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Entrance Examinations - 2020

M.Tech. (Microelectronics and VLSI Design)

Marks: 70
Time: 2.00 hrs

Hall Ticket no:

1. Write your Hall Ticket Number on the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the Space provided above.

2. Read the following instructions carefully before answering the questions.

3. This Question paper has TWO parts: PART 'A' and PART 'B'.

Part 'A': It consists of 20 objective type questions of **1.75** marks each. There is a negative marking of **0.5** marks for every wrong answer.

Part 'B: It consists of 35 objective type questions of **One** mark each with no negative marking.

4. All questions are to be answered. Answers for these questions are to be entered on the OMR sheet, filling the appropriate circle against each question. For example, if the answer to a question is D, it should be marked as below:

(A) (B) (C) ●

5. No additional sheets will be provided. Rough work can be done in the question paper itself.

6. Handover the OMR answer sheet at the end of the examination to the invigilator.

7. Mobile phones, log tables and calculators of any type are NOT permitted

8. Values of some physical constants: Thermal voltage (V_T) at 300 K = 26 mV, $\epsilon_o = 8.85 \times 10^{-12}\ F/m$, Charge of electron (e)=1.6×10^{-19} C, electron mass=9.1×10^{-31}kg.

9. This book contains 15 pages including this cover sheet.

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PART – A

1. The modulus of $\left(\frac{1+i}{1-i} - \frac{1-i}{1+i}\right)$ is

A. 4
B. -2
C. 2
D. 1

2. A group of five persons is formed from five boys and four girls. The probability that there are at least two girls in the group is

A. 110/630
B. 105/126
C. 125/126
D. 100/126

3. The mean, variance and standard deviation of a set of numbers are $<x>$, v_i, and σ_i respectively. If each number is increased by "a" then the variance and standard deviation of the new set of numbers are respectively

A. $v_i+a,\ \sigma_i+\sqrt{a}$
B. $v_i+a,\ \sigma_i+a$
C. $v_i,\ \sigma_i$
D. $v_i+a,\ \sqrt{\sigma_i+a}$

4. If A is an $n \times n$ matrix and the matrix A^2 has a real eigenvalue $\lambda > 0$, then the eigenvalues of the matrix A are

A. $(\lambda)^{1/2}$, $-(\lambda)^{1/2}$
B. λ, 1
C. $-\lambda$, -1
D. $(\lambda/2)^{1/2}$, $-(\lambda/2)^{1/2}$

5. Consider the contour integral $\int_C z^n dz$, where C is a circle of radius $r > 0$ around the origin $z = 0$ in the counter clockwise direction and n is an integer. If $z = re^{i\theta}$, then the value of the integral, for $n = -1$ and $n \neq -1$ are respectively

A. -1,0
B. 1, 1
C. 1,-1
D. 1, 0

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6. The effective mass (m^*) and mobility of electrons in Si at room temperature are $3 \times 10^{-31} kg$ and $0.14\ m^2V^{-1}s^{-1}$ respectively. The mean free time in scattering of electrons is

A. $2.6 \times 10^{-13}\ s$
B. $4.2 \times 10^{-13}\ s$
C. $2.6 \times 10^{-9}\ s$
D. $12.6 \times 10^{-13}\ s$

7. Mobility of electrons and holes in a sample of intrinsic semiconductor at room temperature are $0.36\ m^2V^{-1}s^{-1}$ and $0.17\ m^2V^{-1}s^{-1}$ respectively. If both electron and hole densities in the semiconductor are equal to $2.5 \times 10^{19} m^{-3}$ then the conductivity of this semiconductor is

A. $4.12\ Sm^{-1}$
B. $2.12\ Sm^{-1}$
C. $1.09\ Sm^{-1}$
D. $0.47\ Sm^{-1}$

8. A series RLC circuit with $R = 10\ \Omega$, $C = 0.1\ \mu F$ and $L = 1\ mH$ is excited by a sinusoidal voltage signal of $0.5 cos(\omega t)\ Volts$. The voltage across the capacitor at resonance is

