BHEL Electrical Questions Questions

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Question 1:

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By conducting Swinburne's test on a DC machine, which of the following losses can be determined?

1. Friction and windage losses
2. Constant losses
3. Copper losses in both armature and field
4. Armature copper losses

Answer (Detailed Solution Below)

Option 2 : Constant losses

BHEL Electrical Questions Question 1 Detailed Solution

Swinburne's test is an indirect method of testing a DC machine. We can run the machine as a motor or as a generator. In this method of testing, no-load losses are measured separately and eventually, we can determine the efficiency.

Important Point:

1. This test is very convenient and economical as it is required very less power from supply to perform the test.

2. Since constant losses are known, the efficiency of Swinburne's test can be pre-determined at any load.

3. Series motor cannot operate under no-load hence this test is not suitable for determining the efficiency of a DC series motor.

Question 2:

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Which type of device is JFET?

1. Current controlled device

2. Resistance controlled device

3. Conductance controlled device

4. Voltage controlled device

Answer (Detailed Solution Below)

Option 4 : Voltage controlled device

BHEL Electrical Questions Question 2 Detailed Solution

Concept:

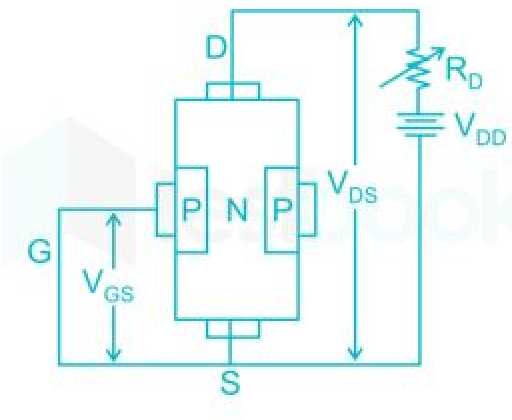
- JFET stands for **Junction Field Effect Transistor.**
- A field effect transistor is a **voltage controlled device** i.e. the output characteristics of the device are controlled by input voltage. There are two basic types of field effect transistors:

  1. Junction field effect transistor (JFET)

  2. Metal oxide semiconductor field effect transistor (MOSFET)

- A JFET is a three terminal semiconductor device in which current conduction is by one type of carrier i.e. electrons or holes.
- The current conduction is controlled by means of an electric field between the gate and the conducting channel of the device. To control the conduction of current from the source to the drain, the gate voltage must be more negative than the source voltage.
- JEFTs are futher divided into two types that n-channel JEFT and p-channel JEFT. The three leads of a JEFT are labeled source, gate and drain.

JFET is a three-terminal voltage controlled device. The voltage applied across the gate is used to control the current through the drain.



The gate to source voltage changes the channel width between two p regions, which ultimately controls the current flowing between drain and source terminals.

Important Point

FET	BJT
Unipolar device: Uses only one type of charge carrier	**Bipolar device:** Uses both electron and hole
Voltage-controlled device: voltage between gate and source control the current through the device.	**Current-controlled device**: Base current control the amount of collector current
High input resistance	Low input impedance
Faster in switching	Slower in switching

Question 3:

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The ZPFC characteristics can be obtained by loading the synchronous generator using:

1. synchronous motor
2. DC series motor
3. lamp load
4. DC shunt motor

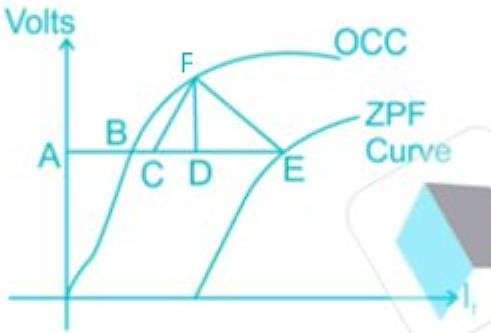
Answer (Detailed Solution Below)

Option 1 : synchronous motor

BHEL Electrical Questions Question 3 Detailed Solution

Zero Power Factor Characteristic (ZPFC):

- ZPFC of a generator is a curve of the armature terminal voltage and the field current.
- The machine is operated with constantly rated armature current at synchronous speed and zero lagging power factor.
- The Zero Power Factor Characteristic is also called as Potier Characteristic.
- **For maintaining very low power factor, the alternator is loaded by means of reactors or by an under excited synchronous motor.**
- The shape of ZPFC is very much like that of the O.C.C. The phasor diagram corresponding to zero power factor lagging is shown below.



