

Sr. No. 17005

ENTRANCE TEST-2024

2-Year M Tech Programme Embedded Systems and Solutions

Total Questions : 60
Time Allowed : 70 Minutes

Roll No.

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1. Write your roll number in the space provided at the top of this page of question booklet and fill up the necessary information in the spaces provided on OMR Answer sheet.
2. OMR Answer sheet has an original copy and a candidate's copy glued beneath it at the top. While making entries in the original copy, candidate should ensure that the two copies are aligned properly so that the entries made in the original copy against each item are exactly copied in the candidate's copy.
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14. If any of the information in the response Sheet/Question Paper has been found missing or not mentioned as stated above the candidate is solely responsible for that lapse.

Q1) An orthogonal set of non zero vectors are

- a) Linearly independent
- b) linear dependent
- c) constant
- d) none of these

Q2) All the eigen values of the matrix $\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ lie in the disc

- a) $|\lambda + 1| \leq 1$
- b) $|\lambda - 1| \leq 1$
- c) $|\lambda + 1| \leq 0$
- d) $|\lambda - 1| \leq 2$

Q3) For $0 < \theta < \pi$, the matrix $\begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$

- a) has no real eigen value
- b) is orthogonal
- c) is symmetric
- d) is skew symmetric

Q4) For function $f(x, y)$ to have maximum value (a, b) is?

- a) $rt - s^2 > 0$ and $r < 0$
- b) $rt - s^2 > 0$ and $r > 0$
- c) $rt - s^2 < 0$ and $r < 0$
- d) $rt - s^2 > 0$ and $r > 0$

Q5) The solution of the partial differential equation $z = px + qy + f(pq)$, where $p = \frac{\partial z}{\partial x}$ and

$$q = \frac{\partial z}{\partial y} \text{ is}$$

- a) $z = ax + by$
- b) $z = ax + by + f(a, b)$
- c) $z = ax - by + f(a, b)$
- d) $z = ax - by$

Q6) The particular solution of $4x^2 \left(\frac{d^2 y}{dx^2} \right) + 8x \left(\frac{dy}{dx} \right) + y = 4\sqrt{x}$ is

- a) $\frac{1}{2\sqrt{x}}$
- b) $\frac{\log x}{2\sqrt{x}}$
- c) $\frac{(\log x)^2}{2\sqrt{x}}$
- d) $\frac{(\sqrt{x} \log x)}{2}$

Q7) The gradient of a scalar function $\phi(x, y, z)$ is

a) $\frac{\partial^2 \phi}{\partial x^2} \hat{i} + \frac{\partial^2 \phi}{\partial y^2} \hat{j} + \frac{\partial^2 \phi}{\partial z^2} \hat{k}$

b) $\frac{\partial \phi}{\partial x} + \frac{\partial \phi}{\partial y} + \frac{\partial \phi}{\partial z}$

c) $\frac{\partial \phi}{\partial x} \hat{i} + \frac{\partial \phi}{\partial y} \hat{j} + \frac{\partial \phi}{\partial z} \hat{k}$

d) $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \frac{\partial^2 \phi}{\partial z^2}$

Q8) The vector field F is solenoidal if

a) $\nabla \times \vec{F} = 0$

b) $\nabla \cdot \vec{F} = 0$

c) $\nabla^2 \vec{F} = 0$

d) $\vec{F} \cdot \nabla = 0$

Q9) If the function $u = 2x(1 - y)$ is harmonic. Then its harmonic conjugate is

a) $v = 2x + x^2 - y^2$

b) $v = 2x + x^2 + y^2$

c) $v = 2y + x^2 - y^2$

d) $v = 2x - x^2 + y^2$

Q10) For the Binomial distribution mean is 10 and variance is 5 then the parameters are

a) $\frac{1}{10}, 20$

b) $20, \frac{1}{2}$

c) $1, \frac{1}{2}$

d) None of these

Q11) Let X has a Poisson distribution, if $P(X = 1) = 0.3$, $P(X = 2) = 0.2$, then $P(X = 0)$ is

a) 0.0264

b) 2.64

c) 0.264

d) None of these

Q12) The smallest positive root of $x^3 - 5x + 3 = 0$ lies between

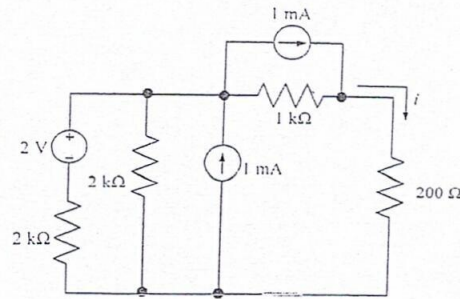
a) 1 and 2

b) 2 and 3

c) 0 and 1

d) None of these

Q13) In the circuit shown below, the current I flowing through 200Ω resistor is ___mA.



- a) 2
- b) 1.36
- c) 2.20
- d) 2.36

Q14) What is the bandwidth of a series R-L-C circuit with $R = 1000\Omega$, $L = 100mH$, $C = 10pF$? Supply voltage is $100V$.

