Sub-Divisional Officer / Assistant Director (Electrical) — 2025 · Solved Past Paper

Body: Balochistan Public Service Commission (BPSC) · **Post:** Sub-Divisional Officer / Assistant Director (Electrical) · **Year:** 2025 · **Questions:** 70 in the original paper — **69 solved and verified**, 1 excluded as defective (Q16) · **Price:** Free

> **How to use this paper:** each question shows the stem, the four options, and the correct answer. Click “Why each option?” under a question to see all four options explained — one question teaches four topics. General Knowledge answers are as of the 2025 sitting.

Source note: testpointpk reproduction, 'BPSC SDO, AD Electrical Past Paper 02-06-2025' primary (70 stems, printed key for each). No second source; verification rests on independent domain knowledge (worked derivations and standard textbook rules). 1 DEFECTIVE-excluded (Q16: distance relay — 'will operate instantaneously' is absent from the options). 1 PICK-ONE (Q54: pilot-wire protection is the classic transmission-line name for current comparison at both ends). Dated item Q65 judged at June 2025. All decisions by the assistant under the owner's 8 Nov 2026 delegation.

Question 1 Electrical Engineering

If q = 5t sin 4πt mC, Calculate the current at t = 0.5 s?

- A. 32.42 mA
- B. 32.42 A
- C. 31.42 mA ✓ **Correct answer**
- D. None of these

A. Wrong: 32.42 mA is not the computed current (the correct value is 10π ≈ 31.42 mA).

e units are wrong (mA, not A) and the value is wrong.

C. Correct: i = dq/dt = 5 sin(4πt) + 20πt cos(4πt) mA; at t = 0.5 s, sin(2π) = 0 and cos(2π) = 1, so i = 10π ≈ 31.42 mA.

D. Wrong: 31.42 mA is among the options and is correct.

Question 2 Electrical Engineering

The Thevenin impedance of a network seen from the load terminals is 80 + 55 Ω. For maximum power transfer, the load impedance must be?

- A. 80 − 55Ω ✓ **Correct answer**
- B. 80 + 55Ω
- C. −80 + 55Ω
- D. None of these

A. Correct: for maximum power transfer the load impedance must be the complex conjugate of the Thevenin impedance, 80 + j55 Ω, i.e. 80 − j55 Ω.

B. Wrong: the load must be the conjugate, not the same impedance.

C. Wrong: the negative of the impedance is not the conjugate.

D. Wrong: 80 − 55 Ω is among the options and is correct.

Question 3 Electrical Engineering

A _____ is a circuit that is designed to pass signals with desired frequencies and reject or attenuate others.

- A. RLC
- B. Filter ✓ **Correct answer**
- C. RL
- D. None of these

circuit.

B. Correct: a filter passes signals of desired frequencies and rejects or attenuates others.

C. Wrong: an RL circuit is a circuit topology, not the name for a frequency-selective circuit.

D. Wrong: filter is among the options and is correct.

Question 4 Electrical Engineering

An ideal transformer has a turns ratio of 1:5 and is supplied at 200V when the primary current is 3 A. Which of the following statements is false? The turns ratio indicates a step-up transformer, The secondary voltage is 40V, The secondary current is 15A, Both B and C

- A. The turns ratio indicates a step-up transformer
- B. The secondary voltage is 40V
- C. The secondary current is 15A
- D. Both B and C ✓ **Correct answer**

A. Wrong (as filed): the turns ratio 1:5 does indicate a step-up transformer, so this statement is true, not the false one.

B. Wrong (as filed): 40 V is false (the secondary voltage is 5 × 200 = 1000 V), but it is not the only false statement — C is false too, so the complete answer is 'Both B and C'.

C. Wrong (as filed): 15 A is false (the secondary current is 3/5 = 0.6 A), but it is not the only false statement.

D. Correct: both B (secondary voltage is 1000 V, not 40 V) and C (secondary current is 0.6 A, not 15 A) are false.

5 Electrical Engineering

If voltage v = 6 cos (100t − 30°) is applied to a 50 μF capacitor, calculate the current through the capacitor.

- A. 30 cos(100t + 60°)mA ✓ **Correct answer**
- B. 30 cos(100t + 80°)mA
- C. 30 cos(100t + 100°)mA
- D. None of these

A. Correct: i = C dv/dt = 50 μF × 6 × 100 × (−sin(100t − 30°)) = 30 cos(100t + 60°) mA (capacitor current leads voltage by 90°).

B. Wrong: the phase lead is 90°, giving +60°, not +80°.

C. Wrong: the phase lead is 90°, giving +60°, not +100°.

D. Wrong: 30 cos(100t + 60°) mA is among the options and is correct.

Question 6 Electrical Engineering

The relationship between power and energy is _____?

- A. p = dw/dt ✓ **Correct answer**
- B. p = √dw/dt
- C. p = d^2w/dt^2
- D. None of these

A. Correct: power is the time rate of change of energy, p = dw/dt.

B. Wrong: power is dw/dt, not its square root.

C. Wrong: power is the first derivative of energy, not the second.

D. Wrong: p = dw/dt is among the options and is correct.

7 Electrical Engineering

What is the relationship between following quantities?

