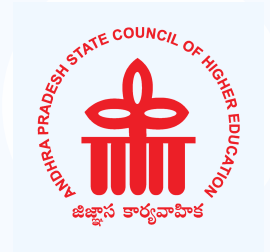


Question Paper

Conducted by National Testing Agency (NTA)



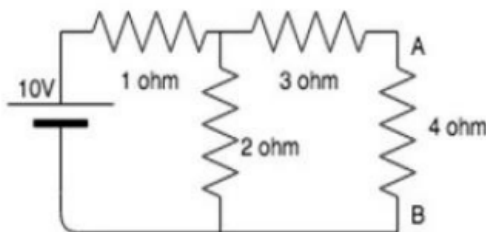
General Instructions

- (i) The examination was conducted in Computer-Based Test (CBT) mode.
- (ii) Question Paper consists of 120 questions.
- (iii) Each correct answer carries 1 mark and there is no negative marking for incorrect answer.
- (iv) Duration of the exam is 2 hour (120 minutes).

1. The number of nodes in a graph having 5 branches and 2 independent loops is

- (A) 3
- (B) 4
- (C) 5
- (D) 6

2. For the given circuit, the values of R_{th} across the terminal AB and V_{th} are ____ and ____, respectively.



- (A) 4.34 Ω , 5.54 V
- (B) 3.67 Ω , 3.33 V
- (C) 3.43 Ω , 6.67 V
- (D) 3.67 Ω , 6.67 V

3. If a Delta circuit has branches $R_{ab} = 10\ \Omega$, $R_{bc} = 20\ \Omega$, and $R_{ca} = 30\ \Omega$, what is the equivalent Wye resistor R_a connected to node?

- (A) $10\ \Omega$
 - (B) $20\ \Omega$
 - (C) $5\ \Omega$
 - (D) $6\ \Omega$
-

4. In sinusoidal steady-state analysis, which of the following best describes the use of phasors?

- (A) Phasors are used to simplify time-domain analysis of RLC circuits by representing sinusoidal signals as complex numbers
 - (B) Phasors are only used for DC analysis
 - (C) Phasors convert differential equations into algebraic equations in the time domain
 - (D) Phasors are used to compute the time derivative of voltage or current
-

5. What does the Laplace transform do the differential equation of an RLC circuit?

- (A) It simplifies the equation by transforming it from the frequency domain to the time domain
 - (B) It retains the differential equation as it is
 - (C) It converts the circuit parameters into phasor form
 - (D) It converts a time-domain differential equation into an algebraic equation in the s-domain
-

6. For a symmetrical two-port network, which of the following is NOT necessarily true?

- (A) $z_{11} = z_{22}$
 - (B) $y_{11} = y_{22}$
 - (C) $A = D$
 - (D) $AD - BC = 1$
-

7. Which of the following best describes the band structure of intrinsic silicon?

- (A) Single energy band
- (B) Completely overlapping conduction and valence bands
- (C) A wide band gap between the conduction and the valence bands
- (D) No conduction band

8. The primary characteristic of a tunnel diode is its ____.

- (A) very high forward resistance
 - (B) negative resistance
 - (C) low breakdown resistance
 - (D) high capacitance
-

9. At very high electric fields in silicon, the drift velocity of electrons becomes independent of the electric field. This phenomenon is known as:

- (A) Velocity Saturation
 - (B) Avalanche Breakdown
 - (C) Negative Differential Resistance
 - (D) High-field Ionization
-

10. In an n-channel JFET, if the gate voltage is made more negative than the pinch-off voltage, what happens to the drain current?

- (A) Drain current increases linearly
 - (B) Drain current saturates
 - (C) Drain current drops to near zero
 - (D) Drain current reverses direction
-

11. Which of the following is a characteristic of the MOS capacitor?

- (A) The capacitance is zero when there is no applied voltage
 - (B) The capacitance increases with increasing voltage applied to the gate
 - (C) The capacitance is independent of the gate voltage
 - (D) The MOS capacitor can only store holes
-

12. What distinguishes the light emitted by a LASER diode from an LED?

- (A) LED light is monochromatic
 - (B) LASER light is coherent
 - (C) LED light is directional
 - (D) LASER light is non-directional
-

13. In silicon IC fabrication, 'Dry Oxidation' is generally preferred over 'Wet Oxidation' for growing:

- (A) Thick field oxides
 - (B) Gate oxides
 - (C) Isolation layers
 - (D) Passivation layers
-

14. In a MOSFET small-signal model, if the drain current is doubled while maintaining the same device dimensions, the trans-conductance will:

- (A) Remain the same
 - (B) Increase by a factor of 2
 - (C) Increase by a factor of $\sqrt{2}$
 - (D) Decrease by a factor of $\sqrt{2}$
-

15. A positive clamper circuit with a 10V DC source is fed with a 20V p-p sinusoidal input. What is the minimum DC voltage level at the output?

