BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.:.....

School of Electrical Skills
Session: 2020-21 (Winter Semester)
B. Voc. Program, 3rd Semester,
1st In-Sem. Examination

Course Code: ELE 1302 **Time: 1 Hour**
Course Name: Electrical Machines-I **Max. Marks: 20**

Instruction: Answer all questions from each and every section. Section A, each question carries one mark, section B, each question carries two marks and in section C, each question carries three marks.

Section – A

05X01 = 05 Marks

1. The field coils of a DC generator are usually made of: -
   (a) Mica (b) Copper
   (c) Cast Iron (d) Steel

2. Which of the following applications require high starting torque?
   (a) Lathe Machine (b) Centrifugal Pump
   (c) Locomotive (d) Air Blower

3. The commercial sources of energy are:
   (a) Solar, wind and biomass
   (b) Fossil fuels, hydropower and nuclear energy
   (c) Wood, animal wastes and agriculture wastes
   (d) None of the above

4. Which of the following does not change in a transformer?
   (a) Voltage (b) Current
   (c) Frequency (d) All of the above

5. Electric power is generated at
   (a) 33 kV (b) 110 kV
   (c) 400 kV (d) 12 kV

Section – B

03X02 = 06 Marks

1. Write the names of the different materials which are mainly used in machine manufacturing.
2. Define:
   (a) Transformer (b) Electric Generator
3. Explain the two types of rotor constructors employed in an induction motor with schematic diagram.

Section – C

03X03 = 09 Marks

1. List the various factors that are considered in electrical machine design.
2. Write the principle of electro-mechanical energy conversion.
3. Draw a neat and clean cross-sectional view of DC machine diagram and explain the construction features of DC machine.

Answer Key

Registration No.:.....

School of Electrical Skills
Session: 2020-21 (Winter Semester)
B. Voc. Program, 3rd Semester,
1st In-Sem. Examination
Course Code: ELE 1302

Course Name: Electrical Machines-I Answer key

Section – A

05X01 = 05 Marks

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   (a) Mica **(b) Copper**
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   (a) 33 kV (b) 110 kV
   (c) 400 kV (d) 12 kV

Section – B

03X02 = 06 Marks

1. What materials are mainly used in machine manufacturing?
   Ans: Three materials are mainly used in machine manufacture; steel to conduct magnetic flux, copper (or aluminium) to conduct electric current and insulation to insulate the voltage induced in conductors confining currents to them.

2. Give the definitions of transformer, electric generator and electric motor.
   Ans: The transformer is an electrical device that is closely related to electrical machines. It converts ac electrical energy at one voltage level to ac electrical energy at another voltage level.

   An efficient and convenient way to generate electric power is by conversion of mechanical power into electrical form in a rotating device called a generator. Thomas Alva Edison developed an electric generator.

   An efficient and convenient way to generate mechanical power is by conversion of electric power into mechanical form in a rotating device called a motor.

3. Explain the two types of rotor constructors employed in an induction motor with schematic diagram.
   Ans: Two types of rotor constructions are employed which distinguish the type of induction motor.
   1. ***Squirrel-cage rotor*** **Here the rotor has copper (or aluminium) bars embedded in slots which are short circuited at each end as shown in**

Figure. It is a rugged economical construction but develops low starting torque.

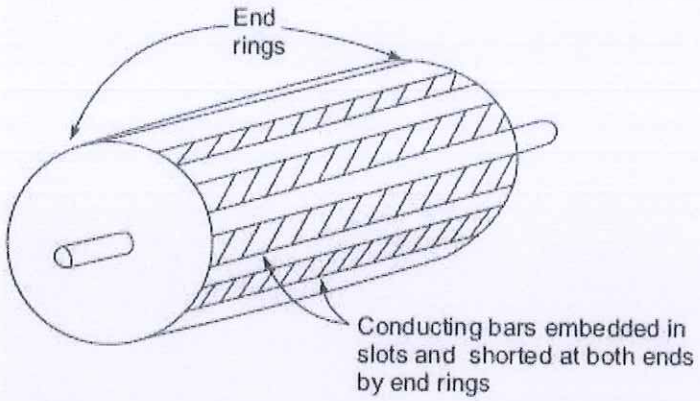


Figure: A squirrel-cage rotor (schematic diagram)

2. *Slip-ring (or wound-rotor) rotor* The rotor has a proper 3-phase winding with three leads brought out through slip-rings and brushes as shown in Figure. These leads are normally short-circuited when the motor is running. Resistances are introduced in the rotor circuit via the slip-rings at the time of starting to improve the starting torque.