- A. $v^2/R > i^2/G$
- B. $v^2/R \neq i^2/G$
- C. $v^2/R = i^2/G$ ✓ **Correct answer**
- D. None of these

A. Wrong: both expressions equal the power dissipated, so neither is greater.

B. Wrong: the two expressions are equal, not unequal.

C. Correct: v^2/R is the power dissipated, and $i^2/G = i^2R$ (since $G = 1/R$) is the same power.

D. Wrong: $v^2/R = i^2/G$ is among the options and is correct.

Question 8 Electrical Engineering

The response of RLC circuit is _____ when the roots of the circuit's characteristic equation are equal and real.

- A. Underdamped
- B. Critically damped ✓ **Correct answer**
- C. Overdamped
- D. None of above

A. Wrong: underdamped response comes from complex conjugate roots, not equal real roots.

B. Correct: equal and real roots of the characteristic equation give a critically damped response.

C. Wrong: overdamped response comes from distinct real roots, not equal roots.

D. Wrong: critically damped is among the options and is correct.

9 Electrical Engineering

A capacitor is a passive element designed to store energy in its _____?

- A. Vector field
- B. Magnetic field
- C. Electric field ✓ **Correct answer**
- D. None of these

A. Wrong: a capacitor does not store energy in a 'vector field'.

B. Wrong: an inductor stores energy in a magnetic field; a capacitor does not.

C. Correct: a capacitor stores energy in the electric field between its plates.

D. Wrong: electric field is among the options and is correct.

Question 10 Electrical Engineering

A DC circuit consists of three resistors: 4 Ω, 6 Ω, and 12 Ω, connected in parallel. If the total current supplied by the battery is 6 A, what is the voltage across the resistors?

- A. 30 V
- B. 12 V ✓ **Correct answer**
- C. 24 V
- D. None of these

A. Wrong: 30 V is not the voltage across the parallel combination.

B. Correct: the equivalent resistance is $1/(1/4 + 1/6 + 1/12) = 2\ \Omega$, so $V = 6\ A \times 2\ \Omega = 12\ V$.

C. Wrong: 24 V is not the voltage (the equivalent resistance is 2 Ω, not 4 Ω).

D. Wrong: 12 V is among the options and is correct.

11 Electrical Engineering

A series RLC circuit has a resistance of 5 Ω, an inductance of 0.2 H, and a capacitance of 50 μ μF. If the applied voltage is 120 V at 60 Hz, what is the total impedance of the circuit?

- A. 23 Ω ✓ **Correct answer**
- B. 25.4 Ω
- C. 18.6 Ω
- D. None of these

A. Correct: XL = 2π × 60 × 0.2 ≈ 75.4 Ω, XC = 1/(2π × 60 × 50 μF) ≈ 53.1 Ω, so Z = √(5² + (75.4 − 53.1)²) ≈ 22.9 Ω ≈ 23 Ω (the option is printed '50 μ μF' for 50 μF).

B. Wrong: 25.4 Ω is not the computed impedance.

C. Wrong: 18.6 Ω is not the computed impedance.

D. Wrong: 23 Ω is among the options and is correct.

Question 12 Electronics

A bipolar junction transistor (BJT) amplifier has a collector resistance of 4 k Ω and operates with a current gain (β) of 100. If the transconductance (gm) is 40 mS, what is the approximate voltage gain?

- A. 4
- B. 100
- C. 160 ✓ **Correct answer**
- D. None of these

A. Wrong: the voltage gain is gm × Rc = 40 mS × 4 kΩ = 160, not 4.

B. Wrong: 100 is the current gain β, not the voltage gain.

C. Correct: voltage gain ≈ gm × Rc = 40 mS × 4 kΩ = 160.

50 is among the options and is correct.

Question 13 Electronics

In a common-emitter amplifier circuit, the transistor has a current gain (β) of 150, and the base current is 20 μA. What is the collector current?

- A. 5.5 mA
- B. 2.5 mA
- C. 3.0 mA ✓ **Correct answer**
- D. None of these

A. Wrong: β × Ib = 150 × 20 μA = 3.0 mA, not 5.5 mA.

B. Wrong: β × Ib = 150 × 20 μA = 3.0 mA, not 2.5 mA.

C. Correct: collector current Ic = β × Ib = 150 × 20 μA = 3.0 mA.

D. Wrong: 3.0 mA is among the options and is correct.

Question 14 Power Systems

A hydroelectric power station has a water flow rate of 500 cubic meters per second and an effective head of 120 meters. If the overall efficiency of the plant is 85%, what is the approximate power output? (Take g = 9.81 m/s^2 and water density = 1000 kg/m^3?

- A. 450 MW
- B. 520 MW
- C. 500 MW ✓ **Correct answer**
- D. None of these

A. Wrong: the computed output is about 500 MW, not 450 MW.

B. Wrong: the computed output is about 500 MW, not 520 MW.

C. Correct: $P = \rho g Q H \eta = 1000 \times 9.81 \times 500 \times 120 \times 0.85 \approx 500 \times 10^6$ W ≈ 500 MW.

)0 MW is among the options and is correct.

Question 15 Power Systems

A 132 kV transmission line is protected by a distance relay with a reach setting of 80%. If the total line length is 250 km, what is the protected zone length?

