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ESE 2026

Prelims Solutions

Electronics & Telecom Engineering

SET-C

Exam held on 08-02-2026

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Paper Analysis of ESE 2026
Preliminary Examination

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ELECTRONICS AND TELECOMMUNICATION ENGINEERING Solutions
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Q.1 Consider the following relations for two-port network:

1. $A = \left(\frac{h_{11}h_{22} - h_{12}h_{21}}{h_{21}}\right)$
2. $h_{22} = \left(\frac{Y_{11}Y_{22} - Y_{12}Y_{21}}{Y_{21}}\right)$
3. $h_{12} = \left(\frac{AD - BC}{D}\right)$

Which of the above relations are **not** correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (a)

For a two-port network, the *h*-parameter representation is

$$V_1 = h_{11}I_1 + h_{12}V_2 \quad ...(1)$$
$$I_2 = h_{21}I_1 + h_{22}V_2 \quad ...(2)$$

Also, *ABCD* parameters is

$$V_1 = AV_2 - BI_2 \quad ...(3)$$
$$I_1 = CV_2 - DI_2 \quad ...(4)$$

$$A = \left.\frac{V_1}{V_2}\right|_{I_2 = 0}$$

Substitute $I_2 = 0$ in eq. (2)

$$0 = h_{21}I_1 + h_{22}V_2$$
$$I_1 = \frac{-h_{22}V_2}{h_{21}}$$

Substitute I_1 in eq. (1)

$$V_1 = \frac{-h_{11}h_{22}V_2}{h_{21}} + h_{12}V_2$$
$$\frac{V_1}{V_2} = \frac{h_{12}h_{21} - h_{11}h_{22}}{h_{21}}$$
$$A = \frac{h_{12}h_{21} - h_{11}h_{22}}{h_{21}}$$

Thus, statement 1 is **incorrect**.

For a two-port network, Y-parameters is

$$I_1 = Y_{11}V_1 + Y_{12}V_2 \quad ...(5)$$
$$I_2 = Y_{21}V_1 + Y_{22}V_2 \quad ...(6)$$

From *h*-parameters

$$h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1 = 0}$$

Substitute h_{22} in eq. (5)

$$0 = Y_{11}V_1 + Y_{12}V_2$$
$$V_1 = \frac{-Y_{12}V_2}{Y_{11}}$$

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Substitute 'V_1' in eq. (6)

$$I_2 = Y_{21}\left(\frac{-Y_{12}V_2}{Y_{11}}\right) + Y_{22}V_2$$

$$\frac{I_2}{V_2} = \frac{Y_{11}Y_{22} - Y_{12}Y_{21}}{Y_{11}}$$

$$h_{22} = \frac{Y_{11}Y_{22} - Y_{12}Y_{21}}{Y_{11}}$$

Thus, statement 2 is also **incorrect**.

Now,

From *h*-parameters

$$h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1 = 0}$$

For Two-port network, *ABCD* parameters is

$$V_1 = AV_2 - BI_2 \quad ...(7)$$

$$I_1 = CV_2 - DI_2 \quad ...(8)$$

Substitute $I_1 = 0$ in eq. (8)

$$0 = CV_2 - DI_2$$

$$I_2 = \frac{CV_2}{D}$$

Sub I_2 in eq. (1)

$$V_1 = AV_2 - B\left(\frac{C}{D}V_2\right)$$

$$\frac{V_1}{V_2} = \frac{AD - BC}{D}$$

$$h_{12} = \frac{AD - BC}{D}$$

Statement 3 is correct.

Therefore, option (a) is correct.

End of Solution

Q.2 Consider the following statements regarding two-port network:

1. The overall *Z*-parameter matrix for series-connected two-port networks is simply the sum of *Z*-matrices of each individual network.
2. The overall *Y*-parameter matrix, if two networks *A* and *B* are connected in parallel, is simply the summation of Y-matrices of each individual two-port network.
3. The overall *ABCD* parameter network matrix for the cascade-connected two-port network is the matrix product of *ABCD* matrices of each individual two-port network.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)

1. $[Z]_T = [Z]_A + [Z]_B \Rightarrow$ For series connection
2. $[Y]_T = [Y]_A + [Y]_B \Rightarrow$ For parallel connection
3. $[T]_T = [T]_A \times [T]_B \Rightarrow$ For cascaded connection.

Therefore option (d) is correct.

End of Solution

Q.3 Consider the following statements regarding small signal model of BJT:

1. The use of r_e-model for AC analysis of transistor does not provide exact analysis.
2. The use of *h*-parameter model as an equivalent circuit of transistor provides exact analysis.
3. In *h*-parameter model, h_{12} is referred to as short-circuit current gain.

Which of the above statements are ***not*** correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (*)

- The use of r_e-model for AC analysis of transistor does not provide exact analysis. Statement 1 is correct.
- The use of *h*-parameter model as an equivalent circuit of transistor provides exact analysis. Statement 2 is also correct.
- In *h*-parameter model, h_{12} is referred to as open-circuit voltage gain. Therefore, statement 3 is incorrect.

End of Solution

Q.4 A BJT is operating at a base current of 7.6 μA and β_0 (AC common-emitter forward short-circuit current gain in hybrid-π model) of 104. Assume V_T = 25 mV The value of trans-conductance at room temperature (T = 293K) is

(a) 0.304 mA/V (b) 1.826 mA/V
(c) 31.60 mA/V (d) 790.40 μA/V

Ans. (c)

We know that, transconductance $g_m = \frac{I_C}{V_T}$.

or, $I_C = \beta I_B = 104 \times 7.6\ \mu A$

$I_C = 0.7904$ mA

$$g_m = \frac{I_c}{V_T} = \frac{0.7904}{25} = 31.6\ \text{mA/V}$$

Hence, option (c) is correct.

End of Solution

Q.5 Consider the following statements regarding rectifier circuits:

1. The transformer needed for the bridge rectifier over the full-wave rectifier is lighter in weight.
2. The Peak Inverse Voltage (PIV) of each diode used in the bridge rectifier is V_{max}, whereas it is $2V_{max}$ for the full-wave rectifier.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (c)

- A full-wave rectifier (center-tapped) requires a center-tapped transformer.
- This increases:
  - Copper usage
  - Number of turns
  - Size and weight of the transformer
- A bridge rectifier does not require a center tap, hence:
  - Transformer is smaller and lighter
- Therefore, Statement 1 is true.
- In a bridge rectifier:
  - Each diode experiences a maximum reverse voltage = V_{max}.
- In a center-tapped full-wave rectifier:
  - Each diode must withstand $2V_{max}$ during the reverse-biased condition.
- Therefore, Statement 2 is true.

Both statements 1 and 2 are correct.
Therefore, option (c) is correct.

End of Solution

Q.6 Consider the following statements regarding transistors:

1. FETs are less temperature stable compared to BJTs.
2. FET is a current-controlled device whereas BJT is a voltage-controlled device.
3. FET has zero offset voltage at zero drain current, hence it makes an excellent signal chopper.

Which of the above statements are **not** correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

- FETs are more temperature stable than BJTs
- Reason:
  - FETs are majority-carrier devices
  - BJTs are minority-carrier devices, hence more prone to thermal runaway.

Hence statement 1 is **not** correct.

- BJT is current-controlled device (base current controls collector current)
- FET is voltage-controlled device (gate-source voltage controls drain current)

Therefore, statement 2 is also **not** correct.

- At zero drain current, FET has negligible offset voltage
- Due to:
  - High input impedance
  - Low noise characteristics
- Hence, FETs are widely used as signal choppers and analog switches.

Therefore, statement 3 is correct.

Thus, option (a) is correct.

End of Solution

Q.7 Consider the following statements regarding biasing in transistors :

1. The DC analysis for FET is slightly simple as compared to BJT due to the linear relationship between input and output quantities.
2. Fixed bias arrangement of JFET has the disadvantage that it uses a separate supply for biasing.
3. It is essential to establish an appropriate DC operating point for the BJT, when it is used as an amplifier.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

- In FETs, the input (gate) current is almost zero.
- Biasing mainly depends on V_{GS} and I_D, making DC analysis simpler.
- Compared to BJTs:
  - BJT biasing depends on I_B, I_C, V_{BE}, and temperature effects
  - Hence, BJT DC analysis is more complex.

Thus, statement 1 is correct.

- In fixed-bias JFET circuits, a separate negative gate supply is required to keep the gate reverse biased.
- This increases:
  - Circuit complexity
  - Cost
  - Hence, it is considered a disadvantage.

Thereore, statement 2 is correct.

- For a BJT amplifier, the transistor must operate in the active region.
- This requires setting a proper DC operating point (Q-point) to:
  - Avoid cut-off and saturation
  - Ensure linear amplification
  - Prevent signal distortion

Thus, statement 3 is also correct.

Hence, option (d) is correct.

End of Solution

Q.8 Consider the following statements regarding field-effect transistor:

1. MOSFETs provide very low input impedance compared to JFET.
2. A depletion-type MOSFET can be used both with V_{GS} positive and negative, i.e., enhancement and depletion mode, respectively.
3. FET should be biased in the saturation region in order to be used as an amplifier.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

- MOSFETs have extremely high input impedance because the gate is insulated by an oxide layer.
- JFETs also have high input impedance, but it is much lower than MOSFETs due to the reverse-biased PN junction at the gate.

Hence statement 1 is incorrect.

- A depletion-type MOSFET already has a conducting channel at $V_{GS} = 0$.
- Applying:
  - Negative V_{GS}, reduces channel width which implies depletion mode
  - Positive V_{GS}, increases channel carriers which implies enhancement mode

Hence, it can operate in both enhancement and depletion modes.

Therefore statement (2) is correct.

- For amplification, FET must operate in the saturation (active) region
- In this region:
  - Drain current is mainly controlled by V_{GS}.
  - Small input signal produces proportional output which implies linear amplification

Therefore statement (3) is also correct.

Hence, option (c) is correct.

End of Solution

Q.9 What is the cutoff frequency of a first-order low-pass filter for $R_1 = 1.2\ \text{k}\Omega$ and $C_1 = 0.02\ \mu\text{F}$?

(a) 3.31 kHz (b) 6.63 kHz
(c) 7.96 kHz (d) 13.26 kHz

Ans. (b)

We know that,

$$f_c = \frac{1}{2\pi R_1 C_1} = \frac{1}{2 \times 3.14 \times 1.2 \times 10^3 \times 0.02 \times 10^{-6}} = 6.63\ \text{kHz}$$

Hence, option (b) is correct.

End of Solution

Q.10 If a 6-bit DAC has a step size of 50 mV, then the full-scale output voltage and percentage resolution are, respectively

(a) 300 mV and 3.174% (b) 3 V and 1.587%
(c) 3.15 V and 1.587% (d) 6.30 V and 3.174%

Ans. (c)

Given:

Number of bits $n = 6$

Step size (LSB) = 50 mV = 0.05

We need:

1. Full-scale output voltage
2. Percentage resolution

For a DAC:

$$\text{Step size} = \frac{\text{Full scale output}}{2^n - 1}$$

So,

Full-Scale Output Voltage = $(2^n - 1) \times$ Step size

$= (2^6 - 1) \times 0.05 = 3.15$ V

Percentage Resolution

Resolution means smallest detectable change as a percentage of full scale.

$$\text{Percentage resolution} = \frac{1}{2^n - 1} \times 100 = \frac{1}{63} \times 100 = 1.587\%$$

Hence, option (c) is correct.

End of Solution

Q.11 Consider the following statements regarding A/D and D/A converters:

1. The settling time of a DAC is the time taken by its output to settle down to within ±0.7 step size of its final value after the application of the digital input.
2. The step size of DAC is the same as the proportionality factor in the DAC I/O relationship.
3. The dual-slope ADC is also called the continuous-conversion type ADC.

Which of the above statements are **not** correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

- The settling time of a DAC is the time taken by its output to settle within ±0.7 step size of its final value.

Therefore, statement 1 is incorrect.

- The step size of a DAC is the same as the proportionality factor in the DAC input–output relationship.

Thus statement (2) is correct.

- Dual-slope ADC is an integrating ADC.
- Continuous-conversion ADC refers to sigma–delta ADC

So this statement is incorrect.

Thus, option (b) is correct.

End of Solution

Q.12 The simplified form of the Boolean function.

$F(A,B,C,D) = A\bar{B}C + B + BD + AB\bar{D} + \bar{A}C$ is

(a) $B + C$ (b) $A(B + C)$

(c) $B + D$ (d) B

Ans. (a)

We have, $F(A, B, C, D) = A\bar{B}C + B + BD + AB\bar{D} + \bar{A}C$

$= A\bar{B}C + B(1 + D + A\bar{D}) + \bar{A}C$

$= A\bar{B}C + B + \bar{A}C$

$= (AC + B) + \bar{A}C = B + C$

Hence, option (a) is correct.