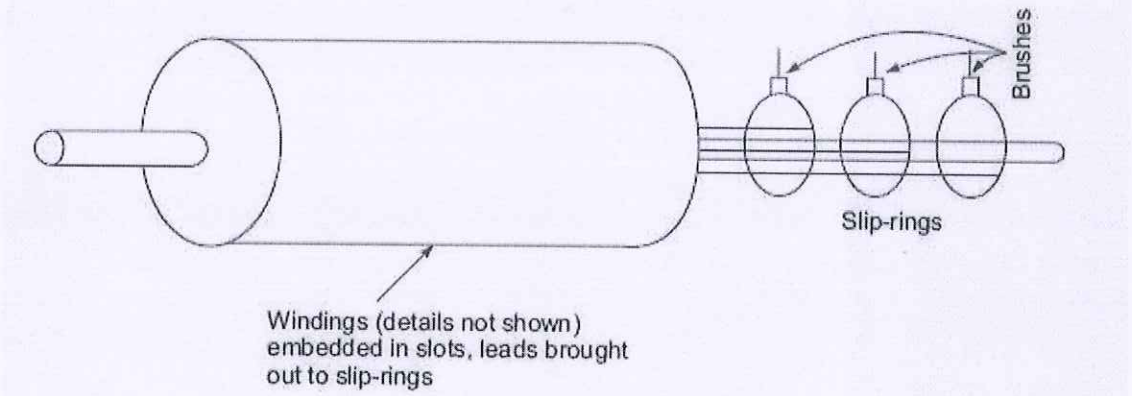


Figure: A wound rotor (schematic diagram)

Section – C

03X03 = 09 Marks

1. What factors are considered in electrical machine design?

Ans: Factors for consideration in electrical machine design:

The basic components of all electromagnetic apparatus are the field and armature windings supported by dielectric or insulation, cooling system and mechanical parts. Therefore, the factors for consideration in the design are,

1. **Magnetic circuit or the flux path: Should establish required amount of flux using minimum mmf. The core losses should be less.**
2. **Electric circuit or windings: Should ensure required emf is induced with no complexity in winding arrangement. The copper losses should be less.**
3. **Insulation: Should ensure trouble free separation of machine parts operating at different potential and confine the current in the prescribed paths.**
4. **Cooling system or ventilation: Should ensure that the machine operates at the specified temperature.**
5. **Machine parts: Should be robust.**

The art of successful design lies not only in resolving the conflict for space between iron, copper, insulation and coolant but also in optimization of cost of manufacturing, and operating and maintenance charges.

The factors, apart from the above, that requires consideration are

a. Limitation in design (saturation, current density, insulation, temperature rise etc.,)
b. Customer's needs
c. National and international standards
d. Convenience in production line and transportation
e. Maintenance and repairs
f. Environmental conditions etc.

2. What is the principle of electro-mechanical energy conversion?

Ans: When energy is converted from one form into another, the principle of conservation o f energy can be invoked. According to the principle of conservation of energy, energy can neither be created nor be destroyed it can only be transformed from one state to another.

In an energy conversion device, out of the total input energy, some energy is converted into the required form, some energy is stored and the rest is dissipated. In view of this the energy equation must include these four energy terms and for a motor, it can be written as

$$\begin{pmatrix}\text{Total electrical}\\ \text{energy input}\end{pmatrix} = \begin{pmatrix}\text{Mechanical}\\ \text{energy output}\end{pmatrix} + \begin{pmatrix}\text{Total energy}\\ \text{stored}\end{pmatrix} + \begin{pmatrix}\text{Total energy}\\ \text{dissipated}\end{pmatrix}$$

The principle of energy conversion is based on energy balance equation. It should be noted above equation is written for motor action where electrical energy input and mechanical energy output are treated as positive terms. For generator action

$$\begin{bmatrix}\text{Total mechanical}\\ \text{energy input}\end{bmatrix} = \begin{bmatrix}\text{Electrical energy}\\ \text{output}\end{bmatrix} + \begin{bmatrix}\text{Total energy}\\ \text{stored}\end{bmatrix} + \begin{bmatrix}\text{Total energy}\\ \text{dissipated}\end{bmatrix}$$

3. Draw a neat and clean cross-sectional view of DC machine diagram and explain the construction features of DC machine.

Ans: In a *dc machine* the field poles are on the stator while the rotor is the armature as shown in the crosssectional view of Figure. The field poles are symmetrical and are even in number, alternately north and south. As the armature rotates, alternating emf and current induced in the armature winding are rectified to dc form by a rotating mechanical switch called the *commutator*, which is tapped by means of stationary carbon *brushes*. The commutator is cylindrical in shape and comprises several wedge-shaped copper segments bound together while they are insulated from each other. The armature is made of laminated steel with slots cut out on the periphery to accommodate the insulated armature winding. The ends of each armature coil are connected to the commutator segments to form a closed winding. The armature when carrying current produces stationary poles (same as number of field poles) which interact with the field poles to produce the electromagnetic torque.

