive or monitor. While computers are permanently attached to a keyboard and other hardware.
- Computers are complex computing machines capable of executing several programs or tasks simultaneously and in any order. Most PLCs, on the other hand, execute a single program in an orderly and sequential fashion from first to last instruction.

Software:

- PLC software that allows the user to monitor and control the process is also called a human machine interface (HMI). It enables the user to view a process—or a graphical representation of a process—on a monitor, determine how the system is running, trend values, and receive alarm condition.
- Programmable automation controllers (PAC) combine PLC ruggedness with PC functionality. Using PACs, you can build advanced systems incorporating software capabilities such as advanced control, communication, data logging, and signal processing with rugged hardware performing logic, motion, process control, and vision.

2. Mode of operations of PLC

Some common operating modes of PLC are explained as follows:

1. Program Mode: The program mode is used to enter a new program, edit or update an existing program, upload files, download files, document (print out) programs, or change any software configuration file in the program. When the PLC is switched into the program mode, all output are forced off regardless of their rung logic status, and the ladder I/O scan sequence is halted.

2. Run Mode: The Run Mode is used to execute the user program. Input devices are monitored and output devices are energized accordingly. After all instructions have been entered in a new program or all changes made to existing program, the processor is put in the run mode.

3. Test Mode: The test mode is used to operate or monitor the user program without energizing any outputs. The processor still reads inputs, executes the ladder program, and update the output status table files, but without energizing the output circuit. This



feature is often used after developing or editing a program to test the program execution before allowing the PLC to operate real-world outputs.

4. Remote Mode: In the Run position, all logic is solved and I/O is enabled. In the program position, all logic solving is stopped and the I/O is disabled. The remote position allows the PLC to be remotely changed between program and run mode by personal computer connected to the PLC processor. The remote mode may be beneficial when the controller is in a location that is not easily accessible.

3. Types of PLC Programming:

The basic functioning of the PLC relies on the control logic or the programming technique used. Programming can be done using flowcharts or using ladder logic or using statement logics or mnemonics.

➤ **Flowchart:** A flowchart is the symbolic representation of the instructions. It is the most basic and simplest form of control logic which involves only logic decisions.

➤ **Boolean algebra:** Boolean algebra usually involves logic operations like AND, OR, NOT, NAND and NOR. The different symbols are:

(+) Or operator (.) AND operator (!)NOT operator.

➤ **Statement logic:** The instructions in simple statement forms can be written as:

“IF Input1 AND Input2 is TRUE Then SET Output1 ELSE SET Output2”

➤ **Mnemonics Logic:** Mnemonics are instructions written in symbolic form. They are also known as Opcode and are used in handheld programming devices. Different Symbols are as given below:

Ldi – Load Inverse

OR-Or logic

Ld- Load

ANI – NAND logic

AND- And logic

ORI- NOR logic

Out – Output

4. Applications of SCADA system:

(1) SCADA In Manufacturing Industries

In manufacturing industries the regular processes like running the production systems to meet the productivity targets, checking the number of units produced and counting the



completed stages of operations along with temperatures at various stages of the manufacturing process, and so on, are taken care by using the SCADA application.

(2) SCADA Application in Waste Water Treatment and Distribution Plants

Wastewater treatment plants are of different types such as surface-water treatment and a well water treatment system in which many control systems and automation processes are involved in water treatment and distribution systems. SCADA systems are used for controlling the automatic operations of the equipment used like backwashing the filters based on the hours of working or amount of water flow through the filters.

(3) SCADA in Power System

- Power system can be defined as constituent of power generation, transmission and distribution. All these sectors are needed to be monitored regularly for improving the system efficiency.
- Thus, the application of SCADA in power system improves the overall efficiency of the system by providing the supervision and control over the generation, transmission and distribution systems.
- SCADA in the power system network increases the system's reliability and stability for integrated grid operation.

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

Course Code: ELE1302**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 hysteresis losses:
(a) Laminated core is used (b) Silicon is added in core material
(c) Heat sink is used (d) None of these
2. Class E insulating material can bear temperature up to:
(a) 180° C (b) 90° C (c) 120° C (d) 150° C
3. Buchholz relay is used for the protection of:
(a) Transformer (b) Alternator (c) Motor (d) Both (a) & (b)
4. Which statement is true for DC shunt motor:
(a) It should never run on no load (b) Flux value is constant
(c) Its coil resistance is high (d) Both (b) & (c)
5. Unit of absolute permeability:
(a) Unit less (b) Ampere-turns
(c) Henry/Meter (d) None of these
6. Transformer is a:
(a) Static device (b) Rotating device
(c) Part of DC generator (d) None of these
7. Fleming right hand rule is used for:
(a) Motor (b) Generator (c) Transformer (d) None of these
8. Number of parallel path in WAVE winding:
(a) 8 (b) Equal to number of poles
(c) 2 (d) None of these
9. MNA full form:
(a) Magnetic Neutral Axis (b) Magnetic Neutral Ampere
(c) Magneto Number axis (d) None of these



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10. Commutator is used for:

- (a) For stepping up DC
- (b) For stepping up AC
- (c) For conversion of AC into DC
- (d) None of these

Section – B

04X04 = 16 Marks

1. A short shunt DC generator supplies a load current of 100Amp. at 250 volts. The generator has following parameters,
 $R_{sh}=130 \text{ ohm}$; $R_a=0.1 \text{ ohm}$; $R_{se}=0.1 \text{ ohm}$; Brush contact drop=1 volt per brush.
Calculate generated emf?
2. Derive emf equation for transformer.
3. Explain principle of
 - (i) Generator
 - (ii) Motor
 - (iii) Transformer
4. Explain the basic structure of an electromagnetic rotating electrical machines.

Section – C

04X06 = 24 Marks

1. Write short note on protection of transformer by percentage differential relay.
2. Explain magnetic hysteresis B-H curve in detail.
3. Explain the following:
 - (i) High conductivity materials
 - (ii) High resistivity materials
4. Develop simplex progressive LAP winding for 24 conductors and 4 poles. (For simplex winding, no. of conductors = no. of slots).



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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

A.1 (b)

A.2 (c)

A.3 (a)

A.4 (d)

A.5 (c)

A.6 (a)

A.7 b

A.8 c

A.9 a

A.10 c

Section-B

Ans. 1

$$I_{sh} = \frac{V - I_L R_{se}}{R_{sh}} = \frac{250 - 100 \times 0.1}{130}$$
$$I_{sh} = 1.84 \text{ Amp.}$$

&
$$I_a = I_L + I_{sh} = 100 + 1.84$$
$$I_a = 101.84 \text{ Amp.}$$

Generated emf is given by,
$$E_g = V + I_a R_a + I_L R_{se} + 2 \times BCD$$
$$= 250 + 101.84 \times 0.1 + 100 \times 0.1 + 2 \times 1$$
$$E_g = 272.2 \text{ volt}$$

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Let

 N_1 = No. of turns in primary N_2 = No. of turns in secondary Φ_m = Maximum flux in core in webers $\Phi_m = B_m \times A$ f = Frequency of a.c. input in Hz

Flux increases from its zero value to maximum value Φ_m in one quarter of the cycle i.e. in $1/4f$ second.

$\therefore$ Average rate of change of flux $= 1/4f\Phi_m = 4f\Phi_m$ Wb/s

Now, rate of change of flux per turn means induced e.m.f. in volts.

$\therefore$ Average e.m.f./turn $= 4f\Phi_m$ volt

If flux Φ varies sinusoidally, then r.m.s. value of induced e.m.f. is obtained by multiplying the average value with form factor.

Form factor = r.m.s. value / avg. value = 1.11

$\therefore$ r.m.s. value of e.m.f./turn $= 1.11 \times 4f\Phi_m = 4.44f\Phi_m$ volt

Now, r.m.s. value of the induced e.m.f. in the whole of primary winding
 $= (\text{induced e.m.f./turn}) \times \text{No. of primary turns}$

• $E_1 = 4.44fN_1\Phi_m = 4.44fN_1B_mA \dots\dots\dots(1)$

Similarly, r.m.s. value of the e.m.f. induced in secondary is,

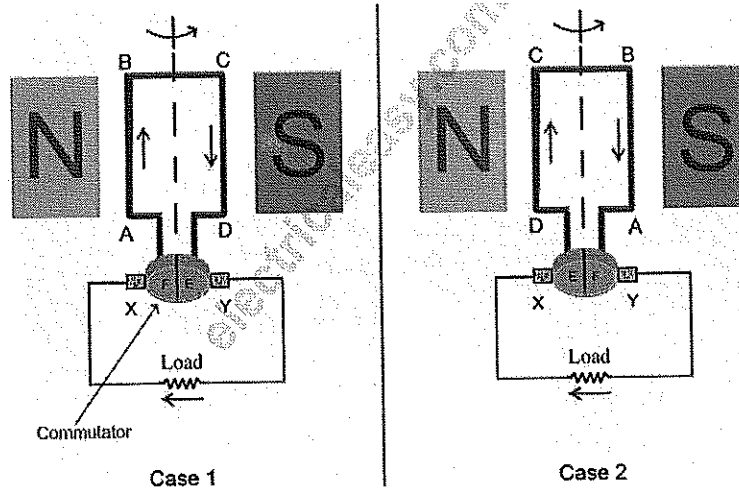
• $E_2 = 4.44fN_2\Phi_m = 4.44fN_2B_mA \dots\dots\dots(2)$

Equation 1,2 represents the e.m.f equation of transformer.