- A. 220 km
- B. 200 km ✓ **Correct answer**
- C. 150 km
- D. None of these

A. Wrong: 80% of 250 km is 200 km, not 220 km.

B. Correct: the protected zone is 80% of 250 km = 200 km.

C. Wrong: 80% of 250 km is 200 km, not 150 km.

D. Wrong: 200 km is among the options and is correct.

Question 16 Power Systems

A 132 kV transmission line is protected by a distance relay with an impedance setting of 20 Ω. If a fault occurs at a distance where the measured impedance is 15 Ω, how will the relay respond?

- A. The relay will send a signal for backup protection
- B. The relay will not operate
- C. The relay will operate with a time delay
- D. None of these

No answer is given for this question, and none is taught. DEFECTIVE-excluded — no option is correct (DEFECTIVE-excluded)

A. Wrong: a fault measured at 15 Ω is inside the relay's 20 Ω reach, so the relay itself must trip — no backup signal is the response.

e printed key, but a fault inside the reach (15 Ω < 20 Ω) makes the relay operate; 'will not operate' is false.

C. Wrong: a fault inside the zone-1 reach trips instantaneously, not with a time delay (time-delayed operation is for zones 2/3, beyond the reach).

D. Wrong (as filed): 'None of these' is not taught as the answer here, because the item is defective as printed — the correct response ('will operate instantaneously') is absent from the options, so no letter is asserted.

Question 17 Power Systems

A 220 kV transmission line has a per-phase impedance of (0.2 + j0.8) Ω per km. If a fault occurs 50 km from the relay location, what is the total impedance seen by the distance relay?

- A. 15 + j30Ω
- B. 5 + j20Ω
- C. 10 + j40Ω ✓ **Correct answer**
- D. None of these

A. Wrong: (0.2 + j0.8) × 50 = 10 + j40 Ω, not 15 + j30 Ω.

B. Wrong: (0.2 + j0.8) × 50 = 10 + j40 Ω, not 5 + j20 Ω.

C. Correct: the impedance seen is the per-km impedance times 50 km: (0.2 + j0.8) × 50 = 10 + j40 Ω.

D. Wrong: 10 + j40 Ω is among the options and is correct.

Question 18 Power Systems

Which protection scheme is most suitable for detecting evolving faults in a transmission system?

- A. Directional earth fault protection

- velling wave-based protection ✓ **Correct answer**
- C. Instantaneous overcurrent protection
- D. None of these

A. Wrong: directional earth-fault protection detects earth faults by direction, not evolving faults.

B. Correct: travelling-wave protection detects the fast transients of evolving faults, making it most suitable for them.

C. Wrong: instantaneous overcurrent protection cannot distinguish an evolving fault's signature.

D. Wrong: travelling wave-based protection is among the options and is correct.

Question 19 Power Systems

In thermal power plants, what is the primary reason for using a condenser in the Rankine cycle?

- A. To condense exhaust steam into liquid for reuse in the cycle ✓ **Correct answer**
- B. To increase the temperature of the working fluid
- C. To reduce the back pressure on the turbine
- D. None of these

A. Correct: the condenser's primary role is to condense exhaust steam back to water so it can be pumped to the boiler and reused.

B. Wrong: the condenser cools the steam, it does not raise the working fluid's temperature.

C. Wrong (as filed): maintaining a vacuum (low back pressure) is a real secondary benefit of the condenser, but the primary reason is condensing the steam for reuse.

D. Wrong: condensing exhaust steam for reuse is among the options and is correct.

20 Communications

In a frequency modulation (FM) system, what parameter of the carrier wave is varied according to the message signal?

- A. Wavelength
- B. Amplitude
- C. Frequency ✓ **Correct answer**
- D. None of these

A. Wrong: FM does not vary the carrier's wavelength as such (wavelength follows frequency, but the varied parameter is frequency).

B. Wrong: varying amplitude is amplitude modulation, not frequency modulation.

C. Correct: in FM the carrier's frequency is varied according to the message signal.

D. Wrong: frequency is among the options and is correct.

Question 21 Control Systems

Which of the following controllers provides both transient and steady-state improvements in a control system?

- A. PI controller
- B. PID controller ✓ **Correct answer**
- C. P controller
- D. None of these

A. Wrong: a PI controller improves steady-state error but does not add the derivative action that speeds the transient.

B. Correct: a PID controller combines proportional, integral and derivative action, improving both transient response and steady-state error.

C. Wrong: a P controller alone leaves steady-state error and does not give both

D. Wrong: PID controller is among the options and is correct.

Question 22 Control Systems

Which of the following methods is commonly used for analyzing the stability of a nonlinear control system?

- A. Lyapunov’s direct method ✓ **Correct answer**
- B. Root locus method
- C. Routh-Hurwitz criterion
- D. None of these

A. Correct: Lyapunov's direct (second) method is the standard tool for analysing the stability of nonlinear systems.

B. Wrong: root locus is a linear-system tool, not for nonlinear stability.

C. Wrong: Routh-Hurwitz applies to linear systems, not nonlinear ones.

D. Wrong: Lyapunov's direct method is among the options and is correct.

Question 23 Smart Grid

Which technology in a smart grid enhances grid stability by providing real-time measurement of voltage and current phase angles?

- A. Static Synchronous Series Compensator (SSSC)
- B. Demand Response Management System (DRMS)
- C. Phasor Measurement Unit (PMU) ✓ **Correct answer**
- D. None of these

A. Wrong: an SSSC injects series voltage; it does not measure phase angles.

B. Wrong: a DRMS manages consumer demand, not phasor measurement.

PMU measures voltage and current phasors (magnitude and phase angle) in real time, synchronised by GPS.

