

SSC JE CBT2 2023

Electrical Engineering

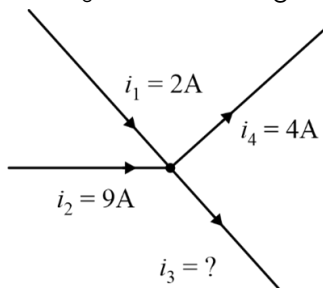
Q1 Which part of a DC motor is responsible for creating the mechanical revolutions of the unit?
(A) Brushes (B) Rotor
(C) Commutator (D) Stator

Q2 If a current of 2 A flowing through one coil produces flux linkage of 5 Wb-turn in the other coil, then what will be the mutual inductance between the two coils?
(A) 7.5 H (B) 5 H
(C) 2.5 H (D) 10 H

Q3 In a single-phase RL series circuit, if the current lags the supply voltage by an angle of 60° , then the voltage across the inductor leads the supply voltage by an angle of
(A) 0° (B) 90°
(C) 60° (D) 30°

Q4 Which component of a commercial electrical installation is responsible for protection against electrical overloads and short circuits?
(A) Electrical panels or switchgear
(B) Power sockets
(C) Lighting systems
(D) HVAC systems

Q5 Find the current ' i_3 ' in the following diagram.



- (A) 11 A (B) 5 A
(C) 7 A (D) 3 A

Q6 Which type of electromagnetic radiation is primarily used in infrared heating to heat

surfaces?

- (A) Ultraviolet radiation
(B) Infrared radiation
(C) X-rays
(D) Microwave radiation

Q7 What is the difference between transmission lines and distribution lines in an electrical power system?

- (A) Transmission lines operate at lower voltages than distribution lines.
(B) Transmission lines use single-phase systems, while distribution lines use three-phase systems.
(C) Transmission lines have lower current carrying capacity compared to distribution lines.
(D) Transmission lines carry electricity from generating stations to substations, while distribution lines transport power to end consumers.

Q8 Which part of a transistor is heavily doped and emits majority carriers, either electrons or holes?

- (A) Emitter
(B) Base and emitter
(C) Base
(D) Collector

Q9 What is the result of the diffusion of electrons and holes when p-type and n-type semiconductor materials are joined to form a diode junction?

- (A) Creation of a layer of holes near the junction in the p-type material
(B) Generation of an electric field that inhibits electron movement
(C) Formation of positive ions in the p-type material and negative ions in the n-type

material

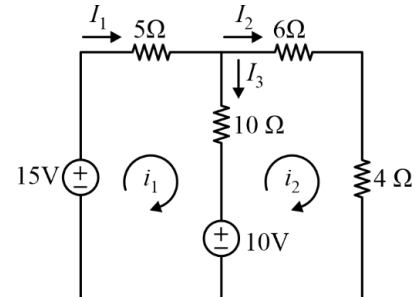
- (D) Depletion of majority charge carriers in the region near the junction

- Q10** What type of substation is responsible for transferring power from the transmission system to the distribution system of an area?
- (A) Relay substation
(B) Collector substation
(C) Converter substation
(D) Distribution substation
- Q11** What is the primary property of a dielectric material that makes it suitable for dielectric heating?
- (A) Ability to be polarised by an applied electric field
(B) Low electrostatic field support
(C) Inefficient heat dissipation
(D) High electrical conductivity
- Q12** What is the primary function of the Wind Turbine Generator (WTG) in a wind power system?
- (A) To regulate the voltage in the electrical grid
(B) To store mechanical rotational power
(C) To control the speed of the wind turbine
(D) To generate usable electricity from wind energy
- Q13** What will be the self-inductance of the coil if an EMF of 10 V is induced in it when the current flowing through it changes at the rate of 5 A/sec?
- (A) 1H (B) 2H
(C) 10H (D) 5H
- Q14** Which of the following theorems is the dual of Norton's theorem?
- (A) Maximum power transfer theorem
(B) Thevenin's theorem
(C) Reciprocity theorem
(D) Superposition theorem
- Q15** Which type of turbine has adjustable blades and wicket gates, allowing for a wider range of

operation?

- (A) Kaplan turbine
(B) Tube turbine
(C) Straflo turbine
(D) Bulb turbine

- Q16** Find the current I_2 in the following circuit.



- (A) 3 A (B) 2 A
(C) 1 A (D) 4 A

- Q17** What type of transmission line is characterised by a length ranging from 80 km to 240 km and includes both inductance and capacitance effects?
- (A) Medium transmission line
(B) Long transmission line
(C) DC transmission line
(D) Short transmission line
- Q18** Identify whether the following statements are true or false.
- I. There is no skin effect in the DC transmission system.
II. In DC transmission, corona losses are very large.
- (A) Both the statements are true
(B) Both the statements are false
(C) Statement 1 is true and statement 2 is false
(D) Statement 1 is false and statement 2 is true
- Q19** What is a brownout in the context of electrical power supply?
- (A) A drop in the electrical power supply causing a drop in voltage
(B) A phenomenon that affects high power installations, leading to partial electric discharges
(C)

A complete loss of power to a geographic area

(D) Protection from power surges using surge protectors and circuit breakers

Q20 What is the primary purpose of control rods in a nuclear reactor?

- (A) To cool the reactor core
- (B) To generate electricity
- (C) To absorb excess neutrons
- (D) To transfer heat to the secondary circuit

Q21 What are the zero power factor characteristics (ZPFC) used for in the context of alternators?

- (A) To assess the power factor when the alternator is loaded by reactors
- (B) To calculate the short-circuit voltage of the alternator
- (C) To plot the armature terminal voltage per phase against field current
- (D) To determine the synchronous speed of the alternator

Q22 The maximum load torque that can be applied to the shaft of an unexcited stepper motor, without causing continuous rotation, is called

- (A) pull-in torque
- (B) detent torque
- (C) pull-out torque
- (D) running torque

Q23 What is a common technique used to reduce core losses and the magnetising component in a current transformer?

- (A) Utilising laminated cores made of insulated sheets
- (B) Decreasing the number of windings in the secondary coil
- (C) Increasing the turns ratio of the current transformer
- (D) Using thicker core materials for better conductivity

Q24 The susceptibility of the paramagnetic material is:

- (A) positive and large

(B) positive and small

(C) negative and small

(D) negative and large

Q25 In a single-phase series RL circuit, $X_L = 15 \Omega$ and $R = 20 \Omega$. Find the impedance of the circuit.

- (A) 15Ω
- (B) 35Ω
- (C) 25Ω
- (D) 20Ω

Q26 Which type of water turbine is generally suitable for high-head, low-flow applications?

- (A) Cross-flow turbine
- (B) Kaplan turbine
- (C) Pelton turbine
- (D) Francis turbine

Q27 What is the function of the moderator in a nuclear reactor during the process of nuclear fission?

- (A) Increasing the reaction rate
- (B) Spinning the turbine
- (C) Slowing down the neutrons produced by fission
- (D) Cooling down the reactor core

Q28 In a multi-plate capacitor, there are a total of nine plates in parallel. This arrangement is equivalent to in parallel.

- (A) four
- (B) ten
- (C) nine
- (D) eight

Q29 Which field control method for a DC series motor involves shunting a portion of motor current around the series field to reduce the field flux and increase the speed of the motor?

- (A) Field diverter method
- (B) Tapped field control
- (C) Rheostatic control method
- (D) Armature control method

Q30 Which type of single-phase motor is known as a 'resistance-start' motor?

- (A) Universal motor
- (B) Permanent-split capacitor motor
- (C) Shaded-pole motor
- (D) Split-phase motor

Q31 In a parallel RC circuit, the phase difference between the applied voltage and the voltage across R and C in parallel will be _____

- (A) 0° (B) 90°
(C) 30° (D) 45°

Q32 If the voltage across a $5\ \mu\text{F}$ capacitor is $24\ \text{V}$ at $t = 6\ \text{ms}$, what is the energy stored in the capacitor at that time?

- (A) $720\ \text{mJ}$ (B) $360\ \mu\text{J}$
(C) $1440\ \mu\text{J}$ (D) $120\ \mu\text{J}$

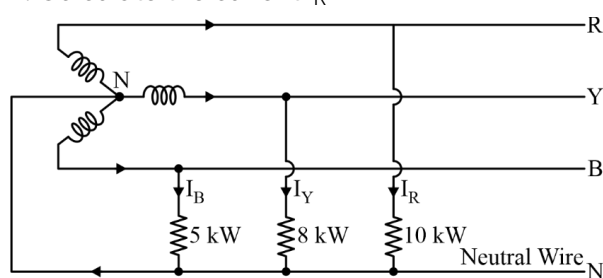
Q33 Two coils having self-inductance of $6\ \text{H}$ and $24\ \text{H}$, respectively, are magnetically coupled. Find the maximum possible value of mutual inductance.