Ans. 3**(a) Principle of generator:**

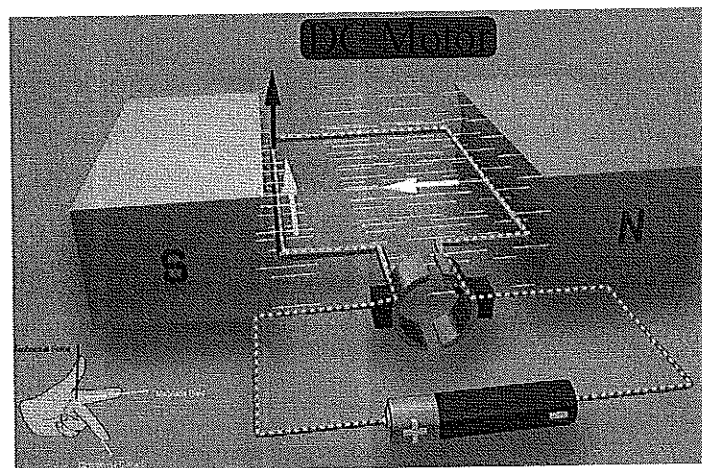
Generator is a machine that converts mechanical energy into electrical energy. It works based on principle of faraday law of electromagnetic induction. The faradays law states that whenever a conductor is placed in a varying magnetic field, EMF is induced and this induced EMF is equal to the rate of change of flux linkages. This EMF can be generated when there is either relative space or relative time variation between the conductor and magnetic field.

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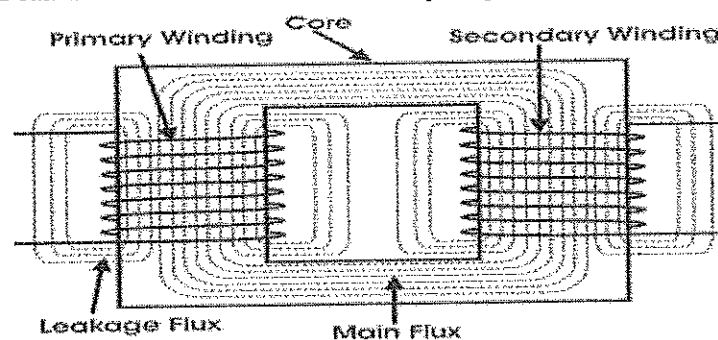
(b) Principle of motor:

An electric motor is a machine which converts electrical energy into mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming's Left Hand Rule and whose magnitude is given by $F = BIl$ Newton.



(c) Principle of Transformer:

The principle of mutual induction states that when two coils are inductively coupled and if the current in one coil changes uniformly, then the e.m.f. is induced in the other coil. This e.m.f. can drive a current when a closed path is provided for it.



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Ans. 4 Basic structure of an electromagnetic rotating electrical machines:

- The basic structure of an electromagnetic rotating electrical machine consists of the following parts :-
- 1> Magnetic circuit :- It provides the path for the magnetic flux and consists of air gap, stator and rotor teeth and stator and rotor cores (Yokes)
 - 2> Electric Circuit :- It consists of stator and rotor windings. The wdg of a x-former or a rotating m/c conveys electrical energy to or from the working region.
 - 3> Dielectric circuit :- It consists of insulation required to isolate one conductor from another and also the wdg from the core.
 - 4> Thermal circuit :- The thermal circuit is concerned with mode and media for dissipation of heat produced inside the machine on account of losses.
 - 5> Mechanical parts :- It consists of frame, bearings and shafts.

Section-C

Ans.1 Differential protection is provided in the electrical power transformer rated more than 5MVA. The Differential Protection of Transformer has many advantages over other schemes of protection.

1. The faults occur in the transformer inside the insulating oil can be detected by Buchholz relay. But if any fault occurs in the transformer but not in oil then it cannot be detected by Buchholz relay. Any flash over at the bushings are not adequately covered by Buchholz relay. Differential relays can detect such type of faults. Moreover Buchholz relay is provided in transformer for detecting any internal fault in the transformer but Differential Protection scheme detects the same in more faster way.
2. The differential relays normally response to those faults which occur in side the differential protection zone of transformer.

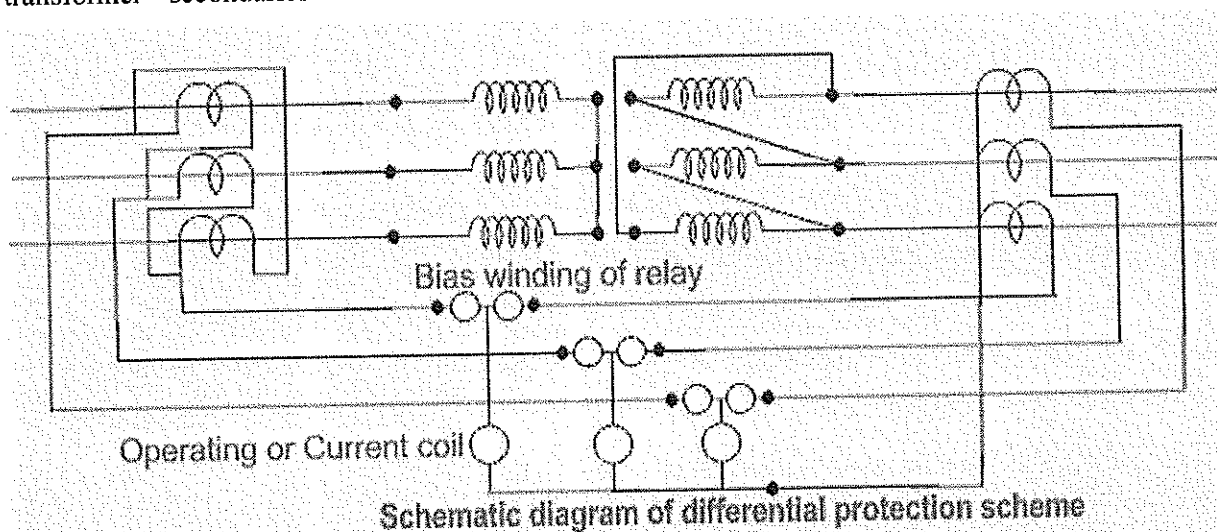
Principle of Differential protection:

Principle of Differential Protection scheme is one simple conceptual technique. The differential relay actually compares between primary current and secondary current of power transformer,

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if any unbalance found in between primary and secondary currents the relay will actuate and inter trip both the primary and secondary circuit breaker of the transformer. Suppose you have one transformer which has primary rated current I_p and secondary current I_s . If you install CT of ratio $I_p/1A$ at the primary side and similarly, CT of ratio $I_s/1A$ at the secondary side of the transformer. The secondaries of these both CTs are connected together in such a manner that secondary currents of both CTs will oppose each other.

In other words, the secondaries of both CTs should be connected to the same current coil of a differential relay in such an opposite manner that there will be no resultant current in that coil in a normal working condition of the transformer. But if any major fault occurs inside the transformer due to which the normal ratio of the transformer disturbed then the secondary current of both transformers will not remain the same and one resultant current will flow through the current coil of the differential relay, which will actuate the relay and inter trip both the primary and secondary circuit breakers. To correct phase shift of current because of star-delta connection of transformer winding in the case of three-phase transformer, the current transformer secondaries should be connected in delta and star as shown here.



At maximum through fault current, the spill output produced by the small percentage unbalance may be substantial. Therefore, differential protection of transformer should be provided with a proportional bias of an amount which exceeds in effect the maximum ratio deviation.

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Ans. 2 Magnetic hysteresis B-H curve:

Consider a coil wound on an iron core which is completely demagnetised. The field intensity in the coil is given by $H = IN/L$. The value of H can be increased or decreased by increasing or decreasing the current through the coil. When the current in the coil is zero, $H = 0$ and $B = 0$. If the current and hence the field strength H increases gradually, the flux density B in the core also increases. The relationship between B and H is represented by the curve OA shown in Fig. 7.13. At point A , the core becomes magnetically saturated and the field strength H reaches its highest value H_m corresponding to the maximum value of the magnetising current. At this point the flux density in the core has a maximum value of B_m .

If H is gradually reduced to zero, it will be seen that the corresponding values of B tend to lag behind the changes in H . This is called *magnetic hysteresis*. The B - H curve for the decreasing values is AR . It lies above the curve OA , for increasing values of B and H . At point B , when $H = 0$, B is not zero but has a value equal to OR . This shows that when the field strength is reduced to zero the core is not completely demagnetised. There still remains a certain flux, called the *residual flux density* or *remanent flux density*. This remaining flux density in the core when H has fallen from the saturation value H_m to zero is called *remnance* of the core material. It is denoted by B_r . In Fig. 7.13, $B_r = OR$. The residual flux density in the core is due to the fact that the domains do not entirely revert to their original disorder. Some domains still remain aligned after H is reduced to zero.

To demagnetise the core (i.e., to remove the residual flux), H is reversed by reversing the current in the coil. The flux density falls to zero along the curve RC . At C , $H = H_c$ and $B = 0$. The demagnetising field strength H_c required to remove the residual flux density is called the *coercive*

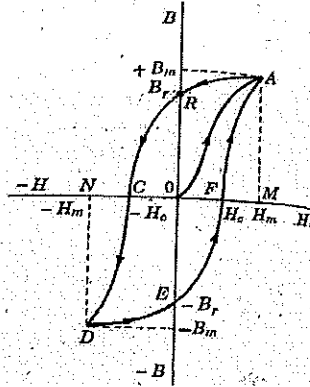


Fig. 7.13. Hysteresis loop.

force. The value of H_c when the material has been taken to saturation is called the *coercivity* of the material.