In the phasor diagram shown above, the terminal voltage V is taken as the reference phasor. At zero power factor lagging, the armature current I_a lags behind V by 90 degrees. I_aR_a is drawn parallel to I_a and I_aX_{aL} perpendicular to I_a.

$V + I_aR_a + I_aX_{aL} = E_g$

E_g is the generated voltage per phase.

Question 4:

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Hot reserve is defined as:

1. a reserve generating capacity which is not in service but is in operation
2. a reserve generating capacity which is in service and in operation
3. a reserve generating capacity which in not in service and not in operation
4. a reserve generating capacity which is in service but not in operation

Answer (Detailed Solution Below)

Option 1 : a reserve generating capacity which is not in service but is in operation

BHEL Electrical Questions Question 4 Detailed Solution

Spinning reserve: Reserve generating capacity that is connected to the bus and ready to take the load

Cold reserve: It is the generating capacity which is available for service but not normally ready for immediate loading.

Hot reserve: It is the reserved capacity available and ready to use. This capacity is in operation but not in services.

Question 5:

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When an induction machine is allowed to run above synchronous speed, then this characteristic exactly matches which of the following options?

1. Synchronous motor

2. Induction motor

3. Induction generator

4. DC motor

Answer (Detailed Solution Below)

Option 3 : Induction generator

BHEL Electrical Questions Question 5 Detailed Solution

- Regenerative braking of an induction motor can only take place if the speed of the motor is greater than its synchronous speed, both rotating in the same direction
- In regenerative braking, induction motor works as an induction generator and power are fed back to the source
- This enhances energy efficiency the motor and improves the operating power factor the machine
- The main advantage of regenerative braking is that the generated power is fully used
- During regenerative braking **slip is negative**
  $s = \frac{N_s - N_r}{N_s}$
  $N_s < N_r$
  Therefore, $s < 0$
- Regenerative braking is used to control the speed of motors driving loads such as in electric locomotives, elevators, cranes and hoists
- Regenerative braking cannot be used for stopping the motor; It is only used for controlling the speed above the no-load speed of the motor

Question 6:

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Find the making current for a circuit breaker rated at 1000 A, 3000 MVA, 66 kV, 3 sec, 3 – phase, oil circuit breaker

1. 86.92 kA

2. 66.92 kA

3. 58.62 kA

4. 76.52 kA

Answer (Detailed Solution Below)

Option 2 : 66.92 kA

BHEL Electrical Questions Question 6 Detailed Solution

Concept:

Breaking current: It expresses the highest number of short-circuit currents that the breakers are capable of breaking under specified conditions of transient recovery voltage and power frequency voltage. It is expressed in kA (RMS) at contact separation. The breaking capacities are divided into two types.

- Symmetrical breaking capacity of a circuit breaker
- Asymmetrical breaking capacity of a circuit breaker

Symmetrical breaking capacity $= \sqrt{3} V_L I_B$

Rated symmetrical breaking current $I_B = \frac{S}{\sqrt{3} V_L}$

Making current of a circuit breaker is the peak value of the maximum current loop during sub transient condition including the DC component when the breaker closes.

Symmetrical making current = 2.55 × symmetrical breaking current

Calculation:

Symmetrical breaking capacity = 3000 MVA

$V_L = 66 kV$

$\Rightarrow I_B = \frac{3000 \times 10^6}{\sqrt{3} \times 66 \times 10^3}$

I_B = 26.24 kA

Making current = 2.55 × Symmetrical breaking current

= 2.55 × I_B

= 2.55 × 26.24 kA

= **66.92 kA**

Question 7:

View this Question Online >

Electrolytic meter is basically a/an:

1. DC ampere-hour meter
2. AC ampere-hour meter
3. AC energy meter
4. DC watt-hour meter

Answer (Detailed Solution Below)

Option 1 : DC ampere-hour meter

BHEL Electrical Questions Question 7 Detailed Solution

D.C. energy meters:

There are four types of dc energy meters.

Electrolytic Meters:

Electrolytic meters are exclusively **ampere-hour meters**, measuring electric quantity directly and electric energy only indirectly, on the assumption that the pressure of the supply is constant.

Motor Meters:

An integrating meter which has a rotor, one or more stators, a retarding element which makes the speed of the rotor proportional to the quantity (such as power or current) whose integral over time is being measured, and a register which counts the total number of revolutions of the rotor.

Clock Meters:

Suppose there are two pendulum clocks, geared to a single counting mechanism which records the difference in the rates of going of the two clocks, one having an ordinary pendulum and the other having a pendulum consisting of a fine coil of wire through which a current is passed proportional to the potential difference of the supply. Below this pendulum let there be placed another coil through which passes the current to be measured.