- (A) $24\ \text{H}$ (B) $18\ \text{H}$
(C) $12\ \text{H}$ (D) $6\ \text{H}$

Q34 Which type of motor requires a DC supply to the rotor to generate the rotor's magnetic field and uses damper windings for starting?

- (A) Reluctance Motor
(B) Direct Current Excited Motor
(C) Three-Phase Induction Motor
(D) Permanent Magnet Synchronous Motor

Q35 Non-reactive loads of $10\ \text{kW}$, $8\ \text{kW}$ and $5\ \text{kW}$ are connected between the neutral and the red, yellow, and blue phases, respectively, of a 3-phase, 4-wire system. The line voltage is $400\ \text{V}$. Calculate the current I_R



- (A) $21.6\ \text{A}$ (B) $18.9\ \text{A}$
(C) $43.3\ \text{A}$ (D) $34.6\ \text{A}$

Q36 Which type of electric meter is typically used for measuring energy consumption in large commercial and industrial properties with high energy needs?

- (A) Three-phase meters

- (B) Prepayment meters
(C) Single-phase meters
(D) Smart meters

Q37 Identify whether the following statements related to starters in DC motors are true or false.

1. In a three-point starter, electromagnets are used as overload release coil.
2. Two-point starters are used with DC series motors.

- (A) Both the statements are true
(B) Statement 1 is false and statement 2 is true
(C) Both the statements are false
(D) Statement 1 is true and statement 2 is false

Q38 Which of the following is a limitation of Millman's theorem?

- (A) Applicable if the circuit has only one independent source
(B) Applicable if the circuit has no resistance between the independent sources
(C) Applicable if the circuit has no dependent sources
(D) Applicable if the circuit has no independent sources

Q39 What is the purpose of a neutral conductor in a star-connected three-phase system, and how does it help in maintaining balance?

- (A) The neutral conductor is used to increase the voltage between two phases, and it assists in load balancing.
(B) The neutral conductor is used for phase shifting, and it helps in generating higher voltage.
(C) The neutral conductor is used for overcurrent protection, and it helps in phase separation.
(D) The neutral conductor is used for grounding the system, and it helps in equalising phase voltages.

Q40 With reference to 1-phase transformers, match the transformer tests in column A with the purpose of the tests in column B.

Column A	Column B
A. Short circuit test	I. Wattmeter reads the core losses
B. Sumpner's test	II. Wattmeter reads the full load copper losses
C. Open circuit test	III. Determines maximum temperature rise

(A) A-III, B-I, C-II

(B) A-I, B-II, C-III

(C) A-II, B-III, C-I

(D) A-II, B-I, C-III

Q41 What is the electrical power consumed by a circuit if a current of 4 A flows through a resistance of 5 k Ω ?

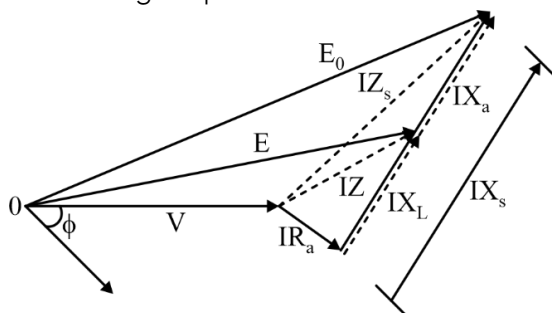
(A) 8000 W

(B) 800 kW

(C) 800 W

(D) 80 kW

Q42 In the phasor diagram of an alternator, what does the angle represent?



(A) Phase angle between voltage and current

(B) Leakage flux

(C) Power factor

(D) Synchronous reactance

Q43 How is the magnetomotive force per unit length denoted, and what is its symbol in equation form?

(A) Magnetic permeability (μ)

(B) Magnetic flux (ϕ)

(C) Magnetic density (B)

(D) Magnetising force (H)

Q44 With reference to PMMC instruments, which of the following statements are correct?

1. For PMMC instruments, the scale is not uniform.

2. PMMC instruments can be used for AC as well as DC quantities.

3. In PMMC instruments, power consumption is low.

4. PMMC instruments offer a high torque/weight ratio.

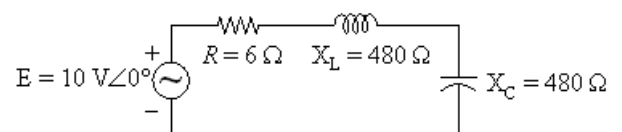
(A) I and III

(B) I and II

(C) III and IV

(D) II and IV

Q45 What is the quality factor for the given series resonance circuit?



(A) 320

(B) 80

(C) 40

(D) 160

Q46 In circuit analysis, what is the term used to describe the closed path in a circuit where you start at a point and continue in the same direction, noting the direction of all voltage drops, and return to the same starting point?

(A) Node

(B) Loop

(C) Branch

(D) Path

Q47 What are the two types of breakdowns that can occur in p-n junctions?

(A) Zener and capacitive breakdowns

(B) Voltage and current breakdowns

(C) Avalanche and tunnelling breakdowns

(D) Forward and reverse breakdowns

Q48 The direction of rotation of a conductor in a

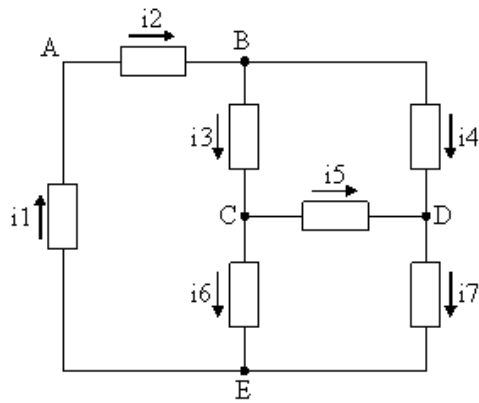
(A) alternator

(B) DC generator

(C) transformer

(D) DC motor

Q49 In the provided circuit, which of the following represents the correct Kirchhoff's Current Law (KCL) equation for node D?



- (A) $i_4 + i_5 = i_7$
- (B) $i_4 + i_5 = -i_7$
- (C) $i_2 = i_3 + i_4$
- (D) $i_3 = i_5 + i_6$

Q50 Which of the following statements is INCORRECT for a reluctance motor?

- (A) A reluctance motor can operate on AC as well as DC supply.
- (B) A reluctance motor is cheaper than any other kind of synchronous motor.
- (C) A reluctance motor has poor efficiency.
- (D) The rotor of a reluctance motor rotates with constant speed.

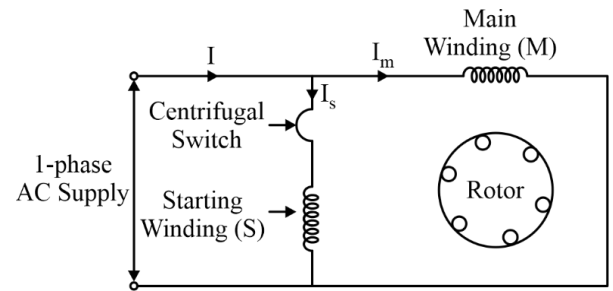
Q51 What is the purpose of the trigger circuit in a cathode ray oscilloscope (CRO)?

- (A) To amplify the input signal
- (B) To control the power supply circuit
- (C) To synchronise the horizontal and vertical deflection
- (D) To generate the electron beam

Q52 For $C = 101.5 \text{ nF}$, determine L for the series resonant circuit if the resonant frequency is 2800 Hz .

- (A) 46.45 mH
- (B) 31.83 mH
- (C) 16.32 mH
- (D) 26.56 mH

Q53 Identify the type of single-phase motor shown in the following figure.



- (A) Split-phase induction motor
- (B) Shaded pole motor
- (C) Permanent-split capacitor
- (D) Capacitor-start motor

Q54 What is the main design criterion for distributors in an electrical power transmission system?

- (A) Current-carrying capacity
- (B) Voltage drop
- (C) Frequency
- (D) Length

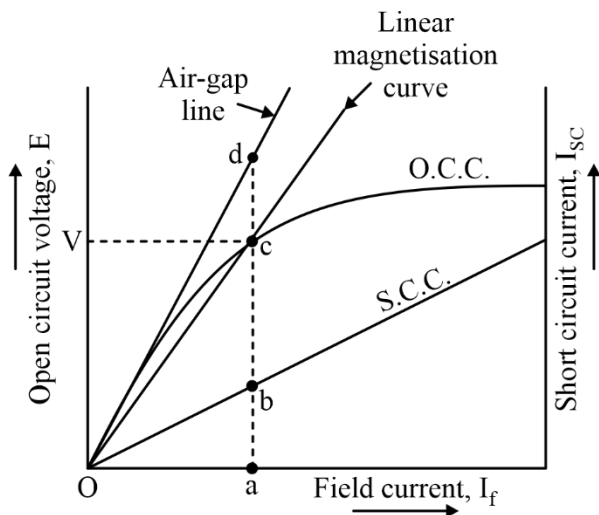
Q55 Which of the following materials is rarely used as dielectric material in power cables?