A. Zero
B. Infinity
C. 10 V
D. 5 V

9. A linear two port network is designed with a forward gain of -10 and feedback capacitance of 0.1 pF. The equivalent capacitance at the input port of the two-port network by Millers theorem is

A. -0.9 pF
B. 11 pF
C. 0.6 pF
D. 1.1 pF

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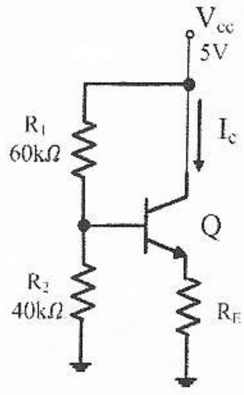
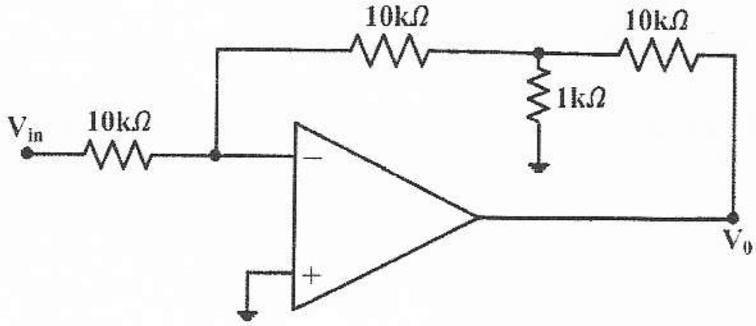
10. In the circuit shown below, the Si transistor Q has a high current gain β. If $I_C = 1mA$ then the required value of R_E is

A. 0.3 kΩ
B. 1.3 kΩ
C. 2.7 kΩ
D. 5 kΩ



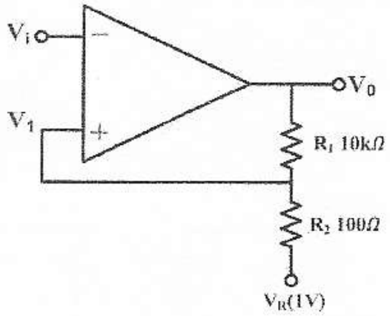
11. An ideal Op-Amp is used in the circuit below. The voltage gain (V_o/V_{in}) of this circuit is



A. -10
B. -12
C. 12
D. 10

12. Consider the Schmitt trigger circuit given below with an ideal Op Amp. If $V_i < V_1$, and $V_0 = +5V$, then the hysteresis of the circuit is approximately

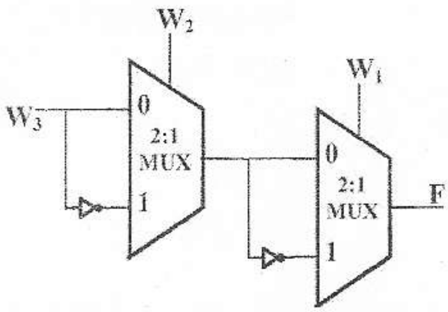
A. +5 V
B. -0.1 V
C. +0.1 V
D. -5 V



13. The circuit that can implement the following truth table is

W_1 (MSB)	W_2	W_3 (LSB)	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

A.



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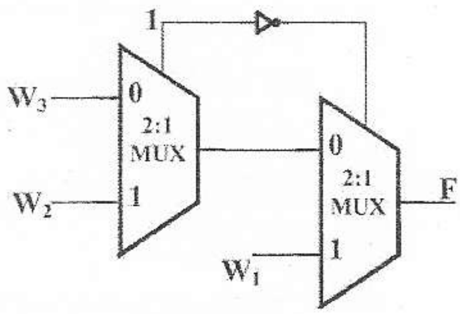