Intermittent Registering Meters:

A clock motion electrically driven is made to take readings at definite intervals - say, every five minutes - and to add up these readings upon a set of registered dials. The arrangement therefore integrates the ampere-hours or watthours.

Question 8:

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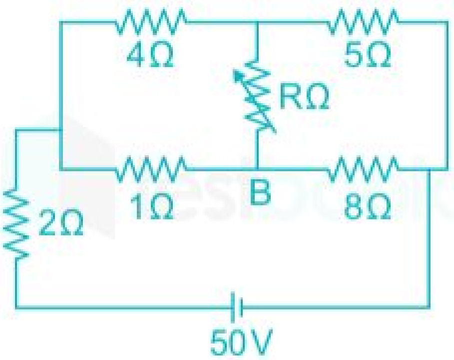
The value of R for maximum power transfer with reference to the given diagram is:



1. 1.21

2. 1.73

3. 3.27

4. 3.64

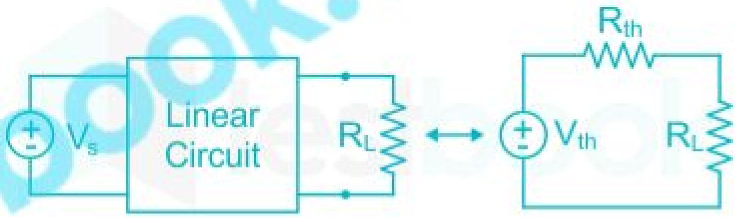
Answer (Detailed Solution Below)

Option 3 : 3.27

BHEL Electrical Questions Question 8 Detailed Solution

Thevenin Concept:

Any linear circuit can be replaced by its Thevenin equivalent representation. This is explained with the help of the following circuits:



V_{th} = Open Circuit Voltage (Thevenin Voltage)

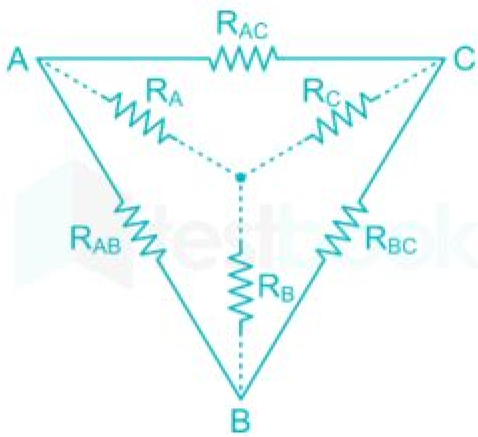
R_{th} = Thevenin Equivalent Resistance

According to the maximum power transfer theorem,

the load resistance is equal to source resistance (or Thevenin's resistance of network) for maximum power to be transferred to the load, i.e.

If $R_L = R_{th}$, Maximum power is transferred.

Types of Conversion:



1) Delta to Star conversion:

$$R_A = \frac{R_{AB} \times R_{AC}}{R_{AB} + R_{AC} + R_{BC}}$$

$$R_B = \frac{R_{AB} \times R_{BC}}{R_{AB} + R_{AC} + R_{BC}}$$

$$R_C = \frac{R_{BC} \times R_{AC}}{R_{AB} + R_{AC} + R_{BC}}$$

2) Star to Delta conversion:

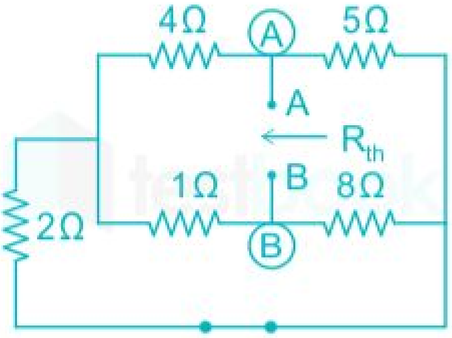
$$R_{AB} = \frac{(R_A \times R_C) + (R_A \times R_B) + (R_B \times R_C)}{R_C}$$