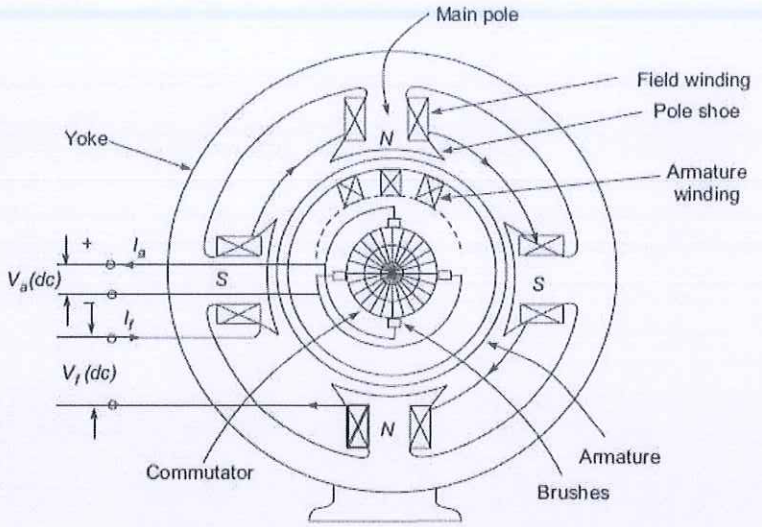


Figure: *Cross-sectional view of dc machine*

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Electrical Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, 3rd Semester,

1st In-Sem. Examination

Course Code: ELE1303 **Time: 1 Hour**

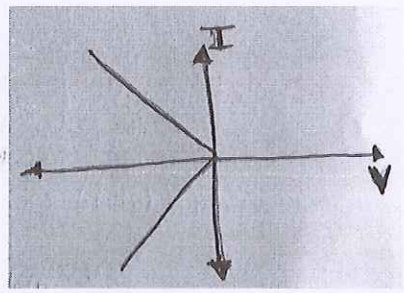
Course Name: Electric Circuit & Drawing **Max. Marks: 20**

Instruction: Answer all questions from each and every section. Section A, each question carries one mark, section B, each question carries two marks and in section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. Value of current is same in:
   (a) Parallel (b) Series (c) Shunt (d) None of these
2. KCL works on the principle of:
   (a) Charge conservation (b) Energy conservation
   (c) Power conservation (d) None of these
3. Unit of Power is:
   (a) Watt (b) Horse Power (c) Kilo Watt (d) All of these
4. Active elements have:
   (a) Positive slope coefficient (b) Negative slope coefficient
   (c) Positive slope in 1st quadrant only (d) None of these
5. Characteristics of given graph is:

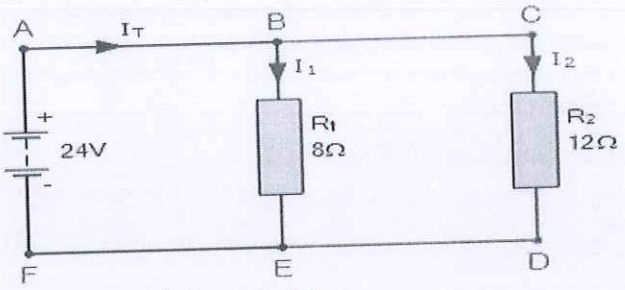


   (a) Non-linear, Active, Unilateral (b) Linear, Passive, Bilateral
   (c) Non-linear, Passive, Bilateral (d) None of these