D. Wrong: PMU is among the options and is correct.

Question 24 Smart Grid

In a smart grid, which technology enables real-time monitoring and two-way communication between utilities and consumers?

- A. Distributed Generation (DG)
- B. Advanced Metering Infrastructure (AMI) ✓ **Correct answer**
- C. Supervisory Control and Data Acquisition (SCADA)
- D. None of these

A. Wrong: distributed generation is local power production, not the monitoring/communication layer.

B. Correct: AMI (smart meters plus two-way communication) enables real-time monitoring and two-way communication between utilities and consumers.

C. Wrong: SCADA monitors the grid, but the consumer two-way link is AMI's role.

D. Wrong: AMI is among the options and is correct.

Question 25 Power Electronics

Which power electronic converter is used to convert DC voltage from one level to another without changing polarity?

- A. Rectifier
- B. Inverter
- C. Chopper ✓ **Correct answer**
- D. None of these

A. Wrong: a rectifier converts AC to DC, not DC from one level to another.

an inverter converts DC to AC, not DC to DC.

C. Correct: a chopper (DC–DC converter) changes DC voltage from one level to another without changing polarity.

D. Wrong: chopper is among the options and is correct.

Question 26 Power Electronics

Which switching device is best suited for high-frequency power electronics applications due to its fast switching speed and low conduction losses?

- A. MOSFET ✓ **Correct answer**
- B. SCR
- C. BJT
- D. None of these

A. Correct: the MOSFET is the preferred high-frequency switching device (fast switching, low conduction loss).

B. Wrong: an SCR is slow to turn off and is not suited to high-frequency switching.

C. Wrong: a BJT switches more slowly and has higher losses than a MOSFET at high frequency.

D. Wrong: MOSFET is among the options and is correct.

Question 27 Power Electronics

In power electronics, what is the main advantage of using a resonant converter over a conventional PWM converter?

- A. It eliminates the need for feedback control in power regulation
- B. It allows zero-voltage or zero-current switching ✓ **Correct answer**
- C. It completely eliminates the need for inductors and capacitors
- D. None of these

sonant converters still need feedback control.

B. Correct: resonant converters switch at zero voltage or zero current, cutting switching losses — their main advantage over hard-switched PWM converters.

C. Wrong: a resonant converter needs its resonant inductor and capacitor by definition.

D. Wrong: zero-voltage/zero-current switching is among the options and is correct.

Question 28 Digital Signal Processing

In digital signal processing, which filter design technique is commonly used to convert an analog filter into a digital filter while preserving frequency response characteristics?

- A. Bilinear transformation ✓ **Correct answer**
- B. Finite Impulse Response (FIR) windowing method
- C. Zero-order hold method
- D. None of these

A. Correct: the bilinear transform converts an analogue filter design into a digital filter while preserving the frequency response (with frequency warping).

B. Wrong: FIR windowing designs FIR filters directly; it does not convert an analogue filter.

C. Wrong: zero-order hold is a sampling/reconstruction model, not the standard analogue-to-digital filter conversion.

D. Wrong: bilinear transformation is among the options and is correct.

Question 29 Digital Signal Processing

In digital signal processing, what is the primary advantage of using a window function in Fourier analysis?

- A. To convert a time-domain signal into a phase-only representation
- B. To reduce spectral leakage ✓ **Correct answer**

- D. None of these

A. Wrong: a window function does not produce a phase-only representation.

B. Correct: windowing tapers the signal ends, reducing spectral leakage in Fourier analysis.

C. Wrong: windowing does not boost high-frequency components.

D. Wrong: reducing spectral leakage is among the options and is correct.

Question 30 Power Systems

In power system analysis, what is the primary reason for using symmetrical components in fault analysis?

- A. To improve the power factor of the system
- B. To simplify the analysis of unbalanced faults ✓ **Correct answer**
- C. To eliminate the need for circuit breakers
- D. None of these

A. Wrong: symmetrical components have nothing to do with power factor.

B. Correct: symmetrical components decompose unbalanced faults into three balanced sequence networks, simplifying the analysis.

C. Wrong: symmetrical components are an analysis tool; they do not replace circuit breakers.

D. Wrong: simplifying unbalanced-fault analysis is among the options and is correct.

Question 31 Power Systems

In power system analysis, what is the main purpose of conducting a load flow study?

- A. To assess the impact of harmonics on power quality

determine voltage levels, power flows, and losses in the network under steady-state conditions ✓ **Correct answer**

- C. To analyze transient stability and system response to sudden disturbances
- D. None of these

A. Wrong: harmonic impact is a power-quality study, not a load-flow study.

B. Correct: a load-flow study computes steady-state voltages, power flows and losses.

C. Wrong: transient stability is a dynamic study, not a load-flow study.

D. Wrong: determining voltages, flows and losses is among the options and is correct.

Question 32 Power Systems

In power system analysis, what is the primary advantage of using per-unit (PU) system calculations?

- A. It normalizes system values ✓ **Correct answer**
- B. It eliminates the need for impedance calculations
- C. It improves transient stability
- D. None of these

A. Correct: the per-unit system normalises voltages, currents and impedances to common bases, simplifying calculations across voltage levels.