- (A) 0 V
 - (B) 10 V
 - (C) 20 V
 - (D) -10 V
-

16. A negative feedback amplifier has an open-loop gain of 100 and a feedback factor $\beta = 0.09$. If the open-loop gain changes by 10% due to aging, what is the percentage change in the closed-loop gain of the amplifier?

- (A) 1 %
 - (B) 10 %
 - (C) 0.1 %
 - (D) 0.9 %
-

17. In an op-amp, which of the following best describes the 'virtual short' concept?

- (A) The op-amp behaves like a short circuit in feedback configuration
 - (B) The op-amp input terminals are shorted together for operation
 - (C) The output voltage of the op-amp is always zero
 - (D) The voltage difference between the inverting and non-inverting inputs is close to zero in an ideal op-amp
-

18. A two-stage RC-coupled amplifier has stage-1 lower cutoff frequency $f_{L1} = 100$ Hz and stage-2 lower cutoff frequency $f_{L2} = 1$ kHz. The overall lower cutoff frequency of the amplifier is approximately:

- (A) 50 Hz
 - (B) 100 Hz
 - (C) 1 kHz
 - (D) 1.1 kHz
-

19. Which of the following is a common application of a 555 timer in monostable mode?

- (A) To generate a constant output signal
 - (B) To generate a fixed pulse with output signal
 - (C) To oscillate continuously
 - (D) To provide a frequency response
-

20. A full-wave rectifier has a load resistor of $1\text{ k}\Omega$ and a capacitor of $100\text{ }\mu\text{F}$. Doubling the load resistor will ____.

- (A) double ripple voltage
 - (B) halve ripple voltage
 - (C) no change
 - (D) quadruple ripple voltage
-

21. The minimal SOP expression for a 3-variable function having m in terms of $\sum m(1, 3, 5, 7)$ is

- (A) C
 - (B) $A + C$
 - (C) B
 - (D) $AB + C$
-

22. The logic family which is least affected by temperature variations, is

- (A) DTL
 - (B) TTL
 - (C) CMOS
 - (D) ECL
-

23. In a positive edge-triggered JK flip-flop, the J input is connected to $\bar{Q}$ (inverted output) and the K input is connected to Q (normal output). If the flip-flop is initially in the RESET state ($Q = 0, \bar{Q} = 1$) and is subjected to 4 consecutive positive clock pulses, what will be the final state of Q ?

- (A) 1
 - (B) 0101 (oscillates)
 - (C) 0
 - (D) Indeterminate
-

24. If a sample and hold circuit is not used with an ADC, the result may be _____.

- (A) more accurate
 - (B) completely error-free
 - (C) corrupted/inaccurate due to aperture error
 - (D) faster with high resolution
-

25. A ring counter (with 4 flip-flops) has how many unique states?

- (A) 2
 - (B) 4
 - (C) 8
 - (D) 16
-

26. Signal distortionless transmission through an LTI system requires:

- (A) Constant magnitude response only
 - (B) Linear phase only
-

- (C) Constant magnitude and linear phase
 - (D) Zero group delay
-

27. The frequency response magnitude of a DT-LTI system tends to infinity when

- (A) Input is zero
 - (B) Poles lie on the unit circle
 - (C) Zeros lie on the unit circle
 - (D) System is causal and stable
-

28. What is the primary difference between CTFT and DTFT?

- (A) CTFT is periodic and DTFT is non-periodic
 - (B) CTFT transforms a discrete-time signal and DTFT transforms a continuous-time signal
 - (C) CTFT is non-periodic and DTFT is periodic
 - (D) CTFT is defined for periodic signals and DTFT is for non-periodic signals
-

29. In a causal and stable LTI system, the impulse response $h(t)$ must satisfy which condition ?

- (A) $h(t)$ is always positive
 - (B) $h(t)$ is periodic
 - (C) $h(t)$ must be absolutely integrable
 - (D) $h(t)$ must be bounded
-

30. What is the Fourier Transform of a Gaussian function e^{-t^2} ?

- (A) A delta function
 - (B) A sinc function
 - (C) Another Gaussian function
 - (D) A step function
-

31. In FFT computation, reducing complexity from $O(N^2)$ to $O(N \log_2 N)$ relies fundamentally on _____.

- (A) periodicity of time-domain signal
 - (B) symmetry and periodicity of twiddle factors
-

- (C) linearity of DFT
 - (D) convolution theorem
-

32. If the impulse response of a discrete-time LTI system is finite in length, which property is always guaranteed?

- (A) Causality
 - (B) Stability
 - (C) Linearity
 - (D) Time invariance
-

33. For a discrete-time periodic signal with period N , how many distinct Fourier coefficients exist?

- (A) Infinite
 - (B) $N/2$
 - (C) N
 - (D) $2N$
-

34. The open loop transfer function of a unity feedback system is $G(s) = \frac{10}{s(s+2)}$, what is the steady state error for a unit step input?