Section – B

03X02 = 06 Marks

1. Calculate value of I_T as shown in the given figure.

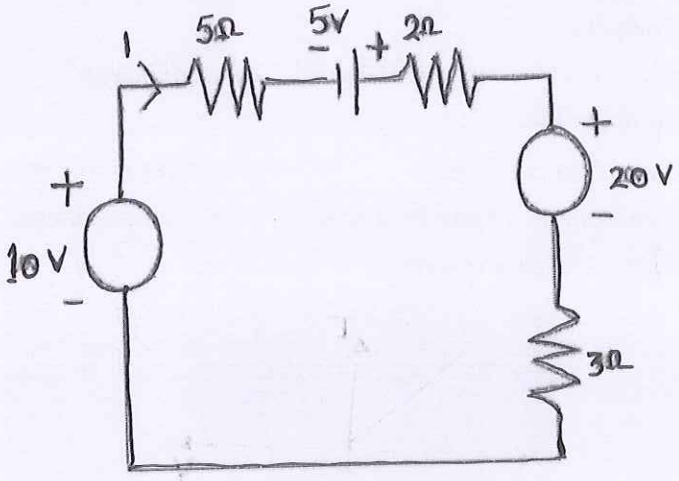


2. State ohm's law and also draw I-V characteristics.
3. If the resistance of an electric iron is 50Ω and 3.2A Current flows through the resistance. Find the voltage between two points.

Section – C

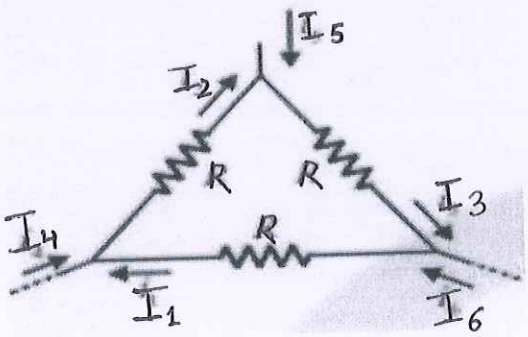
03X03 = 09 Marks

1. State Kirchoff's laws.
2. Calculate the value of Current I in the circuit:



3. Calculate the value of currents from the given figure:

R= 1 Ohm, I1= 2 A ,I4= -1A, I5= -4A



Answer Key

Course Code: ELE1303, Course Name: Electric Circuit & Drawing

School of Electrical Skills, 3rd Semester, 1st In-Sem. Examination

B. Voc. Program, Winter Semester (2020-21)

Section - A

Answer by

A.1 b

A.2 a

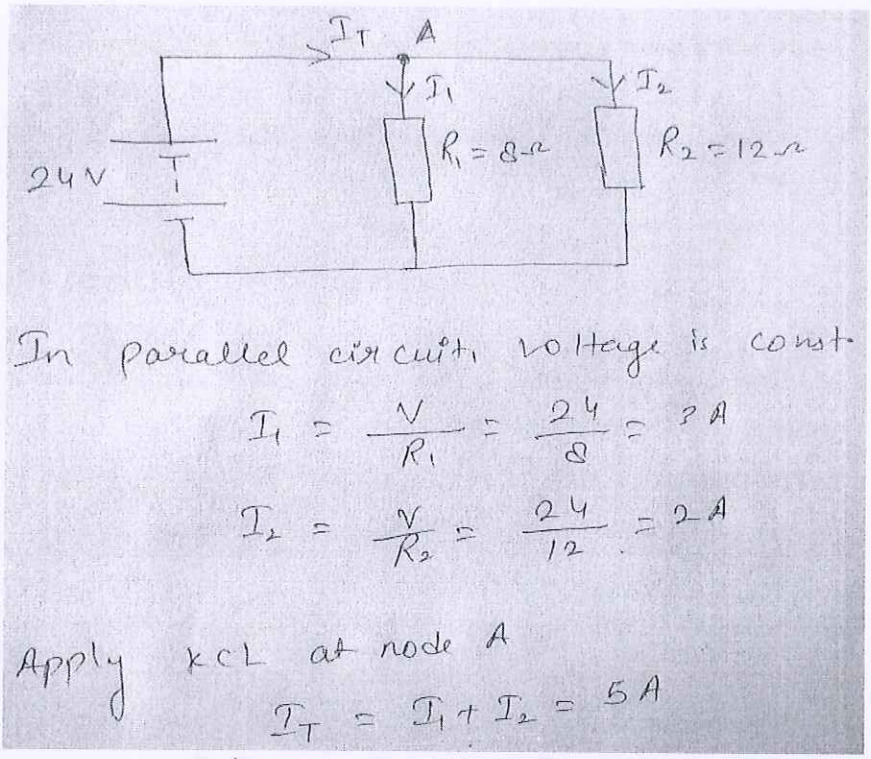
A.3 d

A.4 b

A.5 d

Section-B

Ans.1



Ans.2 Ohm's Law:

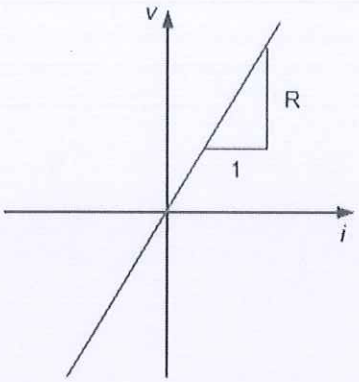
Wherever a voltage source is applied across a conductor, current will start flowing through it because of potential difference from higher potential to lower potential.

