BPSC
Assistant
Professor
Previous Year Paper
EC 2022

1. The solution of differential equation

$$(D^3 - 3D^2 + 3D - 1)y = x^2 e^x$$

is

(A) $(C_1 + C_2 x + C_3 x^2)e^{-x} + \frac{x^5 e^x}{60}$

(B) $(C_1 + C_2 x + C_3 x^2)e^{x} + \frac{x^5 e^x}{60}$

(C) $(C_1 + C_2 x + C_3 x^2)e^{x} + \frac{x^5 e^{-x}}{60}$

(D) $(C_1 + C_2 x + C_3 x^2)e^{-x} + \frac{x^5 e^x}{12}$

2. For the equation

$$(D^2 + 1)y = \text{cosec}x$$

Wronskian Det is

(A) 1

(B) −1

(C) 0

(D) i

3. The solution of the Cauchy-Euler equation

$$x^2 \frac{d^2y}{dx^2} - 2y = x^2 + \frac{1}{x}$$

is

(A) $C_1 e^{2x} + C_2 e^{-x} + \frac{x}{3} e^{2x} - \frac{x}{3} e^{-x}$

(B) $C_1 x^2 + C_2 \frac{1}{x} + \frac{1}{3}\left(x^2 - \frac{1}{x}\right)\log x$

(C) $C_1 x^2 + C_2 \frac{1}{x} + \frac{x}{3} e^{2x} - \frac{x}{3} e^{-x}$

(D) $C_1 e^{x} + C_2 x^2 + \frac{1}{3}\left(x^2 - \frac{1}{x}\right)\log x$

4. A die is thrown thrice. A success is getting 1 or 6 on a toss. Mean and variance of the number of successes are

(A) 1/3, 2/8

(B) 2/3, 1

(C) 1, 1/3

(D) 1, 2/3

5. In an examination taken by 500 candidates, the average and standard deviation of marks obtained (normally distributed) are 40% and 10%. Approximately the number of candidates will pass, if 50 is fixed as a minimum, is

(A) 70

(B) 75

(C) 79

(D) 82

[Given $\int_1^\infty \phi(z)dz = 0{\cdot}1587$]

6. The diameter x of an electric cable is assumed to be continuous variable with probability density function $f(x) = 6x(1-x)$, $0 \le x \le 1$. Mean and variance of the distribution are

(A) 1/2, 1/20

(B) 1/3, 1/30

(C) 1/10, 1/20

(D) 1/20, 2/5

7. The probability that a leap year will have 53 Sundays is

(A) 1/7

(B) 2/7

(C) 3/7

(D) 4/7

8. The records show that the probability of high barometric pressure is 0·82 and the probability of rain and high barometric pressure is 0·20. The probability of rain given high barometric pressure is

(A) 0·2568

(B) 0·2446

(C) 0·2493

(D) 0·2546

9. Mean of two batsmen A and B are $\bar{x}_A = 48$ and $\bar{x}_B = 46$. Their coefficient of variation are 0·37 and 0·26 respectively. Then which of the following is correct?

(A) A is better scorer and more consistent than B

(B) B is better scorer and more consistent than A

(C) B is better scorer and less consistent than A

(D) A is better scorer and B is more consistent than A

10. The number of linearly independent solutions corresponding to $\lambda = 2$ and $\lambda = 8$ of the matrix

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

is

(A) (1, 2)

(B) (2, 2)

(C) (2, 1)

(D) (1, 1)

11. Let P be an orthogonal matrix, then

(A) inverse of P does not exist

(B) P^{-1} exists but P^{-1} is not orthogonal

(C) P is invertible but P^{-1} is not orthogonal

(D) P^{-1} exists and P^{-1} is also orthogonal

12. Given the matrix

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

the algebraic multiplicity and geometric multiplicity are

(A) (1, 2)

(B) (1, 1)

(C) (2, 2)

(D) (2, 1)