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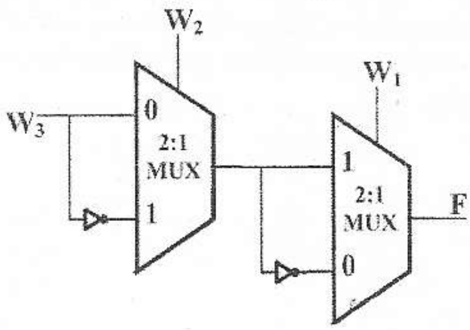
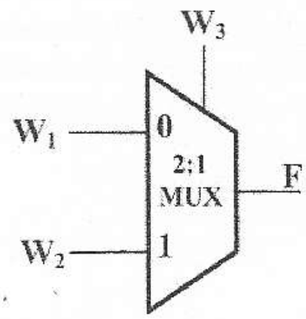


D.



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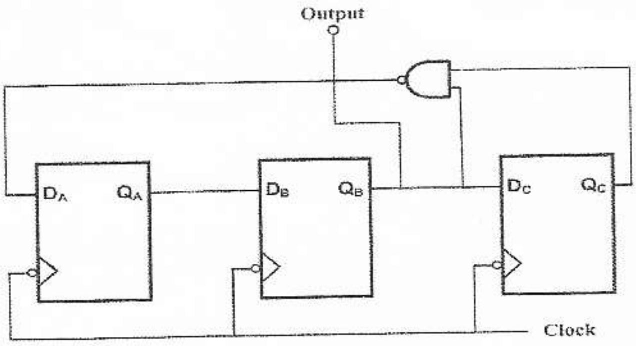
14. Consider the circuit given below. Assuming that all the D-flip flops are reset initially, the output sequence observed at Q_B is



A. 01110011...
B. 00011100...
C. 00101110....
D. 00111001...

15. An input device is interfaced with an 8085 microprocessor as memory mapped I/O. The address of the device is 2100H. Which of the following set of instructions will put the data from the input device to the register B of the microprocessor?

A. LHLD 2100H
MOV B,M

C. LXI H, 2100 H
MOV B,M

B. LXI H 2100H
MOV M,B

D. IN 00H
MOV B,A

16. A rotating five-spoked car wheel is captured on video using a frame rate of 30 frames per second. The angular velocity of the wheel in rotations per minute when the wheel does not appear to be rotating in the video is

A. 900
B. 360
C. 15
D. 30

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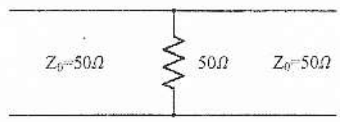
17. A load of 50 Ω is connected as shunt in a 2-wire transmission line of characteristic impedance $Z_0 = 50\ \Omega$ as shown in the figure. The 2-port scattering parameter matrix (S-matrix) of the shunt element is



A. $\begin{bmatrix} -1/2 & 1/2 \\ 1/2 & -1/2 \end{bmatrix}$

B. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

C. $\begin{bmatrix} -1/3 & 2/3 \\ 2/3 & -1/3 \end{bmatrix}$

D. $\begin{bmatrix} 1/4 & -3/4 \\ -3/4 & 1/4 \end{bmatrix}$

18. The electric field of a uniform plane electromagnetic wave in free space, along the positive direction, is given by $E = 10(ay + jaz)e^{-j25x}$. The frequency and polarization of the wave, respectively are ('a' is a constant)

A. 4 GHz, left circular
B. 1.2 GHz, left circular
C. 1.2 GHz, right circular
D. 4 GHz, right circular

19. A sinusoidal signal $m(t) = \sin(4000\pi t)$ is sampled at 20,000 samples/sec. The minimum step size to avoid slope overload in a delta modulation system is

A. $\pi/2$
B. $2\pi/5$
C. $\pi/10$
D. $\pi/5$

20. A speech signal is transmitted over an Additive White Gaussian Noise channel by 4-PAM signalling. If the signal is sampled at a rate of 8 KHz using logarithmically compressed, 8-bit encoded Pulse Code Modulation (PCM) format, then the transmission bandwidth is