If H is further increased in the reversed direction to $-H_m$, the curve follows the path CD . Point D represents saturation in the reversed direction and $ND = -B_m$. If H is again gradually decreased to zero, the curve follows the path DE . At point E , $H = 0$, $B = -B_r$. To remove the residual flux, H is applied in the original positive direction and the curve follows the path EF . At point F , $H = H_c$ and $B = 0$. If H is further increased in this direction, the curve follows the path FA . The closed loop $ARCDEFA$ obtained when the magnetic core is subjected to one complete cycle of magnetisation is called the *hysteresis loop*. To take the core through the complete cycle, an alternating magnetic field intensity of peak-to-peak value equal to $2H_m$ is applied. If this alternating H is maintained, the core continues to follow similar cycles of magnetisation.

Except at points A and D where B and H attain their maximum values, the flux density B lags behind H throughout the cycle. For example, at point F when $B = 0$, H has already reached a positive value $+H_c$. At point E , when $H = 0$, B has a negative value $-B_r$. The word *hysteresis* means lagging behind. The curve gets its name from the fact that the flux density (effect) lags being the magnetic field intensity H (cause).

Hysteresis results from reversals of flux of any value. For a given specimen, a number of hysteresis loops may be obtained, each for a different maximum value of H . All these loops lie within major or largest hysteresis loops corresponding to the saturation values of B and H . A family of such loops is shown in Fig. 7.14. The apexes of all minor loops lie on a curve called the *normal magnetisation curve* shown dotted in the figure.

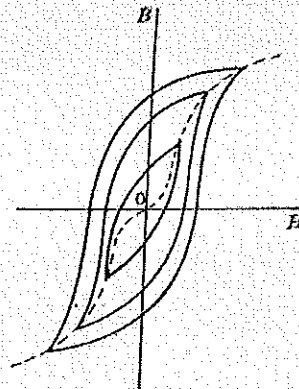


Fig. 7.14. Family of hysteresis loops.



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Ans. 3

(a) High conductivity materials:

These materials are used for making all types of windings, apparatus and devices as well as for transmission and distribution of electrical energy.

Properties of high conductivity materials:

- Highest possible conductivity
- Least possible temperature coefficient of resistance
- Adequate mechanical strength.
- Rollability and draw ability which is important in manufacture of wires.
- Good weld ability and solder ability which ensure high reliability and low electrical resistance of the joints.
- Adequate resistance to corrosion.

Examples: Copper, aluminium, Iron and steel, etc.

(b) High resistivity materials:

These materials are used for making resistances and heating devices.

Materials of high resistivity:

They can be classified according to their purpose. These categories are:

- The first group consist of materials used in precision measuring instruments and in making standard resistance boxes. Examples: Manganin
- The second group consist of materials from which resistance elements are made for all kinds of rheostats and similar control devices. Example: alloy of 60-65% of copper and 40-35% of nickel.
- The third group consists of materials suitable for making high temperature elements for electric furnaces heating devices and loading rheostats. Example: Alloys of nickel, chromium and iron known as Nichrome, etc.

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$$\text{Pole pitch} = \frac{Z}{P} = \frac{24}{4} = 6 \text{ Z/pole}$$

$$\text{Avg. pitch; } \boxed{Y_A = \frac{Y_b + Y_f}{2} = \frac{Z}{P} \Rightarrow \text{Lap winding}}$$

$$\frac{Y_b + Y_f}{2} = 6$$

$$Y_b + Y_f = 12 \quad \text{--- (1)}$$

$$\boxed{Y_b - Y_f = 2m} \rightarrow \text{multiplicity factor}$$

$m = 1$ for simplex

$$Y_b - Y_f = 2 \quad \text{--- (2)}$$

$$Y_b = \frac{14}{2} = 7 \quad \& \quad Y_f = 5$$

first coil side	$Y_b = 7$	1st last coil side	1st last $Y_f = 5$
1	$1 + 7 = 8$	8	$8 - 5 = 3$
3	$3 + 7 = 10$	10	$10 - 5 = 5$
5	$5 + 7 = 12$	12	$12 - 5 = 7$
7	$7 + 7 = 14$	14	$14 - 5 = 9$
9	$9 + 7 = 16$	16	$16 - 5 = 11$
11	$11 + 7 = 18$	18	$18 - 5 = 13$

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$$13 + 7 = 20$$

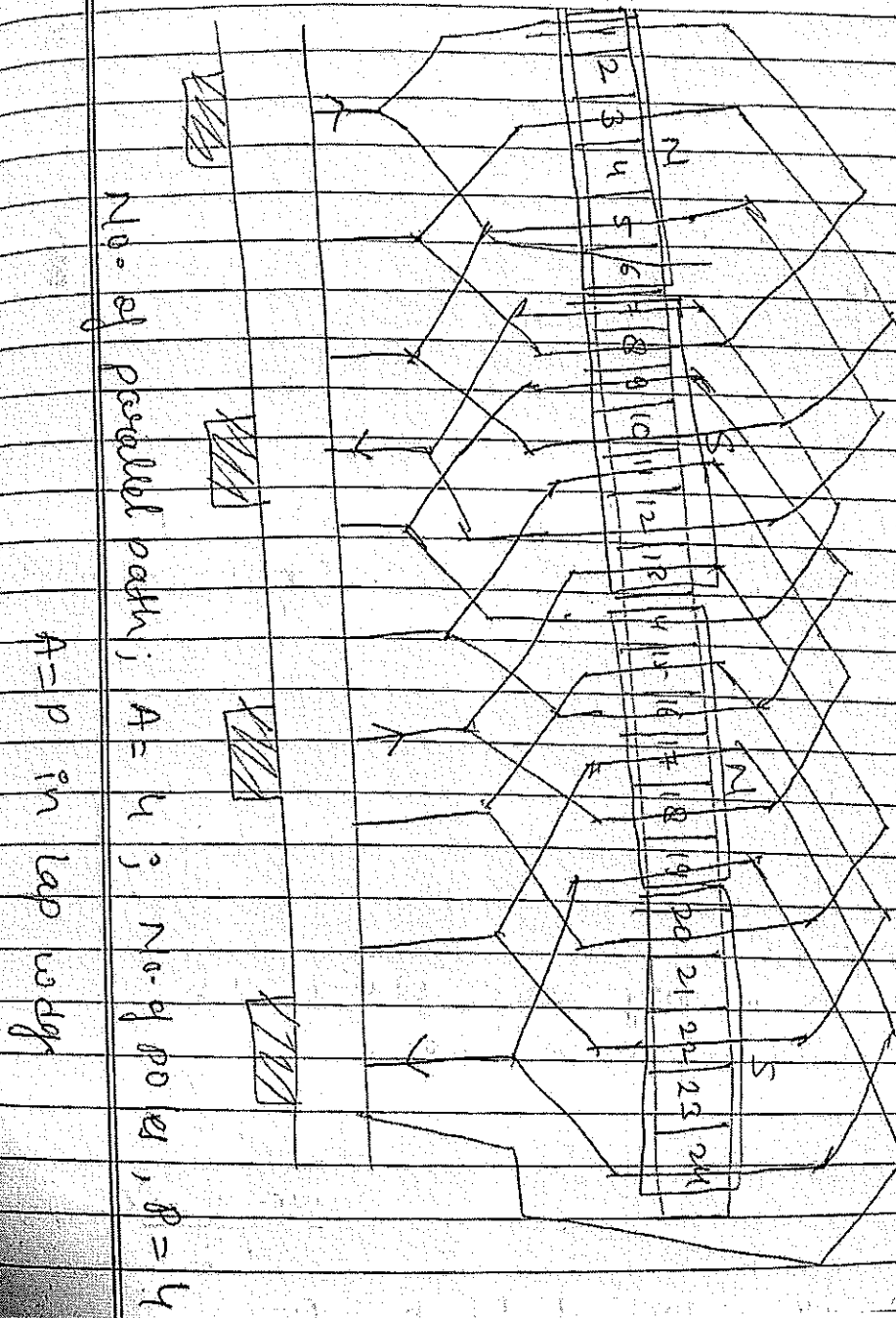
$$15 + 7 = 22$$

$$17 + 7 = 24$$

$$20 - 5 = 15$$

$$22 - 5 = 17$$

$$24 - 5 = 19$$



**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****Course Name: Electrical Circuit Analysis****Time: 2 Hours****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 a nonlinear element?
(a) Gas diode (b) Heater coil (c) Tunnel diode (d) Electric arc
2. Application of Norton's theorem to a circuit yields
(a) Equivalent current source and impedance in series
(b) Equivalent current source and impedance in parallel
(c) Equivalent impedance
(d) Equivalent current source
3. The superposition theorem is applicable to:
(a) Voltage only (b) Current "only"
(c) Both current and voltage (d) Current voltage and power
4. Between the branch voltages of a loop the Kirchhoff's voltage law imposes:
(a) Non-linear constraints (b) Linear constraints
(c) No constraints (d) None of the above
5. While calculating R^{th} in Thevenin's theorem and Norton equivalent:
(a) all independent sources are made dead (b) only current sources are made dead
(c) only voltage sources are made dead (d) all voltage and current sources are made dead
6. The number of independent equations to solve a network is equal to:
(a) the number of chords
(b) the number of branches
(c) sum of the number of branches and chords
(d) sum of number of branches, chords and nodes
7. The tie-set schedule gives the relation between:
(a) branch currents and link currents (b) branch voltages and link currents
(c) branch currents and link voltages (d) none of these
8. The cut-set schedule gives the relation between:
(a) branch currents and link currents (b) branch voltages and tree branch voltages
(c) branch voltages and link voltages (d) branch currents and tree currents
9. if a network contains B branches, and N nodes, then the number of mesh current equations would be:
(a) $B-(N-1)$ (b) $N-(B-1)$ (c) $B-N-1$ (d) $(B+N)-1$
10. A network has 10 nodes and 17 branches. The number of different node pair voltages would be:
(a) 7 (b) 9 (c) 45 (d) 10

Section – B

04X04 = 16 Marks

1. What is DC Current source? Differentiate between ideal and non-ideal current sources.
2. What do you mean by dependent and independent voltage sources?
3. Obtain the incidence matrix A from the following reduced incidence matrix A_1 and draw its graph.