- (A) Infinite
 - (B) 0
 - (C) 0.1
 - (D) 0.2
-

35. A second order system has $\omega_n = 4$ rad/sec and $\zeta = 0.5$. What is the damped natural frequency ω_d ?

- (A) 4
 - (B) 2
 - (C) 1.73
 - (D) 3.46
-

36. The characteristic equation of a system is $s^3 + 3s^2 + 3s + 1 = 0$. How many poles lie in the right half plane?

- (A) 0
 - (B) 1
 - (C) 2
 - (D) 3
-

37. If the open-loop transfer function $G(s)H(s)$ has one pole in the right-half of the s -plane, for the closed-loop system to be stable, the Nyquist plot must encircle the $(-1, j0)$ point _____.

- (A) once in the clockwise direction
 - (B) twice in the counter-clockwise direction
 - (C) once in the counter-clockwise direction
 - (D) zero times
-

38. A phase-lead compensator is primarily used to _____.

- (A) decrease the steady-state error
 - (B) increase the damping and improve transient response
 - (C) reduce the bandwidth of the system
 - (D) increase the rise time
-

39. Which part of a PID controller is specifically responsible for eliminating the steady-state error?

- (A) Proportional term
 - (B) Feedforward term
 - (C) Integral term
 - (D) Derivative term
-

40. For the state equation $\dot{x} = 3x$, the system is _____.

- (A) stable
 - (B) marginally stable
 - (C) unstable
 - (D) oscillatory
-

41. Gain cross over frequency is the frequency at which ____.

- (A) Phase is zero
 - (B) Magnitude is 0 dB
 - (C) Phase is -180°
 - (D) Gain is maximum
-

42. What is the primary advantage of using a super-heterodyne receiver?

- (A) Simplicity in construction
 - (B) High frequency response
 - (C) Improved signal selectivity and sensitivity
 - (D) Direct conversion of the received signal
-

43. Which of the following digital modulation schemes has the lowest probability of error at a given SNR?

- (A) ASK
 - (B) FSK
 - (C) PSK
 - (D) DPSK
-

44. Which of the following is a salient feature of GSM ____.

- (A) frequency modulation for voice transmission
 - (B) advanced multi-carrier transmission
 - (C) digital system using TDMA/FDMA
 - (D) low user capacity compared to analog
-

45. In a coherent BPSK modulation scheme, if the input bit rate is doubled while keeping the symbol energy as constant, what is the effect on the transmission bandwidth (BW) and the probability of bit error (P_e)?

- (A) BW doubles, P_e increases
- (B) BW doubles, P_e remains same

- (C) BW remains same, P_e increases
 - (D) BW doubles, P_e decreases
-

46. A Gaussian noise channel has a bandwidth of 4 kHz and a signal-to-noise power ratio (SNR) of 15. According to the Shannon-Hartley theorem, what is the maximum capacity of this channel?

- (A) 32 kbps
 - (B) 16 kbps
 - (C) 60 kbps
 - (D) 64 kbps
-

47. The total average power of a signal equals:

- (A) Peak value of PSD
 - (B) Area under the PSD curve
 - (C) Value of PSD at zero frequency
 - (D) Average of PSD over the bandwidth
-

48. For a WSS random process, the autocorrelation $R_x(\tau)$ as $\tau \rightarrow \infty$ approaches:

- (A) Zero always
 - (B) Mean square value
 - (C) Square of the mean
 - (D) Signal power
-

49. The skin depth in a conductor is:

- (A) Inversely proportional to conductivity
 - (B) Directly proportional to square root of conductivity
 - (C) Inversely proportional to square root of conductivity
 - (D) Independent of material properties
-

50. Which of the following statements is NOT true about Maxwell's equations in differential form?

- (A) Gauss's Law states that the electric flux density is proportional to the charge density.
 - (B) Faraday's Law implies that a time-varying magnetic field produces an electric field.
 - (C) Ampere's Law in differential form shows that magnetic fields have sources and sinks.
 - (D) Gauss's Law for magnetism states that magnetic monopoles do not exist.
-

51. The radiation pattern of a dipole antenna is characterized by,

- (A) A constant radiation intensity in all directions
 - (B) A doughnut-shaped distribution with maximum radiation perpendicular to the axis
 - (C) Maximum radiation along the axis of the dipole
 - (D) A uniform radiation pattern in the far field
-