13. If $f(x) = \log_e x$, the value of $\log_e 1\cdot1$ correct to four decimal places is

(A) 0·0953

(B) 0·0095

(C) 0·0135

(D) 0·0875

14. If $f(x) = \sin x$ and $F(x) = \cos x$, then the value of

$$\frac{\sin\alpha - \sin\beta}{\cos\beta - \cos\alpha}$$

will be

(A) $-\cot\theta;\ 0 < \alpha < \theta < \beta < \frac{\pi}{2}$

(B) $\cot\theta;\ 0 < \alpha < \theta < \beta < \frac{\pi}{2}$

(C) $\operatorname{cosec}\theta;\ 0 < \alpha < \theta < \beta < \frac{\pi}{2}$

(D) $\tan\theta;\ 0 < \alpha < \theta < \beta < \frac{\pi}{2}$

15. If $f(x) = x^3 + 8x^2 + 15x - 24$, then using Taylor series the value of $f\left(\frac{11}{10}\right)$ will be

(A) 2·511

(B) 3·251

(C) 3·511

(D) 3·212

16. The value of

$$\lim_{x\to0}\left(\frac{1}{x} - \cot x\right)$$

is

(A) 1

(B) −1

(C) 0

(D) $\frac{1}{2}$

17. If $\hat{r} = x\hat{i} + y\hat{j} + z\hat{k}$, the curl $\hat{r}$ is

(A) 0

(B) 1

(C) x

(D) $x + z$

18. If $\vec{a}$ is a constant vector and $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then div $(\vec{a} \times \vec{r})$ and curl $(\vec{a} \times \vec{r})$ are given by

(A) $(2\vec{a}, 0)$

(B) $(\vec{a}, 0)$

(C) $(0, 2\vec{a})$

(D) $(0, \vec{a})$

19. $\nabla\cdot(\phi\vec{f})$ is given by

(A) $\phi\,\text{grad}\vec{f} + \vec{f}\cdot\text{grad}\,\phi$

(B) $(\text{grad}\,\phi)\cdot\vec{f} + \phi\,\text{div}\,f$

(C) $(\text{grad}\,\phi)\times\vec{f} + \phi\,\text{div}\,f$

(D) $(\text{grad}\,\phi)\cdot\vec{f} + \phi\cdot\text{div}\,f$

20. The work done in moving a particle in the force field $\vec{f} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$ along the straight line from (0, 0, 0) to (2, 1, 3) is

(A) 10

(B) 12

(C) 18

(D) 16

21. If S is a closed surface, $\vec{n}$ is the outward drawn normal to S and V is the volume enclosed by S, then $\iint_S \vec{r}\cdot\vec{n}\,dS$ is equal to

(A) V

(B) $3V$

(C) nV

(D) 0

22. If A and B are square matrices of the same order n, then $AB - BA$ is given by

(A) I_n

(B) trace of $AB - BA = 0$

(C) trace of I_n is 0

(D) trace of I_n is 1

23. The value of

$$\int_C \frac{e^z\,dz}{z-2}$$

where C is the circle (i) $|z| = 3$, (ii) $|z| = 1$ will be

(A) $(0,\ e^2)$

(B) $(e^2,\ 0)$

(C) $(2\pi i e^2,\ 0)$

(D) $(0,\ 2\pi i)$

24. In the function $f(z) = \dfrac{1}{z(e^z - 1)}$

(A) poles $z = \pm 2n\pi i$, $n = 0, \pm 1, \pm 2, \ldots$ each of order 1

(B) $z = 0$ is a pole of order 2 and $z = \pm 2n\pi i$, $n = \pm 1, \pm 2, \ldots$ are simple poles

(C) 0 is a pole of order 2 and $z = \pm n\pi i$, $n = \pm 1, \pm 2, \ldots$ are simple poles