A. 16 KHz
B. 32 KHz
C. 64 KHz
D. 128 KHz

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PART B

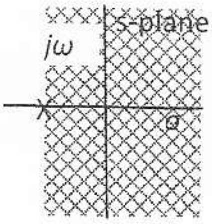
21. $Cos(x)$ can be expressed as

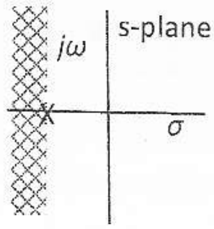
A. $1 + \frac{x^2}{2!} + \frac{x^4}{4!} \ldots$
B. $1 - \frac{x^3}{3!} + \frac{x^5}{5!} \ldots$
C. $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \cdots$
D. $1 - x + \frac{x^2}{2} - \cdots$

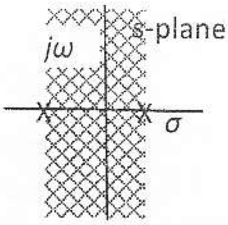
22. The value of the integral $I(\alpha) = \int_{-\infty}^{\infty} e^{-\alpha x^2} dx$ is

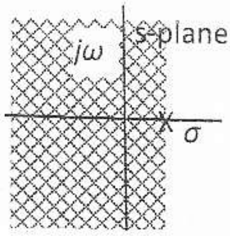
A. π/α
B. $(1/2\pi)(\pi/\alpha)^{1/2}$
C. $(1/2\alpha)(\pi/\alpha)^{1/2}$
D. $(\pi/\alpha)^{1/2}$

23. Which of the following pole-zero plots in the s-plane for the transfer function, $H(s)$, is that of a anti-causal and stable linear, time-invariant system ? (The shaded region is the region of convergence of $H(s)$, they are half-planes in the options A,B, and D)

A.


B.


C.


D.


24. If $\lambda_1, \lambda_2, \ldots \lambda_n$ are the eigenvalues of a matrix A, then which of the following is not true? (where I is identity matrix)

A. The eigenvalues of the matrix A-kI are $\lambda_1 - k, \lambda_2 - k, \lambda_3 - k \ldots\ldots$
B. The eigenvalues of the matrix A-kI are $-k\lambda_1, -k\lambda_2, -k\lambda_3 \ldots\ldots$
C. The eigenvalues of the transpose of A are the same as that of A.
D. If A is an upper triangular matrix, then the eigenvalues are same as the values in the main diagonal.

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A. $1 + \frac{x^2}{2!} + \frac{x^4}{4!} \dots$

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C. $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots$

D. $1 - x + \frac{x^2}{2} - \dots$

22. The value of the integral $I(\alpha) = \int_{-\infty}^{\infty} e^{-\alpha x^2} dx$ is

A. π/α

B. $(1/2\pi)(\pi/\alpha)^{1/2}$

C. $(1/2\alpha)(\pi/\alpha)^{1/2}$

D. $(\pi/\alpha)^{1/2}$

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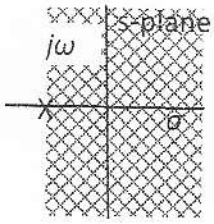
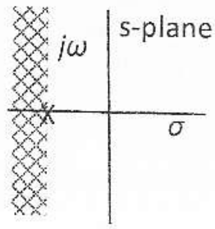
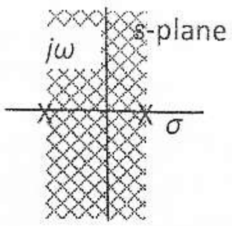
A.



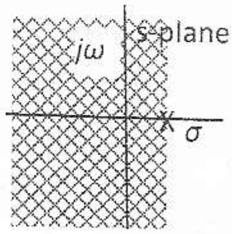
B.



C.



D.