Ohm's Law states that the current flowing through a conductor is directly proportional to the potential difference (voltage) applied across its ends, provided that temperature and other physical conditions remain unchanged.

$$V \propto I$$

$$V = I*R$$

Where R= proportionality constant, known as Resistance



Ans.3 From ohm's law,

$$V=I*R$$

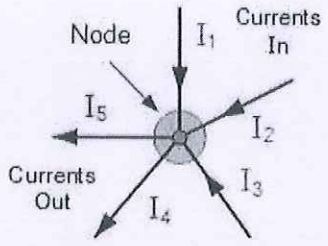
$$V=50*3.2=160 \text{ volts}$$

Section-C

Ans.1 Kirchhoff's Law Statement

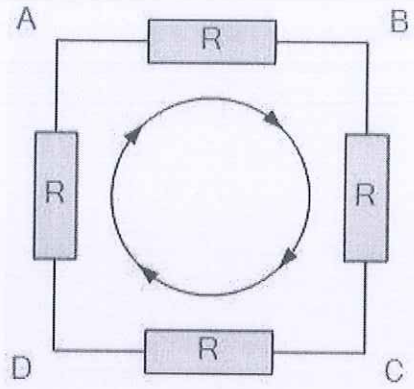
Kirchhoff's laws are one of the fundamental laws that find applications in electrical engineering for formulating the circuits. There are two laws that make up the Kirchhoff's law and they are:

- **Kirchhoff's Current Law (KCL):** KCL is also known as Kirchhoff's first law or junction rule. The principle of this law is to conserve the electric charge. The law states that the amount *of current flowing into a node/junction is equal to the sum of currents flowing out of it.* For performing the nodal analysis in Ohm's law, KCL is used.



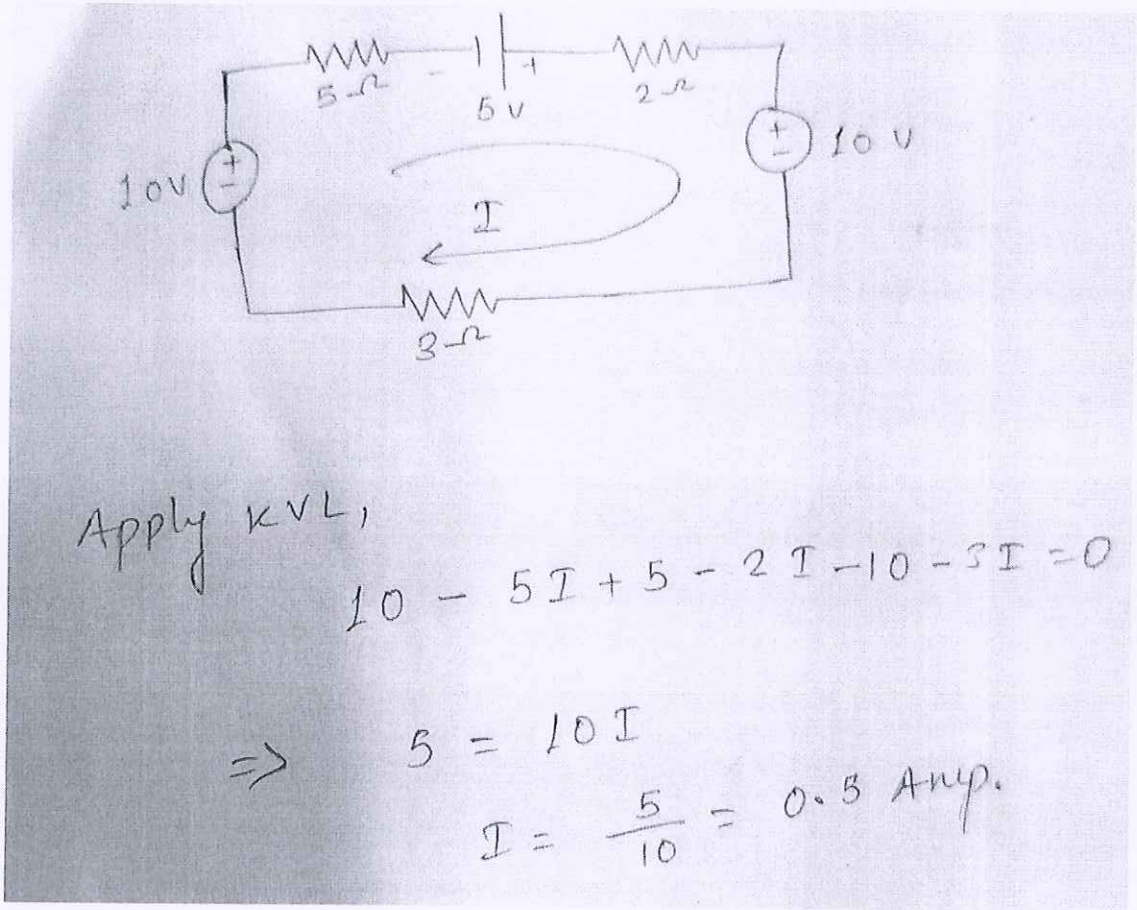
$$I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$$