(D) $z = \pm n\pi i$, $n = 0, \pm 1, \pm 2, \ldots$ are poles of order 2

25. If

$$u = \sin^{-1}\frac{x}{y} + \tan^{-1}\frac{y}{x}$$

then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ will be

(A) 1

(B) $\tan u$

(C) 0

(D) $\sin u$

26. If

$$u = \sin^{-1}\frac{x^2 + y^2}{x + y}$$

then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ will be

(A) $\sin 2u$

(B) $\cos 2u$

(C) $\tan u$

(D) $\sin u$

27. For the function

$f(x, y) = x^3 + y^3 - 3axy$

(A) $f(x, y)$ will have a maximum at (a, a) if a is +ve and will have minimum if a is negative

(B) $f(x, y)$ will have a minimum at (a, a) if a is +ve and maximum at (a, a) if a is negative

(C) Neither a minimum nor a maximum at (a, a)

(D) $f(x, y)$ will have a maximum at (0, 0)

28. For an analytic function, the imaginary part is $v = 3x^2y - y^3$. Then the real part is

(A) $x^3 - 3x^2 + c$

(B) $x^3 - 3xy^2 + c$

(C) $x^3 + 3x^2y + c$

(D) $x^3 + 3xy^2 + c$

29. For what value of λ, the system of linear equation

$$x_1 + x_2 + x_3 = 2$$
$$x_1 + 2x_2 + x_3 = -2$$
$$x_1 + x_2 + (\lambda - 6)x_3 = \lambda$$

has no solution?

(A) $\lambda = 6$

(B) $\lambda \neq 6$

(C) $\lambda = 3$

(D) $\lambda \neq 3$

30. The value of

$$\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz\,dz\,dy\,dx$$

is

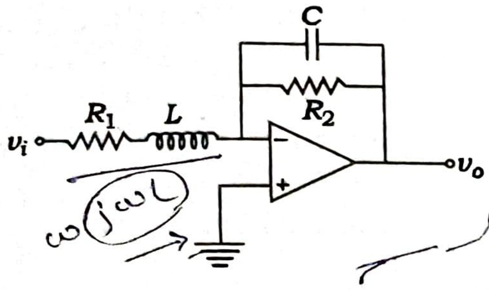
(A) 48

(B) 44

(C) 1/48

(D) 42

31. The OP-AMP circuit shown below represents a



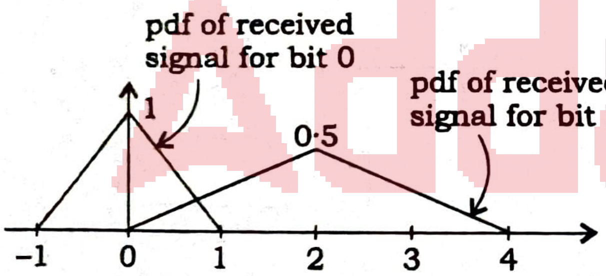
(A) high-pass filter

(B) low-pass filter

(C) band-pass filter

(D) band-reject filter

32. Bits 1 and 0 are transmitted with equal probability. At the receiver, the pdf of the respective received signals for both bits are as shown below :