- a) 50 k rad/s
- b) 1 rad/s
- c) 100 k rad/s
- d) 10 k rad/s

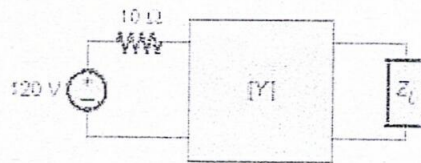
Q15) Between the branch voltage of a loop the KVL imposes

- a) Nonlinear constraints
- b) Linear constraints
- c) No constraints
- d) None

Q16) For the two port network shown below, the $[Y]$ parameters is given below:

$$[Y] = \frac{1}{100} \begin{bmatrix} 2 & -1 \\ -1 & \frac{4}{3} \end{bmatrix} S, \text{ the value of}$$

Z_L , in Ω , for max power transfer will be



- a) 80
- b) 40
- c) 120
- d) 48

Q17) A sequence $x(n)$ has z-transform $X(z)$ with two first order poles at $+j/2$ and $-j/2$. Then the sequence $j^n x(n)$ will have poles at

- a) $+j/2$ and $-j/2$ (no change)
- b) j and $-j$
- c) $+1/2$ and $-1/2$
- d) $+1$ and -1

Q18) The ROC of the transfer function of a system is given as $|z| < 2$

- a) The system is causal but NOT stable
- b) The system is stable but NOT causal
- c) The system is causal AND stable
- d) The system is NEITHER causal NOR stable

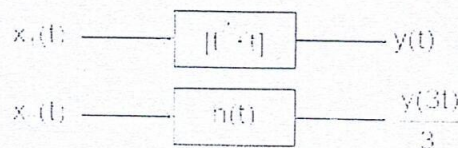
Q19) A periodic signal $x(t)$ has a trigonometric Fourier series expansion

$$x(t) = a_0 + \sum_{n=1}^{\infty} (a_n \cos n\omega_0 t + b_n \sin n\omega_0 t)$$

If $x(t) = -x(-t) = -x(t - \pi/\omega_0)$, we can conclude that

- a) a_n are zero for all n and b_n are zero for n even
- b) a_n are zero for all n and b_n are zero for n odd
- c) a_n are zero for n even and b_n are zero for n odd
- d) a_n are zero for n odd and b_n are zero for n even

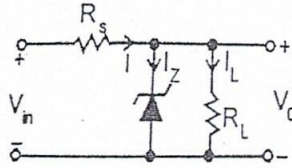
Q20) Two systems are shown below, By using 1st system what should be the value of $h(t)$ in the second system?



- a) $3t^2 + t$
- b) $27t^2 + 3t$
- c) $3t^2 + t$
- d) $9t^2 + 3t$

Q21) Consider the following statements regarding the circuit given in the figure below, where the output voltage is constant.

- 1) $V_{in} >$ the voltage at which the zener breaks down.
- 2) $I_L <$ the difference between " I " and " I_Z ", current at which the zener breaks down.
- 3) $R_s <$ the zener nominal resistance



- a) 1, 2 and 3 are correct
- b) 1 and 2 are correct
- c) 2 and 3 are correct
- d) 1 and 3 are correct

Q22) The values of radiative and non-radiative lifetime of minority carriers in a semiconductor are 50ns and 100ns, respectively. What is the effective lifetime?

- a) 12.2 ns
- b) 150ns
- c) 33.3ns
- d) 75ns

Q23) What is the main purpose of using a twin-tub process in CMOS technology?

- a) To enhance thermal conductivity
- b) To allow for better isolation between n-channel and p-channel devices
- c) To increase the overall chip size
- d) To simplify the packaging process

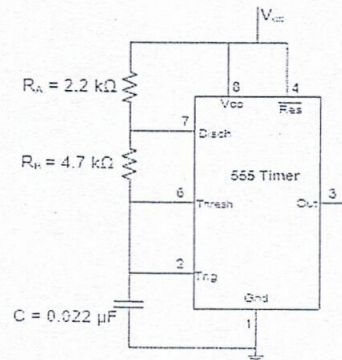
Q24) The drift velocity of electrons in silicon varies with applied electric field in which one of the ways?

- a) It monotonically increases with increasing field
- b) It first increases linearly, then sub-linearly and finally attains saturation with increasing field.
- c) It first increases, then decreases showing a negative differential region, again increases and finally saturates.
- d) The drift velocity remains unchanged with increase in field.

Q25) An operational amplifier has a slew rate of $2 \text{ V}/\mu\text{sec}$. If the peak output is 12 V , what will be the power bandwidth?