- (A) Gases
- (B) Solid
- (C) Liquid
- (D) Compound

Q56 What is the application of overexcited synchronous motor?

- (A) Power factor correction for lagging loads
- (B) Generating different frequencies
- (C) Operating centrifugal pumps
- (D) Controlling voltage at the end of long transmission lines

Q57 What is the unsaturated synchronous reactance (X_{su}) in an alternator if the armature resistance is neglected according to the following graph?



- (A) $X_{su} = E_{ad} / I_{ab}$
 (B) $X_{su} = R_a + jZ_{su}$
 (C) $X_{su} = 1 / (R_a + jX_{su})$
 (D) $X_{su} = E_{ad} I_{ab}$
- Q58** How does armature reaction affect the main field flux in an alternator when the load has a power factor of zero leading ?
 (A) Armature reaction weakens the main field flux and reduces the generated EMF.
 (B) Armature reaction strengthens the main field flux and does not distort it.
 (C) Armature reaction distorts the main field flux and does not affect its strength
 (D) Armature reaction distorts the main field flux and weakens it.
- Q59** The starting torque of a resistance-start induction motor is _____ times the full load torque.
 (A) 7.5 (B) 4.5
 (C) 1.5 (D) 9.5
- Q60** Which of the following terms is NOT related to nuclear power plants?
 (A) Nuclear reactor
 (B) Control rod
 (C) Moderator
 (D) Electrostatic precipitator
- Q61** What is the purpose of outgoing feeders in a distribution substation?
 (A) To generate electrical power
 (B) To protect the substation from faults

- (C) To control the voltage of the substation
 (D) To carry power from the substation to distribution transformers

- Q62** An RLC series circuit has $R = 2\Omega$, $C = 20\mu F$ and the inductance is adjusted such that the voltage across the resistance is maximum. If the applied voltage is 10V at a frequency of 1000 rad/sec, then find the value of inductance L.
 (A) 0.025 H (B) 0.005 H
 (C) 0.25 H (D) 0.05 H
- Q63** What is the function of the 'control system' component in a load drive system?
 (A) To regulate the operation of the load drive
 (B) To provide electrical power to the load
 (C) To measure the temperature of the load
 (D) To convert electrical energy into mechanical energy
- Q64** The voltage gain in common collector configuration of a BJT is
 (A) above 100
 (B) between 50 and 100
 (C) zero
 (D) less than one
- Q65** Why is grounding important in the design of a substation?
 (A) To protect against environmental effects
 (B) To ensure room for expansion due to load growth
 (C) To facilitate access for maintenance
 (D) To protect passers-by during a short circuit in the transmission system
- Q66** Which of the following statements is INCORRECT for parallel resonance?
 (A) At resonance, the power factor will be zero.
 (B) At resonance, the current will be minimum.
 (C) At resonance, the impedance will be maximum.
 (D) At resonance, the line current will be in phase with the applied voltage.

Q67

Which type of work is done by an autotransformer?

- (A) Adjustment of voltage in output side
- (B) Phase shifting primary to secondary
- (C) Multiple windings
- (D) Isolation between primary to secondary

Q68 Which of the following is NOT an application of a synchronous motor?

- (A) Dot matrix printer
- (B) High speed compressor
- (C) Servo drives
- (D) Main line traction

Q69 What type of substation is used for power factor correction, metering and control of the wind farm?

- (A) Converter substation
- (B) Distribution substation
- (C) Collector substation
- (D) Relay substation

Q70 What is one of the functions of circuit breakers in a substation?

- (A) Switching equipment control
- (B) Interrupting short-circuits and overload currents
- (C) Voltage regulation
- (D) Power generation

Q71 Which method of electrical heating involves passing electrical energy through a heating element to generate heat, which is then transferred to the substance to be heated?

- (A) Direct arc heating
- (B) Power frequency heating
- (C) Induction heating
- (D) Resistance heating

Q72 Identify whether the following statements are true or false.

1. Capacitor start motors are more costly than split-phase induction motors.
2. In two-value capacitor motors, the two capacitors are connected in parallel at the starting.

(A) Both the statements are false

(B) Statement 1 is true and statement 2 is false

(C) Statement 1 is false and statement 2 is true

(D) Both the statements are true

Q73 For a certain D-MOSFET, $I_{DSS} = 10 \text{ mA}$ and $V_{GS(off)} = -8 \text{ V}$. Calculate I_D at $V_{GS} = -4 \text{ V}$.

- (A) 20 mA
- (B) 5 mA
- (C) 50 mA
- (D) 2.5 mA

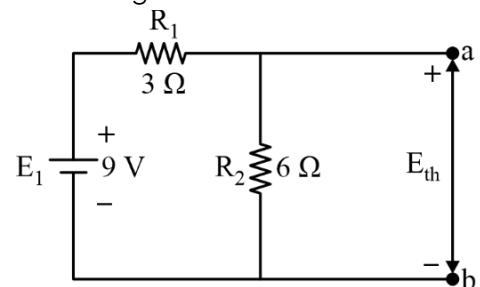
Q74 What is the purpose of damper winding in a synchronous motor?

- (A) To provide a backup power source in case of a power outage
- (B) To generate additional torque for higher efficiency
- (C) To assist in the motor's starting as an induction motor
- (D) To control the speed of the synchronous motor

Q75 In a balanced star connection, the ratio of the magnitude of the line voltage to the magnitude of the phase voltage is:

- (A) $\frac{1}{\sqrt{3}}$
- (B) $\frac{1}{\sqrt{2}}$
- (C) $\sqrt{2}$
- (D) $\sqrt{3}$

Q76 What is the Thevenin's voltage across the a-b terminal in the given circuit?



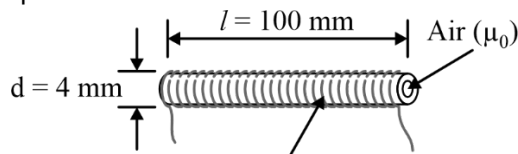
- (A) 6 V
- (B) 3 V
- (C) 15 V
- (D) 9 V

Q77 Which of the following statements is correct regarding the doping levels of the emitter, base and collector regions in a Bipolar Junction Transistor (BJT)?

- (A) The emitter is moderately doped, the base is heavily doped and the collector is lightly doped

- (B) The doping levels of the emitter, base and collector are all the same.
- (C) The emitter is heavily doped, the base is lightly doped and the collector is moderately doped.
- (D) The emitter is lightly doped, the base is heavily doped and the collector is moderately doped.

Q78 Find the number of turns of the coil shown in the following figure, if the inductance of the coil is $1.58 \mu\text{H}$.



- (A) 50
(B) 100
(C) 25
(D) 78

Q79 Which of the following is NOT a characteristic of a radial distribution system?

- (A) Highly reliable
(B) Simple construction
(C) Power flows in only one direction
(D) Low cost

Q80 With reference to tenders, which of the following statements is INCORRECT?

- (A) Normally, the tender offering the lowest rates is accepted.
- (B) Tenders are invited on a tender form prescribed by the purchase department.
- (C) The sealed tenders are invited publicly through news-papers.
- (D) The earnest money is never returned to the unsuccessful contractors after disposal of the tender.

Q81 Which component of the total cost of electrical energy is proportional to the energy generated (kWh)?

- (A) Running cost
(B) Semi-fixed cost
(C) Depreciation cost
(D) Fixed cost

Q82 In a DC series motor, what is the relationship between speed and armature current?

- (A) Speed is inversely proportional to armature current.
- (B) Speed is directly proportional to the square of armature current.
- (C) Speed is independent of armature current.
- (D) Speed is directly proportional to armature current.

Q83 Calculate the speed of the 8-pole alternator if the supply frequency is 50 Hz:

- (A) 1000 rpm
(B) 1500 rpm
(C) 750 rpm
(D) 500 rpm

Q84 Given a 250 : 5 current transformer used with an ammeter reading of 2.7 A, what is the line current (primary current) in the circuit?

- (A) 84 A
(B) 250 A
(C) 135 A
(D) 36 A

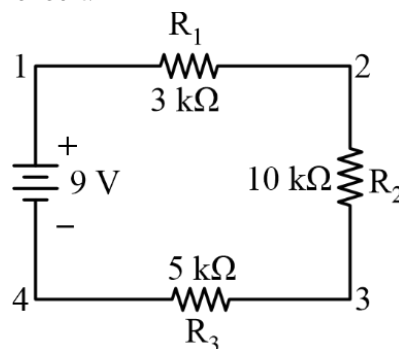
Q85 Why are energy-efficient solutions such as LED lighting and programmable thermostats incorporated into commercial electrical installations?

