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ESE - 2026

Preliminary Examination

QUESTIONS WITH DETAILED SOLUTIONS

ELECTRONICS & TELECOMMUNICATION ENGINEERING (SET-D)

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Electronics & Telecommunication Engineering (SET - D)

SUBJECT WISE WEIGHTAGE

S.No.	Name of the Subject	No. Of Questions
1	Analog & Digital Communication Systems	16
2	Control Systems	10
3	Signals & Systems	7
4	Computer Organization & Architecture	11
5	Electro Magnetics	13
6	Advanced Electronics Topics	4
7	Advanced Communication Topics	10
8	Basic Electronics Engineering	7
9	Basic Electrical Engineering	8
10	Materials Science	13
11	Electronic Measurements & Instrumentation	14
12	Network Theory	16
13	Analog Circuits	10
14	Digital Circuits and Microprocessors & Microcontrollers	7 & 4
Total No. Of Questions		**150**

01. 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 $A1_2O_3$. 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

01. Ans: (a)

Sol: Statement (3) is not correct. Mullite refractories are prepared by high temperature firing of alumina and silica in the proper proportions.

02. 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

02. Ans: (a)

Sol: Statement (3) is true
Electrical conductivity of graphite is more than beryllium.

03. 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.

03. Ans: (a)

Sol:

Metal	**Net magnetic moment in Bohr magneton**
Fe	2.1
Co	1.1
Ni	0.6

04. Consider the following statements regarding magnetic properties 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

04. Ans: (b)

Sol: Anti-ferromagentic material have anti parallel with equal magnitudes of dipoles, so statement (2) is not correct.

05. 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

05. Ans: (c)

Sol: 1. Soft magnetic materials have high permeability.
2. Soft magnetic materials have low coercivity.
3. Hard magnetic materials are used for their ability to retain magnetic fields.

06. 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

06. Ans: (d)

Sol:

- **Superconductors:** Metals and compounds, which loose their electrical resistivity at 0K (nearly) temperature, are called superconductors.
- Superconducting state can be destroyed by applying external magnetic field.
- The materials which become superconductors are not necessarily good conductors, when they are normal metals.

07. 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

07. Ans: (a)

Sol: At absolute zero, the superconductor has a finite (non-zero) energy band gap and it is maximum.
$\Delta E = 1.76k_B T_C$

08. 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

08. Ans: (b)

Sol:

- **Statement 1:** Accuracy is indeed defined as the degree of conformity of a measured value to the true or accepted standard value.

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EXAM SYLLABUS:

ENGINEERING MATHEMATICS	20 Questions
NUMERICAL ABILITY	20 Questions
VERBAL ABILITY	10 Questions

- No. of Questions: 50
- Total Marks: 75
- Duration: 90 Minutes
- Mode: Online

- **Statement 3:** Dead zone refers to the range of input values for which the instrument produces no output change. A larger dead zone means the instrument cannot detect small changes, thus reducing its overall accuracy

Statements 1 & 3 are correct.

09. 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

09. Ans: (b)

Sol: $SC = A_t = A_m$

$-0.75 = A_t - 92.5$

$A_t = -0.75 + 92.5 = 91.75$

10. 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

10. Ans: (d)

Sol: All three statements regarding drift in instruments are correct:

Statement 1: Accurately defines the absence of drift as the ability of an instrument to reproduce the same reading for the same measured variable over different times.

Statement 2: Correctly identifies common causes of drift in resistance thermometers, which include contamination and changes in the metal's atomic or metallurgical structure.

Statement 3: Correctly notes that drift can occur in flowmeters due to physical changes like wear and erosion of component such as the orifice plate, nozzle, or venturimeter.

11. 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

11. Ans: (c)

Sol: **Statement 2:** Null-type instruments are generally more accurate than deflection-type instruments because they rely on a null or balance condition, which can be made very precise, and do not rely on a calibrated scale for the final reading.

Statement 3: Null-type instruments are generally more sensitive than deflection-type instruments. Their high sensitivity is due to the use of a null detector that can detect very small deviations from the balance point.

12. 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

12. Ans: (b)

Sol: **Statement 1:** Box type galvanometer typically are pivot type suspension.
Statement 3: Laboratory DC galvanometers have sensitivity from 2000 to 20000mm/μA.

13. 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 electrodynamo-meter-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

13. Ans: (c)

Sol: **Statement 1:** PMMC is used only for DC.
Statement 2: Calibration is same for both AC and DC
Statement 3: hot wire and thermocouple are used for AC.
So, statements 2 and 3 are correct.

14. 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) 2.00π mm/Pa (d) 2.50π mm/Pa

14. Ans: (d)

Sol: $L = r\theta = 90\text{mm} \times \frac{270 \times \pi}{180} = 135\pi\text{mm}$

$\Delta P = 54\text{Pa}$

$S = \frac{L}{\Delta P} = \frac{135\pi\text{mm}}{54\text{Pa}} = 2.5\text{mm/Pa}$

15. 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

15. Ans: (c)

Sol: Dead zone of the instrument

16. The Curie temperature of nickel (Ni) metal is
(a) 298°C (b) 358°C
(c) 770°C (d) 1120°C

16. Ans: (b)

Sol:

Ferromagnetic Material	Curie Temperature (°C)
Fe	770 °C
Co	1115 °C
Ni	354 °C

17. 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

17. Ans: (d)

Sol: Induced EMF lasts as long as the change in magnetic flux continues.

- $e \propto \frac{d}{dt}(N\phi)$

Induced current opposes the very cause producing it.

18. 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) 0.12H (b) 0.72H
(c) 1.08H (d) 1.32H

18. Ans: (a)

Sol: Given: I = 10 A

N = 2000

$\phi = 0.6 \times 10^{-3}$ Wb

$$L = \frac{N\phi}{I} = \frac{2000 \times 0.6 \times 10^{-3}}{10} = 0.12 \text{ H}$$

19. Consider the following statements regarding autotransformer:
1. Voltage regulation of an autotransformer 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

19. Ans: (d)

Sol: All three statements regarding an autotransformer are correct:

- **Voltage regulation is better:** Due to the common winding, the amount of copper required is less, leading to reduced resistance and reactance voltage drops, thus improving voltage regulation.

- **Variable output voltage:** A sliding contact can be used on the single continuous winding to create a variable tap, allowing for a continuously variable output voltage, which is a key application of autotransformers.
- **Larger short-circuit current:** The internal impedance of an autotransformer is lower compared to a conventional two-winding transformer of the same rating, which results in a larger short-circuit current if a fault occurs.

20. 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

20. Ans: (b)

Sol:

- **Statement 1:** In the air blast cooling method, a forced, continuous blast of filtered air is directed through the core and windings to dissipate heat effectively.
So, statement 1 is correct
- **Statement 2:** In oil blast cooling, a forced blast of oil is passed through the cooling elements, not air. Air is used in air-based cooling methods, while oil is the medium in oil-based methods.
So, statement 2 is incorrect
- **Statement 3:** In forced oil and water cooling (often using a heat exchanger), water is circulated through metallic tubes (or a radiator system) to extract heat from the hot transformer oil.
So, statement 3 is correct

21. 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 the commutator being the reactance voltage, it can be minimized by using 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

21. Ans: (d)

Sol: **Statement 1:** Commutation is indeed the process of converting the alternating current generated in the armature coil into a unidirectional current.

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- **Statement 2:** Sparking at the commutator is primarily caused by reactance voltage, and using high-resistance carbon brushes is a common method to minimize it.
- **Statement 3:** Armature reaction ampere-turns (AT) can be effectively compensated by placing compensating windings in the pole faces, connected in series with the armature, to cancel out the armature reaction AT.

So, statements 1, 2, 3 all are correct.

22. 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

22. Ans: (b)

Sol: **Statement 1:** A lagging power factor indicates an inductive load, and a 0.6 power factor means the current lags the voltage by arccos $(0.6) \approx 53°$.

Statement 3: When the phase angle between voltage and current is zero (unity power factor), the apparent power is equal to the true power, meaning all the power from the supply is dissipated in the load.

Statements (1) and (3) are correct.

23. 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

23. Ans: (d)

Sol: Blondel's theorem is a fundamental principle in electrical engineering for measuring power in polyphase systems.