- a) 36.5 kHz
- b) 26.5 kHz
- c) 22.5 kHz
- d) 12.5 kHz

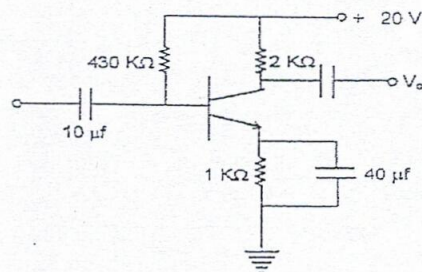
Q26) In the astable multivibrator circuit shown in the figure, the frequency of oscillation (in kHz) at the output pin 3 is ____



- a) 5.618 kHz
- b) 4.518 kHz
- c) 6.918 kHz
- d) 2.228 kHz

Q27) The circuit using a BJT with $\beta = 50$ and $V_{BE} = 0.7 \text{ V}$ is shown in figure. The basecurrent I_B and collector V_C are respectively

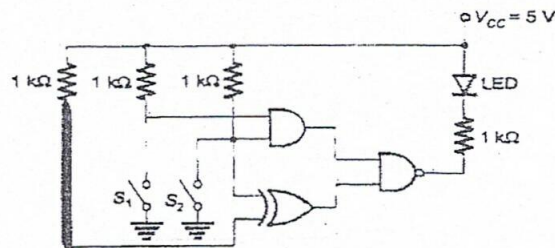
- a) $43 \mu\text{A}$ and 11.4 Volts
- b) $40 \mu\text{A}$ and 14 Volts
- c) $45 \mu\text{A}$ and 11 Volts
- d) $50 \mu\text{A}$ and 10 Volts



Q28) Consider an ideal long channel n MOSFET (enhancement mode) with gate length $10\mu\text{m}$ and width $100\mu\text{m}$. The product of electron mobility (μ_n) and oxide capacitance per unit area (C_{OX}) is $\mu_n C_{OX} = 1\text{mA/V}^2$. The threshold voltage of the transistor is 1V . For a gate-to-source voltage $V_{GS} [2 - \sin(2t)]\text{V}$ and drain-to-source voltage $V_{DS} = 1\text{V}$ (substrate connected to the source), the maximum value of the drain-to-source current is

- a) 15 mA
- b) 20 mA
- c) 5 mA
- d) 40 mA

Q29) In the given circuit, LED



- a) Emits light when both S1 and S2 are closed
- b) Emits light when both S1 and S2 are open
- c) Emits light when only S1 is open and S2 is closed
- d) Does not emit light, irrespective of the switch positions

Q30) Match the items given in List 1 with those in list 2. Select your answer using the codes given below:

List 1
(logic gates)

- A. HTL
- B. CMOS
- C. I^2L
- D. ECL

List 2
(characteristics)

- 1. High fan-out
- 2. Highest speed of operation
- 3. High noise immunity
- 4. Lowest product of power and delay

Codes	A	B	C	D
a)	3	2	4	1
b)	4	2	3	1
c)	3	1	4	2
d)	4	1	3	2

Q31) Consider an IC-FFs and choose the wrong statements regarding its Hold time (T_H) and Setup time (T_S)

- 1) T_S and T_H should be maximum
 - 2) only T_H should be in maximum range
 - 3) T_S and T_H should be minimum
 - 4) T_S should be maximum but T_H should be minimum
- a) Only 3
 - b) 1, 2 and 4
 - c) 1 and 2
 - d) Only 2

Q32) Which of the following statements is/are correct?

- 1) The toggle frequency is the maximum clock frequency at which the flip-flop will toggle reliably.
 - 2) The data input must precede the clock triggering edge transition time by some minimum time.
 - 3) The data input must remain for a given time after the clock triggering edge transition time for reliable operation.
 - 4) Propagation delay time is equal to the rise time and fall time of the data.
- a) 1, 2 and 3
 - b) 1 and 2 only
 - c) 2 and 3 only
 - d) 3 and 4 only

Q33) In an 8085 microprocessor, the contents of the accumulator and the carry flag are A7 (in hex) and 0, respectively. If the instruction RLC is executed, then the contents of the accumulator (in hex) and the carry flag, respectively, will be

- a) 4E and 0
- b) 4E and 1
- c) 4F and 0
- d) 4E and 1

Q34) The following five instructions were executed on an 8085 microprocessor.

MVI A, 33H

MVI B,

78H

ADD B

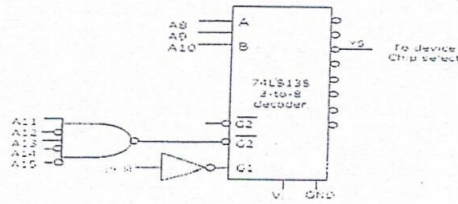
CMA

ANI 32H.

The Accumulator value immediately after the execution of the fifth instruction is

- a) 00H
- b) 10H
- c) 11H
- d) 32H

Q35) In the circuit shown, the device connected to Y5 can have address in the



range

- a) 2000H-20FFH
- b) 2D00H-2DFFH
- c) 2E00H-2F00H
- d) 2B00H-2F00H

Q36) Which of the following pins of a microcontroller are directly connected with 8255?

- a) WR
- b) D0-D7
- c) RD
- d) All of the mentioned

Q37) In a bode magnitude plot, which one of the following slopes would be exhibited at high frequencies by a 4th order all-pole system?