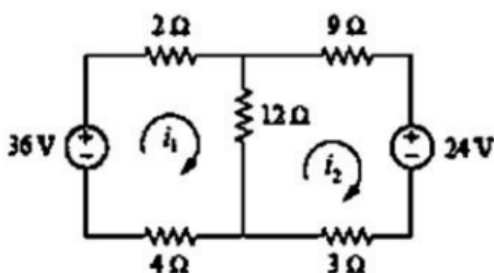
52. The Poynting vector in electromagnetic theory represents,

- (A) The electric field strength at a point
 - (B) The rate at which energy is transported by the electromagnetic wave
 - (C) The potential energy in the electric field
 - (D) The time-averaged power dissipated in a resistor
-

53. Which of the following is the primary condition that must be satisfied at the boundary of a perfect electric conductor (PEC) for an electromagnetic wave?

- (A) The tangential component of the magnetic field is zero
 - (B) The tangential component of the electric field is zero
 - (C) The normal component of the electric field is zero
 - (D) The normal component of the magnetic field is continuous and non-zero
-

54. Find current i_2 in the shown network

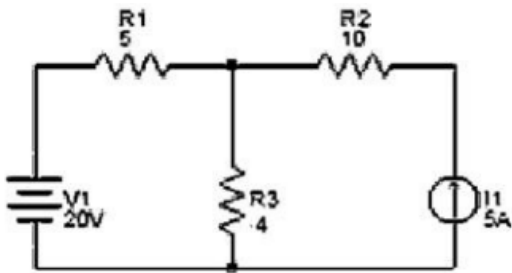


- (A) 0 A
 - (B) 3 A
 - (C) 1 A
 - (D) 2 A
-

55. For every tree there will be _____ number of cut set matrices.

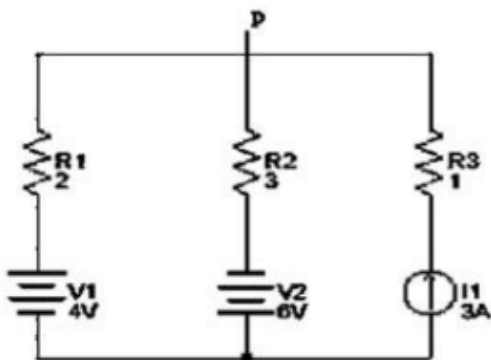
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 4
-

56. In the circuit shown, find the current through 4Ω resistor using Superposition theorem.



- (A) 4
 - (B) 5
 - (C) 6
 - (D) 7
-

57. Find the voltage at node P shown in the figure.



- (A) 9V

- (B) 3.6V
 - (C) 10V
 - (D) 4.3V
-

58. In an R-C circuit, when the switch is closed, the response _____.

- (A) do not vary with time
 - (B) decays with time
 - (C) rises with time
 - (D) first increases and then decreases
-

59. What type of semiconductor is used in LED ?

- (A) Intrinsic semiconductor
 - (B) Compound semiconductor
 - (C) Degenerated semiconductor
 - (D) Compensated semiconductor
-

60. The voltage equivalent of temperature (V_T) in a $p-n$ junctions is given by

- (A) $T/1000$ volts
 - (B) $T/300$ volts
 - (C) $T/1600$ volts
 - (D) $T/11600$ volts
-

61. The application of a CC configured transistor is _____.

- (A) voltage multiplier
 - (B) level shifter
 - (C) rectification
 - (D) impedance matching
-

62. What is the behaviour of a PIN diode under reverse bias?

- (A) It conducts high current.
 - (B) It acts as a variable resistor.
-

- (C) It acts as a variable capacitor.
 - (D) It acts as a closed switch.
-

63. What is the role of input capacitance in the transistor amplifying circuit?

- (A) To prevent input variation from reaching output
 - (B) To prevent DC content in the input from reaching transistor
 - (C) There isn't any role for input capacitance
 - (D) To bypass AC signal to ground
-

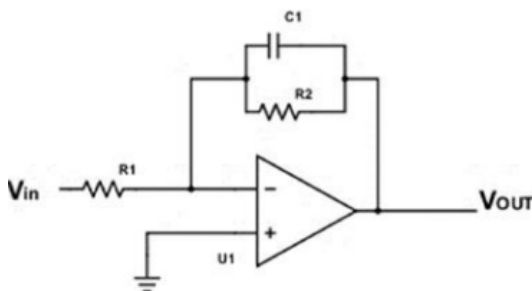
64. Given that $R_1 = 20\text{k}\Omega$, $C_1 = 2\text{nF}$, $R_2 = 20\text{k}\Omega$, $C_2 = 2\text{nF}$, find the approximate resonant frequency of a Wein bridge oscillator.