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B. The eigenvalues of the matrix A-kI are $-k\lambda_1, -k\lambda_2, -k\lambda_3 \dots\dots$

C. The eigenvalues of the transpose of A are the same as that of A.

D. If A is an upper triangular matrix, then the eigenvalues are same as the values in the main diagonal.

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25. If $\bar{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$, then $(\bar{u} . \bar{\nabla})\, \bar{r} = ?$, where, $\bar{u} = u_1\hat{\imath} + u_2\hat{\jmath} + u_3\hat{k}$

A. $\bar{u}$
B. 0
C. $\bar{r}$
D. 1

26. The effective density of states in the conduction band (N_C) of Si is 2.56 x $10^{19} cm^{-3}$ at $300K$. The value of N_C at $77K$ is directly proportional to

A. $\left(\frac{77}{300}\right)$
B. $\left(\frac{77}{300}\right)^{\frac{3}{2}}$
C. $\left(\frac{77}{300}\right)^{\frac{1}{2}}$
D. $\left(\frac{300}{77}\right)^{\frac{3}{2}}$

27. The number of atoms per unit cell in Si is

A. 4
B. 8
C. 6
D. 1

28. Consider the following statements

I. Si has direct bandgap and hence it has many applications in optoelectronics
II. Si has indirect bandgap and hence it is not a good material for optoelectronics
III. GaAs has direct bandgap and hence it has many applications in optoelectronics
IV. GaAs has indirect bandgap and hence it is not a good material for optoelectronics

Which of the following statements are correct?
A. I, IV
B. I, III
C. II, III
D. II, IV

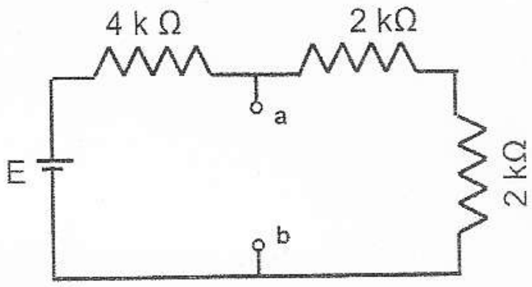
29. If the mobility of holes in Ge at room temperature is 1900 $cm^2\, V^{-1} s^{-1}$, then the diffusion coefficient is approximately
A. 49.4 cm^2/s
B. 46.2 cm^2/s
C. 19 cm^2/s
D. 73.1 cm^2/s

30. The vector sum of the wave-vectors of all the electrons in a completely filled valence band of a semiconductor is

A. always positive
B. always negative
C. zero
D. infinite

31. The voltage (V_{ab}) between the terminals "a" and "b" in the circuit shown in figure is 8 V. If the terminals "a" and "b" are short circuited then the current flowing through the 4 kΩ resistor is

A. 16 mA
B. 8 mA
C. 2 mA
D. 4 mA



32. The input voltage and current to an a.c network are given by $v(t)= 60sin(314t + 80^o)\ V$ and $i(t)= 30sin(314t+20^o)\ A$ respectively. The average power delivered to this circuit is

A. 1800 W
B. 450 W
C. 900 W
D. 636 W

33. The oscillator circuit that employs positive and negative feedback simultaneously to sustain the frequency of oscillations is

A. RC phase shift oscillator
B. Wien bridge oscillator
C. Colpitts oscillator
D. Crystal oscillator

34. The rise time in the step response of an amplifier with finite bandwidth is

A. inversely proportional to the upper 3dB frequency
B. directly proportional to the lower 3 dB frequency.
C. inversely proportional to the lower 3dB frequency
D. directly proportional to the upper 3dB frequency

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35. If for a *Si* *n-p-n* transistor, the base to emitter voltage (V_{BE}) is 0.7 V and collector to base voltage (V_{CB}) is 0.1 V then the transistor will operate in the

A. cut – off mode
B. inverse active mode
C. saturation mode
D. active mode

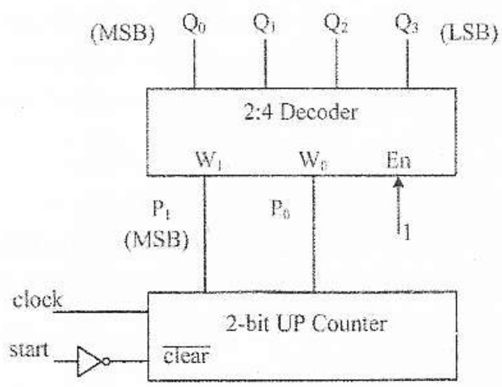
36. In a BJT, if the width of the base is increased then which of the following parameter will increase?