$$R_{AC} = \frac{(R_A\times R_C)+(R_A\times R_B)+(R_B\times R_C)}{R_B}$$

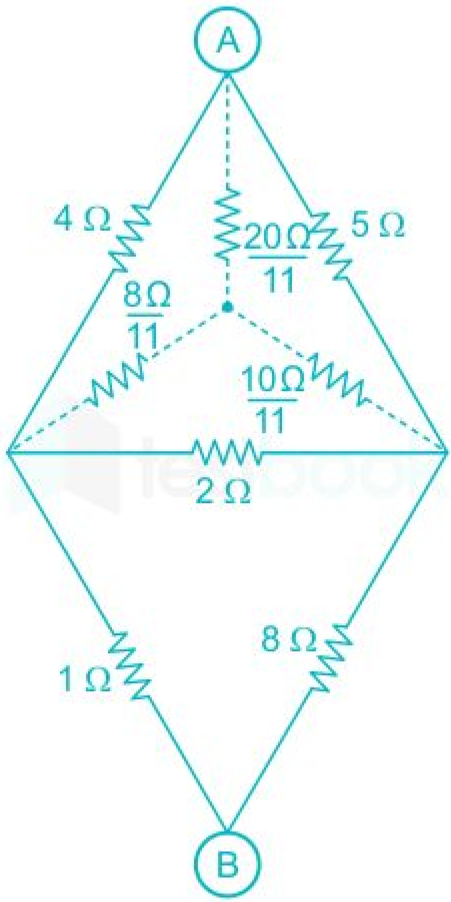
$$R_{BC} = \frac{(R_A\times R_C)+(R_A\times R_B)+(R_B\times R_C)}{R_A}$$

Calculation:

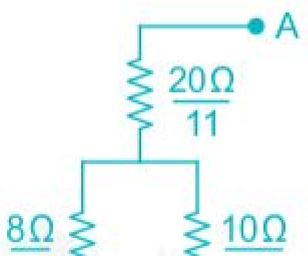
After removing the independent sources, the circuit becomes as shown below.

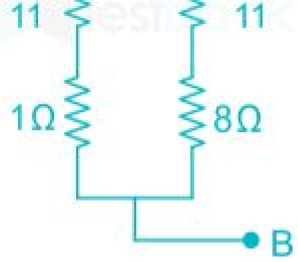


By converting the delta into a star connection, the circuit diagram becomes,



Now, the diagram can be further simplified as follows.



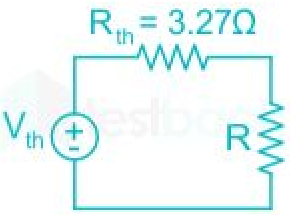


Now, the equivalent value of $R_{AB} = R_{th} = \{(8/11 + 1) \parallel (10/11 + 8)\} + 20/11$

$$R_{th} = \frac{1.727 \times 8.909}{1.727 + 8.909} = 1.446\Omega + \frac{20}{11} = 3.264\Omega$$

$R_{th} \approx$ **3.27Ω**

The thevinin circuit is as shown below:



For maximum power transfer,

$R = R_{th} =$ **3.27Ω**

Question 9:

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Hay's bridge is used for measuring:

1. admittance
2. capacitance
3. inductance of high Q factor

4. resistance

Answer (Detailed Solution Below)

Option 3 : inductance of high Q factor

BHEL Electrical Questions Question 9 Detailed Solution

Hay's bridge is used for measurement of inductance of coils with high quality factor.

Bridge	Application
Maxwell's Bridge	To measure inductance
Maxwell Wein Bridge	To measure a wide range of inductance at the power and audio frequencies but very expensive. Suitable for low Q coils (Q < 10)
Hay's bridge	**To measure the high value of inductance. Suitable for high Q coils (Q > 10)**
Anderson Bridge	Precise measurement of self-inductance over a wide range of values

Question 10:

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The system $\dot{X} = AX + Bu$ with $A = \begin{bmatrix} -1 & 2 \\ 0 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ is

1. Stable and controllable

2. Stable but uncontrollable

3. Unstable but controllable

4. Unstable and uncontrollable

Answer (Detailed Solution Below)

Option 3 : Unstable but controllable

BHEL Electrical Questions Question 10 Detailed Solution

The given system is

$\dot{X} = AX + Bu$

Where,

$$A = \begin{bmatrix} -1 & 2 \\ 0 & 2 \end{bmatrix} \, and \, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

We determine stability using characteristic equation (i.e. poles or eigenvalues of the system).

|sI - A| = 0

$$\begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - \begin{bmatrix} -1 & 2 \\ 0 & 2 \end{bmatrix} = 0$$

$$\begin{matrix} s+1 & -2 \\ 0 & s-2 \end{matrix} = 0$$

(s + 1)(s - 2) = 0

s = -1 and s = 2

i.e. the system has one pole in right half of the s-plane.

Hence, the system is unstable.

Now, the controllability matrix is given by:

C_M = [B AB]

Where

$$[AB] = \begin{bmatrix} -1 & 2 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$$

So,

$$C_M = \begin{bmatrix} 0 & 2 \\ 1 & 2 \end{bmatrix}$$

$|C_M| = -2 \neq 0$

Hence, the system is Controllable.