If the detection threshold is 1, the BER will be

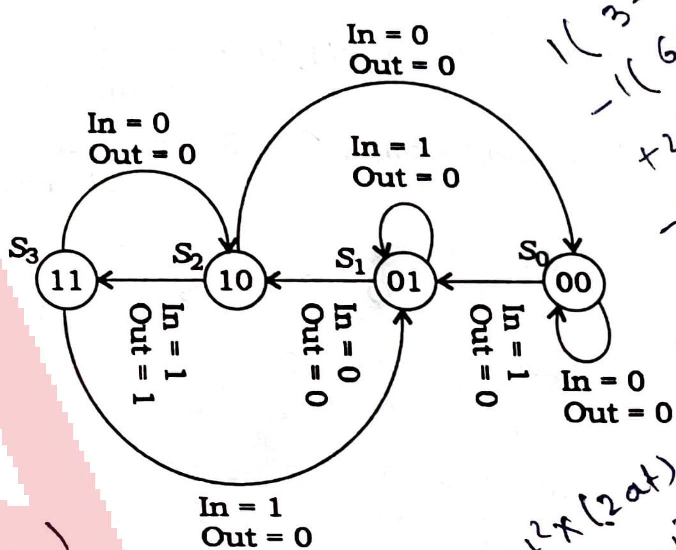
(A) 1/2

(B) 1/4

(C) 1/8

(D) 1/16

33. The finite state machine (FSM) diagram of the sequence detector is shown in the figure. The FSM has an input 'In' and an output 'Out'. The initial state of the FSM is S_0 :



If the input sequence is

110011001010110101

starting with the left-most bit, then the number of times 'Out' will be 1 is

(A) 2 times

(B) 3 times

(C) 4 times

(D) 5 times

34. Match the correct pairs between Group-A and Group-B :

Group-A	*Group—B*
1. $km(t)A\sin(\omega_c t)$	P. Amplitude modulation
2. $[1+km(t)]A\sin(\omega_c t)$	Q. DSBSC modulation
3. $A\sin[\omega_c t + k\int_{-\infty}^{t} m(t)dt]$	R. Phase modulation
4. $A\sin[\omega_c t + km(t)]$	S. Frequency modulation

(A) 1 P, 2 Q, 3 R, 4 S

(B) 1 P, 2 R, 3 Q, 4 S

(C) 1 S, 2 Q, 3 R, 4 P

(D) None of the above

35. Consider the following statements :

Lead compensator

1. increases the margin of stability
2. speeds up transient response
3. does not affect the system error constant

Select the correct answer using the codes given below.

(A) 2 and 3 are correct

(B) 1 and 3 are correct

(C) 1 and 2 are correct

(D) 1, 2 and 3 are correct

36. In a uniformly doped BJT, assume that N_E, N_B and N_C are the emitter, base and collector doping in atoms/cm^3, respectively. If the emitter injection efficiency of the BJT is close to unity, which one of the following conditions is true?

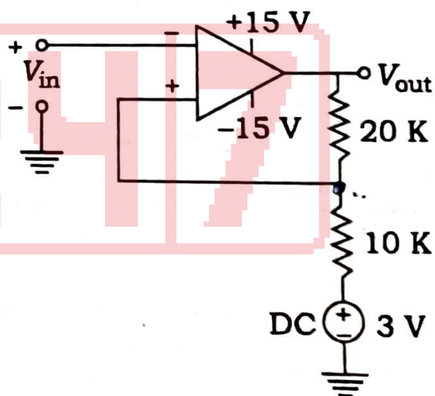
(A) $N_E = N_B = N_C$

(B) $N_E \gg N_B$ and $N_B > N_C$

(C) $N_E = N_B$ and $N_B < N_C$

(D) $N_E < N_B < N_C$

37. For the operational amplifier circuit shown, the output saturation voltages are ±15 V. The upper and lower threshold voltages for the circuit are respectively



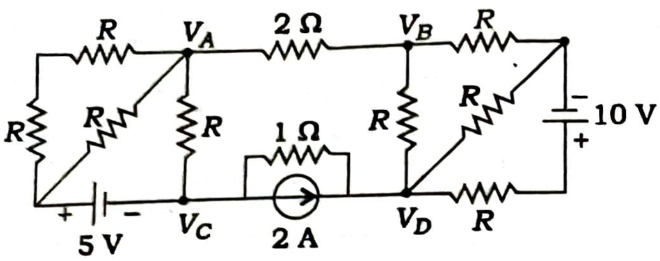
(A) +12 V and −12 V

(B) 7 V and −3 V

(C) +5 V and −5 V

(D) +15 V and −15 V

38. If $V_A - V_B = 6$ V, then $V_C - V_D$ is



(A) −5 V

(B) −2 V

(C) 2 V

(D) 6 V

39. The source of a silicon ($n_i = 10^{10}/\text{cm}^3$) *n*-channel MOS transistor has an area of 10 sq micrometer and a depth of 1 micrometer. If the dopant density in the source is $10^{18}/\text{cm}^3$, the number of holes in the source region with the above volume is approximately