A. unity gain frequency
B. Early voltage
C. emitter – base junction capacitance
D. current gain

37. A negative feedback amplifier, with current sampling at the output and series mixing at the input stabilizes

A. voltage gain
B. current gain
C. transresistance
D. transconductance

38. In the circuit given below, initially the "start" signal is logic "1". The count sequence at the output of $Q_0 Q_1 Q_2 Q_3$ after the start signal is set to logic "0" is



A. 1000,1100,1110,1111,1000...
B. 0000,0001,0010,0011,0100,....
C. 1000,0111,0110,0101,0110....
D. 1000,0100,0010,0001,1000....

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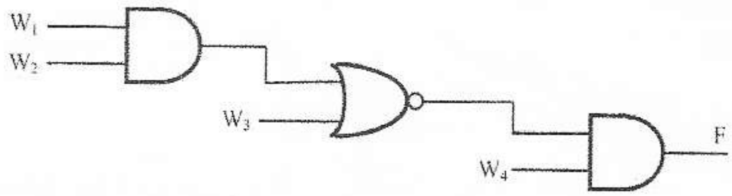
39. The output (F) of the logic circuit shown below is $\overline{W_1}$. The inputs W_2, W_3 and W_4 are respectively



A. 1,0,1
B. 0,1,0
C. 1,1,1
D. 0,1,1

40. A hazard free realisation of the Boolean expression $f = AB + \bar{A}C$ is

A. $AB + \bar{A}C + \bar{B}C$
B. $AB + \bar{A}C + BC$
C. $AB + \bar{A}C + A\bar{C}$
D. $AB + \bar{A}C + B\bar{C}$

41. The number of error checking bits required to correct a single bit error of an N-bit data using the Hamming code is

A. $\log_2 (N)+1$
B. $2\log_2 (N)+1$
C. $\log_2 (2N)-1$
D. $\log_2 (2N)+1$

42. The clock frequency of a microprocessor is 5 MHz. If the time required to execute an instruction is 1.8 μs, then the number of T-states required to execute the instruction is

A. 9
B. 2
C. 5
D. 18

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43. The Verilog code for the module "*test*" given below corresponds to a

```
module test (input i0, i1, i2, output y);
wire i3 ;
not g0 (i3, i2);
test1 g1 (y, i0, i3),
test1 g2 (y, i1, i2 );
endmodule
```

```
module test1(input a, c, output f);
assign f=c?a:1'bz;
endmodule
```

A. Demultiplexer
B. Multiplexer
C. Decoder
D. Encoder

44. Which of the following models cannot be used to represent a transmission line?

A. ABCD parameter model
B. T parameter model
C. h parameter model
D. S parameter model

45. A lossless line having 50 Ohm characteristic impedance and length of $\lambda/4$ (where λ is wavelength of the wave) is short circuited at one end and connected to an ideal voltage source of 1V at the other end. The current drawn from the voltage sources is

A. 0 A
B. 0.02 A
C. Tending to ∞
D. 50 A

46. A uniform plane wave in free space is normally incident on an infinitely thick dielectric slab (dielectric constant $\epsilon_r = 9$). The magnitude of the reflection coefficient is

A. 0
B. 0.3
C. 0.5
D. 0.8

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47. The input impedance of a lossless transmission line is (λ = wavelength)

A. periodic with period λ
B. periodic with period $\lambda/2$
C. periodic with period $\lambda/4$
D. aperiodic

48. Which of the following statement is true with respect to magnetic vector potential?

A. Its curl is equal to the electric field intensity
B. Its curl is equal to the magnetic flux density
C. Its divergence is equal to electric potential
D. It is equal to $\vec{E} \times \vec{H}$, where $\vec{E}$ and $\vec{H}$ are the field strength of electric and magnetic field respectively.