End of Solution

Q.13 The simplest possible POS form of $F(A, B, C, D, E) = \Sigma m(6, 9, 13, 18, 19, 25, 27, 29, 31) + d(2, 3, 11, 15, 17, 24, 28)$ is

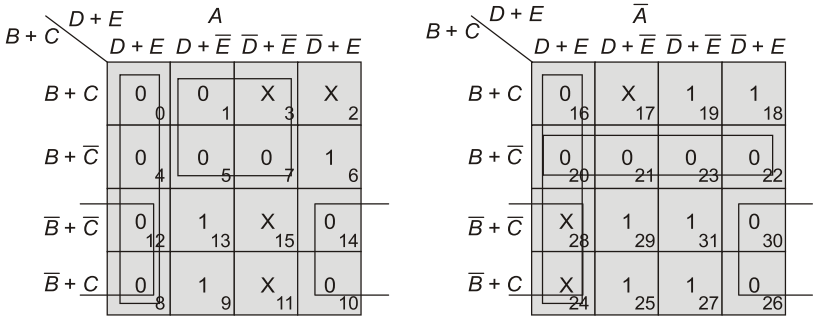
(a) $(B + E)(\bar{B} + \bar{C}D)(\bar{A} + B + D\bar{E})$

(b) $(\bar{B} + \bar{E})(B + C + \bar{D})(A + B + \bar{D} + E)$

(c) $(D + E)(\bar{B} + E)(A + B + \bar{E})(\bar{A} + B + \bar{C})$

(d) $(D + E)(\bar{B} + E)(A + B + \bar{E})(\bar{A} + B + \bar{C})(B + E)$

Ans. (c)



$F(A, B, C, D, E) = (D + E)(\bar{B} + E)(A + B + \bar{E})(\bar{A} + B + \bar{C})$

Hence, option (c) is correct.

End of Solution

Q.14 Consider statements following the regarding Boolean functions:

1. Each one of the product terms in the canonical SOP form is called a minterm.
2. Two squares in K-map are said to be adjacent to each other, if their min (max) terms differ in only one variable.
3. The binary number designations of the rows and columns of K-map are in Gray code.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)

- Canonical SOP (Sum of Products) form consists of minterms.
- A minterm:
  - Contains all variables (each in complemented or uncomplemented form)
  - Produces output = 1 for exactly one input combination

Hence, each product term in canonical SOP is a minterm.

- In a Karnaugh map, adjacency means:
  - Two cells differ in only one variable.
  - This allows simplification by variable elimination
- This rule applies to both:
  - minterms (SOP)
  - maxterms (POS)

Therefore, statement 2 is correct.

- K-map rows and columns are labeled using Gray code.
- Gray code ensures:
  - Adjacent cells differ by only one bit
  - Enables proper adjacency and simplification

Hence, statement (3) is correct.

Therefore, option (d) is correct.

End of Solution

Q.15 Consider the statements following regarding combinational circuits:

1. A ripple carry adder is a parallel adder in which the carry-out of each full-adder is the carry-in to the next most significant adder.
2. Look-ahead carry adder speeds up the process by eliminating the end carry.
3. A priority encoder is a logic circuit that responds to just one input, in accordance with some priority system, among those that may be simultaneously HIGH.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)

- A ripple carry adder (RCA) consists of multiple full adders connected in parallel (one per bit).
- The carry output of a lower bit adder is fed as the carry input to the next higher bit adder.
- Carry propagation happens sequentially ("ripples" through stages).

Hence, statement 1 is correct.

- In a look-ahead carry adder (CLA):
  - Carry signals are generated in advance using generate and propagate logic.
  - This avoids waiting for carry to ripple through all stages.

- Hence, it eliminates carry propagation delay, including the delay to get the final (end) carry.

Thus statement 2 is also correct.

- A priority encoder:
  - Can have multiple inputs HIGH simultaneously.
  - Produces output corresponding to the highest-priority input.
  - Ignores lower-priority inputs.

Therefore, statement 3 is correct.

Thus, option (d) is correct.

End of Solution

Q.16 Consider the following statements regarding dynamic characteristics of a measurement system:

1. In retardation-type measuring lag, the response of the measurement system begins after a dead time after the application of input.
2. Fidelity is defined as the degree to which a measurement system indicates changes in the measured quantity without any dynamic error.
3. Measurement error is the difference between the true value of the quantity changing with time and the value indicated by the measurement system if no static error is assumed.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

- Retardation type measuring lag means the system starts responding immediately, but lags behind the input due to inertia, capacitance or time constant.
  A dead time is different phenomenon, where no response occurs for some time and then response starts suddenly.
  Hence, statement 1 is incorrect.
- Fidelity is defined as the degree to which a measurement system indicates changes in the measured quantity without any dynamic error.
  Hence, statement 2 is correct.
- When the true value varies with time and static error is zero, the remaining error is purely due to dynamic effects.
  Hence, statement 3 is correct.

Thus option (c) is correct.

End of Solution

Q.17 The minimum and maximum ranges of temperature of tungsten used in resistance thermocouple are, respectively

(a) –100°C and 300°C (b) –220° and 300°C
(c) –200°C and 1000°C (d) –260°C and 1100°C

Ans. (d)

Tungsten is used as resistance thermometer material mainly for very high temperature, because of its very high melting point.

Therefore, option (d) is correct.

End of Solution

Q.18 Consider the following statements regarding wattmeters:

1. In pivoted-coil direct-indicating wattmeters, the fixed coil is wound in two halves, which are placed parallel to another at such a distance that the uniform field is obtained.
2. Suspended-coil torsion wattmeters are commonly used as switchboard or portable instruments.
3. In pivoted-coil direct-indicating wattmeters, the eddy current errors within the region of magnetic field of the instrument are minimized by the use of non-metallic parts of high-resistivity material.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

- In pivoted-coil direct-indicating wattmeters, the fixed coil is wound in two halves, which are placed parallel to another at such a distance that the uniform field is obtained. Statement 1 is correct.
- Suspended coil wattmeters are highly sensitive laboratory instruments while pivoted coil wattmeters are robust and suitable for portable and switch board use. Therefore, statement 2 is incorrect.
- Eddy current errors are minimized by using non metallic and high resistivity materials. (e.g. plastics, laminated parts). Hence, statement 3 is correct.

Thus option (b) is correct.

End of Solution

Q.19 Consider the following statements regarding dynamometer wattmeters :

1. Dynamometer wattmeters comparatively consume more power than induction wattmeters.
2. Dynamometer wattmeters can be used for both AC and DC systems.
3. Dynamometer wattmeters provide high degree of accuracy if carefully designed.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

- Dynamometer wattmeter use air-cored coils → lower losses.
  Whereas Induction wattmeters have laminated cores and shading bands → higher losses. Hence induction wattmeters consume more power.
  Hence, statement 1 is incorrect.

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- Dynamometer wattmeters can be used for both AC and DC systems. Hence, statement 2 is correct.
- Dynamometer wattmeters provide high degree of accuracy if carefully designed. Hence, statement 3 is also correct.

Thus, option (c) is correct.

End of Solution

Q.20 Consider statements the following regarding Cathode Ray Oscilloscope (CRO):

1. Cathode is a nickel cylinder coated with an oxide coating of barium and strontium, and emits plenty of electrons, when heated.
2. The typical values of current and voltage required by an indirectly heated cathode are 800 mA at 6-5 V (AC or DC).
3. The control grid is usually a metal cylinder covered at one end but with a small hole in the cover.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

- Typical heater ratings for CRO cathodes are about 6.3 V and 600 mA. Hence, statement 2 is incorrect.

Therefore, option (b) is correct.

End of Solution

Q.21 Consider the following statements regarding graph theory:

1. Chord is that branch of the graph that does not belong to the particular tree.
2. Cut-set is a unique set with respect to a given tree of a connected graph containing one chord and all of the free branches contained in the free path formed between two vertices of the chord.
3. If M represents the number branches and N the number nodes, the minimum number of variables involved in analyzing a network is equal to $(M + N - 1)$

Which of the above statements are **not** correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

In Graph Theory:

- Tree contains all the nodes of main graph but it doesn't make a closed a path.
- Tree branches are called 'Twigs'.
- The branch not included in the tree is known as chord (or) link.

Thus, statement 1 is correct.

- Cutset contains exactly one twig (tree branch) not a chord.

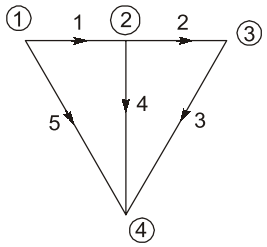
Thus, statement 2 is incorrect.

- Number of branches = M
  Number of Nodes = N
  Number of Independent loops = $M - N + 1$
  Number of Independent voltages = $N - 1$

Thus, statement 3 is incorrect.
Hence, option (c) is correct.

End of Solution

Q.22 The incidence matrix of the graph shown below is



(a) $\begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ -1 & 1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 0 & 0 & 0 & -1 \\ -1 & 1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ -1 & -1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ -1 & 0 & -1 & 1 & -1 \end{bmatrix}$

(d) $\begin{bmatrix} -1 & 0 & 0 & 0 & 1 \\ -1 & -1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ -1 & 0 & -1 & -1 & 0 \end{bmatrix}$

Ans. (a)

The algebraic sum of each column of incidence matrix is zero. Hence, option (a) is correct.

End of Solution

Q.23 Consider the following statements regarding circuit theory:

1. The algebraic sum of the row entries of an incidence matrix is zero.
2. The determinant of the incidence matrix of a closed loop is zero.
3. A fundamental tie-set of a graph with respect to a tree is a loop formed by only one link associated with other twigs.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (c)

- The algebraic sum of each column of incidence matrix is zero.

Thus, statement 1 is not correct.

- The determinant of the incidence matrix of a closed loop is zero.

Thus, statement 2 is correct.

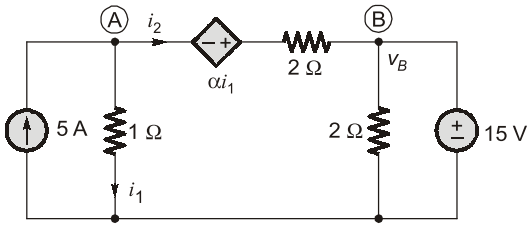
- Fundamental loop consists of only one link (or) chord and remaining are twigs.

Thus, statement 3 is correct.

Hence, option (c) is correct.

End of Solution

Q.24 What is the value of α for the given circuit, when the power loss in 1 Ω resistor is 9 W?



(a) 2.67
(b) 3.67
(c) 4.33
(d) 5.33

Ans. (d)

The power loss in 1 Ω is 9 watts.

$$i_1^2 R = 9$$

$$i_1 = \sqrt{\frac{9}{1}} = 3 \text{ A}$$

On applying KCL at node A, we get

$$5 = i_1 + i_2$$
$$5 = 3 + i_2$$
$$i_2 = 2 \text{ A}$$

The voltage at node (A) is

$$V_A = (3)(1) = 3 \text{ V}$$

The current $(i_2) = \dfrac{V_A + \alpha i_1 + V_B}{2}$

The voltage at node (B) is

$$V_B = 15 \text{ V}$$

$$i_2 = \frac{3 \times \alpha(3) - 15}{2}$$

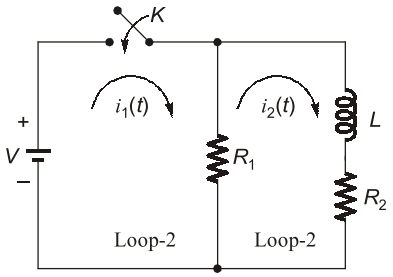
$$2 = \frac{3 + 3\alpha - 15}{2}$$

$$\alpha = \frac{16}{3} = 5.33$$

Thus, option (d) is correct.

End of Solution

Q.25 What is the expression for $I_1(s)$ for the two-mesh network given below, when the switch is closed [assuming the initial condition $i(O+)$ is zero through the inductance]?



(a) $I_1(s) = \frac{V}{s}\left[\frac{R_1(R_2 + sL)}{R_1 + R_2 + sL}\right]$

(b) $I_1(s) = \frac{V}{s}\left[\frac{R_1R_2 + sL}{R_1 + R_2 + sL}\right]$

(c) $I_1(s) = \frac{V}{s}\left[\frac{R_1 + R_2 + sL}{R_1(R_2 + sL)}\right]$

(d) $I_1(s) = \frac{V}{s}\left[\frac{R_1R_2 + sL}{R_1(R_2 + sL)}\right]$

Ans. **(c)**

The Laplace transform of

$V \rightarrow V/s$

$R_1 \rightarrow R_1$

$R_2 \rightarrow R_2$

$L \rightarrow sL$

The KVL equation in first loop

$$\frac{V}{s} = R_1(I_1(s) - I_2(s)) \quad \ldots(1)$$

The KVL equation in second loop

$$0 = R_1(I_2(s) - I_1(s)) + sLI_2(s) + R_2I_2(s))$$

From eq. (2)

$$I_2(s) = \frac{R_1I_1(s)}{R_1 + R_2 + sL}$$

Substitute $I_2(s)$ in equation (1).

$$\frac{V}{s} = R_1I_1(s) - \frac{R_1 \cdot R_1I_1(s)}{R_1 + R_2 + sL}$$

On solving we get,

$$I_1(s) = \frac{V}{s}\left[\frac{(R_1 + R_2 + sL)}{R_1(R_2 + sL)}\right]$$

Hence, option (c) is correct.