- (A) 4kHz
 - (B) 3kHz
 - (C) 25kHz
 - (D) 15kHz
-

65. Which among the following can be used to detect the missing heart beat?

- (A) Mono-stable multivibrator
 - (B) Astable multivibrator
 - (C) Schmitt trigger
 - (D) Filter
-

66. In a low pass filter as below, find the cut-off frequency for the following circuit. Given that $R_1 = 20\text{k}\Omega$, $R_2 = 25\text{k}\Omega$, $C_1 = 10\mu\text{F}$.



- (A) 640 kHz
- (B) 637 Hz

- (C) 5.5 kHz
 - (D) 200 Hz
-

67. Which component is used to reduce ripples in a DC power supply?

- (A) Resistor
 - (B) Filter
 - (C) Transformer
 - (D) Diode
-

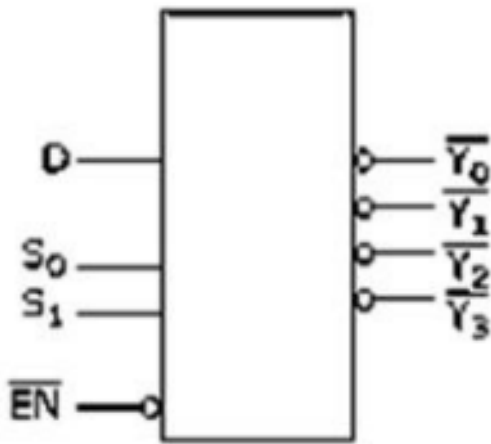
68. Which of the following options comes under the non-saturated logic family?

- (A) Emitter – coupled Logic
 - (B) High-Threshold Logic
 - (C) Integrated – injection Logic
 - (D) Diode-Transistor Logic
-

69. The result “ $X + XY = X$ ” follows which of these laws?

- (A) Consensus law
 - (B) Distributive law
 - (C) Duality law
 - (D) Absorption law
-

70. The device shown here is most likely a _____.



- (A) Comparator
- (B) Multiplexer
- (C) Inverter
- (D) Demultiplexer

71. How many select lines would be required for an 8-line-to-1-line multiplexer?

- (A) 2
- (B) 4
- (C) 8
- (D) 3

72. Which of the following is a register-indirect addressing mode instruction set?

- (A) LDA 2700H
- (B) ADI 36H
- (C) DAA
- (D) LDAX B

73. Find the ROC of $x(t) = e^{-2t}u(t) + e^{-3t}u(t)$.

- (A) $\sigma > 2$
- (B) $\sigma > 3$
- (C) $\sigma > -2$
- (D) $\sigma > -3$

74. Which of the following systems is memoryless?

- (A) $y(t) = x(2t) + x(t)$
 - (B) $y(t) = x(t) + 2x(t)$
 - (C) $y(t) = -x(t) + x(1 - t)$
 - (D) $y(t) = x(t) + 2x(t + 2)$
-

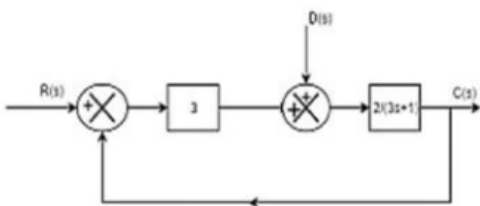
75. Find the convolution sum of sequences $x_1[n] = \{1, 2, 3\}$ and $x_2[n] = \{2, 1, 4\}$.

- (A) $\{2, 5, 12, 11, 12\}$
 - (B) $\{2, 12, 5, 11, 12\}$
 - (C) $\{2, 11, 5, 12, 12\}$
 - (D) $\{-2, 5, -12, 11, 12\}$
-

76. The total number of complex multiplications required to compute an N -point DFT using the Radix-2 FFT algorithm is

- (A) $\frac{N}{2} \log_2 N$
 - (B) $N \log_2 N$
 - (C) $\frac{N}{2} \log N$
 - (D) $\frac{N}{2} \log \left(\frac{N}{2} \right)$
-

77. The transfer function from $D(s)$ to $C(s)$ is _____. Given $G(s) = \frac{2}{3s+1}$ and $H(s) = 3$



- (A) $2/(3s + 7)$
 - (B) $2/(3s + 1)$
 - (C) $6/(3s + 7)$
 - (D) $3/(3s + 1)$
-

78. The greater the Gain Margin in the control system, the greater is its _____.

- (A) stability
 - (B) response
 - (C) profit
 - (D) delay
-

79. The system with the open loop transfer function $\frac{1}{s(1+s)}$ is:

- (A) Type 2 and order 1
 - (B) Type 1 and order 1
 - (C) Type 0 and order 0
 - (D) Type 1 and order 2
-

80. PD controller:

- (A) Decreases steady state error and improves stability
 - (B) Rise time decreases
 - (C) Transient response becomes poorer
 - (D) Increases steady state error
-

81. Calculate power in each sideband, if power of carrier wave is 176W and there is 60% modulation in amplitude modulated signal?