- (A) To increase electricity consumption
- (B) To reduce electricity consumption and lower operating costs
- (C) To improve safety measures
- (D) To raise operating costs

Q86 Usually, the expenditure on supervision charges is _____ of the total cost.

- (A) 2% to 4%
(B) 1% to 1.5%
(C) 5% to 7%
(D) 8% to 10%

Q87 Find the voltage across R_3 in the following circuit:



- (A) 1.5 V (B) 2.5 V
(C) 7.5 V (D) 4.5 V

Q88 Candela per square metre is the unit of _____.

- (A) Illumination
(B) luminous flux
(C) luminance
(D) luminous intensity

Q89 Which type of transformer uses a ring or doughnut-shaped core material, offering low leakage inductance and high inductance and Q factors?

- (A) Toroidal core transformer
(B) Ferrite core transformer
(C) Air core transformer
(D) Iron core transformer

Q90 What is the advantage of overhead cables compared to underground cables in terms of construction?

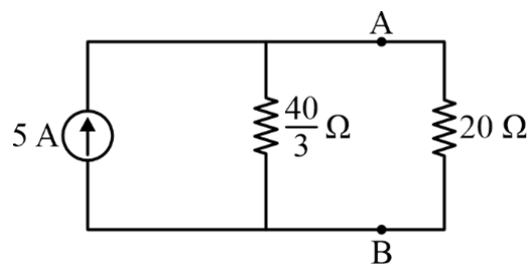
- (A) Overhead cables are more protected against moisture and corrosion.
(B) Overhead cables are more environmentally friendly.
(C) Overhead cables are less expensive to construct.
(D) Overhead cables are better insulated.

Q91 With reference to wind turbines, which of the following statements are correct?

- I. In a propeller-type turbine, the number of blades is three to six.
II. The Darrieus type of turbine is an example of a vertical axis turbine.
III. Propeller-type turbines are rarely used.
IV. A multi-blade type turbine is an example of a horizontal axis turbine.

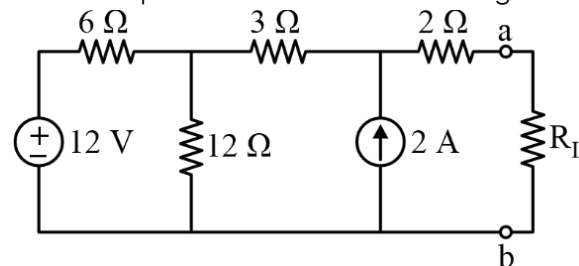
- (A) I, II and IV (B) II, III and IV
(C) I, III and IV (D) I, II and III

Q92 Find the current through 20Ω resistance in the circuit shown in the following figure.



- (A) 4 A (B) 4.5 A
(C) 2 A (D) 3 A

Q93 Find the value of Load resistance (R_L) for maximum power transfer in the following circuit:



- (A) 11 Ω (B) 33 Ω
(C) 9 Ω (D) 22 Ω

Q94 What is the resonant frequency of an RLC circuit with the given values of resistance ($R = 30\Omega$), inductance ($L = 1.3\text{ mH}$), and capacitance ($C = 30\mu\text{F}$)?

- (A) 625.23 Hz (B) 100.53 Hz
(C) 306.63 Hz (D) 254.80 Hz

Q95 Match the oscillator circuits in column A with their respective characteristics in column B.

Column A	Column B
A. Hartley oscillator	I. Two stage RC coupled amplifier
B. Crystal oscillator	II. LC tuned circuit
C. Wien bridge oscillator	III. Greater stability

- (A) A-I, B-III, C-II
(B) A-III, B-I, C-II
(C) A-II, B-I, C-III
(D) A-II, B-III, C-I

Q96 Identify whether the following statements with reference to magnetic circuits are true or false.

1. Magnetic flux lines never intersect.

2. Each line of a magnetic flux is a closed loop by itself.

- (A) Statement 1 is false and statement 2 is true
- (B) Both the statements are true
- (C) Statement 1 is true and statement 2 is false
- (D) Both the statements are false

Q97 Which component is responsible for generating the time scale or time reference in a cathode Ray oscilloscope (CRO)?

- (A) Vertical amplifier
- (B) Delay line
- (C) CRT
- (D) Time - base generator

Q98 The property related to hard magnetic materials is:

- (A) High permeability
- (B) Low coercive force
- (C) High retentivity
- (D) Low hysteresis loss

Q99 Which materials are classified as ferromagnetic based on their permeabilities compared to free space?

- (A) Materials with permeabilities slightly greater than that of free space
- (B) Materials with permeabilities hundreds and thousands of times greater than that of free space
- (C) Materials with permeabilities the same as that of free space
- (D) Materials with permeabilities slightly less than that of free space

Q100 Which type of losses in a transformer are equal to each other resulting in maximum efficiency of the transformer?

- (A) Core loss and hysteresis loss
- (B) Iron loss and copper loss
- (C) Copper loss and winding loss
- (D) Eddy current loss and mechanical loss

Answer Key

Q1 (B)
Q2 (C)
Q3 (D)
Q4 (A)
Q5 (C)
Q6 (B)
Q7 (D)
Q8 (A)
Q9 (D)
Q10 (D)
Q11 (A)
Q12 (D)
Q13 (B)
Q14 (B)
Q15 (A)
Q16 (C)
Q17 (A)
Q18 (C)
Q19 (A)
Q20 (C)
Q21 (B)
Q22 (B)
Q23 (A)
Q24 (B)
Q25 (C)
Q26 (C)
Q27 (C)
Q28 (D)
Q29 (A)
Q30 (D)

Q31 (A)
Q32 (C)
Q33 (C)
Q34 (B)
Q35 (C)
Q36 (A)
Q37 (A)
Q38 (B)
Q39 (D)
Q40 (C)
Q41 (D)
Q42 (A)
Q43 (D)
Q44 (C)
Q45 (B)
Q46 (B)
Q47 (C)
Q48 (D)
Q49 (A)
Q50 (A)
Q51 (C)
Q52 (B)
Q53 (A)
Q54 (B)
Q55 (A)
Q56 (A)
Q57 (A)
Q58 (B)
Q59 (C)
Q60 (D)

Q61 (D)
Q62 (D)
Q63 (A)
Q64 (D)
Q65 (D)
Q66 (A)
Q67 (A)
Q68 (A)
Q69 (C)
Q70 (B)
Q71 (D)
Q72 (D)
Q73 (D)
Q74 (C)
Q75 (D)
Q76 (A)
Q77 (C)
Q78 (B)
Q79 (A)
Q80 (D)

Q81 (A)
Q82 (A)
Q83 (C)
Q84 (C)
Q85 (B)
Q86 (B)
Q87 (B)
Q88 (C)
Q89 (A)
Q90 (C)
Q91 (A)
Q92 (C)
Q93 (C)
Q94 (D)
Q95 (D)
Q96 (B)
Q97 (D)
Q98 (C)
Q99 (B)
Q100 (B)

Hints & Solutions

Q1 Text Solution:

The part of a DC motor that is responsible for creating the mechanical revolutions of the unit is the rotor.

Note

- **Brushes:** Brushes are responsible for transferring electrical current to the commutator, but they do not directly create the rotations.
- **Commutator:** The commutator works in conjunction with the brushes to switch the direction of the current in the rotor, but it does not directly generate the rotations.
- **Stator:** The stator creates a magnetic field that interacts with the current in the rotor to produce torque.
- **Rotor:** The rotor is the part of the motor that spins and creates mechanical revolutions. It carries the windings that are driven by the current and interact with the magnetic field from the stator to create torque.

Therefore, the rotor is the essential element responsible for the mechanical revolutions of a DC motor.

Q2 Text Solution:

$$n\phi = MI$$

$$M = \frac{n\phi}{I}$$

$$n = 1$$

$$\phi = 5 \text{ Wb}$$

$$I = 2 \text{ A}$$

$$M = \frac{5}{2}$$

$$2.5 \text{ H}$$

Q3 Text Solution:

In a single-phase RL series circuit, the current lags the supply voltage due to the inductive reactance of the inductor. The inductor opposes any change in current, causing the current to lag behind the voltage.

Here's how we can find the voltage across the inductor:

1. Phase relationships:

- Supply voltage (V): Reference point, considered to be in phase with 0° .
- Current (I): Lags the supply voltage by 60° .
- Voltage across resistor (V_R): In phase with the current (I).

Voltage across inductor (V_L): Leads the current (I) by 90° (due to the inductive reactance).

2. Finding V_L angle:

Since V_L leads I by 90° , and I lags V by 60° , we can add the angles to find the relationship between V_L and V.

$$V_L \text{ angle} = I \text{ angle} + 90^\circ$$

$$V_L \text{ angle} = -60^\circ + 90^\circ$$

$$V_L \text{ angle} = 30^\circ$$

Therefore, in a single-phase RL series circuit, if the current lags the supply voltage by 60° , the voltage across the inductor leads the supply voltage by an angle of 30° .