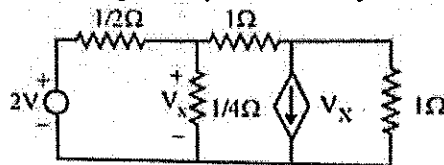
$$[A_1] = \begin{bmatrix} -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 1 \end{bmatrix}$$

4. A resistance of 50 ohm is connected in series with a pure inductor of 250 mH. The circuit is connected to a 50 Hz sinusoidal supply and the voltage across the resistance is 150 V. Calculate the supply voltage.

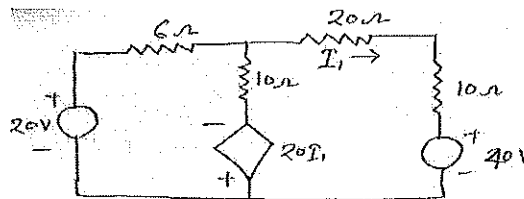
Section – C

04X06 = 24 Marks

1. In the network of figure, find voltage V_x by Nodal analysis.



2. Find voltage across 20 ohm resistor as given in figure using mesh method.

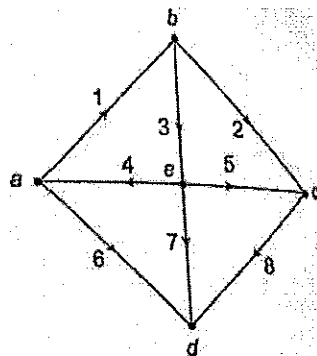


3. The driving point impedance of an LC network is given by:

$$Z(s) = s^4 + 4s^2 + 3/(s^3 + 2s)$$

Determine the second Cauer form of the network.

4. For the network graph shown in Fig. with given orientation obtain the all cut-set matrix.





Registration No.:

School of Electrical Skills
Session: 2019-20 (Summer / Winter Semester)
B. Voc. / M. Voc. Program, _____ 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. Which of the following is not a nonlinear element?
(a) Gas diode
(b) **Heater coil**
(c) Tunnel diode
(d) Electric arc
2. Application of Norton's theorem to a circuit yields
(a) Equivalent current source and impedance in series
(b) **Equivalent current source and impedance in parallel**
(c) Equivalent impedance
(d) Equivalent current source
3. The superposition theorem is applicable to
(a) Voltage only
(b) Current "only"
(c) Both current and voltage
(d) **Current voltage and power**
4. Between the branch voltages of a loop the Kirchhoff's voltage law imposes
(a) Non-linear constraints
(b) **Linear constraints**
(c) No constraints
(d) None of the above
5. While calculating R^{th} in Thevenin's theorem and Norton equivalent
(a) **all independent sources are made dead**
(b) only current sources are made dead
(c) only voltage sources are made dead
(d) all voltage and current sources are made dead
6. The number of independent equations to solve a network is equal to
(a) **the number of chords**
(b) the number of branches
(c) sum of the number of branches and chords
(d) sum of number of branches, chords and nodes
7. the tie-set schedule gives the relation between
(a) **branch currents and link currents**
(b) branch voltages and link currents
(c) branch currents and link voltages
(d) none of the above



8. the cut-set schedule gives the relation between
- (a) branch currents and link currents
 - (b) branch voltages and tree branch voltages**
 - (c) branch voltages and link voltages
 - (d) branch currents and tree currents
9. if a network contains B branches, and N nodes, then the number of mesh current equations would be
- (a) $B-(N-1)$**
 - (b) $N-(B-1)$
 - (c) $B-N-1$
 - (d) $(B+N)-1$
10. A network has 10 nodes and 17 branches. The number of different node pair voltages would be
- (a) 7
 - (b) 9
 - (c) 45**
 - (d) 10

Section – B

04X04 = 16 Marks

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

Q1 What is DC Current source? Differentiate between ideal and non-ideal current sources

Sol. A current source, unlike the DC voltage source, is not a physical reality. However, it is useful in deriving equivalent circuit models of semiconductor devices such as a transistor. It can also be subdivided into ideal and non-ideal categories.

The Ideal Current Source By definition, an ideal current source that produces a current which is independent of the variations in load. In other words the current supplied by an ideal current source does not change with the load voltage.

Non-Ideal or Practical Current Source The current delivered by a practical current source falls off with an increase in load or load voltage.

Q2 What do you mean by dependent and independent voltage sources?

Sol. In general, there are two main types of DC sources

1. Independent (Voltage and Current) Sources
2. Dependent (Voltage and Current) Sources

An independent source produces its own voltage and current through some chemical reaction and does not depend on any other voltage or current variable in the circuit. The output of a dependent source, on the other hand, is subject to a certain parameter (voltage or current) change in a circuit element. Herein, the discussion shall be confined to independent sources only.

Q3 Obtain the incidence matrix A from the following reduced incidence matrix A_1 and draw its graph

$$[A_1] = \begin{bmatrix} -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 1 \end{bmatrix}$$

Ans:

Solution There are five rows and seven columns in the given reduced incidence matrix $[A_1]$. Therefore, the number of rows in the complete incidence matrix A will be $5 + 1 = 6$. There will be six nodes and seven branches in the graph. The dimensions of matrix A is 6×7 . The last row in A , i.e. 6th row for the matrix A can be obtained by using the first property of the incidence matrix. It is seen that the first column of $[A_1]$ has a single non-zero element -1 . Hence, the first element in the 6th row will be $+1(-1 + 1 = 0)$. Second column of A_1 has two non-zero elements $+1$ and -1 , hence the 2nd element in the 6th row will be 0 . Proceeding in this manner we can obtain the 6th row. The complete incidence matrix can therefore be written as

$$[A] = \begin{matrix} a \\ b \\ c \\ d \\ e \\ f \end{matrix} \begin{bmatrix} -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix}$$

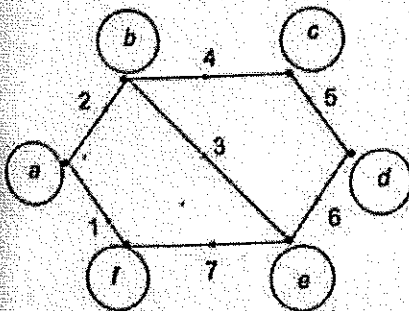


Fig. 2.14

We have seen that any one of the rows of a complete incidence matrix can be obtained from the remaining rows. Thus it is possible to delete any one row from A without losing any information in A_1 . Now the oriented graph can be constructed from the matrix A . The nodes may be placed arbitrarily. The number of nodes to be marked will be six. Taking node 6 as reference node the graph is drawn as shown in Fig. 2.14.

Q4 A resistance of 50 ohm is connected in series with a pure inductor of 250 mH. The circuit is connected to a 50 Hz sinusoidal supply and the voltage across the resistance is 150 V. Calculate the supply voltage.

Solution The current in the series circuit

$$I = \frac{V_R}{R} = \frac{150}{50} = 3 \text{ A}$$

Now, $X_L = 2\pi fL = 2\pi \times 50 \times 250 \times 10^{-3} = 78.5 \Omega$

$$V_L = I \times X_L = 3 \times 78.5 = 235.5 \text{ V}$$

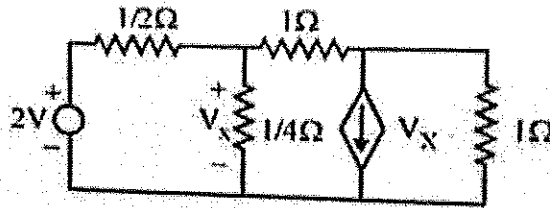
Then $V = \sqrt{V_R^2 + V_L^2} = \sqrt{150^2 + 235.5^2} = \sqrt{77,960.25} = 279.21 \text{ V}$

Section – C

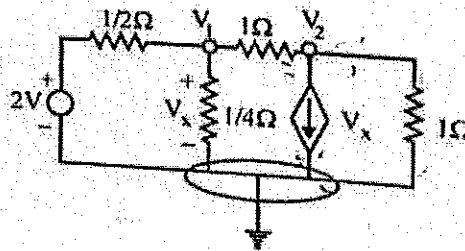
04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

Q1 In the network of figure, find voltage V_x by Nodal analysis.