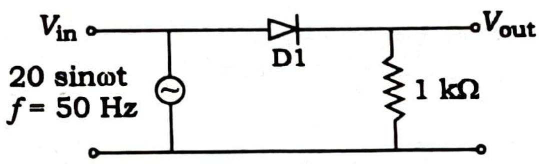
(A) 0

(B) 100

(C) 10

(D) 1010

40. The output V_{out} of the diode circuit shown in the figure is connected to an averaging DC voltmeter. The reading on the DC voltmeter in volts (assume diode D1 is ideal) is



(A) $120/\pi$ V

(B) $2/\pi$ V

(C) $20/\pi$ V

(D) $40/\pi$ V

41. The $u_0(t)$ and $u_1(t)$ signals in binary FSK are given as

$$u_0(t) = 10\cos(5000\pi t)\,;\ 0 \le t \le T$$
$$u_1(t) = 10\cos(6000\pi t);\ 0 \le t \le T$$

where the interval of bit-duration is represented by T and t is in seconds. The $u_0(t)$ and $u_1(t)$ are zero outside $0 \le t \le T$. The smallest positive value of T such that $u_0(t)$ and $u_1(t)$ are uncorrelated for a receiver with matched filter is _____ (ms).

(A) 0·75

(B) 0·25

(C) 0·01

(D) 1

42. Given that $x(t) = \cos(2\pi 800t)$ and $\delta = 0{\cdot}1$. In order to circumvent the slope overload, the required minimum sampling frequency is

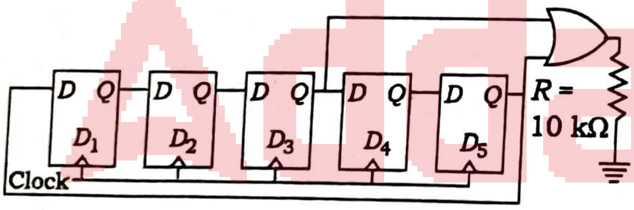
(A) 80π kHz

(B) 800π kHz

(C) 160π kHz

(D) 1600π kHz

43. Assume that all the digital gates in the circuit shown in the figure are ideal. The resistor $R = 10\ k\Omega$ and the supply voltage is 3·3 V. The D flip-flops D_1, D_2, D_3, D_4 and D_5 are initialized with logic values 0, 1, 0, 1 and 0 respectively. The clock has a 30% duty cycle. The average power dissipated (in terms of resistor R and voltage V) is given by



(A) $4\ V^2/25\ R$

(B) $16\ V^2/25\ R$

(C) $9\ V^2/16\ R$

(D) $9\ V^2/25\ R$

44. Consider the following polynomials :

1. $s^4 + 7s^3 + 17s^2 + 17s + 6$
2. $s^4 + 11s^3 + 41s^2 + 61s + 30$
3. $s^4 + s^3 + 2s^2 + 3s + 2$

Among these polynomials, those which are Hurwitz are

(A) 2 and 3

(B) 1 and 2

(C) 1 and 3

(D) 1, 2 and 3

45. The return loss of a device is found to be 20 dB. The voltage standing wave ratio (VSWR) and magnitude of reflection coefficient are respectively

(A) 1·22 and 0·1

(B) 0·81 and 0·01

(C) 1·02 and 0·01

(D) 2·44 and 0·2

46. A sinusoidal message signal is modulated using PCM technique with a uniform quantizer. The 80 dB is the desirable signal to quantization noise ratio (SQNR) at the quantizer's output. This desirable SQNR can be achieved with minimum number of bits per sample