Q4 Text Solution:

The component of a commercial electrical installation responsible for protection against electrical overloads and short circuits is electrical panels or switchgear.

- **Power sockets:** Power sockets are designed to deliver electricity to appliances and equipment. They do not have any built-in protection against overloads or short circuits.
- **Lighting systems:** Lighting systems are primarily responsible for providing illumination. They may have some limited protection against overloads, but they are not designed to handle short circuits.

Electrical panels or switchgear, on the other hand, are specifically designed to provide electrical protection. They contain various components, such as circuit breakers and fuses, which are designed to interrupt the flow of electricity in the event of an overload or short

circuit. This helps to prevent damage to equipment and potential fire hazards.

Q5 Text Solution:

Using KCL

$$\begin{aligned}i_1 + i_2 &= i_4 + i_3 \\i_3 &= i_1 + i_2 - i_4 \\&= 2 + 9 - 4 \\&= 7 \text{ A}\end{aligned}$$

Q6 Text Solution:

The type of electromagnetic radiation primarily used in infrared heating to heat surfaces is infrared radiation.

- Infrared radiation has longer wavelengths than visible light and can be absorbed by most materials, causing them to heat up. This is why you feel warm when standing in sunlight, even though you cannot see the infrared radiation.
- Ultraviolet radiation has shorter wavelengths and higher energy than infrared radiation. It is primarily used for disinfection and sterilization, not for heating.
- X-rays have even shorter wavelengths and higher energy than ultraviolet radiation. They can pass through most materials and are primarily used for imaging purposes.
- Microwave radiation has longer wavelengths than infrared radiation, but it is not as readily absorbed by most materials. However, it is used in some industrial applications for heating objects that need to be heated quickly and evenly.

As we know that , infrared radiation occupies the portion of the electromagnetic spectrum with wavelengths between 700 nanometers and 1 millimeter. This range of wavelengths is ideal for heating surfaces, as it is readily absorbed by most materials and does not cause damage to the material being heated.

Q7 Text Solution:

The correct answer is 4. Transmission lines carry electricity from generating stations to

substations, while distribution lines transport power to end consumers.

- **Transmission lines:** These carry large amounts of electricity over long distances (hundreds of kilometers) from generating stations to substations. They operate at high voltages (110 kV to 765 kV) to minimize energy losses.
- **Distribution lines:** These deliver electricity from substations to end consumers, including homes, businesses, and factories. They operate at lower voltages (12 kV to 33 kV) for safety and practicality.

Q8 Text Solution:

The part of a transistor that is heavily doped and emits majority carriers, is the emitter.

- **Emitter:** The emitter is the source of charge carriers for the transistor. It is heavily doped with impurities to create a large concentration of majority carriers (electrons in an NPN transistor and holes in a PNP transistor). This high concentration of majority carriers allows the emitter to readily inject them into the base region when forward-biased.
- **Base:** The base is lightly doped to create a narrow region with fewer charge carriers. This helps to control the flow of current between the emitter and the collector.
- **Collector:** The collector is moderately doped and collects the majority carriers that are injected from the emitter. It is the largest region of the transistor and is designed to efficiently collect and remove these carriers.

Therefore, the emitter is the key component responsible for emitting the majority carriers that enable the operation of a transistor.

Q9 Text Solution:

The correct answer is 4. Depletion of majority charge carriers in the region near the junction.

Diffusion process:

- When p-type and n-type semiconductor materials are joined, a process called diffusion occurs.

- Electrons from the n-type region (with high electron concentration) diffuse across the junction towards the p-type region (with low electron concentration).
- Similarly, holes from the p-type region diffuse across the junction towards the n-type region.

Formation of depletion region:

- As electrons and holes diffuse, they leave behind immobile positive and negative ions on their respective sides of the junction.
- These charges create an electric field that opposes further diffusion of carriers across the junction.
- This region depleted of mobile charge carriers is called the depletion region.

Therefore, the primary result of the diffusion of electrons and holes in a p-n junction is the formation of the depletion region, which plays a critical role in the diode's electrical properties.

Q10 Text Solution:

- **Relay substations:** These are primarily used for switching and protection of transmission lines. They do not directly transfer power to the distribution system.
- **Collector substations:** These collect power from multiple generating stations and feed it into the transmission system. They do not directly transfer power to the distribution system.
- **Converter substations:** These convert AC power to DC power or vice versa. They are not typically used for transferring power from the transmission system to the distribution system.
- **Distribution substations:** These receive power from the transmission system and step down the voltage to a level suitable for distribution to end consumers. They are the final stage in the power delivery chain before the electricity reaches homes and businesses.

Therefore, distribution substations are the specific type of substation responsible for

transferring power from the transmission system to the distribution system.

Q11 Text Solution:

The ability to be polarized by an applied electric field is the key property that defines a suitable material for dielectric heating. This allows the material to efficiently convert electromagnetic energy into heat through friction generated by the rotation of dipoles and ionic movement.

Q12 Text Solution:

The primary function of the Wind Turbine Generator (WTG) in a wind power system is to generate usable electricity from wind energy.

Q13 Text Solution:

$$V = L \frac{di}{dt}$$

$$\frac{di}{dt} = 5A / \text{sec}$$

$$V = 10 \text{ V}$$

$$L = \frac{V}{\frac{di}{dt}} = \frac{10}{5} = 2H$$

Q14 Text Solution:

The dual of Norton's theorem is Thevenin's theorem.

- Norton's theorem: Replaces the entire circuit beyond two terminals with a current source and a parallel resistance.
- Thevenin's theorem: Replaces the entire circuit beyond two terminals with a voltage source and a series resistance

Q15 Text Solution:

The type of turbine with adjustable blades and wicket gates, allowing for a wider range of operation is the Kaplan turbine.

- **Adjustable blades:** Kaplan turbines have propeller-shaped blades with adjustable pitch. By changing the pitch of the blades, the turbine can efficiently convert the energy of water flow into mechanical energy at different water flow rates and heads.

- **Adjustable wicket gates:** Wicket gates are located just upstream of the runner and control the flow of water into the turbine. By adjusting the opening of the wicket gates, the amount of water entering the turbine can be controlled, allowing the turbine to operate efficiently at different flow rates.

This combination of adjustable blades and wicket gates allows the Kaplan turbine to operate efficiently over a wide range of water flow rates and heads. This makes them ideal for use in hydroelectric power plants with variable water flow conditions.

Q16 Text Solution:

$$\frac{V-15}{5} \times \frac{V-10}{10} \times \frac{V}{10} = 0$$

$$2V - 30 + V - 10 + V = 0$$

$$4V - 40 = 0$$

$$V = 10 \text{ Volt}$$

$$I_2 = \frac{V}{10} = \frac{10}{10} = 1 \text{ A}$$

Q17 Text Solution:

The type of transmission line characterized by a length ranging from 80 km to 240 km and includes both inductance and capacitance effects is a medium transmission line.

- **Short transmission lines:** These lines are typically less than 80 km long and can neglect the effects of inductance and capacitance. They are primarily modeled using resistance-only circuits.
- **Medium transmission lines:** These lines have lengths between 80 km and 240 km, where the effects of inductance and capacitance become significant. They require more complex circuit models that include all three parameters (resistance, inductance, and capacitance).
- **Long transmission lines:** These lines are longer than 240 km and exhibit pronounced inductance and capacitance effects. They require advanced circuit models and analysis techniques to accurately predict their behavior.

- **DC transmission lines:** These lines operate with direct current (DC) instead of alternating current (AC). They do not have inductance effects, and their capacitance effects can be modeled differently than in AC lines.

Q18 Text Solution:

Statement I is true because there is no skin effect in the DC transmission system.

- Skin effect is caused by the alternating nature of AC current, where the current tends to concentrate towards the surface of the conductor due to the varying magnetic field.
- In DC transmission, the current flows in one direction, eliminating the alternating magnetic field and preventing the skin effect.

Statement II is false because the magnitude of corona loss in DC transmission is generally lower than in AC transmission for the same voltage level.

Corona loss occurs when the voltage surrounding a conductor ionizes the air molecules around it, causing a leakage of electrical current.

- The severity of corona loss depends on several factors, including conductor diameter, voltage level, and atmospheric conditions.
- While AC transmission lines are more susceptible to corona loss due to the alternating voltage, DC transmission lines can still experience it, especially at high voltages.

Q19 Text Solution:

The correct answer is a drop in the electrical power supply causing a drop in voltage.

- **Brownout:** A brownout is a temporary reduction in voltage in an electrical power system. This means that the voltage delivered to homes and businesses is lower than normal.

- **High power installations:** While brownouts can affect any part of the electrical grid, high power installations are more susceptible to them due to their higher demand for electricity.
- **Complete loss of power:** Unlike a blackout, which is a complete loss of power, a brownout only causes a decrease in voltage.
- **Protection from power surges:** Surge protectors and circuit breakers are designed to protect against sudden increases in voltage, not brownouts which are decreases in voltage.