End of Solution

Q.26 Consider the following statements regarding circuit theory:

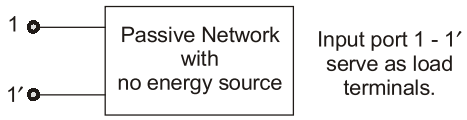
1. A passive network does not contain any source of energy and the input port serves as load terminal.
2. Physically separate network elements like *R*, *L* or *C* are known as lumped elements.
3. When a large circuit consists of similar networks connected one after another, the network is called recurrent network.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

- A passive network does not contain any source of energy and the input port serves as load terminal.



  Hence, statement 1 is correct.
- Physically separate network elements like *R*, *L* or *C* are known as lumped elements.
  Hence, statement 2 is correct.
- When a large circuit consists of similar networks connected one after another, the network is called recurrent network.
  Hence, statement 3 is correct.

Thus, option (d) is correct.

End of Solution

Q.27 Consider the following statements regarding circuit theory:

1. In asymmetrical π section network configuration, the shunt arm impedances are not identical.
2. A balanced form of π network is also known as 'O' section.
3. L section is merely a specific case of the asymmetrical π section with one shunt arm equal to zero.

Which of the above statements are correct?

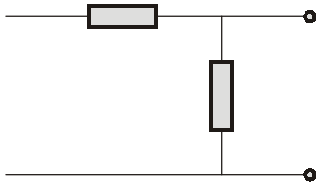
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

- In symmetrical π section network configuration, the shunt arm impedances are identical. Whereas, in asymmetrical π section network configuration, the shunt arm impedances are not identical.
  Hence, statement 1 is correct.
- A balance π network has
  - Equal shunt-arms
  - Series arm in between

  This configuration is commonly known as 'O' section.

- If one shunt arm of a π network is zero. Thus, π network reduces to an '*L*' network as shown below:



Thus statement 3 is correct.

Hence, option (d) is correct.

End of Solution

Q.28 Hybrid parameter h_{21} is called

(a) input impedance
(b) forward current gain
(c) reverse voltage gain
(d) output admittance

Ans. (b)

The h-parameter of two-port network is given as

$$V_1 = h_{11}I_1 + h_{12}V_2 \quad ...(1)$$
$$I_2 = h_{21}I_1 + h_{22}V_2 \quad ...(2)$$

From eq. (2)

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} = \text{Forward current gain}$$

Hence, option (b) is correct.

End of Solution

Q.29 The two-port network will be reciprocal if

(a) $h_{12} = h_{21}$
(b) $Y_{12} = -Y_{21}$
(c) $Z_{12} = -Z_{21}$
(d) $AD = 1 + BC$

Ans. (d)

The reciprocity of a two-port network is given by

$$h_{12} = -h_{21}$$
$$Y_{12} = Y_{21}$$
$$Z_{12} = Z_{21}$$
$$AD - BC = 1$$

(or) $$AD = 1 + BC$$

Hence, option (d) is correct.

End of Solution

Q.30 Consider the following statements regarding two-port network:

1. A network is termed to be reciprocal, if the ratio of the response variable to the excitation variable remains identical even if the positions of the response and excitation in the network are interchanged.

2. A two-port network is said to be symmetrical, if the input and output ports can be interchanged even after altering the port voltages and currents.
3. The condition for symmetry is $Z_{11} = -Z_{22}$.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

- A network is termed to be reciprocal, if the ratio of the response variable to the excitation variable remains identical even if the positions of the response and excitation in the network are interchanged. i.e.,

$$\frac{V_2}{I_1} = \frac{V_1}{I_2}$$

Hence, statement 1 is correct.

- In symmetry, voltages and currents are not arbitrarily altered.

Hence, statement 2 is incorrect.

- The condition for symmetry is $Z_{11} = Z_{22}$.

Hence, statement 3 is incorrect.

End of Solution

Q.31 Consider the following statements regarding ceramic materials:

1. Refractories are special ceramic materials of construction capable of withstanding high temperature in various industrial processes and operations.
2. Castable refractories have been used in applications where abrasion resistance at elevated temperature is required and as a protective barrier against corrosive attack by hot gases and liquids that are highly detrimental to other structural materials.
3. Mullite refractories are prepared by fusing alumina and silica materials in any required proportion or by calcining sillimanite, a naturally occurring mineral of the composition $Al_2O_3 \times SiO_2$.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

Mullite has a fixed composition

$$3Al_2O_3 \cdot 2SiO_2$$

So, it cannot be prepared in any required proportion of alumina and silica.

Hence, statement 3 is incorrect.

Therefore, option (a) is correct.

End of Solution

Q.32 Consider the following statements regarding physical properties of materials:

1. Thermal conductivity of tantalum is more than tungsten.
2. Thermal expansion is more in tin as compared to lead.
3. Electrical conductivity of beryllium is better than graphite.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

- Thermal conductivity of tantalum is less than tungsten. i.e.,
  Tungsten → approx 170 W/m-k
  Tantalum → approx 55 W/m-k
  Hence, statement 1 is incorrect.
- Thermal expansion is less in tin as compared to lead. i.e.
  Tin → 22×10^{-6}/K
  Lead → 29×10^{-6}/K
  Hence, statement 2 is also incorrect.

Therefore, option (a) is correct.

End of Solution

Q.33 The net magnetic moment per atom for ferromagnetic metal Ni is

(a) 0.6 (b) 1.7
(c) 2.2 (d) 5.0

in Bohr magneton.

Ans. (a)

The net magnetic moment per atom for ferromagnetic metal Ni is 0.6 Bohr magneton.

End of Solution

Q.34 Consider the following statements regarding properties magnetic of materials:

1. Anti-ferromagnetism arises from an anti-parallel locking spin, which results in a negative interaction between the nearest neighbors.
2. When the magnetic moments are equal, the anti-parallel arrangement results in ferrimagnetism.
3. Cu_2MnAl is an example of ferromagnetic material.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

When the magnetic moments are unequal, the anti-parallel arrangement results in ferrimagnetism.

Hence, statement 2 is incorrect.

End of Solution

Q.35 Consider the following statements regarding ferromagnetic materials:

1. Soft magnetic materials have low permeability.
2. Soft magnetic materials have low coercive force.
3. Hard magnetic materials are used for their ability to retain magnetic fields.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

As soft magnetic materials have high permeability. Hence, statement 1 is incorrect.

End of Solution

Q.36 Consider the following statements regarding superconductivity:

1. Metals and compounds, which loose their electrical resistivity at absolute zero temperature, are called superconductors.
2. The superconducting state can be destroyed by the application of an external magnetic field.
3. The materials which become superconductors are not necessarily good conductors, when they are normal metals.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and. 3

Ans. (d)

All the statements are correct.

End of Solution

Q.37 At absolute zero, the band gap in a superconductor in terms of Boltzmann's constant (k) and critical temperature (T) is

(a) 1.5 kT (b) 2.5 kT
(c) 3.5 kT (d) 4.5 kT

Ans. (a)

From BCS theory,

The bandgap in superconductors = $1.76\ kT_c$

Hence, closest option is option (a).

End of Solution

Q.38 Consider the following statements regarding electrical measurements:

1. Accuracy of the instruments is defined as conformity with an accepted standard value.
2. Accuracy of an instrument is influenced by reproducibility.
3. Accuracy of an instrument is influenced by dead zone.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

- Accuracy means closeness of the measured value of the true value. In practice, the true value is taken as the accepted standard value.
  Hence, statement 1 is correct.
- Reproducibility relates to precision not accuracy.
  Hence, statement 2 is incorrect.
- Dead zone is the range of input over which there is no output change. This causes incorrect indication for small input variations. Hence, it reduces accuracy.
  Hence, statement 3 is correct.

Thus, option (b) is correct.

End of Solution

Q.39 A thermometer reads 92.5 °C and the static correction given in the correction curves is –0.75 °C. The true value of the temperature is

(a) 91.00 °C (b) 91.75 °C
(c) 93.25 °C (d) 94.00 °C

Ans. (b)

Thermometer reading (indicated value) = 92.5°C
Static correction = –0.75°C
True temperature = 92.5 + (–0.75) = 91.75°C

Thus, option (b) is correct.

End of Solution

Q.40 Consider the following statements regarding drift:

1. An instrument is said to have no drift, if it reproduces same reading at different times for same variation in measured variable.
2. Drift occurs in resistance thermometers due to the contamination of the metal and a change in its atomic or metallurgical structure.
3. Drift may occur in flowmeter due to wear and erosion of the orifice plate, nozzle or venturimeter.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

- Drift is defined as a slow change in instrument output with time, when the input remains constant. If the instrument gives the same reading at different times for the same input, it means 'no drift'.
  Thus, statement 1 is correct.
- In RTD drift occurs due to
  - Contamination
  - Grain growth
  - Oxidation
  - Metallurgical change

  Thus, statement 2 is correct.

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- Wear and erosion change the effective dimensions of flow elements. This leads to gratual change in calibration i.e., Drift.
  Thus, statement 3 is correct.

Hence, option (d) is correct.

End of Solution

Q.41 Consider the following statements:

1. The deflection-type instruments are more suited for the measurements under the dynamic condition whose intrinsic response is slower.
2. Deflection-type instruments are more accurate than null-type instruments.
3. Deflection-type instruments can be highly sensitive as compared with null-type instruments.

Which of the above statements are ***not*** correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

- Deflection-type instruments are less accurate than null-type instruments.
- Deflection-type instruments can be less sensitive as compared with null-type instruments.

As, both statements 2 and 3 are not correct. Hence, option (c) is correct.

End of Solution

Q.42 Consider the following statements regarding DC galvanometers:

1. Box-type DC galvanometers have taut suspension and require exact leveling.
2. Portable point-type DC galvanometers have sensitivity from 0.5 mm/μA to 4.0 mm/μA.
3. Laboratory reflecting-type DC galvanometers have sensitivity from 200 mm/μA to 2000 mm/μA.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

- Box-type DC galvanometers have taut suspension and do not require exact leveling.
- Laboratory reflecting-type DC galvanometers have sensitivity from 250 mm/μA to 100000 mm/μA.

As both statements 1 and 3 are not correct.

Hence, option (b) is correct.

End of Solution

Q.43 Consider the following statements regarding measuring instruments:

1. PMMC (Permanent Magnet Moving Coil) can be used for both AC and DC measurements.
2. The calibration of electrodynamometer-type instrument is same for both AC and DC.
3. Hot wire and thermocouple are used for AC measurements only.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (c)

As, PMMC (Permanent Magnet Moving Coil) can be used only for DC measurements.
Hence, statement 1 is incorrect.
Thus, option (c) is correct.

End of Solution

Q.44 A pressure gauge, which has linear calibration curve, has radius of scale line as 90 mm and pressure of zero to 54 pascals, is displayed over an arc of 270°. The sensitivity of the gauge as a ratio of scale length to pressure is

(a) 1.50π mm/Pa
(b) 1.66π mm/Pa
(c) 200π mm/Pa
(d) 2.50π mm/Pa

Ans. (d)

We have,

Radius of scale (r) = 90 mm

Pressure gauge = 0 to 54 Pa

$$\text{Scale length} = 2\pi r\theta = 2\pi \times 90 \times \frac{270}{360} = 135\pi$$

$$\text{Sensitivity} = \frac{\text{Scale length}}{\text{Pressure gauge}} = \frac{135\pi}{54} = 2.5\,\pi \text{ mm/Pa}$$

End of Solution

Q.45 When the input is slowly increased from some arbitrary (non-zero) input value, it is observed that the output does not change at all until a certain increment is exceeded. This increment is called

(a) threshold of the instrument
(b) discrimination of the instrument
(c) dead zone of the instrument
(d) dead range of the instrument

Ans. (c)

When the input is slowly increased from some arbitrary (non-zero) input value, it is observed that the output does not change at all until a certain increment is exceeded. This increment is called dead zone of the instrument.

End of Solution

Q.46 The Curie temperature of nickel (Ni) metal is

(a) 298 °C (b) 358°C

(c) 770°C (d) 1120°C

Ans. **(b)**

Curie temperature is the temperature above which a ferromagnetic material loses its ferromagnetism and becomes paramagnetic.

Material	Curie Temperature
Iron (Fe)	≈770°C
Nickel (Ni)	≈358°C
Cobalt (Co)	≈1120°C

End of Solution

Q.47 Consider the following statements regarding electromagnetic induction:

1. Whenever magnetic flux linked with a closed coil changes, an induced EMF is set up in the coil and the induced EMF lasts as long as the change in magnetic flux continues.
2. The magnitude of the induced EMF is proportional to the rate of change of magnetic lines of force.
3. Lenz's law states that the direction of the induced current is such that it opposes the very cause producing this current.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(d)**

As,

- Statement 1 defines Faraday's first law of electromagnetic induction.
- Statement 2 defines Faraday's second law of electromagnetic induction.
- Statement 3 defines Lenz's law.

Hence, all the statements are correct.

Thus, option (d) is correct.