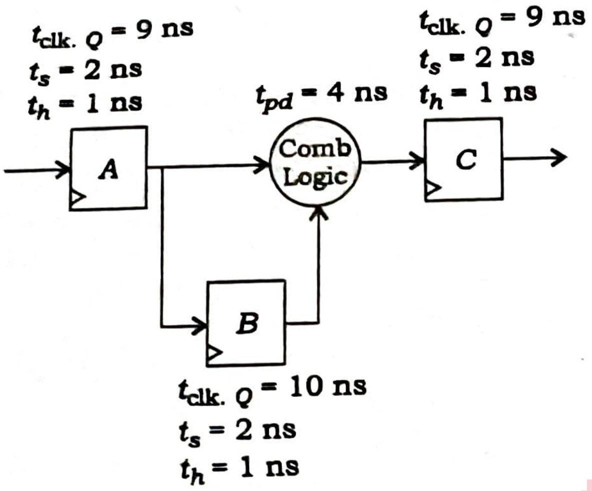
(A) 6

(B) 14

(C) 8

(D) 7

47. Determine the minimum delay of the given digital circuit whose combinational circuit critical path delay (t_{pd}) and sequential elements setup (t_s), hold (t_h) and clk to $Q(t_{clk})$ delay timing specifications are given in the figure :



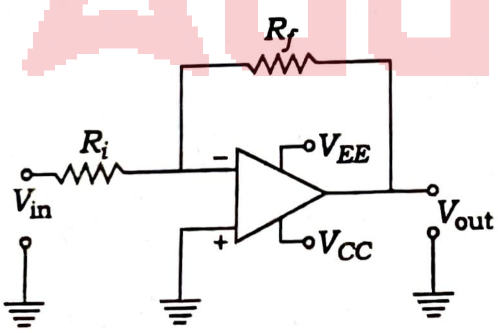
(A) 16 ns

(B) 15 ns

(C) 6 ns

(D) 10 ns

48. The circuit, using an OP-AMP shown below, has



(A) voltage series feedback

(B) current series feedback

(C) current shunt feedback

(D) voltage shunt feedback

49. A lossy transmission line has resistance per unit length $R = 0{\cdot}01\ \Omega/\text{m}$. The line is distortionless and has characteristic impedance of $100\ \Omega$. The attenuation constant (in NP/m, correct to three decimal places) of the line is

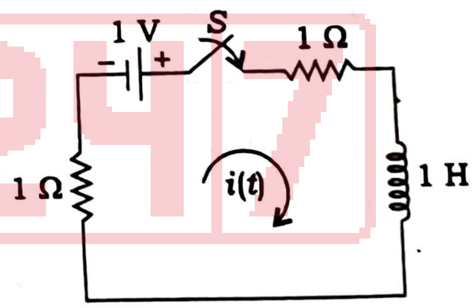
(A) 0·0001

(B) 0·001

(C) 0·01

(D) 0·1

50. For the circuit given in the figure, the magnitudes of the current $i_1(0^-)$ and $i_1(\infty)$ (in amperes) are



(A) 0 and 1

(B) 1 and 0

(C) 0·5 and 0

(D) 0 and 0·5

51. An analog signal is band-limited to 4 kHz, sampled at the Nyquist rate and the samples are quantized into 4 levels. The quantized levels are assumed to be independent and equally probable. If we transmit two quantized samples per second, the information rate is