- (A) 13.36W
 - (B) 52W
 - (C) 67W
 - (D) 15.84W
-

82. In flat top sampling scheme, _____ is kept constant after sampling.

- (A) amplitude
 - (B) phase
 - (C) frequency
 - (D) time period
-

83. The matched filter is equivalent to which of the following?

- (A) A correlator
 - (B) An envelope detector
 - (C) A PLL
 - (D) An equalizer
-

84. Which access technique is primarily used in the Global System for Mobile communications (GSM)?

- (A) CDMA
 - (B) TDMA
 - (C) FDMA
 - (D) WDMA
-

85. The cut off frequency of the dominant mode in a TE wave in the line having a and b as 2.5 cm and 1 cm respectively is,

- (A) 4.5 GHz
 - (B) 5 GHz
 - (C) 5.5 GHz
 - (D) 6 GHz
-

86. Fresnel zone is also called as _____.

- (A) near Field
 - (B) far Field
 - (C) electrostatic Field
 - (D) reactive Field
-

87. What does the parameter S_{11} represent in a two-port network?

- (A) Forward transmission coefficient
 - (B) Reverse transmission coefficient.
 - (C) Input reflection coefficient
 - (D) Output reflection coefficient
-

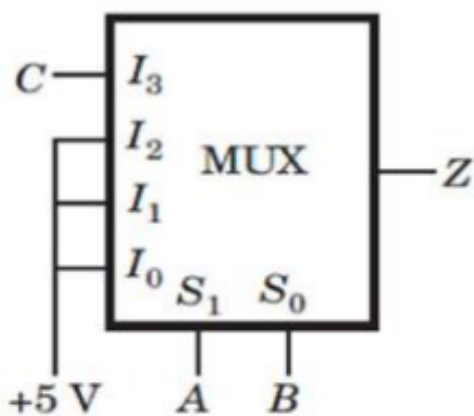
88. An amplifier without feedback has a voltage gain of 50, input resistance of $1\text{ k}\Omega$ and output resistance of $2.5\text{ k}\Omega$. The input resistance of the current-shunt negative feedback amplifier using the above amplifier with a feedback factor of 0.2, is

- (A) $\frac{1}{11}\text{ k}\Omega$
- (B) $\frac{1}{5}\text{ k}\Omega$
- (C) $5\text{ k}\Omega$
- (D) $11\text{ k}\Omega$

89. To double the drain current of an N-channel enhancement mode MOSFET biased in saturation ____.

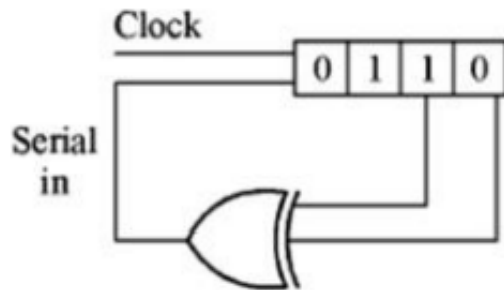
- (A) channel length should be doubled
- (B) channel width should be halved
- (C) channel length should be halved
- (D) gate oxide thickness should be doubled

90. The MUX shown in fig is 4×1 multiplexer. The output Z is



- (A) ABC
- (B) $A \oplus B \oplus C$
- (C) $A \cup B \cup C$
- (D) $A + B + C$

91. The initial contents of the 4-bit serial-in-parallel out right-shift register shown in figure is 0110. After three clock pulse applied, the contents of the shift register will be



- (A) 0000
- (B) 0101
- (C) 1010
- (D) 1111

92. The contents of accumulator after the execution of following instruction will be

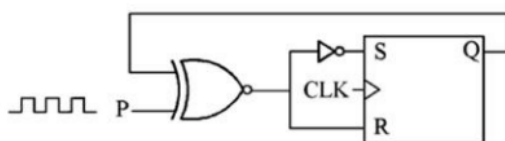
MVI A, B7H

ORA A

RAL

- (A) 6EH
- (B) 6FH
- (C) EEH
- (D) EFH

93. Consider the circuit, the next state Q^+ is



- (A) PQ
- (B) $P\bar{Q}$

(C) $P \oplus Q$

(D) $P \odot \overline{Q}$

94. A system is described by the differential equation $\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 5y(t) = x(t)$. Impulse response of the system is