- **Kirchhoff's Voltage Law (KVL):** KVL is also known as Kirchhoff's second law or loop law. The principle of this law is to conserve energy. The law states that the *sum of voltages in a closed-loop is zero.* The total amount of energy gained is equal to the energy lost per unit charge.

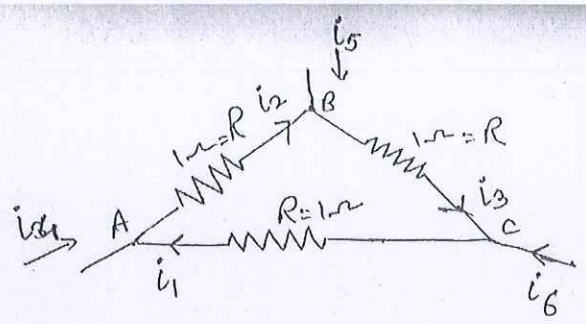


$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$

Ans.2



Ans.3



$i_1 = 2A$; $i_4 = -1A$

$i_5 = -4A$

Apply KCL at node A,

$$i_1 + i_4 = i_2$$

$$\Rightarrow i_2 = 2 - 1 = 1A$$

Apply KCL at node B,

$$i_2 + i_5 = i_3$$

$$\Rightarrow i_3 = 1 + (-4) = -3A$$

Apply KCL at node C,

$$i_6 = i_3 + i_1$$

$$\Rightarrow i_6 = -3 + 2 = -1A$$

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Electrical Skills
Session: 2021-22 (Winter Semester)
B. Voc. Program, 3rd Semester,
1st In-Sem. Examination

Course Code: ELE1304 **Time: 1 Hour**

Course Name: Electrical Measuring Instruments **Max. Marks: 20**

Instruction: All questions are compulsory. Each question carries one mark in section A. Each question carries two marks in section B. Each question carries three marks in section C.

Section – A

05x01 = 05 Marks

1. SI unit of time is:
   (a) Second (b) Minute
   (c) Hour (d) None of the above

2. Area is a derived quantity?
   (a) Yes (b) No

3. Full form of MKS is:
   (a) Metre, Kilogram, Second (b) Mass, Kilometer, Second
   (c) Meter, Kilometer, Second (d) None of these

4. CGS & MKS Systems were first introduced in _____ (Country name).
   (a) UK (b) France
   (c) US (d) None of these

5. Which of the following is most accurate?
   (a) 3.9 s (b) 3 s (c) 3.87 s (d) 3.897 s

Section – B

03x02 = 06 Marks

1. What is the number of significant figures in the following numbers:
   (a) 64.00 (b) 903.1

2. Which measuring instrument is used for measurement of voltage & current?
3. Define estimation. Give one example.

Section – C

03x03 = 09 Marks

1. Define error. How many types of errors are there?
2. Define accuracy and precision. Explain with example.
3. Define Instrument. Also write names of all types of instruments and explain them briefly.

Answer Key (ELE1104)

School of Electrical Skills
Session: 2020-21 (Winter Semester)
B. Voc. Program, 3rd Semester,
1st In-Sem. Examination
Course Code: ELE1304
Course Name: Electrical Measuring Instruments

Section – A

05x01 = 05 Marks

Ans. 1: (a)
Ans. 2: (a)
Ans. 3: (a)
Ans. 4: (b)
Ans. 5: (d)

Section – B

03x02 = 06 Marks

Ans. 1: -
1. 4
2. 4

Ans. 2: - For the measurement of voltage, voltmeter is used while for the measurement of current, ammeter is used.

Ans. 3: - Estimation is a rough idea of anything that a human can see so as to measure the things as accurately as possible without actual measurements. No. of buildings in a city is the perfect example for estimation.