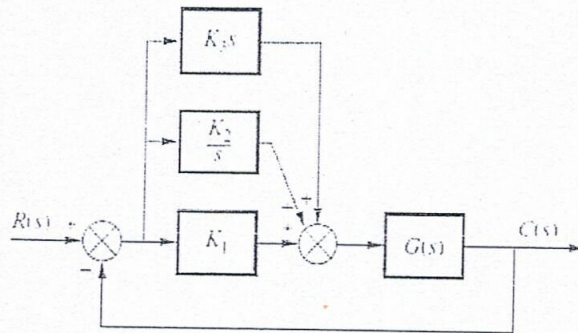
- a) -80dB/decade
- b) -40dB/decade
- c) +40dB/decade
- d) +80dB/decade

Q38) The state variable description of a linear autonomous system is $\dot{x} = Ax$; where x is the two dimensional state vector and A is given by

$A = \begin{bmatrix} 0 & 1 \\ -4 & 5 \end{bmatrix}$. The poles of the system are located at

- a) -5, -4
- b) -5, 4
- c) 4, 1
- d) 1, -5

Q39) the given block diagram resembles which of the following controller?



- a) PD
- b) PI
- c) PID
- d) Integral

Q40) A unity feedback system with the forward transfer function

$$G(s) = \frac{K}{S(S + 8)}$$

Is operating with a closed loop step response that has 15% overshoot. The value of gain K is

- a) 59.86
- b) 67.86
- c) 86.59
- d) 34.86

Q41) A FM signal is described as

$x_c(t) = 10 \cos(6\pi \times 10^6 t + \frac{1}{4} \sin(8 \times 10^2 \pi t))$. The approximate bandwidth of $x_c(t)$ is

- a) 400KHz
- b) 1KHz
- c) 3KHz
- d) 5KHz

- Q42) When probability of error during transmission is 0.5, it indicates that
- a) Channel is very noisy
 - b) No information is received
 - c) Channel is very noisy & No information is received
 - d) None of the mentioned

- Q43) The spectral efficiency of SSB modulation is
- a) Twice that of DSB-SC modulation
 - b) Equal to that of DSB-SC modulation
 - c) Half of DSB-SC modulation
 - d) Four times that of DSB-SC modulation

- Q44) Consider the random process

$x(t) = U + Vt$, Where U is a zero mean Gaussian random variable and V is a random variable uniformly distributed between 0 and 2. Assume that U and V are statistically independent. The mean value of the random process at $t = 2$ is _____

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

- Q45) Sample resolution for LPCM _____ bits per sample.

- a) 8
- b) 16
- c) 24
- d) All of the mentioned

- Q46) Which of the following statements is/are true?

- 1) The attenuation constant (α) causes the frequency distortion, whereas the phase constant(β) causes the phase distortion.
 - 2) α is zero for lossless transmission lines
 - 3) α represents amplitude reduction of travelling waves
- a) only 1) is true
 - b) only 2) is true
 - c) 3) is true
 - d) All are true

Q47) The bit Stream 01101 is differentially encoded using “delay and Ex-OR” scheme for DPSK transmission. Assuming the reference bit as a ‘1’ and assigning phase of 0 and π for 1’s and 0’s resp. in the encoded sequence, the transmitted phase sequence becomes

- a) π 0 π π 0
- b) 0 π π π 0
- c) 0 π 0 0 π
- d) None

Q48) Which of the following is a function of position of antennas in array and the weights?

- a) Array Factor
- b) Field pattern
- c) Total array field
- d) Beamwidth

Q49) Which layer of the OSI model is responsible for encryption & decryption?

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

Q50) Which routing protocol assigns a cost metric to each route?

- a) RIP
- b) BGP
- c) OSPF
- d) EGP

Q51) Class D IP addresses are reserved for

- a) multiplexing
- b) multicasting
- c) multiprocessing
- d) multiprogramming

Q52) Which of the following standards specifies wifi networks

- a) 802.11
- b) 802.15
- c) 802.3
- d) 802.1

Q53) Which of the following would be placed at the top of the memory hierarchy?

- a) register
- b) main memory
- c) cache memory
- d) disk

Q54) Which addressing mode involves no reference to memory?

- a) Indirect
- b) Immediate
- c) Direct
- d) Register Indirect

Q55) IEEE 754 is the standard for

- a) ICs
- b) buses
- c) integers
- d) floating point numbers

Q56) For a k-way set associative cache memory, k represents

- a) number of sets in the cache
- b) number of lines in the cache
- c) number of lines in a set
- d) number of words in a set

Q57) Which of the following cannot be used as the name of a variable?

- a) Mtech_2024
- b) _Mtech2024
- c) 2024_Mtech
- d) M2t0e2c4h

Q58) Which of the following data types occupies the least amount of memory space?

- a) integer
- b) unsigned integer
- c) floating point
- d) character

Q59) If x is a five-element array, then its last element is denoted by

- a) x[4]
- b) x[5]
- c) x[6]
- d) x[end]

Q60) Which of the following is not an operator?