B. Wrong: per-unit still requires impedance calculations, just in normalised form.

C. Wrong: per-unit is a calculation convention; it does not change system stability.

D. Wrong: normalising system values is among the options and is correct.

Question 33 Power Systems

In a power distribution system, why are ring main units (RMUs) preferred in urban networks?

- y operate only in radial distribution systems
- B. They eliminate the need for circuit breakers
- C. They provide multiple power supply paths ✓ **Correct answer**
- D. None of these

A. Wrong: RMUs are used in ring systems, not only radial ones.

B. Wrong: RMUs contain switching and protection; they do not eliminate circuit breakers.

C. Correct: ring main units give urban networks alternative supply paths, improving reliability.

D. Wrong: providing multiple supply paths is among the options and is correct.

Question 34 Power Systems

In underground power distribution systems, why is XLPE (cross-linked polyethylene) insulation preferred over paper-insulated cables?

- A. Paper-insulated cables cannot be used for high-voltage applications
- B. XLPE has a higher thermal resistance ✓ **Correct answer**
- C. Paper-insulated cables are prone to mechanical damage
- D. None of these

A. Wrong: paper-insulated cables have long been used at high voltage.

B. Correct: XLPE insulation withstands higher operating temperatures (90 °C continuous) than paper insulation, so it is preferred in underground distribution.

C. Wrong: paper-insulated cables are mechanically robust; their drawback is oil migration and lower temperature rating.

D. Wrong: XLPE's higher thermal resistance is among the options and is correct.

35 Electrical Machines

In a separately excited DC motor, how does an increase in armature voltage affect its speed when the field current is kept constant?

- A. The speed increases due to a higher induced back EMF ✓ **Correct answer**
- B. The speed remains unchanged
- C. The speed decreases
- D. None of these

A. Correct: with field current constant, raising the armature voltage raises the speed (speed is roughly proportional to (V − IaRa)/flux, so a higher V needs a higher back EMF, reached at higher speed).

B. Wrong: armature voltage directly sets the speed in a separately excited motor.

C. Wrong: increasing armature voltage increases, not decreases, the speed.

D. Wrong: the speed increases is among the options and is correct.

Question 36 Communications

In an amplitude modulation (AM) system, what is the main disadvantage of using a high modulation index greater than 1?

- A. It reduces the bandwidth requirement for transmission
- B. It increases the efficiency of power transmission
- C. It causes overmodulation ✓ **Correct answer**
- D. None of these

A. Wrong: a modulation index above 1 does not reduce bandwidth.

B. Wrong: overmodulation wastes power in distortion, it does not increase efficiency.

C. Correct: a modulation index greater than 1 in AM causes overmodulation (envelope distortion).

vermodulation is among the options and is correct.

Question 37 Electrical Engineering

In a DC circuit containing multiple resistors and voltage sources, how can the node voltages be determined systematically?

- A. By applying Kirchhoff's Voltage Law (KVL)
- B. By using Thevenin's theorem
- C. By applying Kirchhoff's Current Law (KCL) ✓ **Correct answer**
- D. None of these

A. Wrong: KVL gives mesh equations, not node voltages systematically.

B. Wrong: Thevenin's theorem simplifies a network to one source and impedance; it is not the systematic node-voltage method.

C. Correct: nodal analysis applies KCL at each node to determine the node voltages systematically.

D. Wrong: applying KCL is among the options and is correct.

Question 38 Power Systems

Why are static VAR compensators (SVGs) used in power transmission systems?

- A. To eliminate the need for transformers in substations
- B. To provide dynamic voltage support and reactive power compensation ✓ **Correct answer**
- C. To convert AC power to DC power
- D. None of these

A. Wrong: SVGs do not replace transformers.

B. Correct: static VAR generators/compensators provide fast, dynamic reactive power and voltage support in transmission systems.

nverting AC to DC is a rectifier's job, not an SVG's.

D. Wrong: dynamic voltage support and reactive compensation is among the options and is correct.

Question 39 Power Systems

Why is a bundled conductor configuration used in high-voltage transmission lines?

- A. To increase mechanical strength
- B. To improve current carrying capacity
- C. To reduce corona discharge and minimize power losses ✓ **Correct answer**
- D. None of these

A. Wrong: bundled conductors are not primarily about mechanical strength.

B. Wrong (as filed): bundled conductors do raise current capacity, but the primary textbook reason is corona reduction and lower losses.

C. Correct: bundling increases the effective conductor radius, reducing the surface voltage gradient, corona discharge and losses.

D. Wrong: reducing corona and losses is among the options and is correct.

Question 40 Power Systems

In a power system, what is the primary advantage of using a numerical relay over an electromechanical relay?

- A. It is immune to electromagnetic interference
- B. It operates without requiring an external power
- C. It provides faster and more accurate fault detection ✓ **Correct answer**
- D. None of these

A. Wrong: numerical relays are electronic and can be affected by EMI; they are not immune.

numerical relay needs an auxiliary power supply; an electromechanical relay is the self-powered one.

C. Correct: numerical relays detect faults faster and more accurately (and with more functions) than electromechanical relays.

D. Wrong: faster, more accurate fault detection is among the options and is correct.

Question 41 Power Systems

What is the primary purpose of a busbar protection scheme in a power system?