Sol: The circuit has three nodes. The bottom node is selected as reference and other node voltage as V_1 and V_2 .



The KCL equation at node V_1

$$\frac{V_1 - 2}{1/2} + \frac{V_1}{1/4} + \frac{V_1 - V_2}{1} = 0$$

$$7V_1 - V_2 = 4$$

...(1)

The KCL equation at node V_2

$$\frac{V_2 - V_1}{1} + \frac{V_2}{1} = 0$$

As $V_x = V_1$

$$V_2 - V_1 + V_1 + V_2 = 0$$

$$2V_2 = 0$$

$$V_2 = 0$$

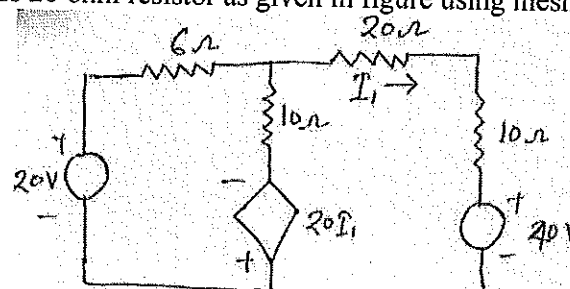
...(2)

From equation (1) and (2)

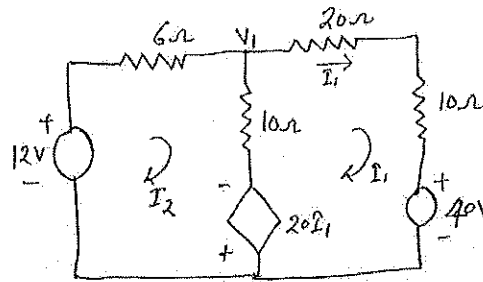
$$V_1 = V_x = \frac{4}{7} \text{ V}$$

Ans.

Q2 Find voltage across 20 ohm resistor as given in figure using mesh method.



Ans: The circuit contains two loops. The second loop current is taken as I_1 because in 20 ohm resistance current given is I_1 . The first loop current is I_2 .



The KVL equation in loop I_2

$$+12V - 6I_2 - 10(I_2 - I_1) + 20I_1 = 0$$

$$-30I_1 + 16I_2 = 12 \quad \text{--- (1)}$$

The KVL equation in loop I_1

$$-20I_1 - 10(I_1 - I_2) - 20I_1 - 40 = 0$$

$$60I_1 - 10I_2 = -40 \quad \text{--- (2)}$$

So using Cramer's rule I_1 is
$$I_1 = \frac{\begin{vmatrix} 12 & 16 \\ -40 & -10 \end{vmatrix}}{\begin{vmatrix} -30 & 16 \\ 60 & -10 \end{vmatrix}} = \frac{-120 + 16 \times 40}{-300 - 16 \times 60} = \frac{-120 + 640}{-300 - 960} = \frac{520}{-1260} = -0.4127 \text{ A}$$

The voltage drop in 20Ω resistance

$$V = I_1 \times 20 = -0.4127 \times 20 = -8.254 \text{ V}$$

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

$$Z(s) = s^4 + 4s^2 + 3/(s^3 + 2s)$$

Determine the second Cauer form of the network

Ans:

Solution To obtain the second Cauer form, we have to arrange the numerator and the denominator of given $Z(s)$ in ascending powers of s before starting the continued fraction expansion.

By taking continued fraction expansion, we get

$$2s + s^3 \Big| 3 + 4s^2 + s^4 \left(\frac{3}{2s} - C_1 \right)$$

$$\frac{3 + \frac{3}{2}s^2}{\frac{5s^2}{2} + s^4} \Big| 2s + s^3 \left(\frac{4}{5s} - L_2 \right)$$

$$\frac{2s + \frac{4}{5}s^3}{\frac{s^3}{5} + \frac{5s^2}{2} + s^4} \Big| \frac{s^3}{5} + \frac{5s^2}{2} + s^4 \left(\frac{2s}{2s} - C_3 \right)$$

$$\frac{\frac{s^3}{5} + \frac{5s^2}{2}}{\frac{s^3}{5} + \frac{5s^2}{2}} \Big| \frac{s^3}{5} + \frac{5s^2}{2} + s^4 \left(\frac{1}{5s} - L_4 \right)$$

$$\frac{\frac{s^3}{5} + \frac{5s^2}{2}}{\frac{s^3}{5} + \frac{5s^2}{2}} \Big| \frac{s^3}{5} + \frac{5s^2}{2} + s^4 \left(\frac{1}{5s} - L_4 \right)$$

$$\frac{s^3}{5} + \frac{5s^2}{2} \Big| \frac{s^3}{5} + \frac{5s^2}{2} + s^4 \left(\frac{1}{5s} - L_4 \right)$$

$$\frac{s^3}{5} + \frac{5s^2}{2} \Big| \frac{s^3}{5} + \frac{5s^2}{2} + s^4 \left(\frac{1}{5s} - L_4 \right)$$

$$\frac{s^3}{5} + \frac{5s^2}{2} \Big| \frac{s^3}{5} + \frac{5s^2}{2} + s^4 \left(\frac{1}{5s} - L_4 \right)$$

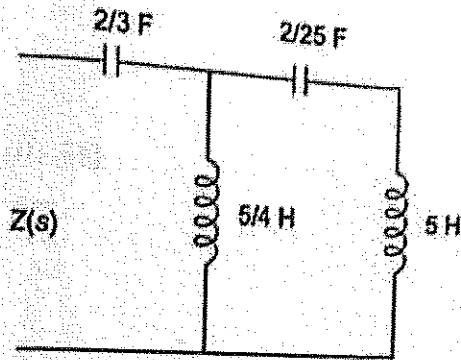
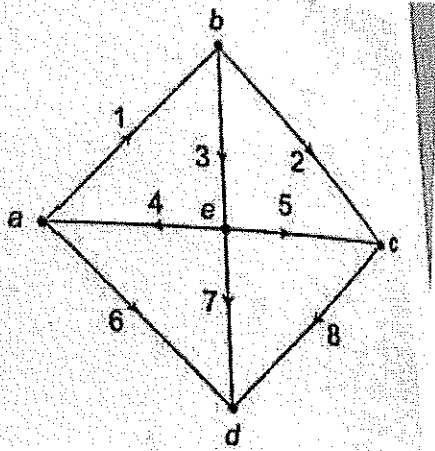


Fig. 18.8

$$\text{Hence, } Z(s) = \frac{3}{2s} + \frac{1}{\frac{4}{5s} + \frac{1}{\frac{25}{2s} + \frac{1}{5s}}}$$

The resulting network shown in Fig. 18.8 is called the second Cauer form.

Q 4 For the network graph shown in Fig. with given orientation obtain the all cut-set matrix.



Ans:

Solution The graph has four nodes and eight branches. There are in all 12 possible cut-sets as shown with dashed lines in Figs 2.23 (b) and (c). The orientation of the cut-sets has been marked arbitrarily. The cut-sets are

$$C_1 : \{1, 4, 6\}; C_2 : \{1, 2, 3\}; C_3 : \{2, 5, 8\}$$

$$C_4 : \{6, 7, 8\}; C_5 : \{1, 3, 5, 8\}; C_6 : \{1, 4, 7, 8\}$$

$$C_7 : \{2, 5, 6, 7\}; C_8 : \{2, 3, 4, 6\}; C_9 : \{1, 4, 7, 5, 2\}$$

$$C_{10} : \{2, 3, 4, 7, 8\}; C_{11} : \{6, 4, 3, 5, 8\}; C_{12} : \{1, 3, 5, 7, 6\}$$

Eight cut-sets C_1 to C_8 are shown in Fig. 2.23 (b) and four cut-sets C_9 to C_{11} are shown in Fig. 2.23 (c) for clarity.

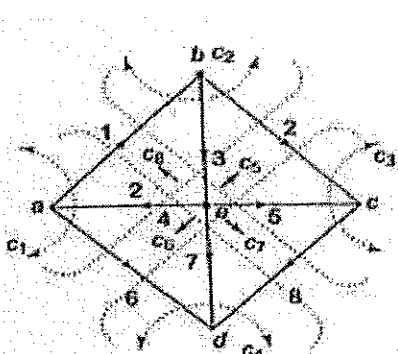


Fig. 2.23 (b)

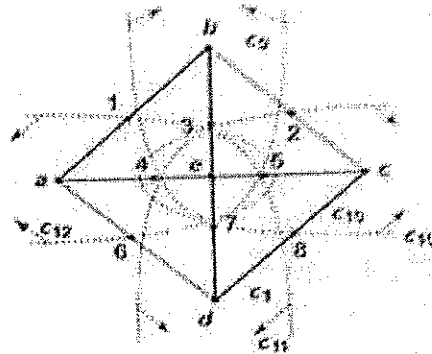


Fig. 2.23 (c)

As explained in section 2.8.2 with the help of Eq. 2.9, the all cut-set matrix Q is given by

cut-sets	branches →							
	1	2	3	4	5	6	7	8
C_1	-1	0	0	1	0	-1	0	0
C_2	1	-1	-1	0	0	0	0	0
C_3	0	1	0	0	1	0	0	-1
C_4	0	0	0	0	0	1	1	1
C_5	1	0	-1	0	1	0	0	-1
C_6	-1	0	0	1	0	0	1	1
C_7	0	1	0	0	1	1	1	0
C_8	0	-1	-1	1	0	-1	0	0
C_9	1	-1	0	-1	-1	0	-1	0
C_{10}	0	1	1	-1	0	0	-1	-1
C_{11}	0	0	1	-1	-1	1	0	1
C_{12}	-1	0	1	0	-1	-1	-1	0

Matrix Q is a 12×8 matrix since there are 12 cut-sets and eight branches in the graph.