49. If a bandlimited channel deploys 8-PAM using the raised cosine roll-off characteristic with $\frac{1}{2T}$ equal to 2.5 MHz, (where T is the symbol period), then the achievable bit rate is

A. 10 Mbits/s
B. 30 Mbits/s
C. 15 Mbits/s
D. 40 Mbits/s

50. If a Linear Time Invariant (LTI) system is characterised by the impulse response $h(n) = u(n+3) + u(n-2) + u(n-6)$, where $u(n)$ is the unit step sequence, then the LTI system is

A. Stable and causal
B. Causal and unstable
C. Unstable and not causal
D. Stable but not causal

51. A Bluetooth super-heterodyne receiver receiving the signal at a carrier frequency of 2.4 GHz, is down converted to 0.4 GHz intermediate frequency. Then the image frequency is located at

A. 4.8 GHz
B. 2.4 GHz
C. 2.0 GHz
D. 1.6 GHz

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52. Consider two smartphones *A* and *B*. The signal to noise ratio of the RF chipset used in A is 10 dB lower than that of B. Which of the following statement is true for the smartphone A ?

A. It has increased data rate for the same bit error rate (BER)
B. It has a lower transmitted power with the same target BER
C. It has increased BER for the same transmitted power
D. It has no effect on BER

53. The impulse response of the linear time-invariant system whose input, $x(t)$, and output, $y(t)$, are related through the differential equation $\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + y(t) = x(t)$

A. $e^{-t}u(t)$
B. $e^{-2t}u(t)$
C. $te^{t}u(t)$
D. $te^{-t}u(t)$

54. The convolution, $y[n]$, of two discrete time signals

$$x_1(n) = \begin{cases} 1 & n = 0,2 \\ 0, & otherwise \end{cases}$$

$$x_2(n) = \begin{cases} 1 & n = 0,1 \\ 0, & otherwise \end{cases}$$

is

A. $y[0]=2, y[1]=3$, $y[n]=0$ for $n\neq 0,1$
B. $y[0]=1, y[1]=2$, $y[n]=0$ for $n\neq 0,1$
C. $y[0]=1, y[1]=3$, $y[2]=2, y[n]=0$ for $n\neq 0,1,2$
D. $y[0]=1, y[1]=3$, $y[2]=1, y[n]=0$ for $n\neq 0,1,2$

55. The Discrete Fourier Transform of the two membered sequence $x[0]=2, x[1]=2j$ is

A. $X(0)=1+j, X(1)=1-j$
B. $X(0)=2, X(1)=2j$
C. $X(0)=1-j, X(1)=1+j$
D. $X(0)=1, X(1)=e^{-j\pi}$

University of Hyderabad
Entrance Examinations - 2020

~~School/Department/~~Centre : Centre for Advanced Studies in Electronics Science and Technology

Course/Subject : M.Tech/ Microelectronics & VLSI Design

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	C	26	B	51	D
2	B	27	B	52	C
3	C	28	C	53	D
4	A	29	A	54	*
5	D	30	C	55	A
6	A	31	D		
7	B	32	B		
8	D	33	B		
9	D	34	A		
10	B	35	D		
11	B	36	B		
12	C	37	D		
13	A	38	D		
14	D	39	A		
15	C	40	B		
16	B	41	A		
17	C	42	A		
18	B	43	B		
19	D	44	C		
20	A	45	A		
21	C	46	C		
22	D	47	B		
23	D	48	B		
24	B	49	C		
25	A	50	D		

Note/Remarks :* For question no 54, all candidates will be given marks.

Signature 30.09.2020

Centre : CASEST