- a) type
- b) typedef
- c) sizeof
- d) &

870

SEAL

ENTRANCE TEST-2019

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SCHOOL OF APPLIED SCIENCES & TECHNOLOGY M.TECH. IN EMBEDDED SYSTEMS & SOLUTIONS

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Question Booklet Series

D

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1. Which one of the following options correctly describes the locations of the roots of the equation $s^4 + s^2 + 1 = 0$ on the complex plane?
- Four left half plane (LHP) roots
 - One right half plane (RHP) root, one LHP root and two roots on the imaginary axis
 - Two RHP roots and two LHP roots
 - All four roots are on the imaginary axis

2. The polar plot of the transfer function $G(s) = \frac{10(s-1)}{s+10}$ for $0 \leq \omega < \infty$ will be in the

- first quadrant
- second quadrant
- third quadrant
- fourth quadrant

3. A unity negative feedback system has an open-loop transfer function $G(s) = \frac{K}{s(s+10)}$. The gain K for the system to have a damping ratio of 0.25 is _____

- 100
- 200
- 300
- 400

4. The phase margin (in degrees) of the system $G(s) = \frac{10}{s(s+10)}$ is _____

- 84.32
- 72
- 64.56
- 35.45

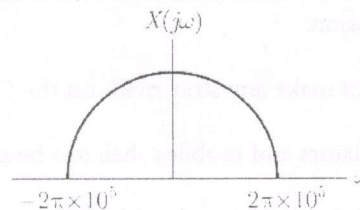
5. A carrier $A_c \cos(\omega_c t)$ is frequency modulated by a signal $E_m \cos(\omega_m t)$. The modulation index is m_f . The expression for the resulting FM signal is

- $A_c \cos[\omega_c t + m_f \sin(\omega_m t)]$
- $A_c \cos[\omega_c t + m_f \cos(\omega_m t)]$
- $A_c \cos[\omega_c t + 2\pi m_f \sin(\omega_m t)]$
- $A_c \cos[\omega_c t + 2\pi m_f E_m \omega_m \cos(\omega_m t)]$

6. Figure given below shows Fourier spectra of signal $x(t)$

The Nyquist sampling rate for $x(t)$ is

- 100 kHz
- 200 kHz
- 300 kHz
- 50 kHz



7. The electric field of a plane wave propagating in a lossless non-magnetic medium is given by the following expression

$$\vec{E} = \hat{c}_x 5 \cos(2\pi \times 10^5 t - \beta z) - \hat{a}_y 3 \cos\left(2\pi \times 10^5 t - \beta z - \frac{\pi}{2}\right)$$

The type of the polarization is

- Right Hand Circular
- Left Hand Elliptical
- Right Hand Elliptical
- Linear

8. The directivity of an antenna array can be increased by adding more antenna elements, as a larger number of elements

- (A) improves the radiation efficiency
- (B) increases the effective area of the antenna
- (C) results in a better impedance matching
- (D) allows more power to be transmitted by the antenna

9. The frequency of an 555 timer based astable multivibrator is given by

- (A) $f = \frac{1.44}{(R_1 + 2R_2)C}$
- (B) $f = \frac{0.5}{(R_1 + 2R_2)C}$
- (C) $f = \frac{1.44}{RC}$
- (D) $f = \frac{0.5}{RC}$

10. Match List – I and List – II and select the correct answer using the codes given below the lists:

List – I

- a. $\nabla \times \vec{H}$
- b. $\nabla \times \vec{E}$
- c. $\nabla \times \vec{D}$
- d. $\nabla \times \vec{J}$

List – II

- i. continuity equation
- ii. current density
- iii. Faraday's law of induction
- iv. Gauss's law

Codes:

- | | a | b | c | d |
|-----|----|-----|-----|-----|
| (A) | i | ii | iii | iv |
| (B) | ii | iii | iv | i |
| (C) | ii | iii | i | iv |
| (D) | iv | i | ii | iii |

11. Consider the following :

- 1. Quantization
- 2. Sampling
- 3. Encoding
- 4. Low-pass filter

The correct sequence for converting a lowpass analog signal to Digital signal is

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

12. The attenuation of single mode fibers is 0.2 dB/km, at a transmission length of 100 kms. The output signal strength is reduced to

- (A) 10% of transmitted power
- (B) 1% of transmitter power
- (C) 5% of the transmitted power
- (D) 20% of the transmitted power

13. Which one of the following statements about differential pulse code modulation (DPCM) is true?

- (A) the sum of message signal sample with its prediction is quantized
- (B) The message signal sample is directly quantized, and its prediction is not used
- (C) The difference of message signal sample and a random signal is quantized
- (D) The difference of message signal sample with its prediction is quantized