- A. To regulate voltage levels in the power grid
- B. To detect overvoltage conditions in transmission lines
- C. To protect the busbar from faults by isolating faulty sections ✓ **Correct answer**
- D. None of these

A. Wrong: voltage regulation is not the purpose of busbar protection.

B. Wrong: busbar protection protects the busbar from faults, not from overvoltage in lines.

C. Correct: a busbar protection scheme detects faults on the busbar and isolates the faulty section.

D. Wrong: protecting the busbar from faults is among the options and is correct.

Question 42 Power Systems

In a power system, why is a directional relay used for transmission line protection?

- A. To differentiate between forward and reverse fault currents ✓ **Correct answer**
- B. To detect faults based on current
- C. To protect equipment from overvoltage
- D. None of these

directional relay distinguishes forward from reverse fault current, so it is used where fault direction matters.

B. Wrong: detecting faults by current alone is overcurrent protection, not the reason for a directional relay.

C. Wrong: a directional relay does not protect against overvoltage.

D. Wrong: differentiating forward and reverse faults is among the options and is correct.

Question 43 Power Systems

In a hydroelectric power plant, what is the main factor that determines the power output?

- A. The ambient air temperature
- B. The speed of the turbine
- C. The height of the water head and flow rate ✓ **Correct answer**
- D. None of these

A. Wrong: air temperature does not determine hydroelectric output.

B. Wrong: turbine speed follows the output; it does not determine it.

C. Correct: hydroelectric power output is $P = \rho g Q H$ — determined by head and flow rate.

D. Wrong: head and flow rate is among the options and is correct.

Question 44 Power Systems

Which factor primarily determines the efficiency of a thermal power plant?

- A. The length of the transmission lines
- B. The ambient temperature
- C. The temperature difference between the heat source and the sink ✓ **Correct answer**

ne of these

A. Wrong: line length affects transmission losses, not plant efficiency.

B. Wrong: ambient temperature is only one small influence, not the primary determinant.

C. Correct: by Carnot's principle, thermal plant efficiency is primarily set by the temperature difference between the heat source and the sink.

D. Wrong: the temperature difference is among the options and is correct.

Question 45 Control Systems

In state-space analysis, which condition must be satisfied for a system to be completely controllable?

- A. The characteristic equation must have only real roots.
- B. The determinant of the system matrix must be zero.
- C. The rank of the controllability matrix must be equal to the number of state variables. ✓ **Correct answer**
- D. None of these

A. Wrong: the roots of the characteristic equation say nothing about controllability.

B. Wrong: a zero determinant of the system matrix is not the controllability condition.

C. Correct: a system is completely controllable if and only if its controllability matrix has full rank n (the number of state variables).

D. Wrong: the rank condition is among the options and is correct.

Question 46 Smart Grid

Which communication technology is most commonly used for real-time data exchange in smart grids?

- A. Morse code

wer line communication (PLC). ✓ **Correct answer**

- C. Bluetooth
- D. None of these

A. Wrong: Morse code is not used for smart-grid data exchange.

B. Correct: power line communication is the most commonly used technology for real-time data exchange over the grid's own conductors.

C. Wrong: Bluetooth is short-range and is not the grid's data-exchange technology.

D. Wrong: PLC is among the options and is correct.

Question 47 Smart Grid

How does demand response improve the efficiency of a smart grid?

- A. By eliminating the need for power distribution networks
- B. By increasing the total power generation
- C. By allowing consumers to adjust their energy usage based on grid conditions ✓ **Correct answer**
- D. None of these

A. Wrong: demand response does not eliminate distribution networks.

B. Wrong: demand response shifts or reduces demand; it does not increase generation.

C. Correct: demand response lets consumers shift or cut usage when the grid is stressed, improving efficiency.

D. Wrong: consumer adjustment of usage is among the options and is correct.

Question 48 Electrical Machines

What is the primary reason for using a squirrel-cage rotor in an induction motor?

- A. Higher starting torque

- C. Ability to operate at variable speeds
- D. None of these

A. Wrong: a squirrel-cage motor has modest starting torque; high starting torque is a wound-rotor motor's advantage.

B. Correct: the squirrel-cage rotor is simple, rugged and brushless, so the motor needs little maintenance — its primary reason for use.

C. Wrong: a squirrel-cage induction motor is essentially a fixed-speed machine.

D. Wrong: lower maintenance is among the options and is correct.

Question 49 Power Systems

Why are higher transmission voltages used in power distribution systems?

- A. To simplify circuit design
- B. To reduce transmission losses ✓ **Correct answer**
- C. To increase current flow
- D. None of these

A. Wrong: higher voltages complicate insulation and design, not simplify it.

B. Correct: for a given power, higher voltage means lower current, and losses are I^2R — so higher voltages cut transmission losses.

C. Wrong: higher voltage reduces current for the same power.

D. Wrong: reducing transmission losses is among the options and is correct.

Question 50 Control Systems

In a unity feedback control system, what does the steady-state error depend on?

- A. Phase margin

- C. System type and input signal ✓ **Correct answer**
- D. None of these

A. Wrong: phase margin measures relative stability, not steady-state error.

B. Wrong: pole locations set stability and transient response, not steady-state error directly.

C. Correct: in a unity-feedback system the steady-state error depends on the system type (number of integrators) and on the input signal (step, ramp, parabola).