End of Solution

Q.48 A current of 10 A when flowing through a coil of 2000 turns establishes a flux of 0.6 milliweber. The inductance of the coil is

(a) 0.12 H (b) 0.72 H

(c) 1.08 H (d) 1.32 H

Ans. **(a)**

We know that,

$$L = \frac{N\phi}{i} = \frac{2000(0.6\times10^{-3})}{10} = 0.12\,\text{H}$$

End of Solution

Q.49 Consider the following regarding statements autotransformer:

1. Voltage regulation of an auto transformer is better because of reduced voltage drop in the resistance and reactance.
2. An autotransformer has variable output voltage, when a sliding contact is used for the secondary.
3. Short-circuit current is larger for an autotransformer due to reduced internal impedance.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

All the given statements are the properties of autotransformer.

End of Solution

Q.50 Consider the following statements regarding transformer cooling methods:

1. In air blast cooling method of transformers, continuous blast of filtered air is forced through the core and windings for better cooling.
2. In oil blast cooling, forced air is passed over cooling elements of transformer immersed in oil.
3. In forced oil and water cooling, metallic tubes are situated inside the tank, below the oil level. Water is circulated through these tubes to extract heat from oil.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

All the given statements are defining the cooling methods of transformer.

End of Solution

Q.51 Consider the following statements regarding DC machines:

1. Commutation is the process of producing a unidirectional or direct current from the alternating current generated in the armature coil.
2. The main cause of sparking at commutator being the reactance voltage, it can be minimized using by high-resistance carbon brushes.
3. Armature reaction AT (Ampere-turns) in DC machines can be compensated by placing a compensating winding in the pole faces with its axis along the brush axis and excited by the armature current in series connection, so that it causes cancellation of armature reaction AT at all values of armature current.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

All statements are true. Commutation converts AC to DC, carbon brushes reduce sparking via high resistance, and compensating windings cancel armature reaction.

End of Solution

Q.52 Consider the following statements regarding electric circuits:

1. A 60% lagging power factor implies an inductive load in which the supply current lags the voltage by an angle with a cosine of 0.6 (i.e., by approximately 53°).
2. A 90% leading power factor would indicate a capacitive load in which the voltage leads the current by an angle with a cosine of 0.9 or approximately 26°.
3. When the phase angle (angle between supply voltage and current) is zero, then all of the apparent power from the supply is dissipated as true power in the load.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Statement 2 is incorrect because in a leading power factor (capacitive), the current leads the voltage.

End of Solution

Q.53 Consider the following statements regarding Blondel's theorem for measurement of power in a polyphase system:

1. If a network is supplied through *N* conductors, the total power is measured by summing the reading of *N* wattmeters so arranged that a current element of a wattmeter is in each line and corresponding voltage element is connected between that line and a common point.
2. If the common point is located on one of the lines, then the power may be measured by (N-1) wattmeters.
3. The most common applications of Blondel's theorem include the two-wattmeter method of measurement of power in 3-phase, 3-wire load circuits and three-wattmeter method of measurement of power in 3-phase, 4-wire load circuits.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

All three statements accurately describe Blondel's theorm.

- Statement 1 correctly describes the general case requiring *N* Wattmeters with voltage element to a common point.
- Statement 2 correctly states that if the common point is on one line, only (*N*-1) wattmeters are needed.
- Statement 3 correctly identifies the most common applications (two-wattmeter method for 3-phase 3-wire and three-wattmeter method for 3-phase 4-wire systems).

End of Solution

Q.54 Consider the following statements regarding cells and batteries:

1. A manganese-alkaline cell can sustain a constant terminal voltage for heavy loads over a much longer period of time than the less expensive zinc-carbon cell.
2. The major advantage of manganese-alkaline cell is that its terminal voltage is maintained constant for much longer periods than either the mercury or zinc-carbon cells.
3. The mercury cell is a modification of the zinc-carbon cell, in which as the mercuric oxide is used negative electrode.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 2 is incorrect because mercury cells have better voltage stability than alkaline.

Statement 3 is incorrect because mercury oxide is the cathode, not the negative electrode.

End of Solution

Q.55 A battery with a rating of 300 Ah is to be charged. If the internal resistance of the battery is 0.008 Ω, the safe maximum charging current of the battery is 37.5 A and its (discharged) terminal voltage is 11.5 V, then the initial output voltage level for the battery charger is

(a) 11.8 V (b) 12.4 V
(c) 13.5 V (d) 15.0 V

Ans. (a)

The initial charger voltage is calculated as

$$V = V_{battery} + (I \times R)$$
$$= 11.5 + (37.5 \times 0.008)$$
$$= 11.8 \text{ V}$$

End of Solution

Q.56 Consider the following statements regarding polymers:

1. Elastomers are better known as rubbers.
2. Isomers are variations in the molecular structure of the same composition.
3. Polymers contain non-metallic elements sharing electrons to build up small molecules, called micro-molecules.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

Statement 3 is incorrect because polymers are composed of large macromolecules, not "micro-molecules".

End of Solution

Q.57 Consider the following statements regarding structure of materials:

1. The number of nearest neighbors around an atom is known as coordination number.
2. For body-centred cubic structure, the coordination number is 8.
3. For close-packed hexagonal structure, the coordination number is 16.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

Statement I is correct because coordination number = number of nearest neighbours.
Statement 2 is correct because BCC has coordination number 8.
Statement 3 is incorrect because HCP close-packed structure has coordination number 12, not 16.

End of Solution

Q.58 Consider the following statements regarding structure of materials:

1. Crystalline solids whether pertaining to a metal or non-metal may have more than one crystal structure. This phenomenon is known as polymorphism.
2. Cobalt exists as an FCC lattice at low temperatures and as an HCP one at high temperatures.
3. Strontium exists as an HCP lattice at low temperatures and as an FCC one at high temperatures.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 1 is correct because polymorphism/allotropy refers to different crystal structures of the same element depending upon conditions of temperature and pressure.
Statement 2 is correct because cobalt shows HCP at low temperature and FCC at high temperature.
Statement 3 is incorrect because strontium is typically FCC at room temperature and shows BCC at high temperature.

End of Solution

Q.59 The atomic stacking sequence in the close-packed hexagonal crystal structure is

(a) AAAA... (b) ABAB.
(c) ABCA..... (d) BBBB...

(where A, B, C represent the close-packed places)

Ans. (b)

The stacking sequence in hexagonal close-packed (HCP) structure is ABAB....., where the third layer repeats the first.

End of Solution

Q.60 Consider the following statements regarding AX-type compounds:

1. The crystal lattice of an ionic compound depends on the size of the ions, but not on their valency.
2. NaCl is a simple compound of AB-type, but the unit cell size is affected by the large chlorine atoms.
3. Silicon carbide has the diamond cubic structure, where each silicon atom is bonded to four carbon atoms and vice versa.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement I is incorrect because the crystal lattice of ionic compounds depends strongly on both the size (radius ratio) and valency/charge of the ions.

Statement 2 is correct because Nacl is a rock-salt structure (Nac*l*-type), and large cl^- ions affect the unit cell size.

Statement 3 is correct because SiC has zinc blende or Wurtzite structure with each Si bonded to four C and vice-versa, diamond-like cubic in one form).

End of Solution

Q.61 Consider the following statements regarding semiconductors:

1. At room temperature, there approximately 1.5×10^{10} free carriers in a cubic centimeter of intrinsic silicon material.
2. The free electrons in the intrinsic material are only due to the natural causes and are referred to as intrinsic carriers.
3. The ratio of the number of carriers in germanium to that of silicon is greater than 10^5.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

Statement 1 is correct because $n_i = 1.5 \times 10^{10}$ cm^{-3} for intrinsic silicon at room temperature.

Statement 2 is correct because intrinsic carriers arise from thermal generation.

Statement 3 is incorrect because the ratio of the number of carriers in germanium to that of silicon is approximately equal to 10^3.

End of Solution

Q.62 Consider the following statements regarding semiconductor diodes :

1. PIV ratings for silicon diodes can be in the neighborhood of 400 V, whereas the maximum value for germanium is closer to 600 V.
2. Silicon can be used for applications in which the temperature may rise to about 300°C.
3. Germanium has a much lower maximum rating (100 deg°C).

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

Statement 1 is incorrect because silicon diodes generally have much higher Peak Inverse Voltage (PIV) ratings than germanium diodes.

Statement 2 is incorrect because silicon is far more thermally stable than germanium, its practical upper operating limit for standard diodes is usually around 150°c to 200°C. Operating a standard silicon diode at 300°C would typically cause it to lose its semi-conducting properties and fail.

End of Solution

Q.63 In P-N junction diode, the factor r_B (resistance of the semiconductor material itself and the resistance introduced by the connection between the semiconductor material and the external metallic conductor) can range from typically

(a) 0.01 Ω for high-power devices to 0.20 Ω for some low-power, general-purpose diodes
(b) 0-01 Ω for high-power devices to 0.40 Ω for some low-power, general-purpose diodes
(c) 0.10 Ω for high-power devices to 0.20 Ω for some low-power, general-purpose diodes
(d) 0.10 Ω for high-power devices to 2.00 Ω for some low-power, general-purpose diodes

Ans. (d)

The typical series resistance R_s in high-power diodes is approximately 0.1 Ω (or lower), while in low-power general-purpose diodes it reaches approximately 2 Ω.

End of Solution

Q.64 Consider the following statements regarding transistor amplifier :

1. Current gain increases with increase in temperature.
2. $|V_{BE}|$ (base-emitter voltage) decreases about 100 mV per degree Celsius increase in temperature.
3. Reverse saturation current doubles in value for every 10 °C increase in temperature.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only.
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Statement 2 is incorrect because V_{BE} decreases by approximately 2.5 mv/°c.

End of Solution

Q.65 Consider the following statements regarding transistors:

1. Networks that are quite stable and relatively insensitive to temperature variations have high stability factors.
2. Higher the stability factor, more sensitive is the network to variations in that parameter.
3. For the emitter-bias configuration, the stability factor $S(I_{CO}) = \beta + 1$ for $R_B/R_E >> \beta + 1$).

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 1 is incorrect because stable networks have low stability factors, as the factor measures sensitivity to change.

End of Solution

Q.66 Consider the following statements regarding JFET:

1. The level of V_{GS} that results in I_D = 0 mA is defined by $V_{GS} = V_P$.
2. In ohmic region, JFET can actually be employed as a variable resistor.
3. In n-channel JFET, for all levels of V_{GS} between 0 V and the pinch-off level, the current I_D will range between I_{DSS} (maximum current) and 0 A, respectively.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

All statements correctly describes JFET behaviour. V_{GS} at V_P stops current, it acts as a variable resistor in the ohmic region, and I_D ranges from I_{DSS} to 0.

End of Solution

Q.67 The efficiency of a class B amplifier for a supply voltage of V_{CC} = 24 V with peak output voltage of $V_L(p)$ = 6 V is

(a) 17.23% (b) 19.63%
(c) 24.35% (d) 72.00%

Ans. (b)

Using the efficiency formula

$$\text{Efficiency } (\eta) = \frac{\pi}{4} \times \frac{V_L(p)}{V_{CC}} = 0.785 \times \frac{6}{24}$$
$$= 0.1963 \text{ or } 19.63\%$$

End of Solution

Q.68 Consider the following statements regarding clamper circuit:

1. The network must have a capacitor, a diode and a resistive element, but it can also employ an independent DC supply to introduce an additional shift.
2. The total swing of the output is equal to the total swing of the input signal.
3. During the period when the diode is in the 'on' state, the capacitor will hold on to its established voltage level.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

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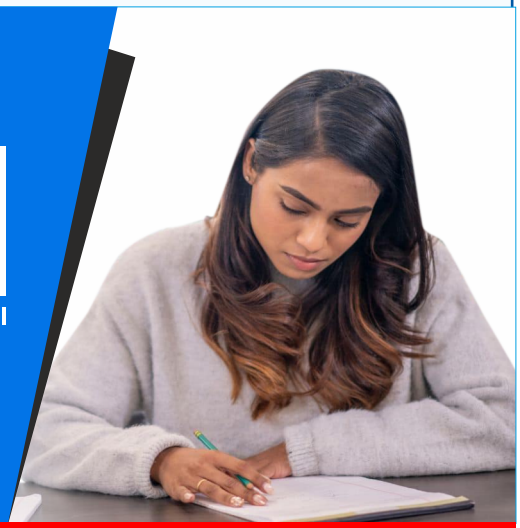

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Ans. (a)

Statement 3 is incorrect because, in a clamper, the capacitor charges rapidly when the diode is "on" rather than simply "holding" its level.

End of Solution

Q.69 Consider the following statements regarding MOSFETS/VMOS FETS:

1. Compared with commercially available planar MOSFETs, VMOS FETs (Vertical Metal-Oxide-Silicon FETs) have reduced channel resistance levels and higher current and power ratings.
2. VMOS FETs have a negative temperature coefficient that will combat the possibility of thermal runaway.
3. The reduced charge storage levels result in faster switching times for VMOS construction compared to those for conventional planar construction.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Statement 2 is incorrect because MOSFETS (including VMOS) generally have a positive temperature coefficient for resistance, which helps prevent thermal runaway.