14. The default subnet mask for an IP address 172.90.10.1 is:
(A) 255.255.255.0
(B) 255.255.0.0
(C) 255.0.0.0
(D) 255.255.255.255
15. IPV6 is _____ address
(A) 128 bit
(B) 64 bit
(C) 256 bit
(D) 2 bit
16. Transmission control protocol (TCP) is _____ protocol
(A) Connection less
(B) Connection Oriented
(C) Serviceless
(D) None of above
17. Which of the following technique is used in congestion control in datagram subnets?
(A) Choke packets
(B) Load shedding
(C) Jitter control
(D) All of above
18. Which of the instruction is used in booth's Algorithm for carrying multiplication
(A) ashr
(B) shr
(C) mul
(D) rol
19. Which of the mappings are used in cache memory?
(A) direct mapping
(B) Associative mapping
(C) Set associative mapping
(D) All of above
20. Memory management algorithm with minimal wastage is
(A) First fit algorithm
(B) Next fit algorithm
(C) Worst fit algorithm
(D) All of above
21. If $a=3$. The expression $a \ll 2$ will yield
(A) 12
(B) 6
(C) 1
(D) 15
22. Which of the function is used to migrate from text mode to graphics mode?
(A) Fopen();
(B) Graph();
(C) Initgraph();
(D) None of above

23. Pointer is a variable which stores:
 (A) The address of another variable
 (B) The immediate data
 (C) Both float and integer data
 (D) Address of integer variables only
24. Which one of the following controls the program flow
 (A) for
 (B) while
 (C) Switch
 (D) All of the above
25. Which one of the following is the general solution of the first order differential equation $\frac{dy}{dx} = (x + y - 1)^2$, where x, y are real?
 (A) $y = 1 + x + \tan^{-1}(x + c)$ where c is a constant
 (B) $y = 1 + x + \tan(x + c)$ where c is a constant
 (C) $y = 1 - x + \tan^{-1}(x - c)$ where c is a constant
 (D) $y = 1 - x + \tan(x + c)$ where c is a constant
26. With initial condition $x(1) = 0.5$, the solution of the differential equation $t \frac{dx}{dt} + x = t$, is
 (A) $x = t - \frac{1}{2}$
 (B) $x = t^2 - \frac{1}{2}$
 (C) $x = \frac{t^2}{2}$
 (D) $x = \frac{t}{2}$
27. Let $f(z) = \frac{az+b}{cz+d}$. If $f(z_1) = f(z_2)$ for all $z_1 \neq z_2$, $a = 2$, $b = 4$ and $c = 5$. then d should be equal to
 (A) 1
 (B) 3
 (C) 10
 (D) 12
28. Find the missing sequence in the letter series below:
 A, CD, GHI,?, UVWXY
 (A) LMN
 (B) MNO
 (C) MNOP
 (D) NOPQ
29. If $x > y > 1$, which of the following must be true?
 (i) $\ln x > \ln y$ (ii) $e^x > e^y$ (iii) $y^x > x^y$ and (iv) $\cos x > \cos y$
 (A) (i) and (ii)
 (B) (i) and (iii)
 (C) (iii) and (iv)
 (D) (ii) and (iv)
30. Rizwan and Furqan appeared in an interview for two vacancies in the same department. The probability of Rizwan's selection is $1/6$ and that of Furqan is $1/8$. What is the probability that only one of them will be selected?
 (A) $1/4$
 (B) $47/48$
 (C) $13/48$
 (D) $35/48$

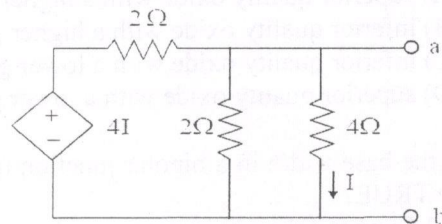
31. The solution of the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 0$ with $y(0) = y'(0) = 1$ is
- (A) $(2 - t)e^{-t}$
 (B) $(1 + 2t)e^{-t}$
 (C) $(2 - t)e^{-t}$
 (D) $(1 - 2t)e^{-t}$
32. The variance of the random variable X with probability density function $f(x) = \frac{1}{2}|x|e^{-|x|}$ is
- (A) 1
 (B) 6
 (C) 3
 (D) 9
33. Let $f(x) = e^{x-x^2}$ for real x . From among the following, choose the Taylor series approximation of f (x) around $x = 0$, which includes all powers of x less than or equal to 3. (A) $1 + x + x^2 + x^3$
 (B) $1 + x + \frac{3}{2}x^2 + x^3$
 (C) $1 + x + \frac{3}{2}x^2 + \frac{7}{6}x^3$
 (D) $1 + x + 3x^2 + 7x^3$
34. The rank of the matrix $M = \begin{bmatrix} 5 & 10 & 10 \\ 1 & 0 & 2 \\ 3 & 6 & 6 \end{bmatrix}$ is
- (A) 0
 (B) 1
 (C) 2
 (D) 3
35. The maximum value of θ until which the approximation $\sin\theta = \theta$ holds to within 10% error is
- (A) 10.3°
 (B) 18.3°
 (C) 44.4°
 (D) 73.4°
36. What is the chance that a leap year, selected at random, will contain 53 Sundays?
- (A) $5/7$
 (B) $3/7$
 (C) $1/7$
 (D) $2/7$
37. The number of independent loops for a network with n nodes and b branches is:
- (A) $n-1$
 (B) $b-n$
 (C) $b-n+1$
 (D) Independent of the number of nodes
38. A network contains linear resistors and ideal voltage sources. If values of all the resistors are doubled, then the voltage across each resistor is:
- (A) Halved
 (B) Doubled
 (C) Increases by four times
 (D) Not changed