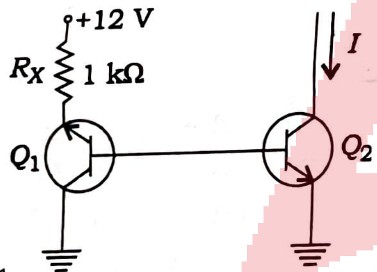
(A) 1 bit/sec

(B) 2 bit/sec

(C) 3 bit/sec

(D) 4 bit/sec

52. Mirrored current I for the given circuit is



(A) 5·300 mA

(B) 5·656 mA

(C) 11·3 mA

(D) 4 mA

53. The z-transform of a signal is given by

$$C(z) = \frac{1z^{-1}(1-z^{-4})}{4(1-z^{-1})^2}$$

Its final value is

(A) zero (B) 1·0

(C) 0·25 (D) infinity

54. The 4-point Discrete Fourier Transform (DFT) of a discrete time sequence $\{1, 0, 2, 3\}$ is

(A) $[0, -2+2j,\ 2,\ -2-2j]$

(B) $[2, 2+2j,\ 6,\ 2-2j]$

(C) $[0, 1+3j,\ 0,\ 1+3j]$

(D) $[6, -1+3j,\ 0,\ -1-3j]$

55. Red (R), Green (G) and Blue (B) light-emitting diodes (LEDs) were fabricated using p-n junctions of three different inorganic semiconductors having different band gaps. The built-in voltages of Red, Green and Blue diodes are V_R, V_G and V_B respectively. Assume donor and acceptor doping to be the same (N_A and N_D respectively) in the p and n sides of all the three diodes. Which one of the following relationships about the built-in voltages is true?

(A) $V_R = V_G = V_B$

(B) $V_R > V_G < V_B$

(C) $V_R > V_G > V_B$

(D) $V_R < V_G < V_B$

56. A p-n junction has a built-in potential of 0·8 V. The depletion layer width at a reverse bias of 1·2 V is 5 micrometer. For a reverse bias of 7·2 V, the depletion layer width will be

(A) 2·5 micrometer

(B) 5 micrometer

(C) 10 micrometer

(D) 12 micrometer

57. The longest wavelength that can be absorbed by silicon, which has the band gap of 1·12 eV, is 1·1 micrometer. If the longest wavelength that can be absorbed by another material is 0·87 micrometer, then band gap of this material is

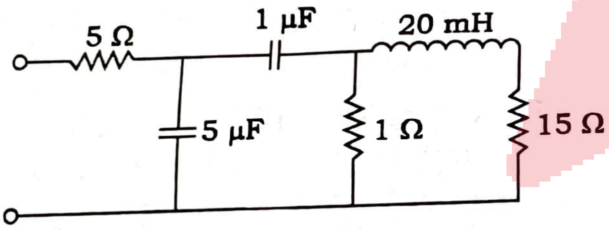
(A) 2·24 eV

(B) 1·12 eV

(C) 0·854 eV

(D) 0·706 eV

58. The minimum number of states required to describe the network shown in the figure in a state variable form is



(A) 0 (B) 6

(C) 1 (D) 3

59. Consider the entropy of a random variable X is 16 bits and for each value of X, a deterministic function $Y(X)$ produces a diverse value. Then the entropy of Y is _____ bits.

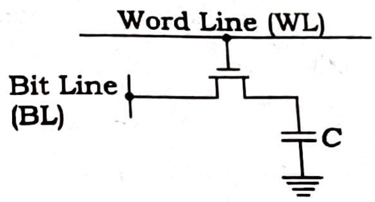
(A) 0

(B) 16

(C) 8

(D) Cannot be determined from the given data

60. In the DRAM cell in the figure, the threshold voltage V_t of the NMOSFET is 1 V, for the following three combinations of WL and BL voltages.



(A) 5 V, 3 V, 7 V

(B) 4 V, 3 V, 4 V

(C) 5 V, 5 V, 5 V

(D) 4 V, 4 V, 4 V

61. The response $c(t)$ of a system to an input $r(t)$ is given by the following differential equation :

$$\frac{d^2c(t)}{dt^2} + 6\frac{dc(t)}{dt} + 5c(t) = 4r(t)$$

The transfer function of the system is given by (assume zero initial conditions)

(A) $G(s) = \dfrac{4}{s^2 + 6s + 5}$

(B) $G(s) = \dfrac{5}{s^2 + 6s + 4}$

(C) $G(s) = \dfrac{6s}{s^2 + 6s + 5}$

(D) $G(s) = \dfrac{s + 6}{s^2 + 6s + 5}$

62. An input of an ideal low-pass filter with a bandwidth of 5 kHz is zero-mean white Gaussian noise. Then its output is sampled uniformly with a sampling period $t_s = 0{\cdot}06$ ms. The obtained samples would be