End of Solution

Q.70 Consider the following statements regarding MOSFETS:

1. For the values of V_{GS} less than the threshold level, the drain current of an enhancement-type MOSFET is 0 mA.
2. For the levels of $V_{GS} \le V_T$, the drain current is related to the applied gate-to-source voltage by the non-linear relationship
$$I_D = k(V_{GS} - V_T)^2$$
3. The k term is a constant that is a function of the construction of the device. The value of k can be determined from the equation
$$k = \frac{I_{D(on)}}{(V_{GS(on)} - V_T)^2}$$
where $I_{D(on)}$ and $V_{GS(on)}$ are the values for each at a particular point on the characteristics of the device.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Statement-2 is incorrect because a channel does not exist until the gate-to-source voltage exceeds the threshold voltage ($V_{GS} > V_T$). Below this, the device is in cut-off-region.

End of Solution

Q.71 If the input voltages of an op-amp are V_{i1} = 150 μV, V_{i2} = 140 μV, the differential is 4000 CMRR is 100, then the output voltage is

(a) 26.4 mV (b) 40.0 mV
(c) 45.8 mV (d) 68.2 mV

Ans. (c)

$$V_{out} = A_{DM}V_d + A_{CM}V_{CM} \quad ...(1)$$

$$V_D = V_{i1} - V_{i2}$$
$$= 150\ \mu V - 140\ \mu V$$
$$= 10\ \mu V$$

$$V_{CM} = \frac{V_{i1} + V_{i2}}{2} = \frac{150\mu V + 140\mu V}{2}$$

$$V_{CM} = 145\ \mu V$$

$$A_{CM} = \frac{A_{DM}}{CMRR} = \frac{4000}{100} = 40$$

Putting all the values in eqn (i)

$$V_{out} = (4000 \times 10 \times 10^{-6}) + (40 \times 145 \times 10^{-6})$$
$$= 45.8\ mV$$

End of Solution

Q.72 An inverting amplifier using op-amp is having R_F = 150 kΩ and R_1 = 2 kΩ. The offset voltage for the op-amp specification listing I_{IO} = 100 nA is

(a) 0.2 mV (b) 7.5 mV
(c) 7.6 mV (d) 15 mV

Ans. (d)

The output offset voltage due to input offset current is calculated as

$$V_0 = I_{IO} \times R_F$$
$$= 100\ nA \times 150\ k\Omega$$
$$= 15\ mV$$

End of Solution

Q.73 Among two cubes, the first one has a length of L m, while the second one has a length of $2L$ m. What is the ratio of the conductivities of the materials of the cubes so that the resistance between any two faces of one cube is same as that of the other cube?

(a) 1/2 (b) 1
(c) 3/2 (d) 2

Ans. (d)

Resistance R between opposite faces of a cube is given by

$$R = \rho \cdot \frac{l}{A} \text{ where } \rho = \frac{1}{\sigma}$$

- Resistance for the first cube:

side = L, so $l = L$, $A = L^2$

$$R_1 = \rho_1 \cdot \frac{L}{L^2} = \frac{\rho_1}{L} = \frac{1}{\sigma_1 L}$$

- Resistance for the second cube

  side = $2L$, so $l = 2L$, $A = (2L)^2 = 4L^2$

$$R_2 = \rho_2 \cdot \frac{2L}{4L^2} = \frac{\rho_2}{2L} = \frac{1}{2\sigma_2 L}$$

- Set resistance equal: $R_1 = R_2$

$$\Rightarrow \quad \frac{1}{\sigma_1 L} = \frac{1}{2\sigma_2 L}$$

This simplifies to $\sigma_1 = 2\sigma_2$

Hence, the ratio $\frac{\sigma_1}{\sigma_2} = 2$.

End of Solution

Q.74 A resistor is made up of alloy 1 dissipating 50 W of electrical power at 110 V at 20°C. Another resistance of alloy 2 is made having the same resistance as the first resistor but consuming double amount of the power of the first one. If the temperature remains constant during the entire process, then the current flowing through alloy 2 resistor at 20°C is

(a) 0.231 A (b) 0.643 A
(c) 1.321 A (d) 1.623 A

Ans. (b)

Given:

Power dissipated (P_1) = 50 W

V_1 = 110 V

and Temperature (T) = 20°C

Resistance (R) of the first resistor

$$R = \frac{V_1^2}{P_1} = \frac{(110)^2}{50} = \frac{12100}{50} = 242\ \Omega$$

The second resistor (alloy 2) has the same resistance R = 242 Ω at 20°C.

Given that second resistor consumes double the power of the first, so

$P_2 = 2 \times 50 = 100$ W (at 20°C as temperature constant).

Hence, the current I_2 through the second-resistor

$$I_2 = \sqrt{\frac{P_2}{R}} = \sqrt{\frac{100}{242}} = \sqrt{0.4132} \approx 0.643\ \text{A}$$

End of Solution

Q.75 Consider the following statements regarding DC network analysis:

1. A voltage source with a parallel resistance can be converted into a current source with a series resistance.
2. A constant current source of I and a parallel resistance R can be converted into a constant voltage source of voltage $V(= IR)$ and a resistance R in series with it.
3. Dependent sources are parts of models which are used to represent electrical properties of electronic devices.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 1 is incorrect because source transformation converts a voltage source with series resistance into a current source with parallel resistance.

End of Solution

Q.76 Consider the following statements regarding Z-transform:

1. The ROC of anti-causal signal is the interior of a circle of some radius r_1.
2. If $x(n)$ is anti-causal, then $x(0) = \lim_{z \to \infty} X(z)$.
3. The ROC of correlation of two sequences $x_1(n)$ and $x_2(n)$ is at least the intersection ROC of $X_1(z)$ and $X_2(z^{-1})$

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Statement 2 is incorrect as it describes the initial value theorem, which applies to causal signal as $Z \to \infty$, not anti-causal.

End of Solution

Q.77 Consider the following statements regarding FIR filters:

1. FIR filters are sometimes called moving-average filters.
2. Because of the linear-phase requirements, the zeros of the transfer function must lie inside the unit circle in the z-plane.
3. The linear-phase characteristic makes the time delay of the filter equal to half its length, which may be large.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Statement 2 is incorrect because linear-phase FIR filters can have zeros anywhere in the z-plane, as long as they satisfy reciprocal symmetry.

End of Solution

Q.78 Consider a multimode step-index optical fiber that has a core radius of 25 μm, a core index of 1.48 and an index difference Δ = 0.01. What is the *V*-number at an operating wavelength of 840 nm?

(a) 39 (b) 76
(c) 42 (d) 16.89

Ans. (b)

Given, Core radius (r) = 25 μm ; n_1 = 1.48 ; Δ = 0.01 ; λ = 840 nm

Numerical aperture (NA) = $n_1\sqrt{2\Delta} = 1.48\sqrt{2\times 0.01} = 0.209$

$$V = \frac{2\pi a}{\lambda} \times NA = \frac{2\pi \times 25 \times 10^{-6}}{840 \times 10^{-9}} \times 0.209$$

Rounding to the nearest whole number, the *V*-number is 39. The correct option is (a).

End of Solution

Q.79 Match the following Lists:

List-I

P. Perigee
Q. Eccentricity
R. Semi-major axis
S. Apogee

List-II

1. It is the point on the orbit that is nearest to the center of the Earth.
2. It is the point on the satellite orbit that is at the farthest distance from the center of the Earth.
3. It is the ratio of the distance between the center of the ellipse and the center of the Earth to the semi-major axis of the ellipse.
4. It is a geometrical parameter of an elliptical orbit.

Select the correct answer using the code given below.

	P	Q	R	S
(a)	2	3	4	1
(b)	1	3	4	2
(c)	2	4	3	1
(d)	3	2	4	1

Ans. (b)

Perigee (nearest), Eccentricity (ratio), semi-major axis (geometry) and Apogee (farthest).

End of Solution

Q.80 An Earth station antenna having a maximum gain of 60 dB at the operational frequency is fed from a power amplifier generating 10 kW. If the feed system has a loss of 2 dB, what is the Earth station EIRP?

(a) 98 dB (b) 110 dB
(c) 48 dB (d) 40 dB

Ans. (a)

Given: $P_t = 10$ kW ; $G_t = 60$ dB ; $L = 2$ dB

$$P_t(\text{In dBW}) = 10\log_{10}^{10^4} \Rightarrow 40\,\text{dBW}$$

$$\text{EIRP} = P_t(\text{dBW}) + G_t(\text{dB}) - \text{Loss}$$
$$= 40\ \text{dBW} + 60\ \text{dB} - 2\ \text{dB} = 98\ \text{dB}$$

End of Solution

Q.81 Consider the following statements related to optical fiber:

1. Multimode step-index fibers are ideally suited for high-bandwidth, very long-haul applications.
2. Single-mode fibers are generally used on lower bandwidth, shorter haul applications using single-mode injection lasers.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (d)

Single-mode is for long-haul or high bandwidth, while multimode is for shorter haul.

End of Solution

Q.82 Match the following Lists:

List-I	List-II
P. Virtual circuit packet switching	1. No dedicated path
Q. Datagram packet switching	2. Fixed bandwidth
R. Circuit switching	3. Route established for each packet

Select the correct answer using the code given below.

	P	Q	R
(a)	2	3	1
(b)	1	2	3
(c)	1	3	2
(d)	3	2	1

Ans. (c)

Virtual circuit (route per packet)
Datagram (no dedicated path)
Circuit switching (fixed bandwidth)

End of Solution

Q.83 Consider the following statements related to CDMA :

1. Because spread spectrum is obtained by the use of noise-like signals, where each user has a unique code, privacy is inherent.
2. The signals closer to the receiver are received with less attenuation than the signals farther away.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (c)

Statement 1 is correct as CDMA uses unique pseudo-random codes that makes signal appear noise-like, providing inherent privacy while statement 2 describes the near a effect where closer signals experience less path loss/attenuation.

End of Solution

Q.84 If A and B choose $p = 47$, $g = 3$, and A picks a random number $x = 8$ and B picks a random number $y = 10$, what are the secret keys for A and B, respectively, using the Diffie-Hellman key exchange algorithm?

(a) 4, 4 (b) 4, 3
(c) 3,4 (d) 3, 3

Ans. (a)

Given that A and B agree on public prime $p = 47$ and $g = 3$

A chooses private key $x = 8$

and B chooses private key $y = 10$

- Computing A's public key (K_A)

$$K_A = g^x \bmod p$$
$$= 3^8 \bmod 47$$

So, $K_A = 28$

- Computing B's public key (K_B)

$$K_B = g^y \bmod p$$
$$= 3^{10} \bmod 47$$

So, $K_B = 17$

- Computing shared secret key from A's side

$$S_A = K_B^x \bmod p$$
$$= 17^8 \bmod 47$$

So, $S_A = 4$

- Computing shared secret key from B's side

$$S_B = K_A^y \bmod p$$
$$= 28^{10} \bmod 47$$

So, $S_B = 4$

Hence, the secret key for A is 4, and for B is 4.

End of Solution

Q.85 Which one of the following is the CRC code for the data word 110101010 using the divisor 10101?

(a) 1011010101011 (b) 1101010101001
(c) 1001010101011 (d) 1101010101011

Ans. (d)

The CRC code is the data word appended with the remainder of the modulo-2 division by the divisor. Hence, the CRC remainder for data 110101010 divided by 10101 is 1011. So, the full codeword is 1101010101011.

End of Solution

Q.86 A host is connected to 16 synchronous terminals through a pair of statistical time-division multiplexers utilizing the bit-map multiplexing. The sixteen asynchronous terminal ports operate at 1200 bps. The line port has a bit rate of 9600 bps. The data link control protocol is HDLC. What are the maximum line utilization efficiency and throughput, respectively?

(a) 0.268 and 1000 bps
(b) 0.696 and 1280 bps
(c) 0.696 and 6678 bps
(d) 0.346 and 128 bps

Ans. (c)

The calculation for the statistical TDM frame with a 16-bit bitmap, 128 data bits, and effective HDLC overhead of 40-bits (considering shared flags), yielding efficiency $\approx \frac{128}{184} = 0.696$ and throughput $\approx 9600 \times 0.696 = 6678$ bps.

End of Solution

Q.87 The bandwidth of QASK signal is

(a) $B = 2f_b N$
(b) $B = 2f_b/N$
(c) $B = f_b N$
(d) $B = f_b/N$

Ans. (b)

Bandwidth of QASK signal $(B) = \frac{2f_b}{N}$

The bandwidth of a QASK (or *M*-ary) signal is inversely proportional to the number of bits per symbol (N).

End of Solution

Q.88 CSMA stands for

(a) Complementary Multiple Access Semiconductor Access
(b) Complementary Sense Multiple
(c) Complete Sense Multimode Access
(d) Carrier Sense Multiple Access

Ans. (d)

CSMA (Carrier Sense Multiple Access) is a media access control protocol where a node verifies the absence of traffic before transmitting.