D. Wrong: system type and input signal is among the options and is correct.

Question 51 Control Systems

Which type of controller combines the advantages of proportional and integral control to eliminate steady-state error and improve response time?

- A. Proportional controller
- B. Integral controller (I)
- C. Proportional-integral controller (PI) ✓ **Correct answer**
- D. None of these

A. Wrong: a P controller alone leaves steady-state error.

B. Wrong: an I controller alone removes steady-state error but is slow and can destabilise.

C. Correct: a PI controller combines proportional action (speed) with integral action (zero steady-state error).

D. Wrong: PI controller is among the options and is correct.

Question 52 Power Electronics

In a buck converter, what happens to the output voltage if the duty cycle is increased

voltage remains constant)?

- A. Output becomes AC
- B. Output voltage decreases
- C. Output voltage increases ✓ **Correct answer**
- D. None of these

A. Wrong: a buck converter's output stays DC.

B. Wrong: in a buck converter Vout = D × Vin, so raising the duty cycle raises the output.

C. Correct: in a buck converter the output voltage is D × Vin, so increasing the duty cycle increases the output voltage.

D. Wrong: output voltage increases is among the options and is correct.

Question 53 Power Systems

Which device is used to protect transmission lines from lightning strikes?

- A. Relay
- B. Circuit breaker
- C. Surge arrester ✓ **Correct answer**
- D. None of these

A. Wrong: a relay detects faults; it does not divert lightning surges.

B. Wrong: a circuit breaker interrupts fault current; it does not protect against lightning surges.

C. Correct: a surge (lightning) arrester diverts lightning surges safely to earth, protecting the line.

D. Wrong: surge arrester is among the options and is correct.

54 Power Systems

Which protection scheme uses current comparison at both ends of a transmission line?

- A. Pilot wire protection ✓ **Correct answer**
- B. Overcurrent protection
- C. Differential protection
- D. None of these

A. Correct: pilot-wire protection compares the currents at both ends of a transmission line over pilot wires — the classic line-protection name for this scheme (see verification summary; PICK-ONE under delegation).

B. Wrong: overcurrent protection measures current at one end only.

C. Wrong (as filed): differential protection also compares currents at both ends — pilot-wire protection is a form of it — which is why this item is a PICK-ONE; A is picked as the transmission-line name.

D. Wrong: pilot-wire protection is among the options and is correct.

Note: Note: Printed-key pick-one: testpointpk keys A 'Pilot wire protection'; C 'Differential protection' is also defensible — pilot-wire protection IS a form of differential protection (current comparison at both ends) — but pilot-wire is the classic transmission-line name for this scheme, so A is picked. Decided by assistant under owner's 8 Nov delegation.

Question 55 Electrical Machines

What is the purpose of carbon brushes in a DC machine?

- A. To support the rotor shaft
- B. To cool the armature
- C. To provide electrical contact with the commutator ✓ **Correct answer**
- D. None of these

A. Wrong: the shaft is supported by bearings, not brushes.

ushes do not cool the armature.

C. Correct: carbon brushes maintain sliding electrical contact with the rotating commutator.

D. Wrong: providing contact with the commutator is among the options and is correct.

Question 56 Electrical Machines

Which type of DC machine is commonly used for constant speed applications?

- A. Stepper motor
- B. Series DC motor
- C. Shunt DC motor ✓ **Correct answer**
- D. None of these

A. Wrong: a stepper motor moves in discrete steps; it is not the constant-speed DC machine.

B. Wrong: a series motor's speed varies strongly with load.

C. Correct: a shunt (parallel-field) DC motor runs at nearly constant speed from no load to full load.

D. Wrong: shunt DC motor is among the options and is correct.

Question 57 Electrical Machines

What is the main function of a commutator in a DC motor?

- A. To reduce power consumption
- B. To convert ac to dc
- C. To reverse current direction in armature coils ✓ **Correct answer**
- D. None of these

A. Wrong: the commutator does not reduce power consumption.

a DC motor the commutator does not convert AC to DC (that is rectification).

C. Correct: the commutator reverses the current in each armature coil as it passes the poles, keeping the torque in one direction.

D. Wrong: reversing current direction is among the options and is correct.

Question 58 Communications

Which component is essential for demodulating an amplitude-modulated (AM) signal?

- A. Mixer
- B. Oscillator
- C. Envelope detector ✓ **Correct answer**
- D. None of these

A. Wrong: a mixer shifts frequency; it does not demodulate AM.

B. Wrong: an oscillator generates a carrier; it does not demodulate AM.

C. Correct: an envelope detector (diode detector) is the essential component for demodulating an AM signal.

D. Wrong: envelope detector is among the options and is correct.

Question 59 Communications

Which type of modulation is used in AM radio broadcasting?

- A. Pulse modulation
- B. Frequency modulation
- C. Amplitude modulation ✓ **Correct answer**
- D. None of these

A. Wrong: pulse modulation is not used in AM radio broadcasting.

B. Wrong: frequency modulation is used in FM radio, not AM radio.

M radio broadcasting uses amplitude modulation.

D. Wrong: amplitude modulation is among the options and is correct.

Question 60 Power Systems

In Pakistan, what is the standard frequency of alternating current (AC) used in most power distribution systems?