10

11

12

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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. Change in output of sensor with change in input is:
(a) Threshold (b) Slew rate
(c) Sensitivity (d) None of the mentioned
2. Smallest change which a sensor can detect is:
(a) Resolution (b) Accuracy
(c) Precision (d) Scale
3. Following acts as detector in Optical sensor:
(a) Light emitting diode (b) Photo diode
(c) Transistor (d) All of the above
4. 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
5. 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
6. An ammeter should have resistance.
(a) Infinite (b) Very large
(c) Very low (d) None of the above
7. Which is the integrating instrument?
(a) Voltmeter (b) Wattmeter
(c) Energy meter (d) Power factor meter



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8. Which of the following is not an example of transducer?
- (a) Analogue voltmeter (b) Thermocouple
- (c) Photo electric cell (d) Pneumatic cylinder
9. The internal resistance of a voltmeter must be very high so that:
- (a) Minimum current passes through the meter
- (b) Range is high
- (c) Accuracy is high
- (d) Loading effect is maximum
10. An instrument to be used for measurement and control should preferably have
- (a) Dead zone and dead time (b) Linear output and fast response
- (c) Non-linear output (d) A highly damped response

Section – B

04X04 = 16 Marks

1. Prove that the deflection torque is directly proportional to the current passing through the coil for PMMC instruments
2. Differentiate between accuracy and precision.
3. Explain any two types of water level sensors, their advantages and disadvantages.
4. What are the different sources of error in measuring instruments?

Section – C

04X06 = 24 Marks

1. Explain different types of sensors (based on technology) that home alarm systems use to detect an intruder.
2. Write difference between sensor and transducer.
3. Differentiate different types of fingerprint sensor technology. Explain the working of any one technology 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} .



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School of Electrical Skills

Session: 2019-20 (Summer Semester)

B. Voc. Program, III Semester,

End-Sem. Examination

Course Code: ELE 1304

Course Name: Electrical Measuring Instruments

Time: 2 Hours

Max. Marks: 50

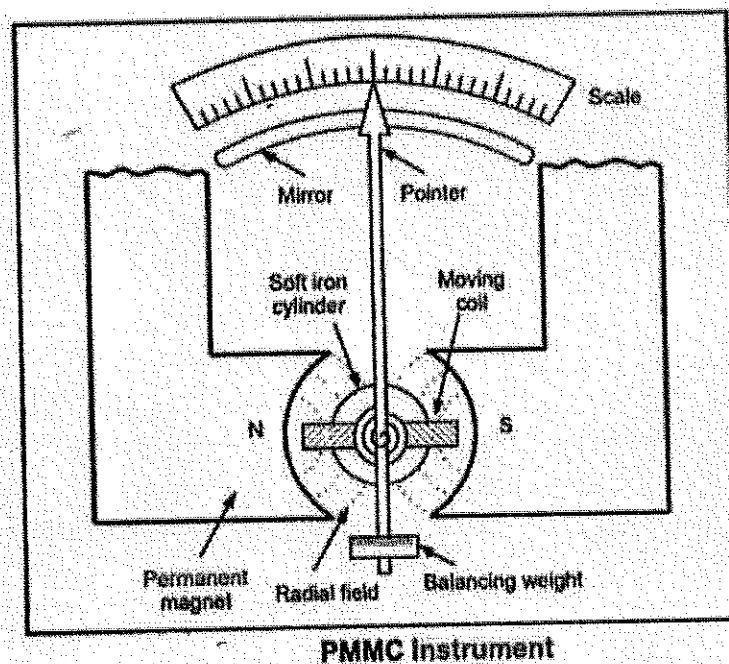
ANSWER KEYS

Section – A

1. c) Sensitivity
2. a) Resolution
3. (b) Photo diode
4. (c) Controlling Torque
5. (c) a large resistance in series with the actual measuring part of the instrument
6. (c) Very low
7. (c) Energy meter
8. (a) Analogue voltmeter
9. (a) Minimum current passes through the meter
10. (b) Linear output and fast response

Section – B

Ans-1



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The equation for the developed torque can be obtained from the basic law of the electromagnetic torque. The deflecting torque 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

$$T_d = GI$$

where

$G = NBA = \text{constant}$

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,

$$T_d = T_c$$

$$GI = K\theta$$

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

or

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

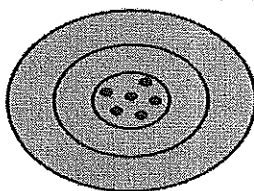
Thus the deflection is directly proportional to the current passing through the coil. The pointer deflection can therefore be used to measure current.

Ans-2 Accuracy: is the capacity of a measuring instrument to give RESULTS close to the TRUE VALUE of the measured quantity.

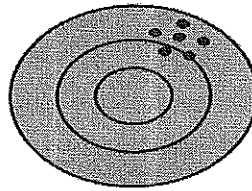
- Accuracy is measured by the absolute and relative errors
- The measurement value (which is sometimes referred to simply as the measurement) is the value given by a measuring instrument and the true value is the actual value of the property being measured.

Precision: is the capacity of a measuring instrument to give the same reading when repetitively measuring the same quantity under the same prescribed conditions.

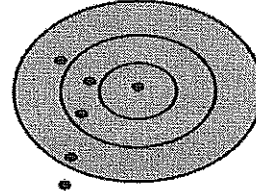
- Precision implies agreement between successive readings, NOT closeness to the true value.
- Precision is related to the variance of a set of measurements.
- Precision is a necessary but not sufficient condition for accuracy.



High Accuracy
High Precision



Low Accuracy
High Precision



Low Accuracy
Low Precision

Ans-3 Different types of water level sensors are-

- Optical
- Vibrating or tuning fork
- Ultrasonic
- Float
- Capacitance



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- Radar
- Conductivity or resistance

Optical Level Switches

- Pros – Compact, no moving parts, high pressure and temperature capability, can detect tiny amounts of liquids
- Cons – Invasive as the sensor requires contact with the liquid, requires power, certain thick substances can cause coating on the prism.

Capacitance

- Pros – Solid-state, can be non-invasive, compact, accurate
- Cons – May require calibration, can only be used in certain liquids

Ultrasonic

- Pros – No moving parts, compact, reliable, not affected by media properties
- Cons – expensive, invasive, performance can be affected by various elements in the environment

Ans-4

- Incorrect magnitude of the fluxes: These may arise from abnormal voltages and load currents.
- Incorrect phase relation of fluxes: These may arise from defective lagging, abnormal frequencies, change in iron losses etc.
- Unsymmetrical magnetic structure: The disc may go on rotating while no current is being drawn but pressure coils alone are excited.
- Changes in the resistance of the disc: It may occur due to change in temperature.
- Changes in strength of the drag magnet: It may arise due to temperature or ageing.
- Phase angle errors due to lowering of power factor.
- Abnormal friction of moving parts.
- Badly distorted waveform.

Section-C

Ans-1: Different type of sensors that home alarm systems use are as follows-

1. Passive Infrared Sensors

This sensor type is passive in a way that it doesn't radiate its own energy. Instead, it detects the infrared light radiating from objects. This way, it can detect whenever there's a human or another living being in its field of view. It's a good choice for many as it's pretty economical, easy to install, and has a wide field of view. It's a basic product that can detect whenever someone enters or leaves the area, and it doesn't pass through glass panes; animals outside your house won't set it off. It might also mean that it won't detect someone stealing your package in the front door, though. However, it won't be able to determine the exact location of the object. Your pets might also set it off.

2. Tomographic Motion Detector

This is a relatively new form of security technology. It detects movement in an area through the use of a mesh network of radio waves. This detection system doesn't involve only one or two components. It has nodes, which you'll put around the areas you want to secure. These nodes then communicate via radio waves. This allows the system to detect movement through any disturbances in the mesh network. This also provides several advantages. You can hide them from view since they don't need to "see" the area, and they can create a network covering up to 5,000 sq. ft. Put them all over your apartment, as they'll be able to pass through walls and obstructions. They use radio waves on the 2.4 GHz band, similar to the ones that wireless networks use.

**BHARTIYA SKILL DEVELOPMENT UNIVERSITY****3. Microwave Detectors**

Another type of sensor that detects motion is a microwave detector that emits radiation. Don't worry, though, they're practically harmless. In fact, more people prefer this type. This one also creates a field between the transmitter and the receiver, but it uses electromagnetic waves. Similar to a tomographic motion detector, any disturbances in the detection zone set off the alarm. Microwave sensors have a long range, about 400 to 1,500 sq. ft. They can detect motion through walls and around corners, but because of this, they're prone to false alarms. Your pets and car can trigger the alarm. It can even detect large insects. The RF field doesn't also penetrate metals, creating a dead zone behind metal objects.