End of Solution

Q.89 The attenuation in optical communication is usually expressed in decibels per unit length as

(a) $10\log_{10}\frac{P_i}{P_o}$
(b) $20\log_{10}\frac{P_i}{P_0}$
(c) $10\log_{10}\frac{P_o}{P_i}$
(d) $20\log_{10}\frac{P_o}{P_i}$

Ans. (a)

Attenuation is defined by the log ratio of input power to output power per unit length

$$\text{Attenuation } (\alpha) = 10\log_{10}\left(\frac{P_i}{P_o}\right)$$

End of Solution

Q.90 Match the following Lists:

List-I	List-II
P. IP layer	1. Transmission of bits
Q. TCP/UDP layer	2. Network layer of the OSI reference model
R. TCP/IP	3. Transport layer of the OSI reference model
S. Physical layer	4. Application layer of the OSI reference model

Select the correct answer using the code given below.

	P	Q	R	S
(a)	2	3	4	1
(b)	1	3	4	2
(c)	2	4	3	1
(d)	3	2	4	1

Ans. (a)

P. **IP Layer:** This corresponds to the network layer of the OSI reference model.

Q. **TCP/UDP layer:** These are protocols that operate at the transport layer of the OSI reference model.

R. **TCP/IP:** In this list, it is paired with the application layer of the OSI reference model.

S. **Physical layer:** This layer is responsible for the actual transmission of bits over a physical medium.

End of Solution

Q.91 A low-loss transmission line of 50 ohms to a load of characteristic impedance is connected 100 ohms. The voltage reflection coefficient and the standing wave ratio are, respectively

(a) 1/2 and 3 (b) 3 and 1/2
(c) 1/3 and 2 (d) 1/3 and 3

Ans. (c)

Given data, $Z_o = 50\ \Omega$; $Z_L = 100\ \Omega$

(i) $$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{100 - 50}{100 + 50} = \frac{50}{150} = \frac{1}{3}$$

(ii) $$S = \frac{1 + |\Gamma|}{1 - |\Gamma|} = \frac{1 + 1/3}{1 - 1/3} = 2$$

End of Solution

Q.92 A dissipation-less whose transmission line characteristic impedance a load is of 200 ohms is connected to (100 + j100) ohms. The frequency is 300 MHz. If the length of the line is 25 cm, then the input impedance of the line is

(a) 141.44 ohms (b) 282.80 ohms
(c) 424.26 ohms (d) 565.68 ohms

Ans. (b)

Given data: $Z_0 = 200\ \Omega$; $Z_L = 100 + j100\ \Omega$; f = 300 MHz ; l = 25 cm

$$Z_{in} = ?$$

$$\beta l = \frac{2\pi}{\lambda} l = \frac{2\pi f}{C} l = \frac{2\pi \times 300 \times 10^6 \times 25 \times 10^{-2}}{3 \times 10^8}$$

$$\beta l = 1.57 \text{ rad} = 90^\circ$$

$$\therefore \quad \tan\beta l = \infty$$

$$\therefore \quad Z_{in} = Z_0 \left[\frac{Z_L + jZ_0 \tan\beta l}{Z_0 + jZ_L \tan\beta l}\right] = Z_o \left[\frac{\frac{Z_L}{\tan\beta l} + jZ_0}{\frac{Z_0}{\tan\beta l} + jZ_L}\right]$$

$$Z_{in} = \frac{Z_0^2}{Z_L}$$

$$\therefore \quad Z_{in} = \frac{(200)^2}{100 + j100} = \frac{(200)^2}{100\sqrt{2}\angle 45^\circ}$$

$$Z_{in} = 282.84 \angle -45^\circ$$

$$\Rightarrow \quad Z_{in} = 200 - j200\ \Omega$$

$$|Z_{in}| = 282.84\ \Omega$$

End of Solution

Q.93 Consider the following Consider statements regarding waveguides :

1. The phase velocity is defined as the velocity of propagation of equiphase surface along the guide.
2. as the Group velocity is defined velocity with which the group of the waves as a whole propagates.
3. Group velocity is always more than free space velocity.

Which of the statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

Statement 3 is incorrect because group velocity in a waveguide is always less than the speed of light in free space.

End of Solution

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Q.94 Consider the following statements regarding modes of propagation of electromagnetic waves:

1. The impedance value of TM_{mn} modes is always less than 376.8 ohms.
2. For the TE_{mn} modes in a rectangular waveguide, m and n denote the number of half sinusoidals in the electric field distribution along the long and short sides, respectively of the guide.
3. TM_{on} modes cannot exist in rectangular waveguides.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

$$\eta_{TM} = \eta_{TEM}\sqrt{1-\left(\frac{f_c}{f}\right)^2}$$

As $\sqrt{1-\left(\frac{f_c}{f}\right)^2} < 1$

$\therefore \quad \eta_{TM} < \eta_{TEM}$

Hence all the statements are correct.

End of Solution

Q.95 Consider the following statements regarding cavity resonators :

1. At high frequencies, the electro-magnetic cavity resonator replaces the lumped-parameter *R-C* resonant circuit.
2. A thin coating of silver is more than sufficient for the inner walls of the cavity to compensate the losses due to the skin effect.
3. The *Q*-factor of the cavity is of the order of 10000 and above.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 1 is incorrect because at high frequencies (microwave range), a cavity resonator replaces L-C (inductor-capacitor) resonant circuits, not *R-C* circuits.

End of Solution

Q.96 Consider the following statements regarding CMOS fabrications :

1. n-well CMOS circuits are superior to *p*-well because of the lower substrate bias effects on transistor threshold voltage and inherently lower parasitic capacitances associated with source and drain regions.
2. Latch-up problems can be considerably reduced by using a low-resistivity epitaxial *p*-type substrate as the starting material, which can subsequently act as a very low-resistance ground plane to collect substrate currents.
3. The twin-tub fabrication process allows separate optimization of the n- and p-transistors.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

- *n*-well CMOS offers lower substrate bias effects and parasitic capacitances.
- Low-resistivity *p*-substrate reduces latch-up.
- Twin-tub enables separate *n*/*p* optimization.

All statements are correct.

End of Solution

Q.97 Consider the following statements regarding CMOS and bipolar technologies :

1. Bipolar technologies are having high delay sensitivity to load as compared to CMOS technologies.
2. CMOS technologies are having low drive current as compared to bipolar technologies.
3. CMOS technologies are having low power dissipation as compared to bipolar technologies.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 1 is incorrect because bipolar technologies has lower delay sensitivity to load than CMOS.

End of Solution

Q.98 Which one of the following approaches is used to reduce the area per bit requirement which basically consists of a capacitor C_m, which can be charged during 'write' from the read/write' line, provided that the 'row select' line is Hi?

(a) One-transistor cell (b) Two-transistor RAM cell
(c) Three-transistor RAM cell (d) Six-transistor cell

Ans. (a)

The DRAM cell uses one transistor and one capacitor to reduce the area required per bit.

End of Solution

Q.99 The microprocessor Zilog Z8000 is a/an

(a) 8-bit microprocessor (b) 16-bit microprocessor
(c) 32-bit microprocessor (d) 64-bit microprocessor

Ans. (b)

The Zilog Z8000 is a 16-bit processor.

End of Solution

Q.100 The execution of ORI instruction requires

(a) 2 M-cycles and 7 T-states
(b) 2 M-cycles and 10 T-states
(c) 3 M-cycles and 7 T-states
(d) 3 M-cycles and 10 T-states

Ans. (a)

In the 8085 microprocessor, the ORI (OR immediate) instruction is a 2-byte instruction (opcode + immediate data) that requires 2 machine cycles (opcode fetch + memory read) and a total of 7 *T*-states (4 opcode fetch + 3 for memory read of immediate data).

End of Solution

Q.101 Which one of the following instructions in 8085 microprocessor does not affect any flag?

(a) RLC
(b) PUSH
(c) ORI
(d) INR

Ans. (b)

PUSH instruction in 8085 microprocessor is not affect the flags. Since, it is a data transfer instruction.

End of Solution

Q.102 Consider the following regarding RISC processor: statements

1. The number of instructions is less than 400.
2. The number of addressing modes is more than 3.
3. Memory is accessed only by Load and Store instructions.

Which of the above statements are ***not*** correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (a)

In RISC processor, memory is accused only by load and store instructions which is true statement and (a) is correct option where ξ^2 are false.

End of Solution

Q.103 Consider the following statements regarding MC68HC11 microcontroller :

1. It has 40 I/O lines with multiple functions.
2. It has two operating modes.
3. It has 8k bytes of ROM and 512 bytes of EEPROM.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)

For the given MC68HC11 microcontroller, all statements are correct.

End of Solution

Q.104 The Z-transform of $x(n) = -a^n(-n-1)$ is

(a) $-\frac{1}{1-az^{-1}}$; ROC is $|z|<|a|$ (b) $-\frac{1}{1-az^{-1}}$; ROC is $|z|>|a|$

(c) $-\frac{z^{-1}}{1-az^{-1}}$; ROC is $|z|<|a|$ (d) $-\frac{1}{1-(az)^{-1}}$; ROC is $|z|<|a|$

Ans. (a)

$$-a^n u[-n-1] \xleftrightarrow{\text{Z.T.}} \frac{1}{1-az^{-1}};\ |z|<|a|$$

End of Solution

Q.105 The inverse Z-transform of $X(z) = \log(1 + az^{-1})$ with ROC $|z|>|a|$ is

(a) $x(n) = \begin{cases} (-1)^n \frac{a^n}{n}, & n \geq 1 \\ 0, & n \leq 0 \end{cases}$ (b) $x(n) = \begin{cases} (-1)^n \frac{a^{n+1}}{n}, & n \geq 0 \\ 0, & n \leq -1 \end{cases}$

(c) $x(n) = \begin{cases} (-1)^{n+1} \frac{a^{n+1}}{n}, & n \geq 0 \\ 0, & n \leq -1 \end{cases}$ (d) $x(n) = \begin{cases} (-1)^{n+1} \frac{a^n}{n}, & n \geq 1 \\ 0, & n \leq 0 \end{cases}$

Ans. (d)

Given, $X(z) = \log(1 + az^{-1})$

$$\frac{dX(z)}{dz} = \frac{1}{1+az^{-1}}(-az^{-2})$$

$$-z\frac{dX(z)}{dz} = -z\left[\frac{1}{1+az^{-1}}\right](-az^{-2})$$

$$= \frac{az^{-1}}{1+az^{-1}};|z|>|a|$$

We know that, $nx(n) \longleftrightarrow -z\frac{dX(z)}{dz} = \frac{az^{-1}}{1+az^{-1}};|z|>|a|$ ...(i)

Let, $(-a)^n u[n] \longleftrightarrow \frac{1}{1+az^{-1}};|z|>|a|$

$$(-a)^{n-1}u[x-1] \longleftrightarrow \frac{z^{-1}}{1+az^{-1}};|z|>|a|$$

$$a\cdot(-a)^{n-1}u[n-1] \longleftrightarrow \frac{az^{-1}}{1+az^{-1}};|z|>|a|$$

$$a\cdot a^{n-1}(-1)^{n-1}u[n-1] \longleftrightarrow \frac{az^{-1}}{1+az^{-1}};|z|>|a|$$

$\therefore$ $$a^n(-1)^2(-1)^{n-1}u[n-1] \longleftrightarrow \frac{az^{-1}}{1+az^{-1}};|z|>|a|$$

$\therefore$ $$a^n(-1)^{n+1}u[n-1] \longleftrightarrow \frac{az^{-1}}{1+az^{-1}};|z|>|a|$$

From equation (i), $nx(n) = a^n(-1)^{n+1}u[n-1]$

$$\Rightarrow \quad x[n] = \begin{cases} (-1)^{n+1}\dfrac{a^n}{n}, & n \geq 1 \\ 0, & n \leq 0 \end{cases}$$

End of Solution

Q.106 The interrupts such as register overflow, attempt to divide by zero, an invalid operation code, stack overflow and protection violation are classified as

(a) external interrupts
(b) internal interrupts
(c) software interrupts
(d) hybrid interrupts

Ans. (b)

Internal interrupt is a signal which is generated by the internal hardware embedded in the motherboard.

i.e., timer
Temperature sensor
Invalid opcode
Divide by zero
Stack overflow etc.

End of Solution

Q.107 Which of the following statements are correct with respect to CISC processor?

1. It provides direct manipulation of operands residing in memory.
2. It has instructions that use only processor registers, the availability of other modes of operations tend to simplify high-level language compilation.
3. If more instructions and addressing modes are a incorporated into computer, the more hardware logic is needed to implement and support them, and this may cause the computations to slow down.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1 and 3 only

Ans. (d)

In CISC processor instructions uses both register and memory not only from the registers.

∴ Second statement is wrong.

End of Solution

Q.108 Which one of the following is a technique of decomposing a sequential process into sub-operations, with each sub-process being executed in a special dedicated segment that operate concurrently with all other segments?

(a) Pipeline processing
(b) Vector processing
(c) Scalar processing
(d) Array processing

Ans. (a)

End of Solution

Q.109 Which type of procedure is employed in which some computers give the responsibility for solving data conflicts problem to the compiler that translate the high-level programming language into a machine language program?

(a) Hardware interlock
(b) Operand forwarding
(c) Branch target buffer
(d) Delayed load

Ans. (d)

Hardware techniques: Hardware interlock operand forwarding branch target buffer.
Software technique: Delayed load.