39. The damping ratio of a series RLC circuit can be expressed as

- (A) $\frac{R^2 C}{2L}$
- (B) $\frac{2L}{R^2 C}$
- (C) $\frac{R}{2} \sqrt{\frac{C}{L}}$
- (D) $\frac{2}{R} \sqrt{\frac{L}{C}}$

40. In the circuit shown, the Norton equivalent resistance (in Ω) across terminals a-b is _____.

- (A) 2.666
- (B) 1.666
- (C) 2.333
- (D) 1.333



41. Which one of the following statements is NOT TRUE for a continuous time causal and stable LTI system?

- (A) All the poles of the system must lie on the left side of the $j\omega$ axis
- (B) Zeros of the system can lie anywhere in the s-plane
- (C) All the poles must lie within $s = 1$
- (D) All the roots of the characteristic equation must be located on the left side of the $j\omega$ axis

42. A periodic signal $x(t)$ has a trigonometric Fourier Series expansion

$$x(t) = a_0 - \sum_{n=1}^{\infty} (a_n \cos n\omega_0 t + b_n \sin n\omega_0 t)$$

If $x(t) = -x(-t)$, we can conclude that

- (A) a_n are zero for all n and b_n are zero for n even
- (B) a_n are zero for all n and b_n are zero for n odd
- (C) b_n are zero for all n
- (D) a_n are zero for all n

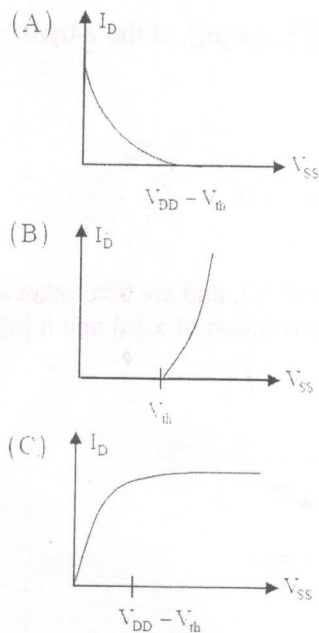
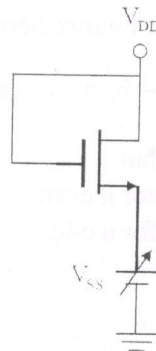
43. Two causal discrete-time signal $x[n]$ and $y[n]$ are related as $y[n] = \sum_{m=-\infty}^n x[m]$. If the z-transform of $y[n]$ is $\frac{2}{z(z-1)^2}$, the value of $x[2]$ is _____

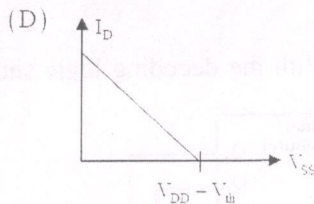
- (A) 3
- (B) 2
- (C) 1
- (D) 0

44. Two discrete-time signals $x[n]$ and $h[n]$ are both non-zero only for $n = 0, 1, 2$, and are zero otherwise. It is given that $x[n] = \{1, 2, 1\}$ and $h[n] = \{1, 1, 1\}$. Let $y[n]$ be the linear convolution of $x[n]$ and $h[n]$. The value of the expression $(y[3] + 2y[4])$ is _____

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

45. In a MOS capacitor with an oxide layer thickness of 10 nm, the maximum depletion layer thickness is 100 nm. The permittivities of the semiconductor and the oxide layer are ϵ_s and ϵ_{ox} respectively. Assuming $\epsilon_s/\epsilon_{ox} = 3$, the ratio of the maximum capacitance to the minimum capacitance of this MOS capacitor is _____
- (A) 1
(B) 2.33
(C) 4.33
(D) 5
46. In IC technology, dry oxidation (using dry oxygen) as compared to wet oxidation (using steam or water vapor) produces
- (A) superior quality oxide with a higher growth rate
(B) inferior quality oxide with a higher growth rate
(C) inferior quality oxide with a lower growth rate
(D) superior quality oxide with a lower growth rate
47. If the base width in a bipolar junction transistor is doubled, which one of the following statements will be TRUE?
- (A) Current gain will increase
(B) Unity gain frequency will increase
(C) Emitter base junction capacitance will increase
(D) Early voltage will increase
48. For the NMOSFET in the circuit shown, the threshold voltage is V_{th} , where $V_{th} > 0$. The source voltage V_{SS} is varied from 0 to V_{DD} . Neglecting the channel length modulation, the drain current I_D as a function V_{SS} is represented by