(A) $h(t) = \frac{1}{4}[e^{-2t} - e^{-3t}]u(t)$

(B) $h(t) = [e^{-t} - e^{-5t}]u(t)$

(C) $h(t) = \frac{1}{4}[e^{-t} - e^{-5t}]u(t)$

(D) $h(t) = \frac{1}{4}[e^{-3t} - e^{-2t}]u(t)$

95. The Fourier transform of a real valued time signal has ____.

(A) odd symmetry

(B) even symmetry

(C) conjugate symmetry

(D) no symmetry

96. Consider a causal LTI system with frequency response $H(j\omega) = \frac{1}{j\omega+3}$. This system produces the output to an input $x(t)$ as $y(t) = e^{-3t}u(t) - e^{-4t}u(t)$. The input $x(t)$ is

(A) $(2e^{-4t} - 3e^{-3t})u(t)$

(B) $e^{-4t}u(t)$

(C) $(e^{-3t} - e^{-4t})u(t)$

(D) $(e^{-4t} - e^{-3t})u(t)$

97. The convolution of two DT sequence is,

$x(n) = \{1 \uparrow, 2, 0, 1\}$

$h(n) = \{2, 2, 3\}$

(A) $\{2 \uparrow, 4, 0, 2, 3, 6\}$

(B) $\{2 \uparrow, 6, 7, 8, 2, 3\}$

(C) $\{2, 6, 7, 8 \uparrow, 2, 3\}$

(D) $\{2, 4, 0 \uparrow, 2, 3, 6\}$

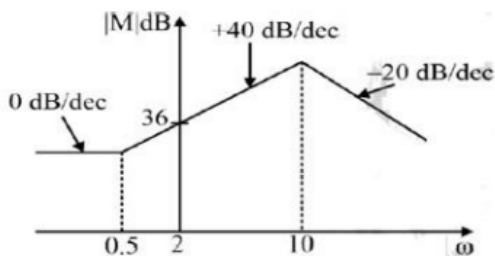
98. The value of K for which the unity feedback system $G(s) = \frac{K}{s(s+2)(s+4)}$ crosses the imaginary axis is

- (A) 2
- (B) 4
- (C) 6
- (D) 48

99. A unity feedback second order system has $G(s) = \frac{100}{s^2 + 10s + 100}$. The 2% settling time is in second.

- (A) 0.4
- (B) 0.8
- (C) 1
- (D) 2

100. What is the transfer function for given bode plot shown in the figure?



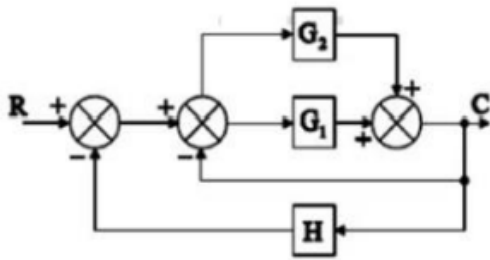
- (A) $\frac{4(s+0.5)^2}{(s+10)^3}$
- (B) $\frac{4000(s+0.5)^2}{(s+10)^3}$
- (C) $\frac{160(s+0.5)^2}{(s+10)^3}$
- (D) $\frac{1600(s+0.5)^2}{(s+10)^3}$

101. Consider the unity feedback system with $G(s) = \frac{2}{s(s+1)(2s+1)}$. what is the phase margin?



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

102. Overall gain of the system shown in the figure is:



- (A) $\frac{G_1 + G_2}{1 + G_1 G_2 + G_1 H + G_2 H}$
 (B) $\frac{G_1 G_2}{1 + G_1 + G_2 + G_1 H + G_2 H}$
 (C) $\frac{G_1 G_2}{1 + G_1 G_2 + G_1 H + G_2 H}$
 (D) $\frac{G_1 + G_2}{1 + G_1 + G_2 + G_1 H + G_2 H}$

103. The carrier $c(t) = A \cos(2\pi \times 10^6 t)$ is angle modulated (PM or FM) by the signal $m(t) = 2 \cos(4000\pi t)$. The deviation constants are $k_p = 3 \text{ rad/V}$ & $k_f = 3000 \text{ Hz/V}$. The value of modulation indices β_f & β_p are:

- (A) 6 & 3
 (B) 12 & 6
 (C) 3 & 6
 (D) Other value

104. A binary channel with bit rate of 56kbps is available for uniform PCM voice transmission having signal bandwidth of 3.4kHz. The signal-to-noise ratio in decibels is:

- (A) 58.8
 (B) 76.9
 (C) 98.6
 (D) 108.5

105. A binary signal is transmitted at 10kbps using NRZ signaling. Find the minimum channel bandwidth required in KHz:

- (A) 2.5
 - (B) 5
 - (C) 1.5
 - (D) 20
-

106. In a DPSK system the input bit sequence is 1101, initial phase = 0. The transmitted phase sequence is:

- (A) $180^\circ, 0^\circ, 0^\circ, 180^\circ$
 - (B) $0^\circ, 180^\circ, 180^\circ, 0^\circ$
 - (C) $180^\circ, 180^\circ, 0^\circ, 0^\circ$
 - (D) $180^\circ, 0^\circ, 0^\circ, 180^\circ$
-