End of Solution

Q.110 In an asynchronous data transfer, a unit receiving the data item responds with another control signal to acknowledge receipt of agreement the data. This type of agreement between two independent units is referred to as

(a) timing diagram
(b) strobe
(c) handshaking
(d) activity diagram

Ans. (c)

Handshaking signals are exchanged between transmitter and receiver for error free transfer of data for proper coordination. Example : acknowledgment signals.

End of Solution

Q.111 Which of the following rules are correct, when a transmitted character is detected by the receiver from knowledge of the transmissions?

1. When a character is not being sent, the line is kept in the 1-state.
2. The initiation EL character of transmission is detected from the start bit, which is always 0.
3. The character bits always follow the start bit.
4. After the last bit of the character is transmitted, a stop bit is detected when the line returns to the 1-state for at least one bit time.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

Ans. (d)

All the given statements are correct.

End of Solution

Q.112 In the serial transmission of a terminal whose transfer rate is 10 characters per second and each transmitted character consists of a start bit, eight information bits and two stop bits, for a total of 11 bits, the approximate baud rate is

(a) 110 baud
(b) 11 baud
(c) 210 baud
(d) 10 baud

Ans. (a)

For 1 character $\rightarrow$ 1 + 8 + 2 = 11 bits

$\therefore$ For 10 characters $\Rightarrow$ 10 $\times$ 11 bits = 110 bits/sec = 110 baud

End of Solution

Q.113 Consider the following statements regarding electromagnetic fields and waves :

1. An incompressible fluid of non-zero value of divergence at a point X represents the rate at which the fluid is being gained or removed at point X.
2. Twice the velocity field (v) at any instant of time equals the curl of the angular velocity of rotation (ω).
3. A field which is not irrotational is sometimes called a vortex field.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

End of Solution

Q.114 If vector $\vec{A}$ in spherical coordinate system is defined as $\vec{A} = A_r a_r + A_\theta a_\theta + A_\phi a_\phi$, then the curl of $\vec{A}$ in a_r direction is

(a) $\frac{1}{r}\left[\frac{\partial}{\partial r}(A_\theta r\sin\theta) - \frac{\partial A_\phi}{\partial \theta}\right]$ (b) $\frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial}{\partial r}(A_r \sin\theta) - \frac{\partial A_\theta}{\partial \phi}\right]$

(c) $\frac{1}{r\sin\theta}\left[\frac{\partial}{\partial \theta}(A_\phi \sin\theta) - \frac{\partial A_\theta}{\partial \phi}\right]$ (d) $\frac{1}{r\sin\theta}\left[\frac{\partial}{\partial \theta}(A_\theta \sin\theta) - \frac{\partial A_\phi}{\partial \phi}\right]$

Ans. (c)

$$\nabla \times \bar{A} = \frac{1}{r^2\sin\theta}\begin{vmatrix} \hat{a}_r & r\hat{a}_\theta & r\sin\theta\hat{a}_\phi \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \phi} \\ A_r & rA_\theta & r\sin\theta A_\phi \end{vmatrix}$$

In the direction of $\hat{a}_r$

$$\nabla \times \bar{A} = \frac{1}{r^2\sin\theta}\left[\frac{\partial}{\partial \theta}(r\sin\theta A_\phi) - \frac{\partial}{\partial \theta}(rA_\phi)\right]$$

$\Rightarrow$

$$\nabla \times \bar{A} = \frac{1}{r\sin\theta}\left[\frac{\partial}{\partial \theta}(r\sin\theta A_\theta) - \frac{\partial}{\partial \theta}(A_\theta)\right]$$

End of Solution

Q.115 Consider the following statements regarding Maxwell's equations:

1. The total electric flux density or total electric displacement through the surface enclosing a volume v is equal to the total charge within the volume.
2. Net electric flux emerging through any closed surface is zero.

3. The magnetomotive force around a closed path is equal to the time derivative of the magnetic flux density or magnetic displacement through any surface bounded by the surface.

Which of the above statements are ***not*** correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

The correct statements corresponding to the statements are

- $\oint \bar{D} \cdot d\bar{S} = Q_{enc.}\ ;\ \nabla \cdot \bar{D} = \rho_v$
- $\oint \bar{B} \cdot d\bar{S} = 0\ ;\ \nabla \cdot \bar{B} = 0$
- $\oint \bar{H} \cdot d\bar{L} = \int \left(\bar{J} + \frac{\partial \bar{D}}{\partial t} \right) \cdot d\bar{S}\ ;\ \nabla \times \bar{H} = \bar{J} + \frac{\partial \bar{D}}{\partial t}$

End of Solution

Q.116 Consider the following statement regarding Maxwell's equations:

1. When the displacement current very much greater than conduction current, the medium behaves like a dielectric.
2. For good conductors, σ and ε are independent of frequency but for most of the dielectrics, the constants σ and ε are functions of frequency. Under these circumstances, the ratio $\frac{\sigma}{\omega \in}$ is called as the frequency factor of the dielectrics.
3. The term $\frac{\sigma}{\omega \in}$ is also sometime referred to the loss tangent.

Which of the above statements correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement 1: $\left|\bar{J}_d\right| >> \left|\bar{J}\right|$

$\Rightarrow \quad \left|j\omega \in \bar{E}\right| >> \left|\sigma \bar{E}\right|$

$\Rightarrow \quad \omega \in >> \sigma$

$\Rightarrow \quad \frac{\sigma}{\omega \in} << 1$

$\Rightarrow$ Good (or) low loss dielectric

Statement 2: $\frac{\sigma}{\omega \in}$ = Frequency factor

Statement 3: $\frac{\sigma}{\omega \in}$ = Loss tangent

End of Solution

Q.117 Consider the following statements regarding electromagnetism:

1. Intrinsic resistance is a function of frequency and it is less than that for a perfect dielectric.
2. An increase in the frequency or loss in the dielectric results in the lowering of intrinsic resistance.
3. In high-frequency case, the skin depth represents the depth at which the electric intensity is 0.707 of its surface value.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

1. Intrinsic resistance, $\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\epsilon}} = f(\omega)$

For a perfect dielectric, $\sigma = 0$, $\eta = \sqrt{\frac{\mu}{\epsilon}}$

Now, if $\sigma \uparrow$, $\eta \uparrow$
So, η_{max} at $\sigma = 0$
Hence, statement 1 is correct.

2. As $\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\epsilon}}$

$$\Rightarrow \quad |\eta| = \frac{\sqrt{\mu/\epsilon}}{\left[1+\left(\frac{\sigma}{\omega\epsilon}\right)^2\right]^{1/4}}; \ \theta_\eta = \frac{1}{2}\tan^{-1}\left(\frac{\sigma}{\omega\epsilon}\right)$$

So, if $f \uparrow \Rightarrow \omega \uparrow \Rightarrow \frac{\sigma}{\omega\epsilon} \downarrow \Rightarrow |\eta| \uparrow \theta_n \downarrow$

So, for intrinsic impedance to become intrinsic resistance, $\theta_n \to 0$ and $|\eta| \uparrow$
Hence statement (2) is wrong.

3. Skin depth, $\delta \propto \frac{1}{\sqrt{f}}$

So, at f $\uparrow$, $\delta \downarrow$ i.e. at high frequency, $\delta \to 0$
Hence statement (3) is wrong.

End of Solution

Q.118 The depth of penetration may be defined that depth in which the wave has as been attenuated by

(a) 33% approximately of its initial value (b) 37% of approximately its initial value
(c) 67% approximately of its initial value (d) 73% approximately of its initial value

Ans. (b)

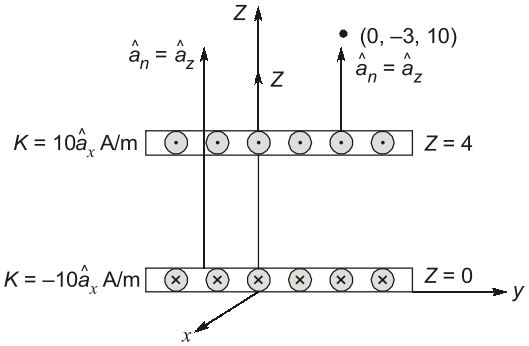
Skin depth is defined as the depth to which EM wave attenuates to e^{-1} times (0.37) times initial value.

End of Solution

Q.119 The planes $z = 0$ and $z = 4$ carry currents $K = -10a_x$ A/m and $K = 10a_x$ A/m is respectively. The value of H at (0, –3, 10)

(a) 0 A/m
(b) $5a_z$ A/m
(c) $10a_z$ A/m
(d) $10a_y$ A/m

Ans. (a)



Mathematically, $\bar{H} = \frac{1}{2}(\bar{K} \times \hat{a}_n)$

$\Rightarrow \quad \bar{H} = \frac{1}{2}[-10\hat{a}_x \times \hat{a}_z] + \frac{1}{2}[10\hat{a}_x \times \hat{a}_z]$

$\Rightarrow \quad \bar{H} = -5[\hat{a}_x \times \hat{a}_z] + 5[\hat{a}_x \times \hat{a}_z] = 0$ A/m

End of Solution

Q.120 Consider the following statements regarding transmission lines:

1. In single-stub matching, the combination of stub and line presents a conductance which is equal to twice of the characteristic conductance of the line.
2. Single-stub matching is useful for all frequencies because the position of the stub can be varied with the variation in frequency.
3. Single-stub matching system is a narrowband system.

Which of the above statements are ***not*** correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (a)

Statement 2 is wrong.

End of Solution

Q.121 Consider the following statements regarding Mason's gain formula $T = \sum_{k=1}^{k} \frac{P_k \Delta_k}{\Delta}$:

1. P_k is the forward path transmittance of kth path from a specified input node to an output node.
2. Δ is the graph determinant which involves closed-loop transmittances and mutual interactions between non-touching loops.

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7	PI	Waleed Shaikh	Test Series
7	ME	Abhinn	Online Course
7	IN	Dev J. Patel	Test Series
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3. The path factor Δ_k for the kth path is equal to the value of the graph determinant of a signal flow graph which exists after erasing the kth path from the graph.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

Q.122 Consider the following statements regarding root locus plot:

1. The root locus starts ($K = 0$) from the open-loop poles and terminates ($K = \infty$) on the finite open-loop zeros only.
2. For higher values of K, the root locus can be approximated by asymptotic lines and these asymptotic lines intersect at a point on the real axis.
3. If the root locus intersect imaginary axis, then the points intersection are conjugate.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

End of Solution

Q.123 Consider the following statements regarding stability in characteristic equation of system:

1. If any oscillations set up in a system in consequence to application of an input are damped out with respect to time, the system is said to be stable.
2. If the magnitude of the oscillations is sustained, the system is unstable.
3. For a stable system, there should be no change of sign in the first column of Routh array formed from the coefficients of the characteristic equation expressed in polynomial form.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

End of Solution

Q.124 Consider the following statements regarding frequency domain analysis of control system:

1. Gain margin is used to indicate the proximity of the intersection of the negative real axis made by the Nyquist (polar) plot of $G(j\omega)\,H(j\omega)$ to the $(-1 + j0)$ point.
2. Phase crossover frequency is the point in the $G(j\omega)$ plane at which the Nyquist $G(j\omega)\,H(j\omega)$ plot intersects the positive real axis.
3. Gain margin is the amount of gain in decibels that is allowed to be increased in the loop before the closed-loop system reaches instability.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

Q.125 Consider the following statements regarding principles of control systems:

1. In control system, controlling variable is the excitation applied to a control system from an external source. It is also a motivating input signal to the system, which is independent of the output of the system.
2. One of the important features of feedback is reduced sensitivity of the ratio of the output to input to variations in system characteristics.
3. In the system, the actuating signal is the difference between the reference input and feedback signal.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)

End of Solution

Q.126 The steady-state errors for type 0 and type 1 systems for the parabolic input are, respectively

(a) 0 and 0
(b) 0 and $1/K$
(c) $1/K$ and
(d) ∞ and ∞

Ans. (d)

End of Solution

Q.127 Consider following the statements regarding feedback compensation:

1. The design procedure for a cascade compensator is more direct than those for a feedback compensator.
2. A faster response can be achieved by the use of parallel compensation.
3. The degree of accuracy and stability of a control system can be improved by the use of a series compensator.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)

End of Solution

Q.128 The stability limit of the servomechanism having open-loop transfer function

$$G(s)H(s) = \frac{K_a(2 + sT_1)}{s^2(1 + sT_2)}$$

(a) $T_1 > T_2$
(b) $T_1 > (3/2)\ T_2$
(c) $T_1 > 2T_2$
(d) $T_2 > (1/2)\ T_1$

Ans. (c)

Given, $s^3T_2 + s^2 + K_aT_1 + 2K_a = 0$

By comparison with $as^3 + bs^2 + cs + d = 0$

$$bc = K_aT_1$$
$$ad = 2K_aT_2$$

$\because \quad bc > ad \quad \Rightarrow \quad K_aT_1 > 2K_aT_2$

$\therefore \quad T_1 > 2T_2$

End of Solution

Q.129 How many number of roots are there on the right half of the s-plane for the system whose characteristic equation is given below?

$$s^6 + s^5 - 2s^4 - 3s^3 - 7s^2 - 4s - 4 = 0$$

(a) 0 (b) 1

(c) 2 (d) 3

Ans. (b)

Given characteristics equation,

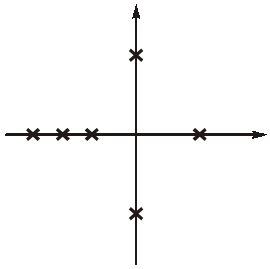
$$s^6 + s^5 - 2s^4 - 3s^3 - 7s^2 - 4s - 4 = 0$$

s^6	1	−2	−7	−4
s^5	1	−3	−4	
s^4	1	−3	−4	
s^3	ϕ_4	ϕ_{-6}		
s^2	−1.5	−4		
s^1	$-\frac{50}{3}$			
s^0	−4			

The auxiliary equation, $s^4 - 23s^2 - 4$

$$\frac{d}{ds}\left[s^4 - 3s^2 - 4\right]$$
$$4s^3 - 6s$$

The placement of roots



Since there is one sign change in the below row of zeros, hence one pole must be on right side which is symmetrical.