49. The ripple factor of a half-wave rectifier is

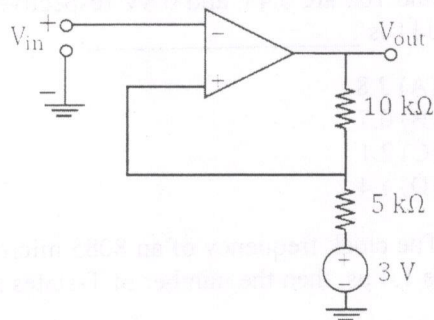
- (A) 2
- (B) 1.21
- (C) 2.5
- (D) 0.48

50. If $A_d = 3500$ and $A_c = 0.35$, the CMRR is

- (A) 60 dB
- (B) 80 dB
- (C) 100 dB
- (D) 120 dB

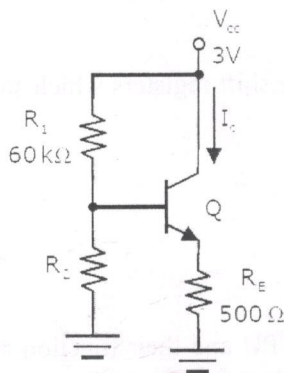
51. For the operational amplifier circuit shown, the output saturation voltages are $\pm 15V$. The upper and lower threshold voltages for the circuit are, respectively.

- (A) +7 V and - 3V
- (B) +5 V and - 5V
- (C) +3V and - 7V
- (D) +3V and - 3V



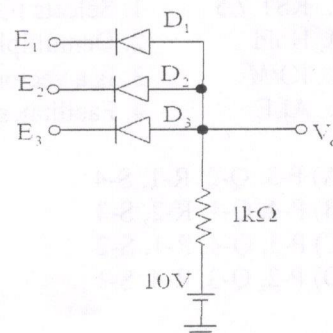
52. In the circuit shown below, the silicon npn transistor Q has a very high value of β . The required value of R_2 in $k\Omega$ to produce $I_C = 1mA$ is

- (A) 30
- (B) 40
- (C) 60
- (D) 70



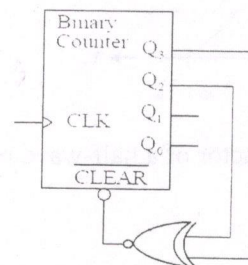
53. In the circuit shown, diodes D_1 , D_2 and D_3 are ideal, and the inputs E_1 , E_2 and E_3 are '0 V' for logic '0' and '10 V' for logic '1'. What logic gate does the circuit represent?

- (A) 3 input OR gate
- (B) 3 input NOR gate
- (C) 3 input AND gate
- (D) 3 input XOR gate



54. The figure shows a binary counter with synchronous clear input. With the decoding logic shown, the counter works as a

- (A) mod-2 counter
- (B) mod-4 counter
- (C) mod-5 counter
- (D) mod-6 counter



55. A function of Boolean variables X , Y and Z is expressed in terms of the min-terms as $F(X,Y,Z) = \Sigma(1,2,5,6,7)$. Which one of the product of sums given below is equal to the function $F(X,Y,Z)$?

- (A) $(X + Y + Z)(X + \bar{Y} + \bar{Z})(\bar{X} + Y + Z)$
- (B) $(\bar{X} + \bar{Y} + \bar{Z})(\bar{X} + Y + Z)(X + \bar{Y} + \bar{Z})$
- (C) $(\bar{X} + \bar{Y} + Z)(\bar{X} + Y + \bar{Z})(X + \bar{Y} + Z)(X + Y + \bar{Z})(X + Y + Z)$
- (D) $(X - Y - \bar{Z})(\bar{X} - Y + Z)(\bar{X} - Y - \bar{Z})(\bar{X} - \bar{Y} - Z)(\bar{X} - \bar{Y} + \bar{Z})$

56. Consider a three-bit D to A converter. The analog value corresponding to digital signals of values 010 and 100 are 0.4V and 0.8V respectively. The analog value (in Volts) corresponding to the digital signal 111 is _____.

- (A) 2.8
- (B) 0.7
- (C) 2.1
- (D) 1.4

57. The clock frequency of an 8085 microprocessor is 5 MHz. If the time required to execute an instruction is 1.4 μ s, then the number of T-states needed for executing the instruction is

- (A) 1
- (B) 6
- (C) 7
- (D) 8

58. In an 8085 microprocessor, the shift registers which store the result of an addition and the overflow bit are, respectively

- (A) B and F
- (B) A and F
- (C) H and F
- (D) A and C

59. Some of the pins of an 8085 CPU and their function are listed below. Identify the correct answer that matches the pins to their respective functions:

- | | |
|------------------------|---|
| P. RST 7.5 | 1. Selects IO or memory |
| Q. Hold | 2. Demultiplexes the address and data bus |
| R. IO/\bar{M} | 3. Is a vectored interrupt |
| S. ALE | 4. Facilitates direct memory access |

- (A) P-3, Q-2, R-1, S-4
- (B) P-4, Q-1, R-2, S-3
- (C) P-3, Q-4, R-1, S-2
- (D) P-2, Q-3, R-4, S-1

60. In 8051, Pin 30 (ALE / PROG), if this bit is set as logic zero ('0'), it signifies

- (A) Address is latched
- (B) For enabling internal ROM of programming
- (C) For disabling internal ROM programming
- (D) Both (A) and (C)