Section – C

03x03 = 09 Marks

Ans. 1: -

The term error in a measurement is defined as:
The instrument reading (which is sometimes referred to simply as the measurement) is the value given by a measuring instrument and the true reading is the actual value of the property being measured. This error is also called absolute error.

Types of Error:

Generally, errors are classified mainly into three categories as follows:
(a) Gross errors
(b) Systematic errors
(c) Random errors

Ans. 2: -

Accuracy of any instrument is defined as how near the measurement was as compared to the actual value of the measurement while the precision tells us about how precise the measurement is. For ex., if a measurement is 49.789, then 49 will be termed as more accurate as compared to 55 while 49.78 will be considered more precise as compared to 49.7.

Ans.3: -

An instrument is used for the measurement of various types of physical quantities that are used in our daily life. They may be fundamental or derived quantities. The types of instruments are as follows:

1. Absolute instruments: These instruments are used for measuring the fundamental physical quantities and does not need calibration. For ex. Voltmeter.
2. Secondary instruments: These types of instruments are used for the calculation of derived quantities and need calibration. For ex, torque meter.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Electrical Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, III Semester,

1st In-Sem. Examination

Course Code: ELE1305 **Time: 1 Hour**

Course Name: Introduction to Power System **Max. Marks: 20**

Instruction: Answer all questions from each and every section. Section A, each question carries one mark, section B, each question carries two marks and in section C, each question carries three marks.

Section – A

05X01 = 05 Marks

1. Which nuclear fuel is usually used in thermal nuclear reactor to create fission?
   (a) U^{234} (b) U^{235}
   (c) U^{236} (d) U^{237}

2. Control rods in nuclear reactor are made of _____
   (a) Cesium (b) Cadmium
   (c) Tin (d) Gallium

3. The most commonly used moderator in nuclear plants is
   (a) heavy water (b) concrete and bricks
   (c) graphite (d) deuterium

4. The main source of production of biogas is_____
   (a) Human waste (b) Wet cow dung
   (c) Wet livestock waste (d) all of the above

5. Minimum quantity of fuel is required in_____ power plant.
   (a) Thermal (b) Nuclear
   (c) Hydro-electric (d) Diesel

Section – B

03X02 = 06 Marks

1. Name three conventional ways of generating power. Of these three, which one contributes maximum generation in India.
2. Why controlling rods is used in nuclear power plant?
3. Why is it necessary to step up the voltage before transmitting?

Section – C

03X03 = 09 Marks

1. Draw and explain single line representation of power system.
2. Differentiate between thermal power plant and nuclear power plant.
3. Explain coal based thermal power plant with diagram.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, III Semester,

1st In-Sem. Answer Key

Course Code: ELE1305

Course Name: Introduction to Power System

Section – A

1. (b) U^{235}
2. (b) Cadmium
3. (c) graphite
4. (d) all of the above
5. (b) Nuclear

Section – B

1.

Fuel	MW	% of Total
Total Thermal	2,33,171	61.5%
Coal	2,01,085	53.0%
Lignite	6,620	1.7%
Gas	24,957	6.6%
Diesel	510	0.1%
Hydro (Renewable)	46,209	12.2%
Nuclear	6,780	1.8%
RES* (MNRE)	91,154	24.5%
Total	379,130	

2. Control rods are the most important part of a nuclear reactor in nuclear power plant, and are made up of Barium or Cadmium. It controls the ongoing nuclear reaction by absorbing the neutrons and we can also control the energy production as per the requirement, by inserting the control rods accordingly.
3. Stepping up the voltage level depends upon the distance at which power is to be transmitted. Longer the distance, higher will be the voltage level. Stepping up of voltage is to reduce the I^2R losses in transmitting the power (when voltage is stepped up, the current reduces by a relative amount so that the power remains constant, and hence I^2R loss also reduces).