4. Ultrasonic Detectors

These sensors use echolocation to detect motion. It's similar to the ones that bats use to "see." This is a highly sensitive type of motion detector; it's even more sensitive than microwaves and PIRs. This means that it's also highly prone to false alarms. Your pets may also be able to hear the sound waves that ultrasonic sensors emit, which can irritate them. They are, however, great for offices and other indoor spaces that contain a lot of obstructions. Ultrasonic sensors don't have an issue of dead zones in their area of coverage.

5. Photoelectric Beams

This is also another type of motion detector, but it doesn't work similarly to the others. For one, it doesn't have a coverage area. It only forms a fence, which triggers the alarm if broken. It consists of two separate parts that form a sort of a fence made of IR beams. When someone steps into the beams, between the two parts, they trigger the alarm. They're great for outside use, but make sure you choose the models that can withstand any weather condition. Intruders can set off the alarm even before they break into your home, minimizing injuries and damage to your property.

6. Magnetic Switches

Magnetic switches are also for doors and windows. In this case, they sound the alarm when someone (or something) opens the doors and windows. This system has 2 components: one attaches to the door or window itself, while the other one attaches to the frame. They should be right beside each other in order for them to work. When a door or window opens, it separates the 2 components. This is the trigger for the alarm.

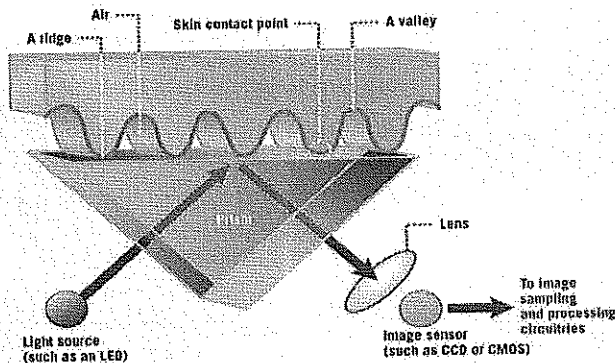
Ans-2

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.

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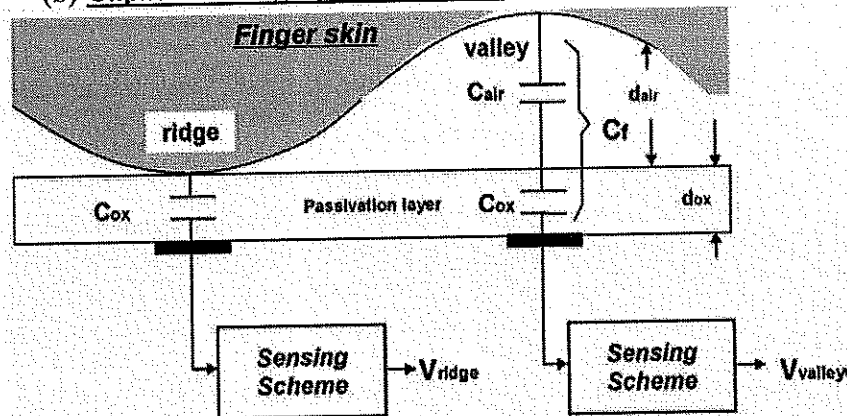
Ans3- Different types of fingerprint sensor technology is as follows-

(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



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

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-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

$$T_d = T_c = K\theta$$

$\therefore$

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

$\therefore$

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

**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. A steam power station requires space:
(a) Equal to diesel power station (b) More than diesel power station
(c) More than diesel power station (d) None of the above
2. Hydroelectric power plant is mainly located in:
(a) Flat areas (b) Deserts (c) Hilly areas (d) Deltas
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 increases with:
(a) Decrease in conductor size and increase in supply frequency
(b) Increase in conductor size and decrease in supply frequency
(c) Increase in both conductor size and supply frequency
(d) Decrease in both conductor size and supply frequency
5. Moisture content in the soil the earth soil resistance.
(a) increase (b) decrease (c) does not affect (d) none of the above
6. A transmission and distribution engineer needed to design the sub transmission substation. The tapping component needed will be:
(a) feeder (b) distributor (c) transmitter (d) tap-changing transformer
7. Lightning arrestor should be located:
(a) Away from the circuit breaker (b) Near the transformer
(c) Away from the transformer (d) Near the circuit breaker
8. Ground resistance should be designed such that:
(a) grounding resistance should be as low as possible
(b) grounding resistance should be as high as possible
(c) grounding resistance should be always zero
(c) none of the above
9. Current transformers are used for:
(a) to provide to measure voltages
(b) to measure high value of currents
(c) to short-circuit the unwanted instruments
(d) to measure low value of currents

B



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

10. Current transformers and potential transformers are used to increase the ranges of:
- (a) AC ammeter and AC voltmeter respectively
 - (b) AC ammeter and DC voltmeter respectively
 - (c) DC ammeter and DC voltmeter respectively
 - (d) DC ammeter and AC voltmeter respectively

Section – B

04X04 = 16 Marks

1. Write a brief comparison between thermal, hydro and nuclear power plant.
2. Explain how the ac resistance of a conductor is affected from skin effect.
3. Classify different distribution system. Explain any one in detail
4. Write the difference between relay and circuit breaker.

Section – C

04X06 = 24 Marks

1. What are the different type of circuit breaker? Explain any one in detail.
2. Compare overhead and underground transmission cables.
3. What is Ferranti Effect? Discuss why it is occurs and how it is reduces .
4. Draw and explain the layout of Nuclear power plant.

**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
Course Name: Introduction to Power System

Time: 2 Hours
Max. Marks: 50

Section – A

10X01 = 10 Marks

10 objective type questions, each question carries 01 mark.

1.	A steam power station requires space..... B. More than diesel power station
2.	Hydroelectric power plant is mainly located in _____ Answer: c Explanation: In order to get sufficient head, hydroelectric power plants are constructed in hilly areas. In desert and flat areas sufficient water head cannot be obtained. Deltas are not suitable for this because of high sedimentation.
3.	Nuclear fuel in reactor lasts for _____ Answer: d 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 increases with Ans: A
5.	Moisture content in the soil the earth soil resistance. (b) decrease
6.	A transmission and distribution engineer needed to design the sub transmission substation. The tapping component needed will be _____ Answer: a Explanation: For the sub transmission level, there is no tapping at various level does not take place. For this a feeder is used.
7.	Lightning arrestor should be located b) Near the transformer
8.	Ground resistance should be designed such that: (a) grounding resistance should be as low as possible
9.	Current transformers are used for _____ Answer: b Explanation: It is the current ratio transformer meant for measuring large currents and provide a step-down current to current measuring instruments like an ammeter. Such instruments present a short-circuit to the CT secondary.
10.	Current transformers and potential transformers are used to increase the ranges of a. AC ammeter and AC voltmeter respectively



Section – B

04X04 = 16 Marks

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

1.	Write a brief comparison between thermal, hydro and nuclear power plant. <u>Thermal Power Station</u> Principle of operation: It works on Modified Rankine Cycle. Location: It is located at a site where coal, water and transportation facilities are available easily. It is located near load centers. Requirement of Space: Need a large space due to coal storage, turbine, boiler and other auxiliaries. Efficiency: Overall efficiency is least compared to other plants. (30%-32%) Fuel Used: Coal (mostly) or oil. Availability of Fuel: Coal reserves are present all over the world. However, coal is non-renewable and limited. Cost of Fuel: High. Coal is heavy and has to be transported to the plant. Initial Cost of Plant: Lower than Hydroelectric and Nuclear power plants. Running Costs: Higher than Hydroelectric and Nuclear power plants. Maintenance Costs: High. Skilled engineers and staff are needed. Transmission and Distribution Cost: Low. It is usually located near load centers. Start-up Power: About 10% of unit capacity. Starting time: Large Standby Losses: More than hydroelectric and nuclear power plants. Boiler flame has to be kept burning, so some amount of coal is used constantly, even when the turbine is not in operation. Cleanliness: Less clean. Smoke and ash are produced. Environmental Considerations: Air pollution occurs and leads to acid rain. Greenhouse gases are also produced. Life Time: 30 - 40 years. <u>Hydroelectric Power Plant</u> Principle of operation: Potential energy of water is converted to Kinetic energy and used to rotate a turbine. Location: Located where a large amount of water can be collected easily in a reservoir by constructing a dam. Usually in a hilly area at high altitude. Requirement of Space: Very large space required. A dam is huge. Efficiency: As high as 85% to 90% Fuel Used: Water Availability of Fuel: Availability of water is unreliable because it depends on the weather (rainfall.) Cost of Fuel: Water is free. Initial Cost of Plant: Very high. Construction of a dam and reservoir is expensive. Running Costs: Zero, because no fuel is needed. Maintenance Costs: Low. Transmission and Distribution Cost: High. It is located in remote areas, away from load centers. Start-up Power: 0.5% to 1% of unit capacity. Starting time: Low. Can be started instantly. Standby Losses: None. Cleanliness: Clean. Environmental Considerations: Affects marine life. People in the region have to be relocated. Life Time: Large (50 to 100 years.) <u>Nuclear Power Plant</u>
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	Principle of operation: Thermonuclear fission. Location: Located away from heavily populated areas. Requirement of Space: Requires minimum space compared to other plants of the same capacity. Efficiency: Higher than Thermal Power Station. About 55% Fuel Used: Uranium (U235) and other radioactive metals. Availability of Fuel: Deposits of nuclear fuel are present all over the world. Also, uranium can be extracted from sea water, but it's a complicated and complex process. Cost of Fuel: Fuel (uranium) itself isn't too costly. However, if enriched uranium is used, then the cost of fuel increases considerably. A small amount of fuel is used, so transportation costs are less. Initial Cost of Plant: Highest. A nuclear reactor is complex and requires the most skilled engineers. Running Costs: Small amount of fuel used, so running cost is low. Maintenance Costs: Very high. Skilled personnel are needed. Transmission and Distribution Cost: Quite low. Such plants can be located near the load centers. Start-up Power: 7% to 10% of unit capacity. Starting time: Less than TPS. Can be started easily. Standby Losses: Less. Cleanliness: Radioactive waste is produced. Less clean than HPS. Environmental Considerations: Disposal of radioactive wastes may affect the environment, especially if it is buried underground. Underwater contamination may occur. Life Time: 40-60 years.
2	Explain how the ac resistance of a conductor is affected from skin effect. The non-uniform distribution of electric current over the surface or skin of the conductor carrying a.c is called the skin effect. In other words, the concentration of charge is more near the surface as compared to the core of the conductor. The ohmic resistance of the conductor is increased due to the concentration of current on the surface of the conductor. Let us consider the conductor is made up of a number of concentric cylinders. When a.c is passed in a conductor, the magnetic flux induces in it. The magnetic flux linking a cylindrical element near the center is greater than that linking another cylindrical element near the surface of the conductor. This is due to the fact that the center cylindrical element is surrounded by both the internal as well as the external flux, while the external cylindrical element is surrounded by the external flux only. The self-inductance in the inner cylindrical element is more and, therefore, will offer a greater inductive reactance than the outer cylindrical element. This difference in the inductive reactance gives a tendency to the current to concentrate towards the surface or skin of the conductor.
3	Classify different distribution system. Explain any one in detail There are four distribution feeder systems are used • Radial • Parallel feeders • Ring main • interconnected systems RADIAL FEEDERS