Therefore, the most accurate description of a brownout is a drop in the electrical power supply causing a drop in voltage.

Q20 Text Solution:

The primary purpose of control rods in a nuclear reactor is to absorb excess neutrons.

- Nuclear reactors work by initiating a chain reaction where neutrons split uranium atoms, releasing energy and more neutrons.
- Control rods are made of materials that readily absorb neutrons. By inserting them into the reactor core, they absorb some of the neutrons, slowing down the chain reaction and regulating the power output of the reactor.
- By adjusting the position of the control rods, operators can precisely control the rate of fission and maintain a stable power output.

Q21 Text Solution:

The correct answer is 3. To plot the armature terminal voltage per phase against field current.

- ZPFC is a curve that shows the relationship between the armature terminal voltage (V) and the field current (I_f) of an alternator when it is operating at synchronous speed and zero lagging power factor.
- In this condition, all the generated current is reactive and does not contribute to real

power output.

- The ZPFC provides valuable information about the alternator's performance, including:
 - Regulation: The change in V with respect to changes in I_f , which indicates the ability of the alternator to maintain constant voltage under varying load conditions.
 - Synchronous impedance: The combined impedance of the armature resistance, leakage reactance, and magnetizing reactance, which affects the voltage regulation and stability of the alternator.
 - Field current for rated voltage: The field current needed to achieve the desired terminal voltage at rated conditions.

Other options:

- To assess the power factor when the alternator is loaded by reactors: ZPFC focuses on zero lagging power factor, not a specific type of load.
- To calculate the short-circuit current of the alternator: This requires a different test and analysis method called the short-circuit test.
- To determine the synchronous speed of the alternator: Synchronous speed is a fixed value determined by the number of poles and frequency, not related to the ZPFC.

Therefore, the primary purpose of Zero Power Factor Characteristics in alternators is to plot the armature terminal voltage per phase against field current, providing valuable insights into the voltage regulation, synchronous impedance, and other performance characteristics of the machine.

Q22 Text Solution:

The correct answer is detent torque.

- **Detent torque:** This is the torque produced by a stepper motor when the windings are not energized. It arises from the interaction between the permanent magnets in the rotor and the stator teeth. This torque acts to

resist the rotation of the motor shaft and prevents it from spinning freely.

- **Pull-in torque:** This is the minimum torque required to start rotating the motor shaft from a stationary position. It is higher than the detent torque and specifies the motor's ability to overcome the initial resistance to motion.
- **Pull-out torque:** This is the maximum torque that the motor can produce while still maintaining rotation. It is typically lower than the pull-in torque and defines the operating range of the motor under load.
- **Running torque:** This is the torque produced by the motor when it is rotating at a constant speed. It is a function of the motor's design and the applied current, and it is always lower than the pull-out torque.

Q23 Text Solution:

Core losses in current transformers:

- Core losses are a major source of energy loss in current transformers. They occur due to the presence of two main phenomena:
 - **Eddy currents:** These are induced currents that circulate within the core material due to the changing magnetic field.
 - **Hysteresis:** This is the energy loss associated with the magnetization and demagnetization of the core material as the direction of the magnetic field changes.

Laminated cores:

- To reduce these losses, current transformer cores are typically made of thin sheets of insulated magnetic steel laminated together. This helps to minimize eddy currents by increasing the electrical resistance of the path for these currents.
- The insulation between the laminations further reduces eddy current flow by preventing the current from flowing between the sheets.

Therefore, utilizing laminated cores made of insulated sheets is the most effective technique

for reducing both core losses and the magnetizing component in a current transformer.

Q24 Text Solution:

- **Susceptibility:** Susceptibility (χ) is a measure of how easily a material can be magnetized. It is a dimensionless quantity that relates the induced magnetization (I) in a material to the applied magnetic field (H) using the following equation:

$$I = \chi * H$$

- **Paramagnetic materials:** These materials have a small positive susceptibility, meaning that they are weakly attracted to magnetic fields. This weak attraction arises from the presence of unpaired electrons in the material's atoms. When an external magnetic field is applied, these unpaired electrons tend to align themselves with the field, creating a small induced magnetization.

Here are the typical ranges of susceptibility for different types of materials:

- **Diamagnetic:** $\chi < 0$ (weakly repelled by magnetic fields)
- **Paramagnetic:** $0 < \chi \leq 10^{-3}$ (weakly attracted by magnetic fields)
- **Ferromagnetic:** $\chi \gg 1$ (strongly attracted by magnetic fields)

Therefore, the susceptibility of a paramagnetic material is positive and small, indicating its weak attraction to magnetic fields.

Q25 Text Solution:

$$Z = \sqrt{X_L^2 + R^2}$$

$$Z = \sqrt{15^2 + 20^2}$$

$$Z = \sqrt{225 + 400}$$

$$Z = \sqrt{625}$$

$$Z = 25\Omega$$

Q26 Text Solution:

The type of water turbine generally suitable for high-head, low-flow applications is the Pelton turbine.

- **High-head:** Pelton turbines are specifically designed to operate under high-head conditions, meaning significant differences in water elevation between the inlet and outlet. Their design allows them to efficiently convert the potential energy of high-head water into mechanical energy.
- **Low-flow:** Pelton turbines also excel in low-flow situations. Unlike other turbines that rely on water volume for power generation, Pelton turbines utilize the high pressure of the water jet to drive the turbine blades. This makes them ideal for situations where water flow is limited but pressure is high.
- **Design:** Pelton turbines have a simple design with a single wheel and a series of buckets arranged around the periphery. The high-pressure water jet strikes the buckets, causing the wheel to rotate. This rotational motion is then used to generate electricity.

Here are some additional advantages of Pelton turbines:

- **High efficiency:** They can achieve efficiencies exceeding 90%, making them one of the most efficient types of water turbines.
- **Simple design:** Their simple design makes them relatively easy to maintain and repair.
- **Wide operating range:** They can operate over a wide range of head and flow conditions, making them suitable for various applications.

Q27 Text Solution:

The function of the moderator in a nuclear reactor during the process of nuclear fission is to slow down the neutrons produced by fission. This is crucial for maintaining a sustained chain reaction and generating energy.

Here's how it works:

- During nuclear fission, a radioactive nucleus, like uranium-235, splits into two smaller nuclei, releasing energy and several neutrons.

- These neutrons are initially released with high kinetic energy (fast neutrons). However, fast neutrons are less likely to cause further fission reactions with other uranium-235 nuclei.
- The moderator slows down the fast neutrons by colliding with them. This process reduces their kinetic energy and converts them into thermal neutrons (slow neutrons).
- Thermal neutrons have a much higher probability of causing fission with uranium-235 nuclei, thus sustaining the chain reaction and generating a continuous flow of energy.

Commonly used moderators in nuclear reactors include:

- **Water:** Light water (ordinary water) and heavy water (deuterium oxide) are commonly used as moderators.
- **Graphite:** This was used in early nuclear reactors but is less common today due to safety concerns.

Q28 Text Solution:

In a multi-plate capacitor with nine plates in parallel, the equivalent is eight capacitors in parallel.

- A capacitor consists of two conductive plates separated by an insulator.
- When multiple plates are arranged in parallel, each plate acts as a separate capacitor.
- However, the capacitance of a parallel plate capacitor is directly proportional to the number of plates.
- Therefore, with nine plates in parallel, the total capacitance would be eight times the capacitance of a single plate capacitor.

Q29 Text Solution:

- **Field diverter method:** This method involves connecting a resistor (diverter) in parallel with the series field winding. This diverts a portion of the armature current away from the field winding, reducing the overall current flowing through it. As a result, the magnetic field

strength weakens, leading to a decrease in torque and an increase in motor speed.

- **Tapped field control:** This method involves using a series field winding with multiple taps at different points along its length. By changing the connections between the taps, the number of turns in the series field circuit can be varied. This affects the magnetic field strength and, consequently, the torque and speed of the motor.
- **Rheostatic control method:** This method involves connecting a variable resistor (rheostat) in series with the armature circuit. By adjusting the resistance, the current flowing through the armature is controlled, which directly affects the torque and speed of the motor.
- **Armature control method:** This method involves adjusting the voltage applied to the armature circuit. By changing the voltage, the current flowing through the armature is controlled, which affects the torque and speed of the motor.

Therefore, the field diverter method is the only option that specifically mentions shunting a portion of motor current around the series field to reduce the field flux and increase the speed of the motor.