Statement 1: Is the primary statement of Blondel's theorem, which requires N wattmeters for a network supplied through N conductors, with a common point of connection for the voltage elements.

Statement 2: Is a crucial corollary of the theorem: If the common point is connected to one of the supply lines, that line's wattmeter reads zero and can be removed, requiring only (N – 1) wattmeters.
Statement 3: Highlights common practical applications of the theorem, such as the two-wattmeter method for 3-phase, 3-wire systems (where N = 3, so N – 1 = 2 meters are needed) and the three wattmeter method for 3-phase, 4-wire systems (where N = 4, so N – 1 = 3 meters are needed, or 4 if using the N meter method).
So, statements 1, 2, 3 all are correct

24. 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 mercuric oxide is used as the 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

24. Ans: (c)

Sol: Manganese alkaline cell provide a more constant voltage under heavy loads than zinc-carbon cells.
- Mercury cell generally maintain a more constant voltage than alkaline cells.
- Mercury oxide is used as positive electrode.

So statement (2) & (3) are not correct.

25. A battery with a rating of 300Ah is to be charged. If the internal resistance of the battery is 0.008 Ω, the safe maximum charging current of the battery is 37.5A 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

25. Ans: (a)

Sol: $V_{charger} = V_{battery} + (37.5 \times 0.008)$
$= 11.5 + 0.3$
$= 11.8\ V$

26. 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

26. Ans: (a)

Sol: 1. Elastomers are also 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 micro-molecules called monomers.

27. 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

27. Ans: (a)

Sol: Coordination number = The number of nearest neighbouring atoms or touching atoms to a specified atom.

Structure	Coordination number
SC	6
BCC	8
FCC	12
HCP	12
DC	4

28. 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

28. Ans: (c)

Sol: Polymorphism:

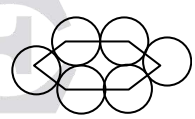
Crystalline solids exists in more than one crystalline structure, even though it's chemical composition is same.
1. Cobalt exists as an HCP at room temperature and FCC at high temperatures.
2. Strontium exists as an FCC at room temperature and HCP at high temperatures.

29. 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)

29. Ans: (b)

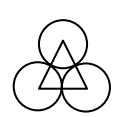
Sol: The atomic stacking sequence in the close-packed hexagonal crystal structure is ABAB.....

Atoms in the first layer (A) are close - packed



→ A-layer

The second layer (B) sits in the triangular voids of A



→ B-layer

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30. 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

30. Ans: (c)

Sol:
1. The crystal lattice of ionic compounds depends on
I. Size of ions
II. Valency of ions
2. NaCl is a rocksalt (AX-type) structure but the unitcell size is affected by large chlorine atoms.
3. SiC has the diamond cubic structure, where each Si atom is bonded with four carbon atoms and form tetrahedral structure.

31. 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

31. Ans: (c)

Sol: **Statement 1:** In a retardation type (first-order) measuring lag, the response begins immediately after the input is applied, but it lags behind the input. A "dead time" (or dead zone) where no response occurs is characteristic of a dead-time element, not a simple retardation lag.
Statement 1 is incorrect.
Statement 2: Fidelity is indeed defined as the ability of a system to reproduce the input signal without dynamic error, indicating how faithfully it follows changes in the measured quantity.
Statement 2 is correct.
Statement 3: Measurement error in this context (assuming no static error) refers to the dynamic error, which is the difference between the true time varying value and the value indicated by the system at a specific time.
Statement 3 is correct.

32. The minimum and maximum ranges of temperature of tungsten used in resistance thermocouple are, respectively
(a) –100°C and 300°C (b) –220°C and 300°C
(c) –200°C and 1000°C (d) –260°C and 1100°C

32. Ans: (d)

Sol: Tungsten thermocouple ⇒ –260°C and 1100°C

33. 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

33. Ans: (b)

Sol: **Statement 1:** In pivoted-coil direct-indicating wattmeters (dynamometer type), the fixed coil (current coil) is indeed wound in two halves and placed parallel to ensure a uniform magnetic field in the region where the moving coil (voltage coil) rotates
Statement 1 is correct

Statement 2: Suspended-coil torsion wattmeters are highly sensitive and accurate standard instruments used for calibration and precision measurements used for calibration and precision measurements in laboratories, not commonly as switchboard or portable instruments which require more robust construction.
Statement 2 is incorrect

Statement 3: Eddy current errors are minimized in such instruments by using non-metallic or high-resistivity materials for the parts within the magnetic field, such as the former on which the coils are wound, to prevent the circulation of unwanted currents.
Statement 3 is correct.

34. 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

34. Ans: (c)

Sol: **Statement 2:** The operating principle of dynamometer wattmeters relies on the ineraction of magnetic fields, which works for both alternating current (AC) and direct current (DC) systems.
Statement 3: When properly designed and used within their specified range, dynamometer wattmeters are considered highly accurate instruments, often used as standard for calibrating other types of wattmeters.

35. Consider the following statements 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

35. Ans: (b)

Sol: → Cathode is a nickel cylinder whose surface is coated with oxide material.

→ When this cathode is indirectly heated by a heater filament then electrons will be evaporated due to thermionic emission.

→ This cathode is held by control grid which is completely open on cathode side and with a pin hole on other side.

→ Control grid is kept negative (highly) w.r.t cathode. As such, the emitted electrons by cathode experience repulsion from metallic surface of control grid as an electron beam.

→ Heater voltage and currents
→ 6.3V AC/DC
300 to 600mA
→ Cathode/Grid voltage → −14V to −200V
(relative to cathode)

36. 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 of branches and N the number of nodes, the minimum number of variables involved in analyzing a network is equal to (M + N – 1).

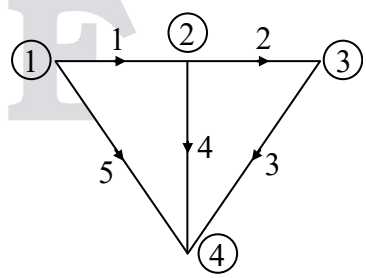
Which of the above statements are **not** correct?

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

36. Ans: (c)

Sol: 1 → Chord → link, not a part of tree (correct)
2 → Wrong → cut-set one twig and remaining chords.
3 → M = b
N = n
m = b – n + 1
m = [M – N + 1]
Minimal KVL equations
2 and 3 → wrong → option (c)

37. The incidence matrix of the graph shown below is



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

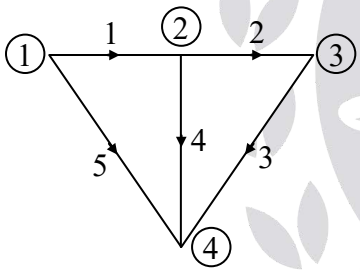
(b) $\begin{bmatrix} 1 & 0 & 0 & 0 & -1 \\ -1 & 1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \end{bmatrix}$

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

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

37. Ans: (a)

Sol:



$$[A]=[A]_C=\begin{array}{c} \\ (1) \\ (2) \\ (3) \\ (4) \end{array}\begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ -1 & 1 & 0 & 1 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \end{bmatrix} \end{array}$$

38. 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

38. Ans: (c)

Sol: From the given statements

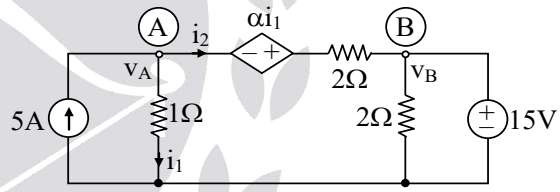
1 → wrong

2 → correct

3 → correct

(2) and (3) correct → option (c)

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



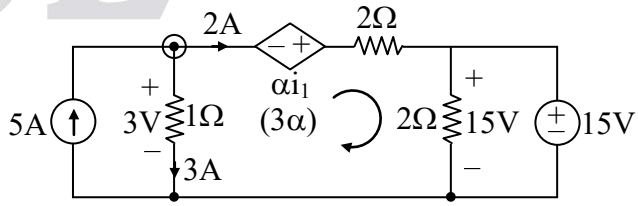
(a) 2.67 (b) 3.67 (c) 4.33 (d) 5.33

39. Ans: (d)

Sol: $P_{1\Omega} = 9W$

$(i_1)^2 (1) = 9$

$i_1 = \pm 3A$



$-3-3\alpha+4+15=0$

$3\alpha = 16$

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

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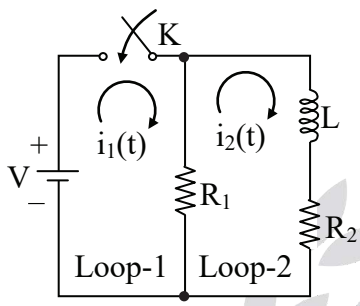
40. What is the expression for $I_1(s)$ for the two-mesh network given below, when the switch is closed [assuming the initial condition i(0+) is zero through the inductance]?



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

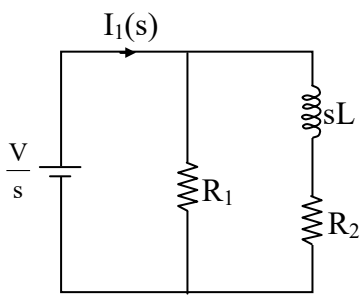
(b) $I_1(s) = \frac{V}{s}\left[\frac{R_1R_2+sL}{R_1+R_2+sL}\right]$

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

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

40. Ans: (c)

Sol:



$$Z(s) = R_1//(SL+R_2) = \frac{sLR_1+R_1R_2}{R_1+R_2+sL}$$

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

41. 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

41. Ans: (d)

Sol: All the statements are correct

42. 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.

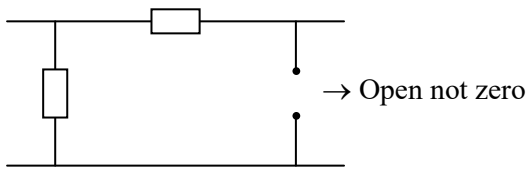
Which of the above statements are correct?

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

42. Ans: (a)

Sol: 1. Asymmetrical π → not equal (correct)
2. Balance π → 'O' section (correct)

3. 'L' section in π is when one shunt arm equal to zero (wrong)



So (1) & (2) only correct.

43. Hybrid parameter h_{21} is called
(a) input impedance
(b) forward current gain
(c) reverse voltage gain
(d) output admittance

43. Ans: (b)

Sol: $V_1 = h_{11} I_1 + h_{12} V_2$

$I_2 = h_{21} I_1 + h_{22} V_2$

$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0}$ → Short circuit forward current gain

44. 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

44. Ans: (d)

Sol: **Reciprocal condition:**

Z] $Z_{12} = Z_{21}$

Y] $Y_{12} = Y_{21}$

h] $h_{12} = -h_{21}$

ABCD] [AD – BC] = 1

So option (d) is correct

45. 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

45. Ans: (c)

Sol: 1 → correct.

2 → wrong (not clear statement)

3 → wrong

46. Consider the following statements regarding semiconductors:
1. At room temperature, there are 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

46. Ans: (a)

Sol: (1) statement is TRUE

because $((n_i)_{Si})$ 300°K = 1.5×10^{10} /cm^3

(2) Since no impurities are added implies, free

electrons is intrinsic material only due to natural cause (mainly due to G_{Th})

(3) $(n_i)_{Ge} = 2.1\times10^{13}/\ cm^3$

$(n_i)_{Si} = 1.5\times10^{10}/\ cm^3$

$$\therefore \frac{(n_i)_{Ge}}{(n_i)_{Si}} = \frac{2.1\times10^{13}}{1.5\times10^{13}} \neq 10^5$$

Statements (1) & (2) are true

47. 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 °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

47. Ans: (a)

Sol: Si diodes generally have higher PIV rating than Ge

For Si → ≅ 1000V, while for Ge = 100V

∴ Statement (1) → Incorrect

For most of applications Si diodes operate between 150 °C to 200°C

⇒ Statement (2) → Incorrect

Ge has much lower temperature rating and maximum upto 100°C (Around range of 75°C → 100°C)

(In most of applications)

⇒ Statement (3) → correct

48. 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) 0.01Ω for high-power devices to 0.20Ω for some low-power, general-purpose diodes
(b) 0.01Ω for high-power devices to 0.40Ω for some low-power, general-purpose diodes
(c) 0.10Ω for high-power devices to 0.20Ω for some low-power, general-purpose diodes
(d) 0.10Ω for high-power devices to 2.00Ω for some low-power, general-purpose diodes

48. Ans: (a)

Sol: High power devices very low series resistance

$\therefore r_s \cong 0.01\Omega$

Low power/general purpose devices

$r_s \cong 0.2\Omega$

49. 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

49. Ans: (b)

Sol: In BJT, the current gain (β) increases with increase in temperature.

- V_{BE} decreases by 2.5 mV/°C.
  Reverse saturation current doubles in value for every 10°C increase in temperature.

50. 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

50. Ans: (c)

Sol: If a network/Amplifier is stable then the stability factor is low (not high).

- If the stability factor is high then it is sensitive to variations in that parameter.
- For emitter bias the stability factor

$$S = \frac{\partial I_C}{\partial I_{CO}} = \frac{1+\beta}{1-\beta\left[\frac{\partial I_B}{\partial I_C}\right]} = \frac{1+\beta}{1-\beta\left[\frac{-R_E}{R_B+R_E}\right]}$$

If $RB >> (1 + \beta)R_E$

then $S = 1 + \beta$

51. 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

51. Ans: (d)

Sol: Since we know

at $V_{GS} = V_P = (V_{GS})_{off} \rightarrow I_D = 0$

$\Rightarrow$ statement (1) $\rightarrow$ TRUE

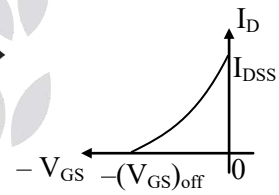
Also in ohmic region (Triode region),

I_D varies linearly with V_{DS}.

Hence we can use it as a voltage variable resistor.

statement (2) TRUE

From statement (3) $\rightarrow$



$\Rightarrow$ (3) is True

(1), (2) & (3) are TRUE $\Rightarrow$ (d)

52. 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%

52. Ans: (b)

Sol: $\eta = \frac{\pi}{4} \times \frac{V_L}{V_{CC}} \times 100\%$

$\eta = \frac{\pi}{4} \times \frac{6}{24} \times 100\% = 19.63\ \%$

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53. 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

53. Ans: (a)

Sol: In a clamper $V_{0\,(p\text{-}p)} = V_{in\,(p\text{-}p)}$
- Clamper has diode capacitor and resistor.

When the diode is ON, capacitor charges and when diode is OFF, it holds the charge.

54. 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

54. Ans: (b)

Sol: VMOS FETS have reduced channel resistance and higher current and power ratings.

MOSFET and VMOS FETS both have positive temperature coefficient.

VMOS FETs device exhibits reduced charge storage due to vertical structure.

55. 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

55. Ans: (b)

Sol: If $V_{GS} < V_{Th} \Rightarrow$ no channel $\rightarrow$ True
$\Rightarrow I_D = 0$ True for enhancement MOSFET

Statement (2) is false, because for $V_{GS} \le V_{Th}$
$\Rightarrow$ No channel $\Rightarrow I_D = 0$
From statement (3)
$I_D = K(V_{GS} - V_{Th})^2$ when Q-point is in saturation

$\therefore\ K = \dfrac{I_D}{K(V_{GS} - V_{Th})^2} \rightarrow$ True

$\therefore$ Statements (1) & (3) are correct

56. If the input voltages of an op-amp are $V_{i1} = 150\mu V$, $V_{i2} = 140\mu V$, the differential gain is 4000 and CMRR is 100, then the output voltage is
(a) 26.4 mV (b) 40.0 mV
(c) 45.8 mV (d) 68.2 mV

56. Ans: (c)

Sol: $V_0 = A_d V_d + A_{cm} V_{cm}$

$$V_0 = A_d V_d + \frac{A_d}{CMRR} V_{cm}$$

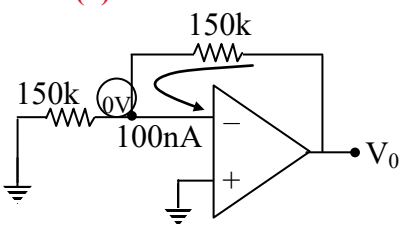
$$V_0 = 4000[150\mu - 140\mu] + \frac{4000}{1000}\left[\frac{150\mu + 140\mu}{2}\right]$$

$= 45.8$ mV

57. An inverting amplifier using op-amp is having $R_F = 150k\Omega$ and $R_1 = 2k\Omega$. The offset voltage for the op-amp specification listing $I_{IO} = 100nA$ is
(a) 0.2 mV (b) 7.5 mV
(c) 7.6 mV (d) 15 mV

57. Ans: (d)

Sol:

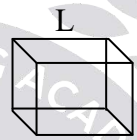


$V_0 = (100nA)150\ k = 15$ mV

58. 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

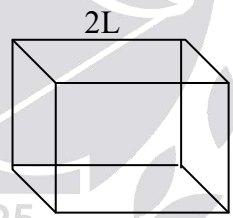
58. Ans: (d)

Sol:



$$R_1 = \frac{\rho_1 L}{(L)^2} = \frac{L}{\sigma_1 (L)^2}$$

$$R_1 = \frac{1}{\sigma_1 L}$$



$$R_2 = \frac{\rho_2 (2L)}{(2L)^2} = \frac{\rho_2 2L}{4L^2}$$

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

$$\frac{R_1}{R_2} = \frac{\frac{1}{\sigma_1 L}}{\frac{1}{\sigma_2 2L}} = \frac{\sigma_2 2L}{\sigma_1 L} \quad [\because R_1 = R_2]$$

$\Rightarrow \sigma_2 (2L) = \sigma_1 (L)$

$$\frac{\sigma_1}{\sigma_2} = \frac{2}{1}$$

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59. 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

59. Ans: (b)

Sol: $\mathbf{R_1}$:

$$\left.\begin{matrix} P_1 = 50W \\ V_1 = 110V \end{matrix}\right\} \text{at } 20^\circ C$$

$$R_1 = \frac{V_1^2}{P_1} = \frac{(110)^2}{50} = 242\Omega$$

$$R_2 = R_1 = 242\Omega$$

$$P_2 = 1000W \text{ at } 20^\circ C$$

$$\Rightarrow P_2 = \frac{[V_2]^2}{R_2}$$

$$\Rightarrow V_2 = \sqrt{P_2 \times R_2}$$

$$= \sqrt{100 \times 242}$$

$$V_2 = 155.563V$$

$$I_2 = \frac{P_2}{V_2} = \frac{100}{155.563} = 0.643A$$

60. 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

60. Ans: (c)

Sol: 1 → wrong
2 → correct
3 → correct

61. 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

61. Ans: (a)

Sol: → $V_1 = AV_2 - BI_2$
$I_1 = CV_2 - DI_2$

$$V_1 = h_{11} I_1 + h_{12} V_2$$
$$V_2 = h_{21} I_1 + h_{22} V_2$$

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

$$V_1 = h_{11} I_1 + h_{12} V_2$$
$$h_{21} I_1 = -h_{22} V_2$$

$$V_1 = h_{11}\left[\frac{-h_{22}}{h_{21}}\right]V_2 + h_{12} V_2$$

$$V_1 = -\frac{\Delta h}{h_{21}} V_2 \Rightarrow A = \frac{V_1}{V_2} = -\frac{\Delta h}{h_{21}}$$

Where, $\Delta h = h_{11}h_{22} - h_{12}h_{21}$

So, (1) is wrong.

$$\rightarrow [h] = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} = \begin{bmatrix} \frac{1}{Y_{11}} & -\frac{Y_{12}}{Y_{11}} \\ \frac{Y_{21}}{Y_{11}} & \frac{\Delta Y}{Y_{11}} \end{bmatrix}$$

Where, $\Delta Y = Y_{11}Y_{22} - Y_{12}Y_{21}$

So (2) is wrong

$$\rightarrow [h] = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} = \begin{bmatrix} \frac{B}{D} & \frac{\Delta T}{D} \\ -\frac{1}{D} & \frac{C}{D} \end{bmatrix}$$

Where, $\Delta T = AD - BC$

So (3) is correct

62. 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

62. Ans: (d)

Sol: All the statements are correct.

63. 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

63. Ans: (a)

Sol: r_e model does not provide exact analysis where as h-model provides exact analysis

$h_{11} \rightarrow$ SC input resistance

$h_{12} \rightarrow$ reverse voltage ratio

$h_{21} \rightarrow$ SC current gain

$h_{22} \rightarrow$ Output admittance

64. A BJT is operating at a base current of 7.6μA 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 transconductance 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

64. Ans: (c)

Sol: Given $I_B = 7.6\ \mu A$

$\beta = 104$

$V_T = 25$ mV

$$g_m = \frac{I_C}{V_T} = \frac{(104)(7.6\mu)}{25m} = 31.6 \text{ mA/V}$$

65. 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

65. Ans: (c)

Sol: Yes bridge rectifier has smaller transformer compared to center tap full wave rectifier
PIV of diode is bridge rectifier is V_m.
PIV of diode is FWR (center tap) is $2V_m$.

66. 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

66. Ans: (a)

Sol: (1) → False because FET has no leakage & free from thermal runaway

⇒ A Field Effect Transistor exhibits superior temperature stability compared to a Bipolar Junction Transistor.

(2) → False because
BJT → current control device
FET → Voltage control device.

(3) As we know FET has zero OFFSET Voltage → Ideal for chopping → True

67. 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

67. Ans: (c)

Sol: FET has a nonlinear relation between voltage and current.
- Fixed bias has disadvantage that uses a separate DC supply for biasing.

The DC operating point has to be fixed.

68. 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

68. Ans: (c)

Sol: (1) → False because $(Zi)_{MOSFET} \cong 100\ T\Omega$

$(Zi)_{JFET} \cong 100\ M\Omega$

(2) → Yes TRUE, Depletion type MOSFET, we can use with Gate to source Forward Bias & reverse bias.

(3) → Yes TRUE → For Amplification

Q point of FET must be selected in saturation, because it act as a current source

Statements (2) & (3) are correct.

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

(a) 3.31 kHz (b) 6.63 kHz

(c) 7.96 kHz (d) 13.26 kHz

69. Ans: (b)

Sol: Cut-off frequency of first order low pass R-C filter is

$$\omega_c = \frac{1}{RC}\text{rad/sec (or) } f_c = \frac{1}{2\pi RC}\text{Hz}$$

$$f_c = \frac{1}{2\pi[1200][0.02]\times 10^{-6}} = \frac{10^6}{150.786}$$

$$f_c = 6.631\text{kHz}$$

70. 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%

70. Ans: (c)

Sol: Full scale voltage $= \Delta(2^n - 1)$

$= 50\ mV(2^6 - 1) = 3.15\ V$

$$\%\text{ Resolution} = \frac{1}{2^n - 1}\times 100 = \frac{1}{2^6 - 1}\times 100$$

$= 1.587\ \%$

71. 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

71. Ans: (b)

Sol: Statement (2) is correct

$V_0 = K$ (decimal equivalent of digital)

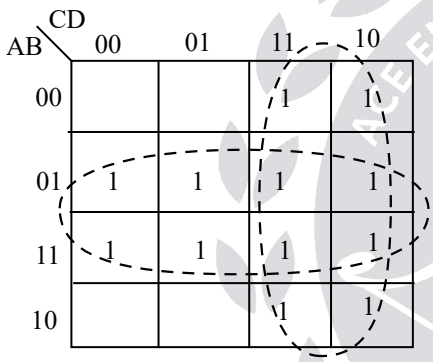
'K' is the step size

72. The simplified form of the Boolean function
$F(A,B,C,D) = A\overline{B}C + B + B\overline{D} + AB\overline{D} + \overline{A}C$ is
(a) B + C
(b) A(B + C)
(c) B + D
(d) B

72. Ans: (a)

Sol: Given,
$F(A,B,C,D) = A\overline{B}C + B + B\overline{D} + AB\overline{D} + \overline{A}C$

K-map



$F = B + C$

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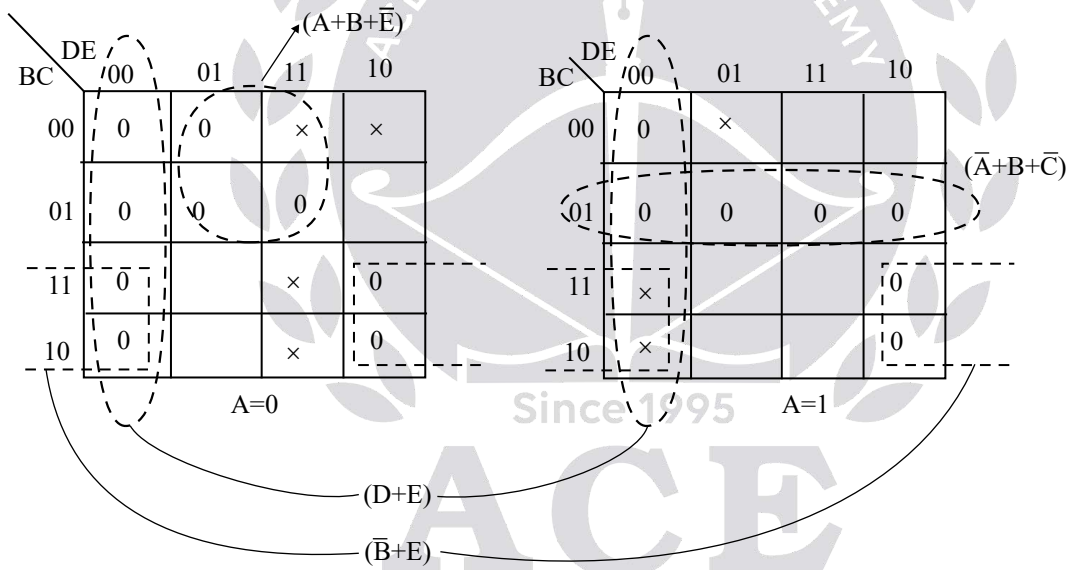
73. The simplest possible POS form of
F(A,B,C,D,E)
$= \sum m(6, 9, 13, 18, 19, 25, 27, 29, 31)$
$+ d(2, 3, 11, 15, 17, 24, 28)$ is
(a) $(B + E)(\overline{B} + \overline{C}D)(\overline{A} + \overline{B} + D\overline{E})$
(b) $(\overline{B} + \overline{E})(B + C + \overline{D})(A + B + \overline{D} + E)$
(c) $(D + E)(\overline{B} + E)(A + B + \overline{E})(\overline{A} + B + \overline{C})$
(d) $(D + E)(\overline{B} + E)(A + B + \overline{E})(\overline{A} + B + \overline{C})(B + E)$

73. Ans: (c)

Sol: F(A,B,C,D,E)
$= \sum m(6, 9, 13, 18, 19, 25, 27, 29, 31)$
$+ d(2, 3, 11, 15, 17, 24, 28)$



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

74. Consider the following statements 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

74. Ans: (d)

Sol: All the statements are correct.

75. Consider the following statements 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

75. Ans: (b)

Sol: Statement (2) is wrong.
The carry look ahead adder is propagating the carry but not eliminating the carry.

76. 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

76. Ans: (c)

Sol: 1. TRUE
2. FALSE
$I_S(\alpha)\sqrt{I_{DC}}$
3. Partition noise comes at junctions.
As transistors have more junctions than diode, the partition noise is more in transistors than in diodes.

77. 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

77. Ans: (d)

Sol: AWGN
White-effects all frequencies equally.
White noise/Johnson noise/Thermal noise all have same PSD's
The noise is represented using GRV.

78. Consider the following statements regarding random variables:
1. A discrete random variable will have a countable number of 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 1and 2 (d) Neither 1 nor 2

78. Ans: (a)

Sol: DRV → Countable discrete values
CRV → Uncountable continuous values

79. 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

79. Ans: (b)

Sol: 1. TRUE
2. FALSE
Repeaters are used in digital communication systems.
3. TRUE

80. 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

80. Ans: (d)

Sol: 1. TRUE
Class A (or) Class AB Amplifiers are used
2. TRUE
Class B (or) Class C Amplifiers are used

81. Consider the following statements regarding detectors:
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) 1and 3 (d) 2 and 3

81. Ans: (c)

Sol: 1. FALSE
Diagonal clipping is present in envelope detector
2. TRUE
3. FALSE

82. 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

82. Ans: (a)

Sol: 1. FALSE
Used at low frequency's and not at VHF
2. FALSE
Up conversion is not required
3. TRUE

83. 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

83. Ans: (a)

Sol: 1. FALSE
Noise has more effect on PAM when compared with PWM and PPM
2. FALSE
As width changes power also changes
3. TRUE

84. 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

84. Ans: (c)

Sol: 1. FALSE (synchronization not required)
2. TRUE
3. TRUE

85. 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 Modulation Code (DPCM), the fixed number of levels 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

85. Ans: (d)

Sol: 1. ADM is one bit DPCM → TRUE
2. In DPCM, $L = 2^n$ → TRUE
3. TRUE

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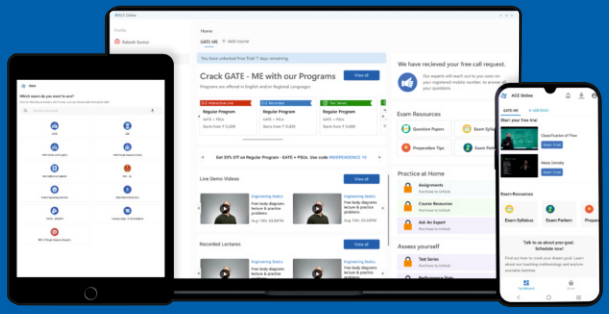

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86. Consider the following statements:
1. The signal-to-noise ratio of Pulse Code Modulation (PCM) remains almost constant with companding.
2. Analog to digital converter is not required in Delta Modulation (DM).
3. Because of variable step size, the 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

86. Ans: (b)

Sol: 1. Compression at T_x
Expansion at $R_x \rightarrow$ Companding increases overall S/N ratio. TRUE
2. FALSE $\rightarrow$ A/D converters are must
3. TRUE

87. 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

87. Ans: (b)

Sol: 1. FALSE
FSK is better than ASK but inferior to PSK.
2. TRUE
Synchronous detectors are complex systems.
3. FALSE

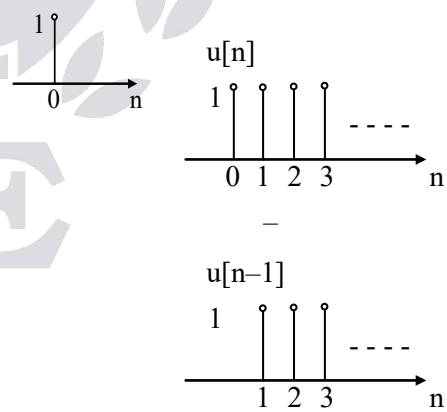
88. Consider the following statements regarding unit impulse signal :
1. The discrete-time unit impulse is the first difference of the discrete-time step signal.
2. The amplitude of unit impulse signal is equal to '1' at n = 1.
3. The continuous-time unit impulse can be obtained as first derivative of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

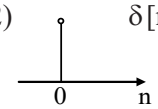
88. Ans: (b)

Sol:

(1) $\delta[n] = u[n] - u[n-1]$

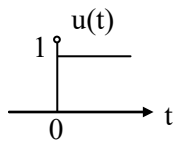


(2) $\delta[n] = \begin{cases} 1; & n = 0 \\ 0; & n \neq 0 \end{cases}$



Statement (2) is False

(3)



$$\delta(t) = \frac{d}{dt}u(t)$$

89. 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

89. Ans: (d)

Sol: Statement (1) is TRUE

$$y[n] = \sum_{k=-\infty}^{n} x[k] \rightarrow \text{Memory}$$

Statements (1), (2) & (3) are TRUE

90. Consider the following statements regarding Laplace transform:
1. The ROC of X(s) consists of strips parallel to the jω-axis in the s-plane.
2. For rational Laplace transforms, the ROC does not contain any poles.
3. If x(t) is of finite duration and is absolutely integrable, then the ROC is the entire s-plane.

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

90. Ans: (d)

Sol: 1. The ROC of X(s) consists of strips parallel to the jω-axis in the s-plane.
2. For rational Laplace transforms, the ROC does not contain any poles.
3. If x(t) is of finite duration and is absolutely integrable, then the ROC is the entire s-plane.

Statements 1, 2, 3 are TRUE.

91. 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

91. Ans: (b)

Sol: **External interrupts:** Come from outside devices (keyboard, I/O, timer).

Software interrupts: Explicitly invoked by instructions (e.g., INT in 8086, system calls).

Hybrid interrupts: Not a standard classification for these error conditions.

92. 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 incorporated into a 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

92. Ans: (d)

Sol: CISC instructions can operate directly on operands in memory (e.g., memory-to-memory operations). RISC architectures mainly use register-to-register (load–store) instructions. Memory is accessed only by explicit load/store instructions, and the simple, regular instruction formats make it easier for the compiler to translate high-level language constructs into machine code. CISC provides many instruction formats and addressing modes, which historically aimed to make compilation from high-level languages easier. more complex hardware, possibly slower. Adding many instructions and addressing modes increases hardware/control complexity, which can increase cycle time and slow down execution compared to simpler designs.

93. 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 operates concurrently with all other segments?

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

93. Ans: (a)

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

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

94. Ans: (d)

Sol: In computer architecture, specifically in pipelined processors, a data conflict (or data hazard) occurs when an instruction depends on the result of a previous instruction that hasn't finished yet.

When a "load" instruction is executed, the data might not be available in a register quickly enough for the very next instruction to use it.

The solution is….The compiler identifies this conflict and rearranges the code. It inserts a "useful" but independent instruction (or a NOP - No Operation) immediately after the load.

This gives the hardware enough time to finish the load before the data is actually needed, ensuring the pipeline doesn't stall due to hardware-based checks.

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

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

95. Ans: (c)

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

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

1. When a character is not being sent, the line is kept in the 1-state.
2. The initiation of a character 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

96. Ans: (d)

Sol: When no character is being sent, the line stays at logic 1. Transmission of a character begins with a start bit = 0, which alerts the receiver. After the start bit, the character (data bits) are sent sequentially. After the last data (and optional parity) bit, the stop bit = 1 indicates the end of the character and line returns to idle.

97. 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

97. Ans: (a)

Sol: Total no. of bits = 11
Total baud rate = $10 \times 11 = 110$

98. 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 (ν) 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

98. Ans: (b)

Sol:

- $\nabla.\overline{V} \neq 0 \rightarrow$ Source or sink
  (1) is correct
- $\overline{\omega} = \frac{1}{2}(\nabla \times \overline{v})$

  $\nabla \times \overline{v} = 2\omega$
  (2) is wrong
- $\nabla \times \overline{A} \neq 0 \rightarrow$ Vortex flow
  (3) is correct

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

99. Ans: (c)

Sol: $\nabla \times \overline{A} = \frac{1}{r^2 \sin\theta}\begin{vmatrix} \hat{r} & r\hat{\theta} & r\sin\theta\hat{\phi} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \phi} \\ A_r & rA_\theta & r\sin\theta A_\phi \end{vmatrix}$

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

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

100. Consider the following statements regarding Maxwell's equations :

1. The total electric flux density or total electric displacement through the surface enclosing a volume ν 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

100. Ans: (c)

Sol: (1) $\oiint \overline{D}.\overline{ds} = Q_{enc}$ (i.e.) correct

(2) $\oiint \overline{n}.\overline{ds} = 0$ (i.e.) wrong

(3) $\oint \overline{H}.\overline{dl} = \frac{\partial \overline{B}}{\partial t}$ (i.e.) wrong

101. Consider the following statements regarding Maxwell's equations :

1. When the displacement current is very much greater than the 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 $\frac{\sigma}{\omega\varepsilon}$ is called as the frequency factor of the dielectrics.

3. The term $\frac{\sigma}{\omega\varepsilon}$ is also sometimes referred to the loss tangent.

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

101. Ans: (d)

Sol: We have,

$$\frac{|J_C|}{|J_D|} = \frac{\sigma}{\omega\varepsilon}$$

So statements (1), (2) & (3) are correct.

102. 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

102. Ans: (*)

Sol: We know,

$$\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\varepsilon}}$$

So statements (1), (2) are correct and (3) is wrong.

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

(a) 33% approximately of its initial value

(b) 37% approximately of its initial value

(c) 67% approximately of its initial value

(d) 73% approximately of its initial value

103. Ans: (b)

Sol: The distance, through which the wave amplitude decreases to a factor e^{-1} (about 37% of the original value) is called depth of penetration.

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

(a) 0 A/m (b) $5a_z$ A/m

(c) $10a_z$ A/m (d) $10a_y$ A/m

104. Ans: (a)

Sol: **Field due to an infinite current sheet:**

For an infinite current sheet in the plane $z = z_0$ with surface current density K, the magnetic field intensity on either side is:

$$H = \frac{1}{2}(K \times a_n)$$

where a_n is the unit normal directed from the sheet into the region of interest.

Contribution of sheet at z = 0:

$K_1 = 10a_x$ A/m. Point is at z = 10 (> 0), so $a_n = a_z$.

$$H_1 = \frac{1}{2}(K_1 \times a_z) = \frac{1}{2}[(-10a_x) \times a_z]$$

Using $a_x \times a_z = -a_y$:

$$H_2 = \frac{1}{2}(-10)(-a_y) = 5a_y \text{ A/m}$$

Contribution of sheet at z = 4:

$K_2 = -10a_x$ A/m. Point is at z = 10 (> 4), so $a_n = a_z$.

$$H_2 = \frac{1}{2}(K_2 \times a_z) = \frac{1}{2}[(10a_x) \times a_z]$$

$$= \frac{1}{2}(10)(-a_y) = -5a_y \text{ A/m}$$

Total field:

$$H = H_1 + H_2 = (5a_y) + (-5a_y) = 0 \text{ A/m}$$

105. 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

105. Ans: (a)

Sol: (1) $Y = 1 + jb$
$G = Y_0$
So is statement (1) is wrong
(2) is wrong
(3) is a correct statement

106. Consider the regarding following statements regarding Mason's gain formula $T = \sum_{k=1}^{k} \frac{P_k \triangle_k}{\triangle}$:
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.
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

106. Ans: (a)

Sol: Mason's gain formula $T = \sum_{k=1}^{k} \frac{P_k \triangle_k}{\triangle}$:
where P_k is forward path gain from input node to output node.
- $\Delta = 1 -$ (sum of all individual loop gains) + (sum of gains products of all possible two non-touching loops) – (sum of product of gains of all possible three non-touching loops) + - - - -
- Δ is describes that it involves closed-loop transmittances and mutual interaction between non-touching loops.
- Δ_k is calculated from Δ by removing the all the loops touching k^{th} forward path.

107. Consider the following statements regarding root locus plot :
1. The root locus starts (K = 0) from the open-loop poles and terminates (K = ∞) 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 intersects the imaginary axis, then the points of 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

107. Ans: (c)

Sol:

- The root locus starts at k = 0 (open loop poles) and terminates at k = ∞. (open loop zeros). open loop zeros may be located at finite or infinite.
- Asymptotes meet at centroid on the real axis.
- Root locus intersect on jω-axis, which are conjugate.

108. Consider the following Statements regarding stability in terms characteristic equation of a control 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

108. Ans: (b)

Sol:

- Damped oscillations makes the system stable.
- Magnitude of the oscillations is sustained, then system is marginal stable.
- For a stable system, there should not be any change in the first column.

109. 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(jω) H(jω) to the (–1+ j0) point.
2. Phase crossover frequency is the point in the G(jω) plane at which the Nyquist G(jω) H(jω) plot inter-sects 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

109. Ans: (b)

Sol:

- Gain margin measure the distance from the intersection of the Nyquist plot with the negative real axis to the critical point (–1 + j0).
- Phase crossover frequency is the point in the G(jω) H(jω) plane at which the plot intersects the negative real axis.
- Gain margin is the amount of gain increased in the loop before the closed loop system reaches instability.

110. 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

110. Ans: (c)

Sol:

- Controlling variable is the manipulated input within the system, not the external excitation.
- Feedback reduces sensitivity of the system to variations in system characteristics or parameters.

111. 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 ∞

111. Ans: (d)

Sol: **Type-0 system**

$$G(s) = \frac{K(1+sT_1)(1+sT_2)....}{s^0(1+sT_a)(1+sT_b)....}, H(s) = 1$$

$$K_a = \lim_{s\to 0} s^2 G(s) = 0$$

$$e_{ss} = \frac{A}{K_a} = \frac{1}{0} = \infty$$

Type-1 system

$$G(s) = \frac{K(1+sT_1)(1+sT_2)....}{s^1(1+sT_a)(1+sT_b)....}, H(s) = 1$$

$$K_a = \lim_{s\to 0} s^2 G(s) = 0$$

$$e_{ss} = \frac{A}{K_a} = \frac{1}{0} = \infty$$

112. Consider the following 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

112. Ans: (d)

Sol: Cascade compensator are generally direct compare to feedback or parallel compensation.

Parallel compensation is an effective method to achieve a faster transient response.

By using PD controller in series compensation accuracy and stability of control system improved.

113. The stability limit of the servo- mechanism having open-loop transfer function $G(s)H(s) = \frac{K_a(2+sT_1)}{s^2(1+sT_2)}$ is

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

113. Ans: (c)

Sol: $\xrightarrow{CE}\ 1 + G(s)H(s) = 0$

$\xrightarrow{CE}\ s^3 T_2 + s^2 + sK_aT_1 + 2K_a = 0$

s^3	T_2	K_aT_1
s^2	1	$2K_a$
s^1	$\frac{(K_aT_1 - 2K_aT_2)}{1} > 0$	for stability
		$(K_aT_1 - 2K_aT_2) > 0$
		$T_1 > 2T_2$
s^0	$2K_a$	

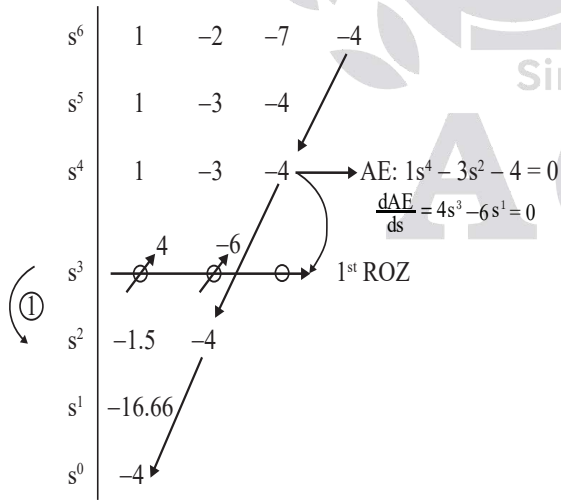
114. How many number of roots are there on the right half of the s-plane for the system whose characteristic equation is given below?

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

(a) 0 (b) 1 (c) 2 (d) 3

114. Ans: (b)

Sol: $\xrightarrow{CE}\ s^6 + s^5 - 2s^4 - 3s^3 - 7s^2 - 4s - 4 = 0$



1 sign change

1 pole right half s-plane

115. 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

115. Ans: (d)

Sol: By increasing gain (k) of the system, the sluggish over damped response made faster.

By using PD controller peak overshoot reduced without sacrificing steady - state accuracy.

116. 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

116. Ans: (d)

Sol: All the statements are correct

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

(a) 6 bits (b) 64 bits

(c) 8 bits (d) 16 bits

117. Ans: (a)

Sol: A 64-word stack has 64 locations, so the stack pointer must uniquely address 64 positions, which requires $\log_2 64 = 6$ bits.

118. 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

118. Ans: (c)

Sol: Given expression: (A+B) * [C * (D + E) + F]

⇒ Its post fix notation is AB + DE + C*F +*

119. 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

119. Ans: (b)

Sol: In direct address mode the operand specifies the effective address.

120. 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

120. Ans: (*)

Sol: Given A = 1111 0000 B = 0001 0100

A – B = A + 2's complement of B

= 1111 0000 + 2's complement of 0001 0100

= 1111 0000 + 1110 1100

⇒ 1 1 1 1 0 0 0 0

+ 1 1 1 0 1 1 0 0

1 1

EAC (1) 1 1 0 1 1 1 0 0

↓

Cy = 0

- As EAC = 1 ⇒ Cy = $\overline{EAC}$ = 0
- As MSB of result = 1 ⇒ S =1
- As result is not equal to zero ⇒ Z = 0
- As two negative numbers are added and the result is negative ⇒ overflow V = 0

i.e Cy = 0, S = 1, Z = 0, V = 0

This do not match with any of the given options.

The closest option is (a)

121. 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 of the 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

121. Ans: (b)

Sol: 1. ROC of anti-causal interior of a a circle $|r_1|$

2. False

$x[n]$ is anti-causal

$$X[z] = \sum_{k=-\infty}^{0} x[n]z^{-n} ..... + x[-2]z^2 + x[-1]z^1 + x[0] + x[0]$$

3. $r_{x_1x_2}[n] = x_1[n] * x_2[-n]$

$\downarrow$ Z.T

$X_1(z)\ X_2(z^{-1})$

Assume ROC of $x_1[n]$ as R_1

ROC of $x_2[n]$ as R_2

ROC: $R_1 \cap \frac{1}{R_2}$

(1) and (3) are correct.

122. 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

122. Ans: (b)

Sol: (1) FIR filter is moving average

$$y[n] = \frac{1}{m}\sum_{k=0}^{m-1} x[n-k]$$

For stability, poles must lie inside unit circle

(2) Zeros can lie any where in z-plane statement (2) is incorrect

(3) Advantage of linear phase filter is $\alpha = \frac{N-1}{2}$

Delay can be large for long length filters.

123. 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 $\Delta = 0.01$. What is the V-number at an operating wavelength of 840 nm?

(a) 39 (b) 76

(c) 42 (d) 16.89

123. Ans: (a)

Sol: $V = \frac{2\pi a}{\lambda} n_1 \sqrt{2\Delta}$

Substituting all parameters V = 39.

124. 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

124. Ans: (b)

Sol: P. Perigee → (1) It is the point on the orbit that is nearest to the center of the Earth.

Q. Eccentricity → (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.

R. Semi-major axis → (4) It is a geometrical parameter of an elliptical orbit.

S. Apogee → (2) It is the point on the satellite orbit that is at the farthest distance from the center of the Earth.

125. 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

125. Ans: (a)

Sol: $EIRP = P_{T\ (dBW)} + G_{(dB)} - \text{Losses (dB)}$
$= 40 + 60 - 2$
$= 98(dB)$

126. 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

126. Ans: (d)

Sol: Statements (1) & (2) are wrong.

127. Match the following Lists :

List-I

P. Virtual circuit packet switching
Q. Datagram packet switching
R. Circuit switching

List-II

1. No dedicated path
2. Fixed bandwidth
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

127. Ans: (c)

Sol: P. Virtual circuit packet switching
→ (1) No dedicated path

- It uses a logical path, but not a physically dedicated one like circuit switching.

Q. Datagram packet switching
→(3) Route established for each packet
- Every packet can take a different route.

R. Circuit switching → (2) Fixed bandwidth
- A dedicated channel with reserved bandwidth is established.

So, the correct answer: (c) P-1, Q-3, R-2.

128. 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

128. Ans: (c)

Sol: 1. TRUE → CDMA uses pseudo-random noise codes to spread the signal over a wide BW.
2. TRUE

129. 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

129. Ans: (a)

Sol: p = 47, g = 3, x = 8, y = 10
Therefore, the D - H key is
$K = g^{xy} \bmod p = 3^{80} \bmod 47 = 4$

130. 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

130. Ans: (d)

Sol: 110101010 (data bits) 0000 (Initial parity bits)

```
10101)11010101000000(111000111
      10101
      -----
      )11111
       10101
       -----
       )10100
        10101
        -----
        )00011
         00000
         -----
         )00110
          00000
          -----
          )01100
           00000
           -----
           )11000
            10101
            -----
            )11010
             10101
             -----
             )11110
              10101
              -----
              )1011  → Final parity bits
```

∴ Transmitted code word is 1101010101011

131. 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

131. Ans: (c)

Sol: Bit rate = 9600 bps
HDLC protocol
Bitmap multiplexing
16 Asynchronous terminals, each at 1200 bps
In bit map multiplexing,

- Each cycle sends 1-bit per terminal to indicate whether it has data.
- For 16 terminals → 16 overhead bits.

$\therefore$ Total possible input = 16×1200 = 19200 bps
HDLC frame typically has about 32 bits overhead.
For a typical payload of 128 bytes = 1024 bits

$\therefore$ Efficiency $= \frac{1024}{1024+32} = 0.97$

$\Rightarrow$ Effective efficiency = 0.696

$\therefore$ Throughput = 0.696×9600 = 6678 bps

132. The bandwidth of QASK signal is
(a) $B = 2f_b N$ (b) $B = 2f_b/N$
(c) $B = f_b N$ (d) $B = f_b/N$

132. Ans: (b) or (d)

Sol: Bandwidth of M-ASK $= \frac{2F_b}{N}$

Bandwidth of M-ASK (min value) $= \frac{f_b}{N}$

133. CSMA stands for
(a) Complementary Semiconductor Multiple Access
(b) Complementary Sense Multiple Access
(c) Complete Sense Multimode Access
(d) Carrier Sense Multiple Access

133. Ans: (d)

Sol: CSMA stands for Carrier Sense Multiple Access. It is used as a MAC protocol to handle the collisions.

134. The attenuation in optical communication is usually expressed in decibels per unit length as
(a) $10\log_{10}\frac{P_i}{P_o}$ (b) $20\log_{10}\frac{P_i}{P_o}$
(c) $10\log_{10}\frac{P_o}{P_i}$ (d) $20\log_{10}\frac{P_o}{P_i}$

134. Ans: (a)

Sol: Attenuation in OFC $= 10\log_{10}\left[\frac{P_I}{P_0}\right]$

135. Match the following Lists :

List-I
P. IP layer
Q. TCP/UDP layer
R. TCP/IP
S. Physical layer

List-II
1. Transmission of bits
2. Network layer of the OSI reference model
3. Transport layer of the OSI reference model
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

135. Ans: (a)

Sol: P. IP layer → (2) Network layer of the OSI reference model

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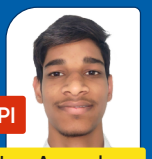

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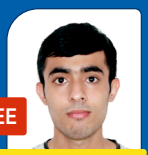

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Total 41 Ranks in Top-10

(ME: 10 | EC: 04 | EE: 05 | CE: 04 | CS: 02 | IN: 05 | DA: 01 | PI: 07 | XE: 02 | ES: 01)

- IP is responsible for routing and logical addressing → Network layer.

Q. TCP/UDP layer → (3) Transport layer of the OSI reference model

- TCP and UDP provide end-to-end communication → Transport layer.

R. TCP/IP → (4) Application layer of the OSI reference model

- In the TCP/IP suite, the application layer combines OSI's application, presentation and session layers.

S. Physical layer → (1) Transmission of bits

- Physical layer handles raw bit transmission over the medium.

Therefore, correct answer: (a) P-2, Q-3, R-4, S-1

136. A low-loss transmission line of 50 ohms characteristic impedance is connected to a load of 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

136. Ans: (c)

Sol: $\Gamma_L = \frac{100-50}{100+50} = \frac{1}{3}$

$$\rho = \frac{1+\frac{1}{3}}{1-\frac{1}{3}} = \frac{4}{2} = 2$$

137. A dissipation-less transmission line whose characteristic impedance is 200 ohms is connected to a load of (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

137. Ans: (b)

Sol: $\lambda = \frac{3\times10^8}{300\times10^6} = 1\text{m}$

$l = 25\text{ cm}, \quad \frac{\lambda}{l} = \frac{300}{25} = 4$

$\Rightarrow l = \frac{\lambda}{4} \Rightarrow$ inverter

$$Z_{in} = \frac{Z_0^2}{Z_L} = \frac{200\times200}{100+j100} = \frac{400}{1+j}\left[\frac{1-j}{1-j}\right]$$

$$Z_{in} = \frac{400}{1+1}(1-j) = 200 - j\,200$$

$$|Z_{in}| = \sqrt{200^2+200^2} = 200\sqrt{2} = 282.80\,\Omega$$

138. Consider the following statements regarding waveguides :
1. The phase velocity is defined as the velocity of propagation of equiphase surface along the guide.
2. Group velocity is defined as the 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 above statements are correct?
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

138. Ans: (a)

Sol: 1 → correct
2 → correct
3 → wrong

139. Consider the following statements regarding modes of propagation of electromagnetic waves :
1. The impedance value for TM_{mn}, modes is always 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_{0n} 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

139. Ans: (d)

Sol: All the statements are correct

140. 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

140. Ans: (d)

Sol: All the statements are correct

141. 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

141. Ans: (d)

Sol: All three statements are true

142. 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.

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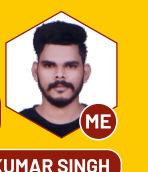
AIR 10 —  ME — AMIT KUMAR SINGH

Total 36 Ranks in Top-10 (E&T:10 | EE: 09 | CE:07 | ME: 10)

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

142. Ans: (d)

Sol: All three statements are true

143. 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

143. Ans: (a)

Sol: Assuming all the transistors are having a capacitance at every terminal, one transistor and a capacitor can store one bit data.

144. The microprocessor Zilog Z8000 is a/an
(a) 8-bit microprocessor
(b) 16-bit microprocessor
(c) 32-bit microprocessor
(d) 64-bit microprocessor

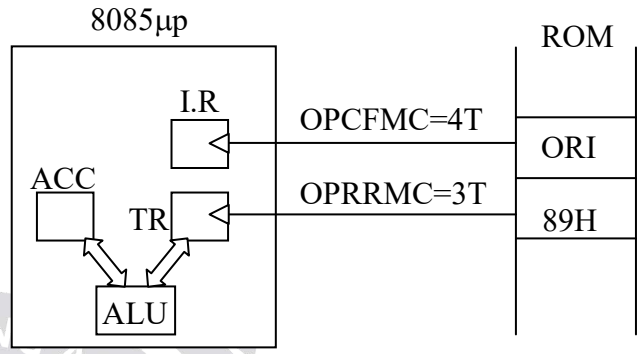
144. Ans: (b)

Sol: Zilog Z8000 is a 16bit microprocessor

145. 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

145. Ans: (a)

Sol: ORI 89H is a 2byte instruction



Execution done in 3rd T state of OPRRMC since it is internal 8bit operation
I.C = OPCFMC + OPRRMC
= 2MCS
= 4T + 3T
= 7T

146. Which one of the following instructions in 8085 microprocessor does **not** affect any flag?
(a) RLC (b) PUSH
(c) ORI (d) INR

146. Ans: (b)

Sol: PUSH instruction is a data transfer instruction that does not effect any flags

147. Consider the following statements regarding RISC processor :
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

147. Ans: (*)

Sol: Statements (1) & (3) are correct and Statement (2) is wrong.

148. 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

148. Ans: (b)

Sol: → MC68HC11 is a 8bit CISC microcontroller introduced by motorola company in 1985 that has 8KB ROM, 512B E^2PROM, 256B RAM

→ MC68HC11 can operate in one of 4 modes namely Single chip mode, Expanded mode, Bootstrap mode, Test Mode.

→ The majority of the pins of this 48pin DIP organized into four 8bit input-output ports.

149. The Z-transform of $x(n) = -a^n u(-n-1)$ 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 $|z| < |a|$

149. Ans: (*) no options matching

Sol: $x[n] = -a^n u[-n-1]$

$\downarrow$ Z.T

$X(z) = \frac{1}{1-az^{-1}};\ |z| < |a|$

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

150. Ans: (d)

Sol: $X(z) = \log(1 + az^{-1});\ |z| > |a|$

$\downarrow$

right sided sequences

$\frac{d}{dz}X(z) = \frac{-az^{-2}}{1+az^{-1}}$ $\qquad nx[n] \leftrightarrow -z\frac{d}{dz}X(z)$

$-z\frac{d}{dz}X(z) = \frac{az^{-1}}{1+az^{-1}}$

$\downarrow$

$nx[n] = a(-a)^{n-1}u(n-1)$

$x[n] = \frac{a(-a)^n(-a)^{-1}u(n-1)}{n}$

$x[n] = \frac{-(+a)^n(-1)^n}{n}u(n-1)$

$x[n] = \frac{(-1)^{n+1}a^n}{n};\ n \geq 1$

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