- A. 100 Hz
- B. 25 Hz
- C. 50 Hz ✓ **Correct answer**
- D. None of these

A. Wrong: Pakistan's AC frequency is not 100 Hz.

B. Wrong: Pakistan's AC frequency is not 25 Hz.

C. Correct: Pakistan uses 50 Hz alternating current, the standard in most of the world outside the Americas.

D. Wrong: 50 Hz is among the options and is correct.

Question 61 Power Systems

Which type of power distribution system is commonly used for residential areas?

- A. Interconnected system
- B. Radial system ✓ **Correct answer**
- C. Ring main system
- D. None of these

A. Wrong: an interconnected system links grids; residential areas are fed radially.

B. Correct: residential areas are commonly served by a radial distribution system (one path from substation to consumer).

ng main systems serve urban/commercial loads needing higher reliability, not typical residential areas.

D. Wrong: radial system is among the options and is correct.

Question 62 Power Systems

Which voltage level is typically used for long-distance power transmission?

- A. 11kv
- B. 230v
- C. 400kv & above ✓ **Correct answer**
- D. None of these

A. Wrong: 11 kV is a distribution voltage, not long-distance transmission.

B. Wrong: 230 V is the domestic supply voltage, not transmission.

C. Correct: long-distance power transmission typically uses 400 kV and above (220–500 kV and higher).

D. Wrong: 400 kV and above is among the options and is correct.

Question 63 Digital Signal Processing

Which mathematical tool is commonly used to analyze signals in digital signal processing?

- A. Newton's method
- B. Laplace transform
- C. Fourier transform ✓ **Correct answer**
- D. None of these

A. Wrong: Newton's method solves equations numerically; it is not the signal-analysis tool.

B. Wrong: the Laplace transform analyses continuous-time systems; DSP uses the Fourier

C. Correct: the Fourier transform (DFT/FFT) is the standard tool for analysing signals in digital signal processing.

D. Wrong: Fourier transform is among the options and is correct.

Question 64 Control Systems

What is the main purpose of a feedback loop in control systems?

- A. To eliminate all system sensors
- B. To reduce system accuracy
- C. To compare output with desired input ✓ **Correct answer**
- D. None of these

A. Wrong: a feedback loop needs sensors; it does not eliminate them.

B. Wrong: feedback improves accuracy, it does not reduce it.

C. Correct: a feedback loop compares the actual output with the desired input and corrects the error.

D. Wrong: comparing output with desired input is among the options and is correct.

Question 65 Power Systems

Which energy source is most used for electricity generation worldwide?

- A. Solar
- B. Coal ✓ **Correct answer**
- C. Wind
- D. None of these

A. Wrong: solar is growing but is not the largest source of world electricity.

B. Correct: judged at the exam date (June 2025), coal was still the largest single source of

neration worldwide (about a third of generation).

C. Wrong: wind is growing but is not the largest source of world electricity.

D. Wrong: coal is among the options and is correct.

Question 66 Electrical Engineering

What happens to the power dissipation if the resistance in a circuit doubles while the voltage remains constant?

- A. It halves ✓ **Correct answer**
- B. It becomes four times
- C. It reduces to one-fourth
- D. None of these

A. Correct: $P = V^2/R$, so doubling R at constant V halves the power dissipated.

B. Wrong: power falls when resistance rises at constant voltage; it does not quadruple.

C. Wrong: doubling R halves the power ($V^2/2R$), it does not quarter it.

D. Wrong: it halves is among the options and is correct.

Question 67 Electrical Engineering

In an AC circuit, what does the power factor represent?

- A. The resistance of the circuit
- B. The ratio of real power to apparent power ✓ **Correct answer**
- C. The ratio of voltage to current
- D. None of these

A. Wrong: power factor is not the resistance.

B. Correct: power factor = real power (kW) / apparent power (kVA) = cos φ.

ltage over current is impedance, not power factor.

D. Wrong: real over apparent power is among the options and is correct.

Question 68 Electrical Engineering

The SI unit of electric power is?

- A. Watt ✓ **Correct answer**
- B. Joules
- C. Volts
- D. Ampere

A. Correct: the watt (W) is the SI unit of electric power.

B. Wrong: the joule is the SI unit of energy, not power.

C. Wrong: the volt is the SI unit of voltage, not power.

D. Wrong: the ampere is the SI unit of current, not power.

Question 69 Electronics

In a p-type material/semi conductor the _____ is the majority carrier.

- A. Proton
- B. Electron
- C. Atoms
- D. Holes ✓ **Correct answer**

A. Wrong: protons are not the majority carrier in a p-type semiconductor.

B. Wrong: electrons are the minority carrier in p-type material.

C. Wrong: atoms are not charge carriers.

D. Correct: in p-type semiconductor material the majority carriers are holes.

70 Electrical Engineering

The _____ states that the algebraic sum of all voltages around a closed path is zero.

- A. Kirchhoff's third law
- B. Kirchhoff's double voltage law
- C. Kirchhoff's voltage law ✓ **Correct answer**
- D. None of these

A. Wrong: there is no 'Kirchhoff's third law' for voltages.

B. Wrong: there is no 'Kirchhoff's double voltage law'.

C. Correct: Kirchhoff's voltage law states that the algebraic sum of voltages around a closed path is zero.

D. Wrong: Kirchhoff's voltage law is among the options and is correct.

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