	It is used for many distribution processes it is really cheap and simple it is only used when the substation or the generating stations are located at the center of the consumers in this type feeder will radiate from the generating stations or substations and it will reach the distributors at one end. Thus the power flow is in one direction Although this system is simplest and least expensive, it is not highly reliable. A major drawback of a radial distribution system is, a fault in the feeder will result in supply failure to associated consumers as there won't be any alternative feeder to feed distributors.																		
4	Write the difference between relay and circuit breaker. The Difference Between Relay and Circuit Breaker are given below in the tabulated form. <table><tr><th>BASIS</th><th>RELAY</th><th>CIRCUIT BREAKER</th></tr><tr><td>Principle</td><td>The Relay is a switching device which gives a signal to the circuit breaker as soon as the fault occurs in the power system.</td><td>Circuit breaker breaks the circuit automatically when receives the signal from the relay.</td></tr><tr><td>Working</td><td>The Relay does not break the contact. It only senses the error and send the signal to the circuit breaker.</td><td>It breaks the circuit contacts.</td></tr><tr><td>Type of device</td><td>The Relay is a switching and sensing device.</td><td>The Circuit breaker is an isolating or disconnecting device.</td></tr><tr><td>Voltage</td><td>Relays operate on low power input voltage.</td><td>The Circuit breaker is an automatic on load device.</td></tr><tr><td>Usability</td><td>It is used to control or select one among many circuits.</td><td>It uses one per circuit.</td></tr></table>	BASIS	RELAY	CIRCUIT BREAKER	Principle	The Relay is a switching device which gives a signal to the circuit breaker as soon as the fault occurs in the power system.	Circuit breaker breaks the circuit automatically when receives the signal from the relay.	Working	The Relay does not break the contact. It only senses the error and send the signal to the circuit breaker.	It breaks the circuit contacts.	Type of device	The Relay is a switching and sensing device.	The Circuit breaker is an isolating or disconnecting device.	Voltage	Relays operate on low power input voltage.	The Circuit breaker is an automatic on load device.	Usability	It is used to control or select one among many circuits.	It uses one per circuit.
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Section – C

04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

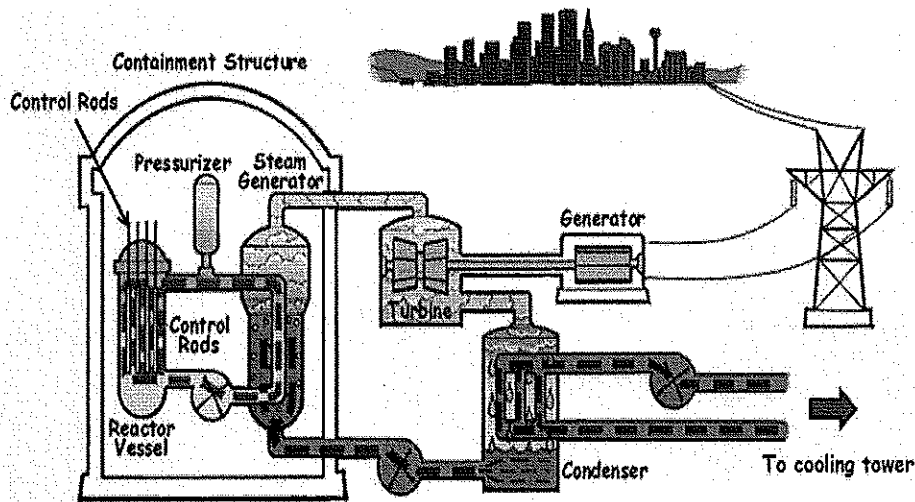
1	What are the different type of circuit breaker? Explain any one in detail. Types of Circuit Breaker Circuit breakers are mainly classified on the basis of rated voltages. Circuit breakers below rated voltage of 1000V are known as the low voltage circuit breakers and above 1000V are called the high voltage circuit breakers. The most general way of the classification of the circuit breaker is on the basis of the medium of arc extinction. Such types of circuit breakers are as follows :- 1. Oil Circuit Breaker • Bulk Oil Circuit Breaker • Minimum Oil Circuit Breaker 2. Minimum Circuit Breaker 3. Air Blast Circuit Breaker 4. Sulphur Hexafluoride Circuit Breaker 5. Vacuum Circuit Breaker 6. Air Break Circuit Breaker 7.
2	Compare overhead and underground transmission cables. To understand how the two cable types differ from one another, below are the notable differences between the two.



	Construction Underground cables are more expensive to construct since they have to be electrically insulated and have protection against moisture, corrosion, mechanical damage and other environmental impacts from the soil. Construction of the cables is more complicated compared to the overhead cables which are simple to construct, and do not require insulation and sheathing. The overhead cables have lesser requirements and cheaper to construct. Installation The installation of overhead lines on poles is easier and straightforward. However, the underground cables require digging trenches and this may be complicated by other utility service lines such as water pipes, oil and gas pipelines, sewer lines. Other complications may arise due to rocks, loose soil and water along the routes, making them more expensive to install. Heat dissipation Heat dissipation in underground cables is limited by the layers of insulation and protection such as armoring and sheaths. Most of the heat is therefore retained near the cable unlike the overhead cables where most of the heat is released to the surrounding and automatic natural cooling is provided by the air. Size of Conductors Underground cables have larger conductor sizes compared to overhead lines for the same amount of power. This is due to the fact that the overhead lines have a natural cooling and hence the ability to carry more power without heating up.
3	What is Ferranti Effect ? Discuss why it occurs and how it is reduced . Definition: The effect in which the voltage at the receiving end of the transmission line is more than the sending voltage is known as the Ferranti effect. Such type of effect mainly occurs because of light load or open circuit at the receiving end. Ferranti effect is due to the charging current of the line. When an alternating voltage is applied, the current that flows into the capacitor is called charging current. A charging current is also known as capacitive current. The charging current increases in the line when the receiving end voltage of the line is larger than the sending end. Why Ferranti effect occurs? Capacitance and inductance are the main parameters of the lines having a length 240km or above. On such transmission lines, the capacitance is not concentrated at some definite points. It is distributed uniformly along the whole length of the line. When the voltage is applied at the sending end, the current drawn by the capacitance of the line is more than current associated with the load. Thus, at no load or light load, the voltage at the receiving end is quite large as compared to the constant voltage at the sending end. How to reduce Ferranti effect: Electrical devices are designed to work at some particular voltage. If the voltages are high at the user ends their equipment get damaged, and their windings burn because of high voltage. Ferranti effect on long transmission lines at low load or no load increases the receiving end voltage. <i>This voltage can be controlled by placing the shunt reactors at the receiving end of the lines.</i> Shunt reactor is an inductive current element connected between line and neutral to compensate the capacitive current from transmission lines. When this effect occurs in long transmission lines, shunt reactors compensate the capacitive VAR of the lines and therefore the voltage is regulated within the prescribed limits.

4

Draw and explain the layout of Nuclear power plant.



The energy source of a nuclear power plant is fission reaction. In fission reaction we start with an unstable atom (uranium-235) which splits apart into two small more stable atoms. When we go from something that is really very unstable (uranium-235) to thing that is more stable (barium and krypton), energy is released. Now to split the uranium atom we need to aggravate it, what we do is we strike a neutron into this big uranium atom, which converts it into uranium-236 from uranium -235. Uranium-236 is super unstable atom and splits up into krypton-92 and barium-141, which are way more stable. Other than release of energy, 3 free neutrons are also released in the process. These neutrons further strikes another 3 uranium atoms and starts up a chain reaction, helping in getting a great amount of thermal energy.