107. For electrostatic fields in charge free atmosphere, which one of the following is correct?

- (A) $\nabla \times E = 0$ and $\nabla \cdot E = 0$
 - (B) $\nabla \times E \neq 0$ and $\nabla \cdot E = 0$
 - (C) $\nabla \times E = 0$ and $\nabla \cdot E \neq 0$
 - (D) $\nabla \times E \neq 0$ and $\nabla \cdot E \neq 0$
-

108. In a non-magnetic medium electric field $E = E_0 \cos \omega t$ is applied. If the permittivity of the medium is ϵ and the conductivity is σ then the ratio of the amplitudes of the conduction current density and displacement current density will be:

- (A) $\mu_0/\omega\epsilon$
 - (B) $\sigma/\omega\epsilon$
 - (C) $\sigma\mu_0/\omega\epsilon$
 - (D) Other value
-

109. If maximum and minimum voltage on a transmission line are 2V and 5V respectively, VSWR is:

- (A) 0.5
 - (B) 2
-

- (C) 1
(D) 8
-

110. If a transmission line of characteristic impedance $25\ \Omega$ is to be matched to a load of $100\ \Omega$, then the characteristic impedance of the $\lambda/4$ transmission line to be used is:

- (A) $70.71\ \Omega$
(B) $50\ \Omega$
(C) $100\ \Omega$
(D) $75\ \Omega$
-

111. Let A be a 3×3 matrix with real entries such that $\det(A) = 6$ and $\text{trace}(A) = 0$. If $\det(A + I) = 0$, where I is the 3×3 identity matrix, then the eigenvalues of A are:

- (A) $-1, 2, 3$
(B) $-1, 2, -3$
(C) $1, 2, -3$
(D) $-1, -2, 3$
-

112. Consider the following system of equations:

$$x - 2y + 3z = -1$$

$$x - 3y + 4z = 1$$

$$-2x + 4y - 6z = k$$

The value of k for which the system has infinitely many solutions is

- (A) 0
(B) 1
(C) 2
(D) -1
-

113. The value of the improper integral $\int_{-\infty}^0 \frac{e^x}{e^{2x}+1} dx$ is equal to

- (A) 0
(B) $\frac{\pi}{2}$
-

- (C) $\frac{\pi}{4}$
(D) $-\infty$
-

114. Suppose C is the closed curve defined as the circle $x^2 + y^2 = 1$ with C oriented anti-clockwise. The value of the line integral $\oint_C (x dy - y dx)$ is equal to

- (A) 0
(B) π
(C) 2π
(D) Other value
-

115. The general solution of the differential equation $x^2 \frac{d^2 y}{dx^2} - 5x \frac{dy}{dx} + 13y = 0$ is

- (A) $y = e^{3x}(C_1 \cos 2x + C_2 \sin 2x)$
(B) $y = e^{3x}(C_1 \cos x + C_2 \sin x)$
(C) $y = x^3(C_1 \cos(2 \ln x) + C_2 \sin(2 \ln x))$
(D) $y = x^3(C_1 \cos(\ln x) + C_2 \sin(\ln x))$
-

116. Let S be the surface of the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. The value of the surface integral $\iint_S \vec{F} \cdot d\vec{s}$ of a vector field $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ over the entire surface S of the cube, is

- (A) $\frac{5}{2}$
(B) 1
(C) $\frac{1}{2}$
(D) $\frac{3}{2}$
-

117. The value of the integral $\int_C \frac{e^z}{z^3} dz$, where $C : |z| = 1$ is

- (A) 0
(B) 1
(C) πi
(D) Other value
-

118. The coefficient of $\frac{1}{z}$ in the Laurent's series expansion of the function $f(z) = \frac{1}{z^2(1-z)}$ about $z = 0$, is

- (A) -1
 - (B) 0
 - (C) 1
 - (D) 2
-

119. Suppose that X has the density function $f(x) = cx^2$ for $0 \leq x \leq 1$ and $f(x) = 0$ otherwise. What is $P(0.1 \leq X \leq 0.5)$?

- (A) $\frac{1}{25}$
 - (B) $\frac{6}{25}$
 - (C) $\frac{4}{250}$
 - (D) $\frac{31}{250}$
-

120. Consider the function $f(x) = x^3 - x - 1$ for finding the root of the equation $f(x) = 0$. If the initial approximation is $x_0 = 1$, then the next approximation x_1 using the Newton-Raphson method is:

- (A) 1.25
 - (B) 1.75
 - (C) 1.50
 - (D) 1.33
-