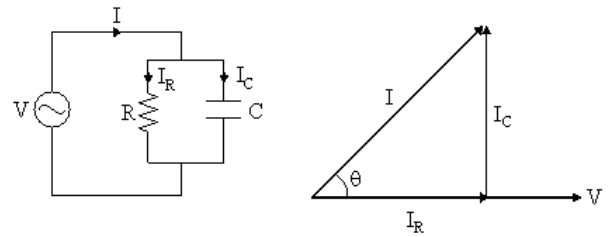
Q30 Text Solution:

The type of single-phase motor known as a "resistance-start" motor is the Split-phase motor.

- **Split-phase motor:** This motor has two windings in its stator: a main winding and a starting winding. The starting winding has a higher resistance and lower inductance than the main winding. This difference in resistance creates a phase difference between the currents in the two windings, resulting in a rotating magnetic field that starts the motor.
- **Resistance-start motor:** Since the starting winding relies on its high resistance to

generate the phase difference, it is often referred to as a "resistance-start" motor.

Q31 Text Solution:



There is no phase difference between the applied voltage and the voltage across R and C in parallel.

Q32 Text Solution:

$$\begin{aligned}
 E &= \frac{1}{2} C \times V^2 \\
 &= \frac{1}{2} \times 5 \times 10^{-6} \times 24^2 \\
 &= 1440 \mu\text{J}
 \end{aligned}$$

Q33 Text Solution:

$$\begin{aligned}
 M &= k\sqrt{L_1 L_2} \\
 \text{For maximum possible value of mutual inductance} \\
 k &= 1 \\
 M &= \sqrt{L_1 L_2} \\
 M &= \sqrt{6 \times 24} \\
 M &= \sqrt{144} \\
 M &= 12\text{H}
 \end{aligned}$$

Q34 Text Solution:

The type of motor that requires a DC supply to the rotor to generate the rotor's magnetic field and uses damper windings for starting is a Direct Current Excited Motor.

Q35 Text Solution:

$$\begin{aligned}
 (V_R) (I)_R \cos\phi &= 10 \times 10^3 \text{ W} \\
 \sin\theta &\text{ it is given that load is non-reactive} \\
 \text{So, } \cos\theta &= 1 \\
 \therefore (V_R) \times (I)_R \cos\theta &= 10 \times 10^3 \text{ W} \\
 I_R &= \frac{10 \times 10^3}{V_R} \\
 &= \frac{10 \times 10^3}{\frac{400}{\sqrt{3}}} \\
 &= 43.3 \text{ A}
 \end{aligned}$$

Q36 Text Solution:

Three phase meters are typically used for measuring energy consumption in large

commercial and industrial properties with high energy needs.

Q37 Text Solution:

- Two point starters are used for starting of DC series motor.
- Three point starters are used for starting of shunt or compound motors.

Q38 Text Solution:

Applicable if the circuit has no resistance between the independent sources.

Q39 Text Solution:

Neutral conductor is used for grounding the system and it helps in equalising phase voltages.

Q40 Text Solution:

Short circuit test → Full load current loss.
Open circuit test → Core or iron loss.
Sumpner's test → temperature rise.

Q41 Text Solution:

Power consumed
 $P = I^2 R$
 $P = (4)^2 \times 5 = 80 \text{ kW}.$

Q42 Text Solution:

Angle ϕ represents phase angle between voltage and current.

Q43 Text Solution:

Magnetising force,
 $H = \frac{mmf}{l} = \frac{Ni}{l}$
It is measured in $\frac{AT}{m}$.

Q44 Text Solution:

In PMMC, $\theta \propto I$
 $\therefore$ It has uniform scale

- It works only on DC

 $\therefore T_d \propto I$

- It has low power consumption and offer high torque to weight ratio.

Q45 Text Solution:

Quality factor,
 $Q_0 = \frac{X_L}{R} = \frac{480}{6} = 80$

Q46 Text Solution:

Loop is a closed path in which we start at a point and continue in the same direction, noting the direction of all voltage drops and return to same starting point.

Q47 Text Solution:

Avalanche and tunnelling breakdowns.

Q48 Text Solution:

Direction of rotation of conductor in a motor is obtained by Fleming's left hand rule.

Q49 Text Solution:

At node D,
Apply KCL
 $-i5 - i4 + i7 = 0$
 $i7 = i4 + i5$

Q50 Text Solution:

A reluctance motor can operate on AC as well as DC supply.

Q51 Text Solution:

Trigger circuit is used to produce trigger signal for synchronization of horizontal and vertical deflection.

Q52 Text Solution:

$$\begin{aligned} f &= \frac{1}{2\pi\sqrt{LC}} \\ f^2 &= \frac{1}{4\pi^2 LC} \\ L &= \frac{1}{4\pi^2 f^2 C} \\ &= \frac{1}{4 \times \pi^2 \times 2800 \times 2800 \times 101.5 \times 10^{-9}} \\ &= 31.83 \text{ mH} \end{aligned}$$

Q53 Text Solution:

Split-phase induction motor.

Q54 Text Solution:

Voltage drop is the main design criterion for distributors in an electrical power transmission system.

Q55 Text Solution:

Gases are rarely used dielectric materials in power cable.

Q56 Text Solution:

Over-excited synchronous motor is used for power factor correction for lagging load.

Q57 Text Solution:

Unsaturated synchronous reactance for particular field current,

$$X_{su} = \frac{\text{air-gap line voltage}}{\text{short circuit current}}$$

$$X_{su} = \frac{E_{ad}}{I_{ab}}$$

Q58 Text Solution:

If the load on an alternator has zero leading p.f. i.e. pure capacitive load then armature reaction will be only magnetising i.e. armature reaction strengthens the main flux and does not distort it.

Q59 Text Solution:

In resistance start induction motor

$$T_{st} = 1.5 T_{fl}$$

i.e. starting torque is 1.5 times of full load torque.

Q60 Text Solution:

Electrostatic precipitator is used to absorb the dust particle from the flue gases. It is used in thermal power plants.

Q61 Text Solution:

The purpose of outgoing feeders in distribution substations is to carry power from the substation to distribution transformers.

Q62 Text Solution:

According to the given condition, the circuit will be at resonance, so

$$f = \frac{1}{\sqrt{LC}} \rightarrow f^2 = \frac{1}{LC} \rightarrow L = \frac{1}{f^2 C}$$

$$L = \frac{1}{1000 \times 1000 \times 20 \times 10^{-6}} = 0.05 H$$

Q63 Text Solution:

The function of control system component is to regulate the operation of load drive.

Q64 Text Solution:

The voltage gain in common collector configuration of a BJT is less than one.

Q65 Text Solution:

To protect passers-by during a short circuit in the transmission system.

Q66 Text Solution:

At parallel resonance,

- Current drawn by the circuit becomes minimum.

- Impedance becomes maximum.
- Pf becomes unity at resonance because the current will be in phase with applied voltage.

Q67 Text Solution:

Autotransformer is used for variable voltage supply i.e. adjustment of voltage in output side.

Q68 Text Solution:

Dot matrix printers do not use synchronous motors. They typically use stepper motors to control the print head movement. While high-speed compressors, servo drives and mainline traction are all applications of synchronous motors.

Q69 Text Solution:

Collector Substation: These substations are specifically designed for wind farms and other distributed generation projects. They collect the power generated by the individual turbines and convert it to a higher voltage for transmission to the grid. They also perform power factor correction, metering and control of the wind farm.

Q70 Text Solution:

The primary function of the circuit breakers in a substation is to interrupt short-circuits and overload currents. This is crucial for protecting the substation equipment and ensuring the stability of the power grid.

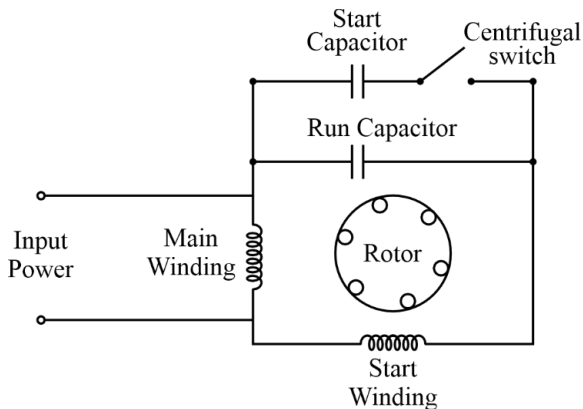
Q71 Text Solution:

Resistance Heating : This type of heating involves passing a current through a resistive element, which converts electrical energy into heat due to its resistance. This heat is then transferred to the surrounding substance.

Q72 Text Solution:

1. Capacitor start motors require additional components like capacitors and centrifugal switches, which add to their cost compared to the simpler design of split-phase induction motors. So, this statement is correct.