End of Solution

Q.130 Consider the following statements regarding time response analysis of control system:

1. In proportional control, the actuating signal for the control action in a control system is proportional to the difference between the reference input signal and the feedback signal obtained from the output.
2. The sluggish overdamped response of a control system can be made faster by increasing forward path gain of the system.
3. Without sacrificing the steady-state accuracy, the maximum overshoot can be reduced to same extent by modifying the actuating signal.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

Q.131 The design of combinational circuits starts from the verbal outline of the problem and ends in a logic circuit diagram. The procedure involves the following steps:

1. The problem is stated, and the input and output variables are assigned letter symbols.
2. The truth table that defines the relationship between inputs and outputs is derived.
3. The simplified Boolean functions for each output are obtained.
4. The logic diagram is drawn.

Which of the above steps are correct?

(a) 1 and 3 only (b) 1, 2 and 4 only
(c) 1, 3 and 4 only (d) 1, 2, 3 and 4

Ans. (d)

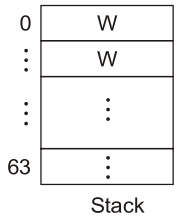
End of Solution

Q.132 In a 64-word stack, the stack pointer contains how many bits?

(a) 6 bits (b) 64 bits
(c) 8 bits (d) 16 bits

Ans. (a)

Stack size = 64 word



SP holds the top of the stack address.

$\therefore$ $SP = \log_{264}\log_2^{64} = 6$ bit

End of Solution

Q.133 For the simple arithmetic expression $(A + B) * [C * (D + E) + F]$, the expression can be written in reverse Polish notation as

(a) $AB + DE * C + F + *$ (b) $A * B + D * E + C + F *$

(c) $AB + DE + C * F + *$ (d) $A + B * D + E + C * F$

Ans. (c)

Reverse Polish Notation (means post fix notation) is a way of writing expressions without brackets.

Rule: Operator comes after its operands $(A + B) * (C * (D + E) + F)$

- We convert it from inside to outside.
- First bracket is $(A + B)$ i.e., $AB+$
- Second bracket is $(D + E)$ i.e., $DE+$
- Next bracket is $C * (D + E)$ i.e., $DE + C *$
- Next bracket is $C * (D + E) + f$ i.e., $DE + C * F +$
- Multiply with $(A + B)$, i.e., $AB + DE + C * F + *$

End of Solution

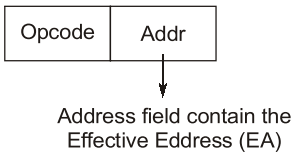
Q.134 In which one of the following addressing modes, the effective address is equal to the address part of the instruction?

(a) Implied Mode (b) Direct Address Mode

(c) Immediate Mode (d) Register Indirect Mode

Ans. (b)

Direct AM instruction design is



End of Solution

Q.135 In an 8-bit ALU, let A = 11110000 and B = 00010100. After performing $A - B$, the compare instruction updates the status bits as

(a) $C = 1, S = 1, V = 0, Z = 0$ (b) $C = 0, S = 0, V = 1, Z = 1$

(c) $C = 1, S = 1, V = 1, Z = 1$ (d) $C = 0, S = 0, V = 1, Z = 0$

Ans. (*)

$$A - B = A + (2\text{'s complement of } B)$$

Here, $CY = 1$ but for subtraction operation

$$CY = \overline{CY} = 0$$

$$S = 1, \quad Z = 0, \quad V = 0 \qquad (\because C_T \oplus C_8 = 1 \oplus 1 = 0)$$

No option is matching.

End of Solution

Q.136 Consider the following statements regarding noise:

1. The shot noise has a uniform spectral density like thermal noise.
2. For the amplifying devices, the shot noise is inversely proportional to the output current.
3. The partition noise in a diode will be higher than that in a transistor.

Which of the above statements is/are not correct?

(a) 1 only (b) 2 only
(c) 2 and 3 (d) 1 and 2

Ans. (c)

PSD of shot noise, $s(f) = 2qI_{DC}$

$q \rightarrow$ Electron charge

$I_{dc} \rightarrow$ Direct current

PSD is independent of frequency, it is considered to be uniform.

The root mean square (RMS) shot noise current is,

$$I_n = \sqrt{2qI_{DC} \times \Delta f}$$

So, that shot noise is directly proportional to the square of the current.

Partition noise in a transistor is always higher than in a diode.

So that statement 2 and 3 are incorrect.

End of Solution

Q.137 Consider the following statements regarding white noise:

1. The white noise contains all the frequency components in equal proportion.
2. Johnson noise is an example of white noise.
3. The white noise has a Gaussian distribution.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

End of Solution

Q.138 Consider the following statements regarding random variables:

1. A discrete random variable will have a countable number of have distinct values.
2. Continuous random variable is defined for the system which generates a finite number of outcomes within a finite period of time.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (a)

End of Solution

Q.139 Consider the following statements regarding modulation:

1. Analog modulation requires lower bandwidth than that for the digital modulation methods.
2. Separation of signal from noise is not possible in analog modulation. Therefore, repeaters can be used.
3. FDM is used for multiplexing in analog modulation.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Repeaters i.e., regenerative repeaters used in digital communication only.

End of Solution

Q.140 Consider the following statements regarding modulation:

1. In low-level modulation, linear amplifiers are required in order to avoid any waveform distortion.
2. High-efficiency class *B* amplifiers are used in high-level modulation.
3. In high level, modulation takes place in the last RF amplifier stage of the transmitter.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

High-Level modulation typically employs Class C amplifiers, not Class B.
Class C amplifiers offer much higher efficiency than Class B, making them the standard choice for the final power stage in high-level modulators.
So statement 2 is not correct.

End of Solution

Q.141 Consider regarding detectors: the following statements

1. Synchronous detectors suffer with diagonal clipping errors.
2. Operating principle of envelope detector is to rectify the incoming signal and pass it through an LPF.
3. Envelope detector is used for DSB-SC.

Which of the above statements is/are not correct?

(a) 1 only (b) 2 only
(c) 1 and 3 (d) 2 and 3

Ans. (c)

Statements 1 and 3 are correct.

End of Solution

Q.142 Consider the following statements regarding sideband suppression methods:

1. Frequency discrimination method can be used to generate SSB at higher frequency.
2. Up conversion is needed in phase discrimination method.
3. In phase discrimination method, unwanted sideband is cancelled out by shifting AF and RF signals to balance modulator by 90°.

Which of the above statements are ***not*** correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

From the handwritten explanation:

1. **Phase discrimination method** generates the SSB signal directly at the required frequency, so up-conversion is not required.
   Therefore, the statement 2 is incorrect.
2. **Frequency discrimination method** is difficult to use for generating SSB directly at high frequency because:
   - High-frequency filters generally have **poor Q factor**
   - It becomes difficult to suppress the unwanted sideband at higher frequencies.

   So that statement 1 is also incorrect.

Hence, the correct answer marked is option (a).

End of Solution

Q.143 Consider the following statements regarding various pulse analog modulation techniques:

1. Noise interference is minimum in PAM as compared to PWM and PPM.
2. The instantaneous power of the transmitter remains constant in PWM.
3. In PAM, the bandwidth of the transmission channel depends on width of the pulse.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

- In **PAM (Pulse Amplitude Modulation)**, the information is carried in the amplitude of the pulses. Since noise mainly affects amplitude, noise interference is maximum in PAM. Hence, Statement (1) is incorrect.
- In **PWM (Pulse Width Modulation),** the width (duration) of the pulses changes according to the modulating signal. "Because pulse width changes, the instantaneous transmitted power varies. Therefore, Statement (2) is incorrect.
- In **PAM**, the **bandwidth depends on the pulse width.** Bandwidth is inversely proportional to pulse width (narrower pulses require more bandwidth). Hence, statement 3 is correct.

End of Solution

Q.144 Consider the following statements regarding Frequency Division Multiplexing (FDM):

1. FDM needs synchronization between its transmitter and receiver for proper operation.
2. In FDM, due to slow narrow band fading only a single channel gets affected.
3. All the FDM channels get affected due to wideband fading.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

- **TDM (Time Division Multiplexing)** requires synchronization between transmitter and receiver so that time slots are properly identified. **FDM does not require time synchronization** in that way. Therefore, Statement (1) is incorrect.
- In FDM (Frequency Division Multiplexing):
  - The total available bandwidth is divided into **multiple non-overlapping narrowband channels**.
  - If slow narrowband fading occurs, it typically affects only the **specific frequency band** of single channel.

  Hence, Statement (2) is correct.
- Statement 3 also correct.

End of Solution

Q.145 Consider the following statements regarding modulations:

1. Only one bit is used to encode one sample in Adaptive Delta Modulation (ADM).
2. In Differential Pulse Code Modulation (DPCM), the fixed number of level is used.
3. In ADM, quantization noise and slope overload distortion are present.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

1. In **DM (Delta Modulation)** and **ADM (Adaptive Delta Modulation),** 1-bit quantization is used (one bit per sample). Statement (1) is correct.
2. In **DPCM (Differential PCM),** the difference between the actual sample and the predicted value is quantized using a fixed number of levels (i.e. bits). Statement (2) is correct.

End of Solution

Q.146 Consider the following statements:

1. The signal-to-noise ratio of Pulse Code Modulation (PCM) remains almost constant with companding.
2. Analog to digital converter is not required in Delta Modulation (DM).
3. Because of variable step size, the dynamic range of Adaptive Delta Modulation (ADM) is wider than simple Delta Modulation.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

1. **Companding in PCM:**
   - Companding is used to improve the signal-to-quantization-noise ratio (SQNR) for weak (low-amplitude) signals.
   - It compresses large signals and expands small signals before quantization.
   - This helps maintain nearly constant SNR over a wide dynamic range.

   Statement (1) is correct.

2. **Delta Modulation (DM):**
   - DM is fundamentally a digital modulation technique.
   - It converts an analog input signal into a 1-bit digital data stream.

3. **In ADM (Adaptive Delta Modulation):**
   - The step size increases when the signal has a large slope.
   - The step size decreases when the signal variation is small.
   - This allows ADM to track signals with both large and small amplitudes better than standard DM.
   - It reduces slope overload distortion and granular noise compared to basic Delta Modulation.

   Therefore, Statement (3) is correct.

End of Solution

Q.147 Consider the following statements regarding Binary ASK, Binary FSK and Binary PSK:

1. The performance of Binary FSK in presence of noise is better than that of Binary ASK and Binary PSK.
2. Binary PSK systems are more complex than that for Binary ASK and Binary FSK.
3. Binary ASK supports the data rate up to 1200 bits/second.

Which of the above statements are not correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

1. **Noise Performance:**
   - BPSK (Binary Phase Shift Keying) has better noise performance compared to BASK (Binary ASK) and BFSK (Binary FSK).
   - So any statement saying BPSK does not have better noise immunity is incorrect.

   Statement (1) is incorrect.

2. **Complexity:**
   - BPSK requires coherent detection, which increases receiver complexity.
   - Non-Coherent ASK and FSK receivers are generally simpler.
   - Therefore, BPSK has higher complexity compared to non-coherent ASK/FSK.

3. **Data Rate (ASK)**
   - BASK is typically used for low-speed data transmission.
   - Many practical systems support data rates around 1200 bps.

   Statement (3) is correct.

End of Solution

Q.148 Consider the following statements regarding unit impulse signal:

1. The discrete-time unit impulse is the first difference of the discrete-time step signal.
2. The amplitude of unit impulse signal is equal to '1' at $n = 1$.
3. The continuous-time unit impulse can be obtained as first derivative of the continuous-time unit step.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

End of Solution

Q.149 Consider the following statements regarding system properties:

1. A system is a causal, if the output at any time depends on values of the input at only the present and past times. Such a system is often referred to as being non anticipative.
2. Summer is an example of a discrete-time system with memory.
3. A system is said to be memoryless if its output for each value of the independent variable at a given time is dependent on the input at only that same time.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

Q.150 Consider the following statement regarding Laplace transform:

1. The ROC of $X(s)$ consists of strip parallel to the $j\omega$-axis in the s-plane.
2. For rational Laplace transform, the ROC does not contain any poles.
3. If $x(t)$ is of finite duration and absolutely integrable, then the ROC is the entire s-plane.

Which of the above statements a correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution