
DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : MKA-S-ETN

Test Booklet Series

Serial No.

TEST BOOKLET
ELECTRONICS AND
TELECOMMUNICATION ENGINEERING

B

Time Allowed : Three Hours

Maximum Marks : 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET **DOES NOT** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. **DO NOT** write *anything else* on the Test Booklet.
4. This Test Booklet contains 150 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
5. You have to mark your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.
 - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.33)** of the marks assigned to that question will be deducted as penalty.
 - (ii) If a candidate gives more than one answer, it will be treated as **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
 - (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

1. A 12-bit A/D converter has a full-scale analog input of 5 V. Its resolution is

- (a) 1.22 mV
- (b) 2.44 mV
- (c) 3.66 mV
- (d) 4.88 mV

Handwritten notes for Q1:
 1010.2
 $8) 12 (2.4$
 10
 20
 15
 15

2. Which of the following circuits converts/convert a binary number on the input to a one-hot encoding at the output?

1. 3-to-8 binary decoder
2. 8-to-3 binary decoder
3. Comparator

Select the correct answer using the code given below.

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

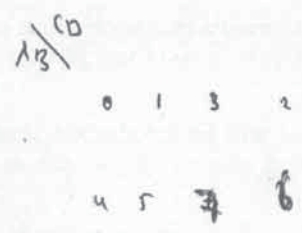
3. The simplification in minimal sum of product (SOP) of

$$Y = F(A, B, C, D)$$

$$= \sum_m(0, 2, 3, 6, 7) + \sum_d(8, 10, 11, 15)$$

using K-maps is

- (a) $Y = AC + B\bar{D}$
- (b) $Y = A\bar{C} + B\bar{D}$
- (c) $Y = \bar{A}\bar{C} + \bar{B}D$
- (d) $Y = \bar{A}C + \bar{B}\bar{D}$



4. A circuit outputs a digit in the form of 4 bits. 0 is represented by 0000, 1 is represented by 0001, ..., 9 by 1001. A combinational circuit is to be designed which takes these 4 bits as input and output as 1, if the digit is ≥ 5 , and 0 otherwise. If only AND, OR and NOT gates may be used, what is the minimum number of gates required?

- (a) 4
- (b) 3
- (c) 2
- (d) 1

Handwritten notes for Q4:
 $R_4 = 2^4$
 $R_4 = 5 \times (2^4 - 1)$
 $2^4 - 1 = 15$
 $5 \times 15 = 75$

5. How many 3-to-8 line decoders with an enabler input are needed to construct a 6-to-64 line decoder without using any other logic gates?

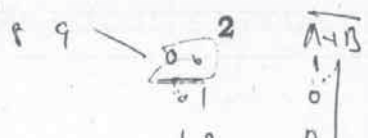
- (a) 11
- (b) 10
- (c) 9
- (d) 8

6. The minterm expansion of $F(A, B, C) = AB + B\bar{C} + A\bar{C}$ is

- (a) $m_2 + m_4 + m_6 + m_1$
- (b) $m_0 + m_1 + m_3 + m_5$
- (c) $m_7 + m_6 + m_2 + m_4$
- (d) $m_2 + m_3 + m_4 + m_5$

7. The output of a NOR gate is

- (a) high if all of its inputs are high
- (b) low if all of its inputs are low
- (c) high if all of its inputs are low
- (d) high if only one of its inputs is low



8. If the input to a T flip-flop is a 100 MHz signal, the final output of three T flip-flops in a cascade is

- (a) 1000 MHz
- (b) 520 MHz
- (c) 333 MHz
- (d) 12.5 MHz

9. The addition of the two numbers $(1A8)_{16} + (67B)_{16}$ will be

- (a) $(889)_{16}$
- (b) $(832)_{16}$
- (c) $(823)_{16}$
- (d) $(723)_{16}$

10. If the operating frequency of an 8086 microprocessor is 10 MHz and, if, for the given instruction, the machine cycle consists of 4 T-states, what will be the time taken by the machine cycle to complete the execution of that same instruction when three wait states are inserted?

- (a) $0.4 \mu s$
- (b) $0.7 \mu s$
- (c) $7 \mu s$
- (d) $70 \mu s$

11. The probability density function $F(x) = ae^{-b|x|}$, where x is a random variable whose allowable value range is from $x = -\infty$ to $x = +\infty$. The CDF for this function for $x \geq 0$ is

- (a) $\frac{a}{b}e^{bx}$
- (b) $\frac{a}{b}(2 - e^{-bx})$
- (c) $-\frac{a}{b}e^{bx}$
- (d) $-\frac{a}{b}(2 + e^{-bx})$

12. Consider the following statements regarding electrical properties of ceramic materials :

1. They are practically non-conductors at lower temperatures.
2. Ordinary glass and silicates in molten state are dependable as electrical non-conductors.
3. They offer high resistance to current transmission and get heated soon when conducting electric 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

13. If primary and secondary windings of core-type single-phase transformer are wound on non-magnetic core, then the

1. efficiency of the transformer will decrease
2. efficiency of the transformer will increase
3. transformer regulation will increase
4. transformer regulation will decrease

Which of the above possibilities are realized?

- (a) 1 and 4
- (b) 1 and 3
- (c) 2 and 3
- (d) 2 and 4

14. In the case of small BJT model with common emitter, the collector current i_c is 1.3 mA, when the collector-emitter voltage is v_{ce} of 2.6 V. The output conductance of the circuit is

- (a) 2.0 mΩ (b) 2.0 mΩ
- (c) 0.5 mΩ (d) 0.5 mΩ

15. An FM broadcasting radio station transmits signals of frequency 100 MHz with a power of 10 kW. The bandwidth of the modulation signal is from 100 Hz to 1.5 kHz. If the maximum deviation set by the FCC, (δ), is 75 kHz, the range of the modulation index is

- (a) 100 to 750
- (b) 100 to 250
- (c) 50 to 750
- (d) 50 to 250

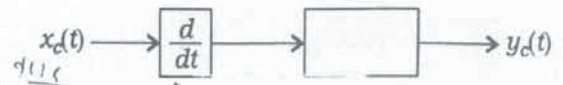
$f_m = 1.5 \text{ kHz}$
 $P = 10 \text{ kW}$



16. An amplitude-modulated amplifier has a radio frequency output of 60 W at 100% modulation. The internal loss in the modulator is 6 W. What is the unmodulated carrier power?

- (a) 33 W
- (b) 36 W
- (c) 40 W
- (d) 44 W

17. The figure shows the block diagram of a frequency discriminator. What does the second block represent?



- (a) Envelope detector
- (b) Low-pass filter
- (c) Ratio detector
- (d) Band-reject filter

18. A dominant pole is determined as

- (a) the highest frequency pole among all poles
- (b) the lowest frequency pole at least two octaves lower than other poles
- (c) the lowest frequency pole among all poles
- (d) the highest frequency pole at least two octaves higher than other poles



19. If only one multiplexer and one inverter are allowed to be used to implement any Boolean function of n variables, what is the maximum size of the multiplexer needed?

- (a) 2^{n-2} line to 1 line
- (b) 2^{n-1} line to 1 line
- (c) 2^{n+1} line to 1 line
- (d) 2^{n+2} line to 1 line

20. What is the minimum $\frac{E_b}{N_0}$ required to achieve a spectral efficiency of 6 bps/Hz?

- (a) 5.2
- (b) 5.3
- (c) 10.5
- (d) 15.8

$\frac{1.3 \times 6}{2.5} = 3.12$

21. What is the required bandwidth of a PCM system for 256 quantization levels when 48 telephone channels, each band-limited to 4 kHz, are to be time-division multiplexed by this PCM?

- (a) 6.246 MHz
- (b) 3.464 MHz
- (c) 3.072 MHz
- (d) 1.544 MHz

$C = 256 \times 2k \times 48$
 $n = 8$
 $\frac{1}{4 \times 10^3 \times 2}$

22. The modulation scheme used in GSM is

- (a) frequency shift keying
- (b) phase shift keying
- (c) Gaussian minimum shift keying
- (d) amplitude shift keying

23. The basic motivation behind the development of digital modulation techniques is

- (a) to develop a digital communication field
- (b) to institute methods for translating digital message from baseband to passband
- (c) to develop digitized versions of analog modulation schemes
- (d) to improve upon pulse modulation schemes

24. The received signal level for a particular digital system is -151 dBW and the effective noise temperature of the receiver system is 1500 K. The value of $\frac{E_b}{N_0}$ required for a link transmitting 2400 bps is

- (a) -12 dB
- (b) -1.2 dB
- (c) +1.2 dB
- (d) +12 dB

25. The largest error between reference input and output during the transient period is called

- (a) peak error
- (b) transient overshoot
- (c) peak overshoot
- (d) transient deviation

$\frac{1.544 \times 48}{1.5}$

26. Consider the following statements regarding 'relative stability':

It is defined

1. in terms of gain margin only
2. in terms of phase margin and certain other parameters
3. in terms of gain margin, phase margin and location of poles in s-plane
4. in relation to another identified system

Which of the above statements are correct?

- (a) 1 and 2
 (b) 2 and 3
 ✓ (c) 3 and 4
 (d) 1 and 4

27. Consider the following statements:

For a type-1 and a unity feedback system, having unity gain in the forward path

1. positional error constant K_p is equal to zero
2. acceleration error constant K_a is equal to zero
- ✓ 3. steady-state error e_{ss} per unit-step displacement input is equal to 1

Which of the above statements are correct?

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

28. Consider a discrete memoryless source with source alphabet $S = \{s_0, s_1, s_2\}$ with probabilities

$$P(s_0) = \frac{1}{4}, P(s_1) = \frac{1}{4} \text{ and } P(s_2) = \frac{1}{2}$$

The entropy of the source is

- (a) $\frac{1}{2}$ bit
 (b) $\frac{2}{3}$ bit
 ✓ (c) $\frac{3}{2}$ bits
 (d) $\frac{1}{3}$ bit

$$\frac{1}{4} \log_2 4 + \frac{1}{4} \log_2 4 + \frac{1}{2} \log_2 2$$

$$= \frac{1}{4}(2) + \frac{1}{4}(2) + \frac{1}{2}(1) = 1.5 = \frac{3}{2}$$

29. For a lead compensator, whose transfer function is given by $K \frac{s+a}{s+b}$; $a, b \geq 0$

- (a) $a < b$
 (b) $a > b$
 (c) $a \geq Kb$
 (d) $a = 0$

30. A unity feedback system has open-loop transfer function with two of its poles located at $-0.1, 1$; and two zeros located at -2 and -1 with a variable gain K . For what value(s) of K would the closed-loop system have one pole in the right half of the s-plane?

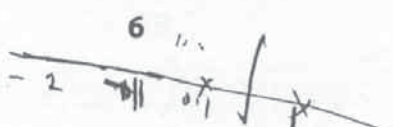
- (a) $K > 0.3$
 (b) $K < 0.05$
 (c) $0.05 < K < 0.3$
 ✓ (d) $K > 0$

$$\frac{1}{1+Kp}$$

$$\frac{1}{1} = 1$$

$$-0.1, 1$$

$$(s+0.1)(s-1)$$



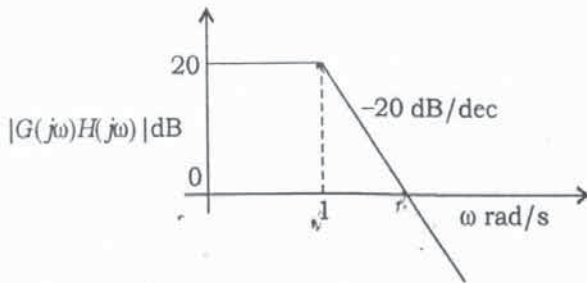
31. Consider that in a system loop transfer function, addition of a pole results in the following :

1. Root locus gets pulled to the right-hand side.
2. Steady-state error is increased.
3. System response gets slower.

Which of the above are correct?

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

32. The magnitude plot for the open-loop transfer function of a control system is shown in the figure given below :



Its open-loop transfer function, $G(s)H(s)$, is

- (a) $10(s+1)$
- (b) $\frac{1}{s+1}$
- (c) $\frac{10}{s+1}$
- (d) $20(s+1)$

33. The open-loop transfer function of a unity feedback control system is

$$G(s)H(s) = \frac{10}{s(s+2)(s+K)}$$

Here K is a variable parameter. The system will be stable for all values of

- (a) $K > -2$
- (b) $K > 0$
- (c) $K > 1$
- (d) $K > 1.45$

34. A control system has $G(s) = \frac{10}{s(s+5)}$ and

$H(s) = K$. What is the value of K for which the steady-state error for unit-step input is less than 5%?

- (a) 0.913
- (b) 0.927
- (c) 0.953
- (d) 1.050

35. What is the time required to reach 2% of steady-state value, for the closed-loop transfer function $\frac{2}{(s+10)(s+100)}$, when the input is $u(t)$?

- (a) 20 s
- (b) 2 s
- (c) 0.2 s
- (d) 0.02 s

36. If the characteristic equation of a closed-loop system is $2s^2 + 6s + 6 = 0$, then the system is

- (a) overdamped
- (b) critically damped
- (c) underdamped
- (d) undamped

37. For derivative control action, the actuating signal consists of proportional error signal with addition of

- (a) derivative of the error signals
- (b) integral of the error signals
- (c) steady-state error
- (d) a constant which is a function of the system type

38. Consider the following statements regarding a PID controller :

1. The error is multiplied by a negative (for reverse action) proportional constant P , and added to the current output.
2. The error is integrated (averaged) over a period of time, and then divided by a constant I , and added to the current control output.
3. The rate of change of the error is calculated with respect to time, multiplied by another constant D , and added to the output.

Which of the above statements are correct?

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

39. A 32 kB RAM is formed by 16 numbers of a particular type of SRAM IC. If each IC needs 14 address bits, what is the IC capacity?

- (a) 32 kbits
- (b) 16 kbits
- (c) 8 kbits
- (d) 4 kbits

40. A cache line has 128 bytes. The main memory has latency 64 ns and bandwidth 1 GB/s. The time required to fetch the entire cache line is

- (a) 32 ns
- (b) 64 ns
- (c) 96 ns
- (d) 192 ns

41. An asynchronous link between two computers uses the start-stop scheme, with one start bit and one stop bit, and a transmission rate of 48.8 kbits/s. What is the effective transmission rate as seen by the two computers?

- (a) 480 bytes/s
- (b) 488 bytes/s
- (c) 4880 bytes/s
- (d) 4800 bytes/s

42. The noise factor of an attenuator pad that has an insertion loss of 6 dB is

- (a) 0.25
- (b) 0.5
- (c) 2
- (d) 4

43. A weighted complete graph with n vertices has weights $2|i-j|$ at edges (v_i, v_j) . The weight of a minimum spanning tree is

- (a) $\frac{n^2}{2}$
- (b) $\frac{n}{2}$
- (c) $2n-2$
- (d) $n-1$

44. Consider the following statements regarding the functions of an operating system in a computer :

1. It controls hardware access.
2. It manages files and folders.
3. It provides a user interface.
4. It manages applications.

Which of the above statements are correct?

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

45. Consider the following processes which arrived in the order P_1, P_2 and P_3 :

Process	Burst time
P_1	24 ms
P_2	3 ms
P_3	3 ms

What is the average waiting time by FCFS scheduling?

- (a) 17 ms
- (b) 19 ms
- (c) 21 ms
- (d) 23 ms

46. The cumulative distribution function of a random variable x is the probability that X takes the value

- (a) less than or equal to x
- (b) equal to x
- (c) greater than x
- (d) zero

47. A disk unit has 24 recording surfaces. It has a total of 14000 cylinders. There is an average of 400 sectors per track. Each sector contains 512 bytes of data. What is the data transfer rate at a rotational speed of 7200 r.p.m.?

- (a) 68.80×10^6 bytes/s
- (b) 24.58×10^6 bytes/s
- (c) 68.80×10^3 bytes/s
- (d) 24.58×10^3 bytes/s

48. In the demand paging memory, a page table is held in registers. If it takes 1000 ms to service a page fault and if the memory access time is 10 ms, what is the effective access time for a page fault rate of 0.01?

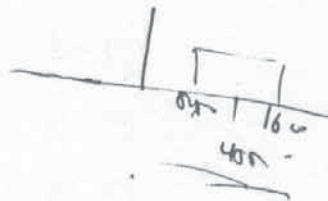
- (a) 19.9 ms
- (b) 10.9 ms
- (c) 9.99 ms
- (d) 0.99 ms

49. Consider the following statements regarding database normal forms :

1. Any relation with two attributes is BCNF.
2. Lossless, dependency-preserving decomposition into BCNF is always possible.
3. Lossless, dependency-preserving decomposition into 3NF is always possible.
4. BCNF is stricter than 3NF.

Which of the above statements are correct?

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



50. Consider the following schedules for transactions T_1 , T_2 and T_3 :

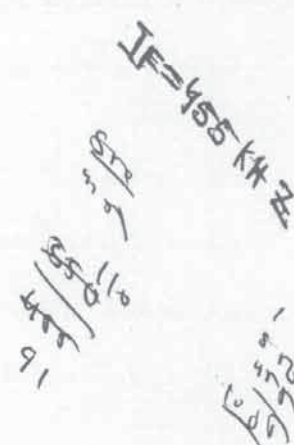
T_1	T_2	T_3
Read (X)		
	Read (Y)	
		Read (Y)
	Write (Y)	
Write (X)		
		Write (X)
	Read (X)	
	Write (X)	

The correct schedule of serialization will be

- (a) $T_1 \rightarrow T_2 \rightarrow T_3$
- (b) $T_2 \rightarrow T_3 \rightarrow T_1$
- (c) $T_3 \rightarrow T_1 \rightarrow T_2$
- (d) $T_1 \rightarrow T_3 \rightarrow T_2$

51. A receiver tunes signals from 550 kHz to 1600 kHz with an IF of 455 kHz. The frequency tuning range ratio for the oscillator section of the receiver is nearly

- (a) 2.90
- (b) 2.05
- (c) 1.65
- (d) 1.30



52. In a basic transmission line, the voltage at the receiving end without load is 660 V; and it is 420 V with full load. What is the percentage of voltage regulation?

- (a) 77%
- (b) 67%
- (c) 57%
- (d) 47%



53. A quarter-wave transformer of characteristic impedance 60Ω has been used to match a transmission line of characteristic impedance Z_0 with a load of 72Ω . What is the characteristic impedance of the transformer, when the load of 72Ω is replaced by 98Ω ?

- (a) 98Ω
- (b) 80Ω
- (c) 70Ω
- (d) 60Ω

54. Consider the following statements :

Stokes' theorem is valid irrespective of

1. shape of closed curve C
2. type of vector A
3. type of coordinate system
4. whether the surface is closed or open

Which of the above statements are correct?

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

55. A plane $y=2$ carries an infinite sheet of charge 4 nC/m^2 . If the medium is free space, what is the force on a point charge of 5 mC located at the origin?

- (a) $0.54\pi \bar{a}_y \text{ N}$
- (b) $0.18\pi \bar{a}_y \text{ N}$
- (c) $-0.36\pi \bar{a}_y \text{ N}$
- (d) $-0.18\pi \bar{a}_y \text{ N}$

56. A random process $X(t)$ is called 'white noise' if the power spectral density is equal to

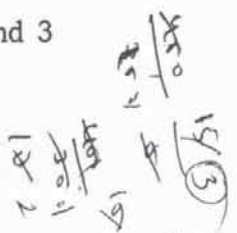
- (a) $\frac{\pi}{8}$
- (b) $\frac{\pi}{2}$
- (c) $\frac{3\pi}{4}$
- (d) π

57. What is the reflection coefficient for the line $Z_0 = 300 \angle 0^\circ \Omega$ and $Z_L = 150 \angle 0^\circ \Omega$?

- (a) 0.5
- (b) 0.333
- (c) -0.333
- (d) -0.5

58. An electromagnetic wave is transmitted into a conducting medium of conductivity σ . The depth of penetration is

- (a) directly proportional to frequency
- (b) directly proportional to square root of frequency
- (c) inversely proportional to frequency
- (d) inversely proportional to square root of frequency



59. Which of the following are the properties of TEM mode in a lossless medium?

1. Its cut-off frequency is zero.
2. Its transmission line is a hollow waveguide.
3. Its wave impedance is the impedance in a bounded dielectric.
4. Its phase velocity is the velocity of light in an unbounded dielectric.

Select the correct answer using the code given below.

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

60. Consider the following statements :

Plane wave propagation through a circular waveguide results in

1. TE modes
2. TM modes

Which of the above statements is/are correct?

- (a) 1 only
(b) 2 only
(c) Either 1 or 2
(d) Both 1 and 2

61. Consider the following statements :

The output of a linear circuit, driven with a sine wave at a frequency f , is itself a sine wave

1. at the same frequency
2. with chance of changed amplitude
3. with chances of changed amplitude and phase

Which of the above statements is/are correct?

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

62. Consider the following statements :

The main contribution to photo-conduction is by

1. the generation of electron and hole pair by a photon
2. a donor electron jumping into the conduction band because of a photon's energy
3. a valence electron jumping into an acceptor state because of a photon's energy

Which of the above statements is/are correct?

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

63. Thermal runaway is not possible in FET because as the temperature of the FET increases

- (a) mobility decreases
- (b) trans-conductance increases
- (c) drain current increases
- (d) trans-conductance decreases

64. For JFET, the drain current I_D is

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

(b) $I_{DSS} \left(1 - \frac{V_{GS}}{V_p}\right)$

(c) $I_{DSS} \left(1 - \frac{V_{GS}}{V_p}\right)^{\frac{3}{2}}$

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

65. For n -channel depletion MOSFET, the highest trans-conductance gain for small signal is at

- (a) $V_{GS} = 0 \text{ V}$
- (b) $V_{GS} = V_p$
- (c) $V_{GS} = |V_p|$
- (d) $V_{GS} = -V_p$

66. The n - p - n transistor made of silicon has a 6DC base bias voltage 15 V and an input base resistor 150 k Ω . Then the value of the base current into the transistor is

- (a) 0.953 μA
- (b) 9.53 μA
- (c) 95.3 μA
- (d) 953 μA

67. A signal may have frequency components which lie in the range of 0.001 Hz to 10 Hz. Which one of the following types of couplings should be chosen in a multistage amplifier designed to amplify the signal?

- (a) Capacitor coupling
- (b) Direct coupling
- (c) Transformer coupling
- (d) Double-tuned transformer coupling

68. If an input impedance of op-amp is finite, then which one of the following statements related to virtual ground is correct?

- (a) Virtual ground condition may exist.
- (b) Virtual ground condition cannot exist.
- (c) In case of op-amp, virtual ground condition always exists.
- (d) Cannot make a valid declaration.

69. Hysteresis is desirable in a Schmitt trigger because

- (a) energy is to be stored/discharged in parasitic capacitances
- (b) effects of temperature variations would be compensated
- (c) devices in the circuit should be allowed time for saturation and de-saturation
- (d) it would prevent noise from causing false triggering

70. In a photoconductive cell, the resistance of the semiconductor material varies with intensity of incident light

- (a) directly
- (b) inversely
- (c) exponentially
- (d) logarithmically

71. In graded index multimode optical fiber, the refractive index of the core is

- (a) uniform across its radial distance, except for the cladding
- (b) maximum at the fiber axis and decreases stepwise towards the cladding
- (c) maximum at the fiber axis and decreases gradually towards the cladding
- (d) maximum at the fiber axis and increases stepwise towards the cladding

72. Consider the following factors :

1. Number of turns of the coil
2. Length of the coil
3. Area of cross-section of the coil
4. Permeability of the core

On which of the above factors does inductance depend?

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

73. A mathematical expression for 50 Hz sinusoidal voltage of peak value 80 V will be

- (a) $v = 50 \sin 314t$
- (b) $v = 50 \sin 80t$
- (c) $v = 80 \sin 314t$
- (d) $v = 80 \sin 50t$

74. Consider the following statements :

1. Fleming's rule is used where induced e.m.f. is due to flux cutting.
2. Lenz's law is used when the induced e.m.f. is due to change in flux linkages.
3. Lenz's law is a direct consequence of the law of conservation of energy.

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. A conductor of length 1 m moves at right angles to a uniform magnetic field of flux density 2 Wb/m^2 with a velocity of 50 m/s. What is the value of the induced e.m.f. when the conductor moves at an angle of 30° to the direction of the field?
- (a) 75 V
(b) 50 V
(c) 25 V
(d) 12.5 V
76. The total flux at the end of a long bar magnet is $500 \mu\text{Wb}$. The end of the bar magnet is withdrawn through a 1000-turn coil in $\frac{1}{10}$ second. The e.m.f. generated across the terminals of the coil is
- (a) 5 V
(b) 10 V
(c) 25 V
(d) 50 V
77. The slip of a 400 V, 3-phase, 4-pole, 50 Hz machine running at 1440 r.p.m. is
- (a) 6%
(b) 5%
(c) 4%
(d) 3%
78. A 500 HP, 440 V, 3-phase, 50 Hz induction motor runs at 950 r.p.m. when on full load with a synchronous speed of 1000 r.p.m. For this condition, the frequency of the rotor current will be
- (a) 4.0 Hz
(b) 3.5 Hz
(c) 2.5 Hz
(d) 2.0 Hz
79. By adding resistance in the rotor circuit of a slip ring induction motor, the starting current
- (a) as well as torque reduce
(b) as well as torque increase
(c) reduces but the starting torque increases
(d) increases but the starting torque decreases
80. Consider the following statements with regards to an induction motor :
1. Maximum torque is independent of rotor resistance.
 2. Starting torque is maximum when rotor resistance equals rotor reactance.
 3. Torque is very sensitive to any changes in supply voltage.
- 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

81. A transformer has 2% resistance and 5% reactance. What is its voltage regulation at full load with 0.8 p.f. lagging?

- (a) 5.3%
- (b) 4.6%
- (c) 0.53%
- (d) 0.46%

82. A voltage is generated across a piezoelectric material, 0.5 cm thick, subjected to an impact of 5 N/m^2 . The voltage coefficient of the material is 23 kV-m/N . The magnitude of the voltage generated will be

- (a) 2300 V
- (b) 1650 V
- (c) 1150 V
- (d) 575 V

83. The 'residual resistivity' of a metal is

- (a) due to lattice vibrations at high temperature
- (b) due to photon scattering at high temperature
- (c) temperature-dependent
- (d) temperature-independent

84. Electrical conductivity, thermal conductivity and magnetic properties of ceramic material are

- (a) very high all the time
- (b) very low all the time
- (c) dependent on the material
- (d) ascertainable, instance to instance

85. Laminated insulation, coated with varnish, is a staple adoption in transformer assemblage in order to

- (a) reduce the reluctance of the magnetic path
- (b) minimize losses due to eddy currents
- (c) increase the reluctance of the magnetic path
- (d) increase the effect of eddy current

86. When a ferromagnetic substance is magnetized, there are marginal diminutions in its linear dimensions. This phenomenon is called

- (a) hysteresis
- (b) magnetostriction
- (c) diamagnetism
- (d) dipolar relaxation

87. When the working temperature becomes more than the Curie temperature, a ferromagnetic material becomes a

- (a) diamagnetic material
- (b) paramagnetic material
- (c) ferromagnetic material
- (d) μ -material

88. Compared to other materials, a material with a wider hysteresis loop has

- (a) lower permeability, higher retentivity and higher coercivity
- (b) higher permeability, lower retentivity and higher coercivity
- (c) lower permeability, higher retentivity and lower reluctance
- (d) lower permeability, lower retentivity and lower residual magnetism

89. Which of the following materials is used in light-emitting diodes?

- (a) Gallium arsenide sulphate
- (b) Gallium arsenide phosphide
- (c) Gallium chromate phosphide
- (d) Gallium phosphide sulphate

90. Consider the following methods in nanoparticle synthesis :

1. Bottom-up
2. Top-down
3. Side-by-side

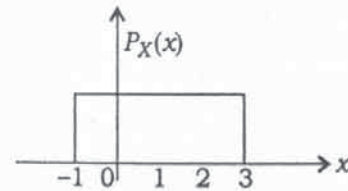
Which of these methods is/are slow and does/do **not** conduce to large-scale production?

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

91. In VLSI *n*-MOS process, the thinox mask

- (a) patterns the ion implantation within the thinox region
- (b) deposits polysilicon all over the thinox region
- (c) patterns thinox regions to expose silicon where source, drain or gate areas are required
- (d) grows thinox over thinox regions in gate areas

92. For a random variable x having the PDF shown in the figure given below



the mean and the variance are, respectively

- (a) 0.5 and 0.66
- (b) 2.0 and 1.33
- (c) 1.0 and 0.66
- (d) 1.0 and 1.33

93. Consider the following statements with respect to bilinear transformation method of digital filter design :

1. It preserves the number of poles and thereby the order of the filter.
2. It maintains the phase response of the analog filter.
3. The impulse response of the analog filter is not preserved.

Which of the above statements are correct?

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

94. Consider the following statements :

The 8259A Programmable Interrupt Controller can

1. manage eight interrupts
2. vector an interrupt request anywhere in the memory map
3. have 8-bit or 16-bit interval between interrupt vector locations
4. be initialized with operational command words

Which of the above statements are correct?

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

95. What are the conditions which are necessary for using a parallel port?

1. Initializing by placing appropriate bits at the control register
2. Calling on interrupt whenever a status flag sets at the status register
3. Interrupting servicing (device driver) programming

Select the correct answer using the code given below.

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

96. Consider a point-to-point communication network represented by a graph. In terms of the graph parameters, the maximum delay (quality of service) experienced by a packet employing Bellman-Ford routing algorithm is/are

1. diameter of the graph
2. shortest path on the graph
3. sum of all edge weights in the graph

Select the correct answer using the code given below.

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

97. Let RSA prime numbers be $p = 3$ and $q = 11$. If the corresponding public key $e = 3$, what is the private key?

- (a) 4
- (b) 5
- (c) 6
- (d) 7

98. The maximum radiation for an endfire array occurs at

- (a) $\phi_0 = 0$
- (b) $\phi_0 = \frac{\pi}{2}$
- (c) $\phi_0 = -\frac{\pi}{2}$
- (d) $\phi_0 = \frac{3\pi}{2}$

99. Consider the following statements regarding TCP :

1. It enables two hosts to establish a connection and exchange streams of data.
2. It guarantees delivery of data in the same order in which they are sent.
3. TCP segmentation offload is used to reduce the CPU overhead of TCP/IP on fast networks.

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

100. The transmission path loss for a geostationary satellite signal for uplink frequency of 6 GHz is

- (a) 60 dB
- (b) 92 dB
- (c) 184 dB
- (d) 200 dB

101. Consider the following statements :

If the maximum range of radar has to be doubled

1. the peak transmitted power may be increased 16 folds
2. the antenna diameter may be doubled
3. the sensitivity of receiver may be doubled
4. the transmitted pulse width may be doubled

Which of the above statements are correct?

- (a) 1 and 2
- (b) 2 and 3
- (c) 3 and 4
- (d) 1 and 4

102. What is the maximum signal propagation time for a geosynchronous satellite transmission system?

- (a) 140 ms
- (b) 220 ms
- (c) 280 ms
- (d) 560 ms



103. The field strength at the receiving antenna location at a distance of 28 km from a half-wave dipole transmitter radiating 0.1 kW is

- (a) 1.5 mV/m
- (b) 2.5 mV/m
- (c) 3.5 mV/m
- (d) 4.5 mV/m

104. Consider the following loop :

```

MOV CX, 8000h
L1 : DEC CX
    JNZ L1
    
```

The processor is running at 14.7456/3 MHz and DEC CX requires 2 clock cycles and JNZ requires 16 clock cycles. The total time taken is nearly

- (a) 0.01 s
- (b) 0.12 s
- (c) 3.66 s
- (d) 4.19 s

105. A microwave communication link employs two antennas for transmission and reception elevated at 200 m and 80 m, respectively. Considering obliqueness of the Earth, the maximum possible link distance is

- (a) 46 km
- (b) 64 km
- (c) 96 km
- (d) 102 km

106. Consider a packet switched network based on a virtual circuit mode of switching. The delay jitter for the packets of a session from the source node to the destination node is/are

1. always zero
2. non-zero
3. for some networks, zero

Select the correct answer using the code given below.

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

107. Molybdenum has a Body-Centered Cubic (BCC) structure with an atomic radius of 1.36 Å. Then the lattice parameter for BCC molybdenum is

- (a) 2.77 Å
- (b) 3.14 Å
- (c) 5.12 Å
- (d) 6.28 Å

Directions :

Each of the next **thirteen (13)** items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the code given below :

Code :

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
- (b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **not** the correct explanation of Statement (I)
- (c) Statement (I) is true but Statement (II) is false
- (d) Statement (I) is false but Statement (II) is true

108. Statement (I) :

The coupling between two magnetically coupled coils is said to be ideal if the coefficient of coupling is unity.

Statement (II) :

Lower the self-inductance of a coil, more will be the e.m.f. induced.

109. Statement (I) :

The direction of dynamically induced e.m.f. in a conductor is determined by Fleming's left-hand rule.

Statement (II) :

The mutual inductance between two magnetically isolated coils is zero.

110. Statement (I) :

Photodiodes are not used in relay circuits.

Statement (II) :

The current needed to activate photodiodes is very low even at high light intensities.

111. Statement (I) :

An autotransformer is economical in using copper in its manufacture.

Statement (II) :

The section of the winding common to both primary and secondary circuits carries only the difference of primary and secondary currents.

112. Statement (I) :

FIR filters are always stable.

Statement (II) :

IIR filters require less memory and are less complex.

113. Statement (I) :

Nuclear power plants are suitable only for base load operation.

Statement (II) :

Nuclear power reactor cannot respond to load fluctuation efficiently.

114. Statement (I) :

Solar insolation is a measure of solar irradiance over a specified period of time.

Statement (II) :

Solar insolation data are commonly used for isolated PV system design.

115. Statement (I) :

The smallest change of input detectable at the output is called the resolution of a transducer.

Statement (II) :

A high resolution means high accuracy.

116. Statement (I) :

Constant M and N circles, as also Nichols' charts, are graphical techniques to assess closed-loop performance in the frequency domain.

Statement (II) :

While constant M and N circles use Nyquist polar plots data, Nichols' chart uses Bode plots data.

117. Statement (I) :

PID controller is an essential part of any control loop in process industry.

Statement (II) :

PID control system performs better than most predictive control methods in the context of measured disturbances.

118. Statement (I) :

Large RAM with MOS circuit technology is used for the main memory in a computer system.

Statement (II) :

An important application of ROM is to store system programs, library subroutines, etc.

119. Statement (I) :

Elements with non-minimum phase transfer functions introduce large phase lags with increasing frequency resulting in complex compensation problems.

Statement (II) :

Transportation lag commonly encountered in process control systems is a non-minimum phase element.

120. Statement (I) :

Speech enhancement techniques are used to make a processed speech signal sound superior to the unprocessed one.

Statement (II) :

A 'perfect signal' is required as reference for speech enhancement.

121. Consider the following statements :

1. Type-I superconductors undergo abrupt transition to the normal state above a critical magnetic field.
2. Type-II superconductors are highly technologically useful superconductors because the incidence of a second critical field in them is useful in the preparation of high field electromagnets.

Which of the above statements is/are correct?

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

122. Consider the following statements :

1. Metal conductors have more R at higher temperatures.
2. Tungsten can be used as a resistance wire.
3. A superconductive material is one which has practically zero resistance.

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

123. Consider the following statements regarding precision in measurements of a quantity. :

1. Precision is the measure of the spread of the incident errors.
2. Precision is independent of the realizable correctness of the measurement.
3. Precision is usually described in terms of number of digits used in the measurement by a digital instrument.

Which of the above statements are correct?

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

124. Consider the following statements in connection with deflection-type and null-type instruments :

1. Null-type instruments are more accurate than the deflection-type ones.
2. Null-type of instrument can be highly sensitive compared to a deflection-type instrument.
3. Under dynamic conditions, null-type instruments are less preferred to deflection-type instruments.
4. Response is faster in null-type instruments as compared to deflection-type instruments.

Which of the above statements are correct?

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

125. A voltmeter having a sensitivity of 1000 Ω/V reads 100 V on its 150 V scale when connected across a resistor of unidentified specifications in series with a milliammeter. When the milliammeter reads 5 mA, the error due to the loading effect of the voltmeter will be nearly

- (a) 13%
- (b) 18%
- (c) 23%
- (d) 33%

126. Consider the following statements :

Sphere gap method of voltage measurement is used

1. for measuring r.m.s. value of a high voltage
2. for measuring peak value of a high voltage
3. as the standard for calibration purposes

Which of the above statements are correct?

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

127. High frequency (in the MHz range) and low amplitude (in the mV range) signals are best measured using

- (a) VTVM with a high impedance probe
- (b) CRO
- (c) moving-iron instrument
- (d) digital multimeter

128. In scintillation coating applications, shields of which material are generally placed around the photomultiplier tube to overcome interference effects of electrons deflected from their normal path?

- (a) Ferromagnetic
- (b) Mu-metal magnetic
- (c) Electromagnetic
- (d) Dielectric

129. A PMMC instrument if connected directly to measure alternating current, it indicates

- (a) the actual value of the subject AC quantity
- (b) zero reading
- (c) $\frac{1}{\sqrt{2}}$ of the scale value where the pointer rests
- (d) $\frac{\sqrt{3}}{2}$ of the scale value where the pointer rests

130. Which of the following are measured by using a vector voltmeter?

1. Amplifier gain and phase shift
2. Filler transfer function
3. Complex insertion loss

Select the correct answer using the code given below.

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

131. In a transistor, the base current and collector current are, respectively, $60 \mu\text{A}$ and 1.75 mA . The value of α is nearly

- (a) 0.91
- (b) 0.97
- (c) 1.3
- (d) 1.7

132. A liquid flows through a pipe of 100 mm diameter at a velocity of 1 m/s. If the diameter is guaranteed within $\pm 1\%$ and the velocity is known to be within $\pm 3\%$ of measured value, the limiting error for the rate of flow is

- (a) $\pm 1\%$
- (b) $\pm 2\%$
- (c) $\pm 3\%$
- (d) $\pm 5\%$

133. A $3\frac{1}{2}$ digit digital voltmeter is accurate to $\pm 0.5\%$ of reading ± 2 digits. What is the percentage error, when the voltmeter reads 0.10 V on its 10 V range?

- (a) 0.025%
- (b) 0.25%
- (c) 2.05%
- (d) 20.5%

134. The simplest and most common method of reducing any 'effect of inductive coupling' between measurement and power circuits is achieved by using

- (a) a screen around the entire measurement circuit
- (b) twisted pairs of cable
- (c) capacitor(s) to be connected at the power circuit
- (d) capacitor(s) to be connected at the measurement circuit

135. A capacitance transducer uses two quartz diaphragms of area 750 mm^2 separated by a distance 3.5 mm. The capacitance is 370 pF. When a pressure of 900 kN/m^2 is applied, the deflection is 0.6 mm. The capacitance at this pressure would be

- (a) 619 pF
- (b) 447 pF
- (c) 325 pF
- (d) 275 pF

136. Consider the following statements regarding Time-Division Multiplexing (TDM) :

1. The information from different measuring points is transmitted serially on the same communication channel.
2. It involves transmission of data samples rather than continuous data transmission.
3. It is especially useful when telemetering fast-changing, high bandwidth data.

Which of the above statements are valid in respect to TDM?

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

137. Consider the following regarding essential functional operations of a digital data acquisition system :

1. Handling of analog signals
2. Converting the data to digital form and handling it
3. Making the measurement
4. Internal programming and telemetry

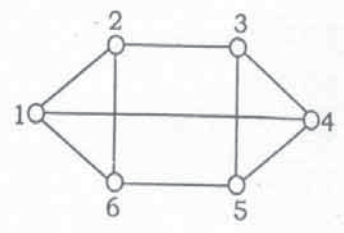
Which of the above are valid in the stated context?

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

138. A low resistance LDR of 20Ω , operated at a certain intensity of light, is to be protected through a series resistance in such a way that up to 12 mA of current is to flow at a supply voltage of 10 V. What is the nearest value of the protective resistance?

- (a) $873\ \Omega$
- (b) $813\ \Omega$
- (c) $273\ \Omega$
- (d) $81\ \Omega$

139. Consider the following with regards to graph as shown in the figure given below :



1. Regular graph
2. Connected graph
3. Complete graph
4. Non-regular graph

Which of the above are correct?

- (a) 1 and 4
- (b) 3 and 4
- (c) 2 and 3
- (d) 1 and 2

140. A network in which all the elements are physically separable is called a

- (a) distributed network
- (b) lumped network
- (c) passive network
- (d) reactive network

141. Three identical impedances are first connected in delta across a 3-phase balanced supply. If the same impedances are now connected in star across the same supply, then

- (a) the phase current will be one-third
- (b) the line current will be one-third
- (c) the power consumed will be one-third
- (d) the power consumed will be halved

142. Consider the following statements regarding trees :

1. A tree contains all the nodes of the graph.
2. A tree shall contain any one of the loops.
3. Every connected graph has at least one tree.

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

143. A voltage $v(t) = 173 \sin(314t + 10^\circ)$ is applied to a circuit. It causes a current flow described by

$$i(t) = 14.14 \sin(314t - 20^\circ)$$

The average power delivered is nearly

- (a) 2500 W
- (b) 2167 W
- (c) 1500 W
- (d) 1060 W

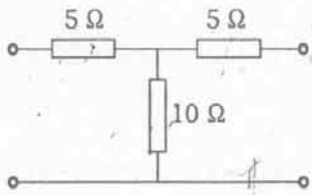
144. Consider the following statements with respect to a parallel $R-L-C$ circuit :

1. The bandwidth of the circuit decreases if R is increased.
2. The bandwidth of the circuit remains same if L is increased.
3. At resonance, input impedance is a real quantity.
4. At resonance, the magnitude of the input impedance attains its minimum value.

Which of the above statements are correct?

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

145. What is the admittance matrix for a two-port network shown in the figure given below?



(a) $\begin{bmatrix} 15 & 5 \\ 5 & 15 \end{bmatrix}$ (b) $\frac{1}{200} \begin{bmatrix} 15 & -5 \\ -5 & 15 \end{bmatrix}$

(c) $\begin{bmatrix} 5 & 15 \\ 15 & 5 \end{bmatrix}$ (d) $\frac{1}{200} \begin{bmatrix} 20 & 5 \\ 15 & 20 \end{bmatrix}$

146. A two-port network is characterized by

$$I_1 = 3V_1 + 4V_2$$

$$6I_2 = 2V_1 - 4V_2$$

Its A, B, C and D parameters are, respectively

(a) 2, 3, 6 and 9

(b) 2, -3, 10 and -9

(c) 3, 2, -9 and 6

(d) 3, -2, 9 and -6

147. A unit-step voltage is applied at $t = 0$ to a series R-L circuit with zero initial condition. Then

(a) it is possible for the current to be oscillatory

(b) the voltage across the resistor at $t = 0^+$ is zero

(c) the voltage across the resistor at $t = 0^-$ is zero

(d) the resistor current eventually falls to zero

148. One of the basic characteristics of any steady-state sinusoidal response of a linear R-L-C circuit with constant R, L and C values is

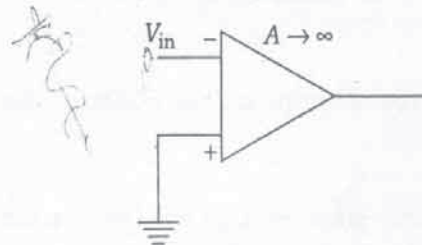
(a) the output remains sinusoidal with its frequency being the same as that of the source

(b) the output remains sinusoidal with its frequency differing from that of the source

(c) the output amplitude equals the source amplitude

(d) the phase angle difference between the source and the output is always zero

149. If the input (V_{in}) to the circuit is a sine wave, the output will be



(a) half-wave rectified sine wave

(b) full-wave rectified sine wave

(c) triangular wave

(d) square wave

150. Which one of the following Analog-to-Digital Converters (ADC) does **not** use a DAC?

(a) Digital ramp ADC

(b) Successive approximation ADC

(c) Single-slope ADC

(d) Counting ADC