2. Statement 2 is also correct as the two capacitors are connected in parallel as shown in the figure,



Q73 Text Solution:

Given :

$$V_{GS} = -4 \text{ V}, I_{DSS} = 10 \text{ mA}, V_{GS(off)} = V_p = -8 \text{ V}$$

Drain current is given by:

$$I_D = I_{DSS} \left(1 - \frac{V_{GS}}{V_p} \right)^2$$

$$I_D = 10 \times 10^{-3} \left(1 - \frac{-4}{-8} \right)^2 = 2.5 \times 10^{-3} \text{ A}$$

$$I_D = 2.5 \text{ mA.}$$

Q74 Text Solution:

The main purpose of the damper winding in a synchronous motor is to assist in the starting of the motor and to damp out any oscillations that might occur during operation.

Q75 Text Solution:

In a balanced star connection:

$$\text{Line voltage } (V_L) = \sqrt{3} \times \text{phase voltage } (V_{ph})$$

$$\frac{V_L}{V_{ph}} = \sqrt{3}$$

Q76 Text Solution:

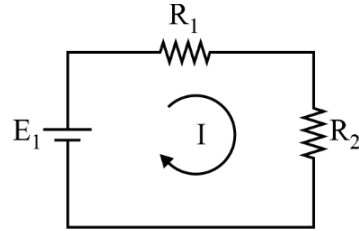
From the given circuit we can see that E_{Th} will be equal to the voltage across resistor R_2 , which can be calculated by using the voltage division rule as below:

$$E_{Th} = E_1 \times \frac{R_2}{R_1 + R_2} = 9 \times \frac{6}{9} = 6 \text{ V}$$

$$E_{Th} = 6 \text{ V}$$

Alternate method:

To calculate Thevenin voltage, we have to open circuit terminals ab and our circuit will be as shown:



By applying KVL:

$$I = \frac{9}{9} = 1 \text{ A}$$

$$E_{Th} = V_{R_2} = I \times R_2 = 1 \times 6 = 6 \text{ V}$$

$$E_{Th} = 6 \text{ V.}$$

Q77 Text Solution:

The emitter is heavily doped, the base is lightly doped and the collector is moderately doped.

Emitter >> Collector > Base

Q78 Text Solution:

Given:

$$\text{Length } (l) = 100 \text{ mm} = 100 \times 10^{-3} \text{ m}$$

$$\text{Diameter } (d) = 4 \text{ mm} = 4 \times 10^{-3} \text{ m}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$$

$$\mu_{air} = 1,$$

$$\text{Inductance } (L) = 1.58 \text{ } \mu\text{H} = 1.58 \times 10^{-6} \text{ H}$$

$$\text{We know that: } L = \frac{\mu_0 \mu_r AN^2}{l}$$

$$N = \sqrt{\frac{L \times l}{\mu_0 \cdot A}} = \sqrt{\frac{1.5 \times 10^{-6} \times 100 \times 10^{-3}}{4\pi \times 10^{-7} \times \frac{\pi}{4} \times 10^{-3}^2}} = 100$$

$$N = 100.$$

Q79 Text Solution:

Characteristics of radial distribution system are:

- Low cost
- Simple construction
- Limited maintenance
- Unidirectional power flow
- Limited control
- Not highly reliable

Q80 Text Solution:

Earnest Money : Earnest money is a deposit submitted by bidders along with their tenders as a guarantee of their seriousness in participating in the tender process.

If a bidder's tender is unsuccessful. The earnest money is typically returned to them after the tender process is finalized. This process ensures fair competition and prevents bidders from submitting frivolous or non-serious tenders.

Q81 Text Solution:

Running Cost : This cost includes expenses directly related to generating electricity, such as fuel, lubrication, maintenance and operating staff services. The more electricity generated, the higher these costs will be.

Q82 Text Solution:

In a DC series motor, speed is inversely proportional to armature current.

$$N \propto \frac{1}{I_a}, \quad N = \text{speed}$$

Q83 Text Solution:

Given :

Number of poles (P) = 8

Supply frequency (f) = 50 Hz

We know that,

$$N = \frac{120f}{P} = \frac{120 \times 50}{8} = 750 \text{ rpm}$$

N = 750 rpm.

Q84 Text Solution:

Given :

Current transformer ratio = 250 : 5

Ammeter reading = 2.7 A

Line current = ?

Line current = current transformer ratio × ammeter reading

$$= \frac{250}{5} \times 2.7 = 135 \text{ A}$$

Line current = 135 A.

Q85 Text Solution:

Energy-efficient solutions like LED lighting and programmable thermostats are incorporated into commercial electrical installation for several reasons, including,

- Reduced electricity consumption
- Lower operating costs
- Improved environmental impact
- Enhanced comfort and productivity

Q86 Text Solution:

The expenditure on supervision charges is usually between 1% and 1.5% of the total cost.

Q87 Text Solution:

Current flowing in the circuit will be given as:

$$I = \frac{\text{Total Voltage}}{\text{Total Resistance}} = \frac{9}{3 + 10 + 5} = \frac{9}{18 \times 10^3} \text{ A}$$

Now voltage across R_3

$$= \frac{9}{18 \times 10^3} \times 5 \times 10^3 = 2.5 \text{ V} \quad \therefore V = IR$$

Q88 Text Solution:

The unit of luminance is candela per square meter (cd/m^2).

It is the measure of the luminous intensity per unit area of a light source.

Q89 Text Solution:

Toroidal transformers use a ring-shaped core made of ferrite or other ferromagnetic material. This close-loop design offers several advantages like:

- Low leakage inductance
- High inductance
- High Q factor.

Q90 Text Solution:

Overhead cables offer several advantages over underground cables as follows:

- Lower installation cost
- Lower maintenance cost
- Flexibility
- Less susceptible to damage
- Lower energy losses

Q91 Text Solution:

Propeller-type turbines are the most common type of wind turbine and typically have three blades, though some larger models can have six blades. So, this statement is correct.

Derrius turbines are indeed a type of vertical-axis turbine

Propeller-type turbines are not rare but in fact, they make up over 95% of the global wind turbine market.

Multi-blade turbines are a type of horizontal axis turbine, though they are not as common as three-blade turbines.

So, statements I, II and IV are correct.

Q92 Text Solution:

Using the current division rule:

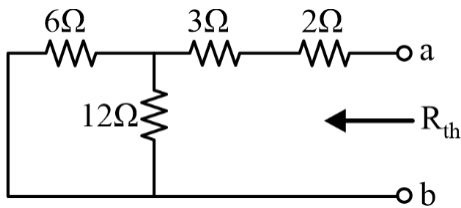
$$I_{20\Omega} = 5 \times \frac{\frac{40}{3}}{\frac{40}{3} + 20} = 2 \text{ A}$$

$$I_{20\Omega} = 2 \text{ A}$$

Q93 Text Solution:

The value of load resistance (R_L) for maximum power transfer will be equal to the resistance of the circuit as seen from terminals ab.

The internal resistance of this circuit will also be equal to Thevenin resistance as seen from terminals ab, which can be found by open-circuiting all independent current sources and short-circuiting all independent voltage sources as shown below :



$$= 6 \parallel 12 + 5$$

$$= \frac{6 \times 12}{6 + 12} + 5$$

$$R_L = R_{th} = 9 \Omega$$

Q94 Text Solution:

Given:

$$R = 30 \Omega, L = 1.3 \text{ mH}, C = 30 \mu\text{F}$$

$$\begin{aligned} \text{Resonant frequency } (f_r) &= \frac{1}{2\pi\sqrt{LC}} \\ &= \frac{1}{2\pi\sqrt{1.3 \times 10^{-3} \times 30 \times 10^{-6}}} = 805.91 \text{ Hz} \\ f_r &= 805.91 \text{ Hz} \end{aligned}$$

Note: None of the options is correct.

Q95 Text Solution:

Hartley oscillator → This oscillator uses an LC tank circuit for frequency selection.

Crystal oscillator → This oscillator utilizes a piezoelectric crystal for frequency control. Its frequency is highly stable which makes this oscillator ideal for precise applications.

Wein-bridge oscillator → This oscillator employs an RC network for frequency selection.

Q96 Text Solution:

Magnetic flux lines never intersect each other. As these lines represent the direction and strength of the magnetic field. As the magnetic field can have only one direction at any single point, so these can never intersect.

As these typically originate from a source of magnetism and terminate at another point, creating a continuous path through space and may appear as closed loops within a specific region, such as around a toroidal magnet.

Q97 Text Solution:

The time base generator is responsible for generating the time scale or time reference in a CRO. It produces a sawtooth waveform that is applied to the horizontal deflection plates of the CRT. This causes the electron beam to sweep across the screen at a constant rate, creating a time axis on which the input signal is displayed.

Q98 Text Solution:

The properties of hard magnetic materials are:

- High retentivity
- High coercivity
- Large hysteresis loop
- Small permeability

Q99 Text Solution:

Ferromagnetic materials are materials that have permeabilities hundreds and thousands of times greater than that of free space.

Q100 Text Solution:

At maximum efficiency of a transformer iron losses are equal to copper losses.

$$P_{\text{iron}} = P_{\text{copper}} \quad \text{at } \eta_{\text{max}}$$