Section – C

03X03 = 09 Marks

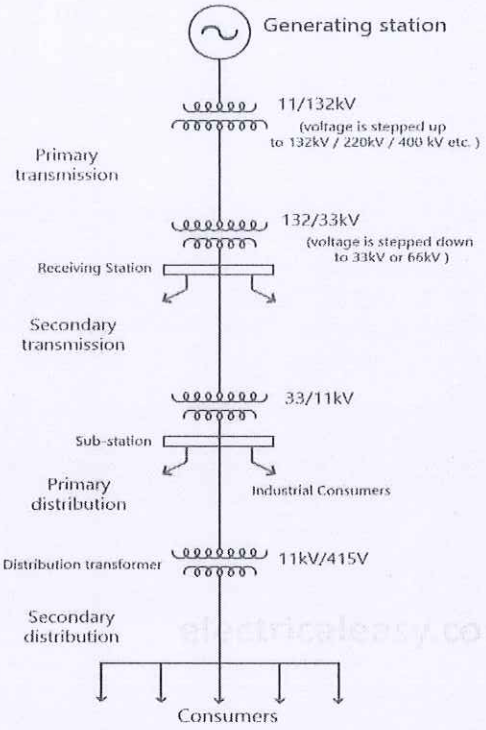
1.
   (a) Electrical power is normally generated at 11kV in a power station. While in some cases, power may be generated at 33 kV.
   (b) This generating voltage is then stepped up to 132kV, 220kV, 400kV or 765kV etc. Stepping up the voltage level depends upon the distance at which power is to be transmitted. Longer the distance, higher will be the voltage level. Stepping up of voltage is to reduce the I^2 R losses in transmitting the power (when voltage is stepped up, the current reduces by a relative amount so that the power remains constant, and hence I^2 R loss also reduces). This stage is called as primary transmission.
   (c) The voltage is the stepped down at a receiving station to 33kV or 66kV. Secondary transmission lines emerge from this receiving station to connect substations located near load centers (cities etc.).

(d) The voltage is stepped down again to 11kV at a substation. Large industrial consumers can be supplied at 11kV directly from these substations. Also, feeders emerge from these substations. This stage is called as primary distribution.

(e) Feeders are either overhead lines or underground cables which carry power close to the load points (end consumers) up to a couple of kilometers.

(f) Finally, the voltage is stepped down to 415 volts by a pole-mounted distribution transformer and delivered to the distributors.

(g) Draw and explain single line representation of power system.



2. Thermal Power Plant

(a) Principle of operation: It works on Modified Rankine Cycle.

(b) Location: It is located at a site where coal, water and transportation facilities are available easily. It is located near load centers.

(c) Requirement of Space: Need a large space due to coal storage, turbine, boiler and other auxiliaries.

(d) Efficiency: Overall efficiency is least compared to other plants. (30%-32%)

(e) Fuel Used: Coal (mostly) or oil.

(f) Availability of Fuel: Coal reserves are present all over the world. However, coal is non-renewable and limited.

(g) Cost of Fuel: High. Coal is heavy and has to be transported to the plant.

(h) Initial Cost of Plant: Lower than Hydroelectric and Nuclear power plants.

(i) Running Costs: Higher than Hydroelectric and Nuclear power plants.

(j) Maintenance Costs: High. Skilled engineers and staff are needed.

(k) Transmission and Distribution Cost: Low. It is usually located near load centers.

(l) Start-up Power: About 10% of unit capacity.

(m) Starting time: Large

(n) 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.

(o) Cleanliness: Less clean. Smoke and ash are produced.

(p) Environmental Considerations: Air pollution occurs and leads to acid rain. Greenhouse gases are also produced.

(q) Life Time: 30 - 40 years. Differentiate between thermal power plant and nuclear power plant.

Nuclear Power Plant

(a) Principle of operation: Thermonuclear fission.
(b) Location: Located away from heavily populated areas.
(c) Requirement of Space: Requires minimum space compared to other plants of the same capacity.
(d) Efficiency: Higher than Thermal Power Station. About 55%
(e) Fuel Used: Uranium (U235) and other radioactive metals.
(f) 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.
(g) 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.
(h) Initial Cost of Plant: Highest. A nuclear reactor is complex and requires the most skilled engineers.
(i) Running Costs: Small amount of fuel used, so running cost is low.
(j) Maintenance Costs: Very high. Skilled personnel are needed.
(k) Transmission and Distribution Cost: Quite low. Such plants can be located near the load centers.
(l) Start-up Power: 7% to 10% of unit capacity.
(m) Starting time: Less than TPS. Can be started easily.
(n) Standby Losses: Less.
(o) Cleanliness: Radioactive waste is produced. Less clean than HPS.
(p) Environmental Considerations: Disposal of radioactive wastes may affect the environment, especially if it is buried underground. Underwater contamination may occur.
(q) Life Time: 40-60 years.

3. Firstly the water is taken into the boiler from a water source. The boiler is heated with the help of coal. The increase in temperature helps in the transformation of water into steam. The steam generated in the boiler is sent through a steam turbine. The turbine has blades that rotate when high velocity steam flows across them. This rotation of turbine blades is used to generate electricity. A generator is connected to the steam turbine. When the turbine turns, electricity is generated and given as output by the generator, which is then supplied to the consumers through high-voltage power lines.