(A) correlated

(B) uncorrelated

(C) orthogonal

(D) statistically independent

63. The phase velocity for the TE10 mode in air-filled rectangular waveguide is (*c* is the velocity of plane waves in free space)

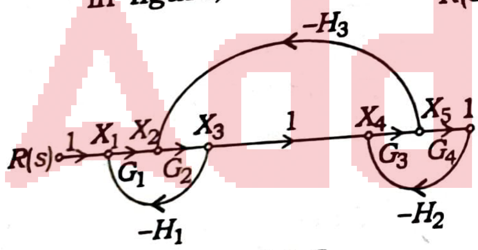
(A) less than *c*

(B) equal to *c*

(C) greater than *c*

(D) None of the above

64. For the signal-flow graph shown in figure, the value of $\frac{C(s)}{R(s)}$ is



(A) $\frac{G_1G_2G_3G_4}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(B) $\frac{G_1G_2G_3G_4}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(C) $\frac{1}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(D) $\frac{1}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

65. How many minimum numbers of bits are required to represent the range of floating number $-1{\cdot}0$ to $1024{\cdot}75$ in binary number system?

(A) 11

(B) 12

(C) 13

(D) 14

66. A carrier is phase modulated (PM) with frequency deviation of 10 kHz by a single-tone frequency of 1 kHz. If the single-tone frequency is increased to 2 kHz, assuming that phase deviation remains unchanged, the bandwidth of the PM signal is

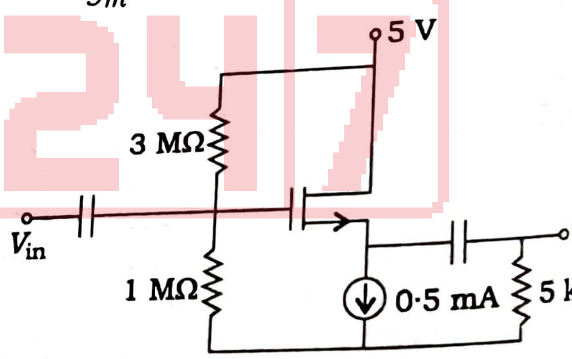
(A) 21 kHz

(B) 22 kHz

(C) 42 kHz

(D) 44 kHz

67. Consider the common-drain amplifier circuit shown in the figure with $k = 2\ \text{mA/V}^2$ and $V_T = 1$ V, the transconductance g_m is



(A) 1·6 mA/V

(B) 2·0 mA/V

(C) 2·4 mA/V

(D) 1·2 mA/V

68. The following instructions have been executed by an 8085 microprocessor :

Address (Hex)	*Instruction*
6010	LXI H, 8A79 H
6013	MOV A, L
6015	ADDH
6016	DAA
6017	MOV H, A
6018	PCHL

From which address will the next instruction be fetched?

(A) 6979

(B) 6019

(C) 6379

(D) Address not available

69. The dispersion equation in a rectangular waveguide, which relates the wave number k to the frequency ω, is $k(\omega) = ((\omega^2 - \omega_0^2)^{1/2})\ 1/c$, where the speed of light $c = 3 \times 10^8$ m/s and ω_0 is a constant. If the group velocity $V_g = 10 \times 10^8$ m/s, then the phase velocity is

(A) $4{\cdot}5 \times 10^7$ m/s

(B) 3×10^7 m/s

(C) 9×10^7 m/s

(D) $1{\cdot}5 \times 10^7$ m/s

70. In a MOSFET operating in the saturation region, the channel length modulation effect causes

(A) an increase in the gate-source capacitance

(B) a decrease in the trans-conductance

(C) a decrease in the unity gain cutoff frequency

(D) a decrease in the output resistance

71. The most commonly used amplifier in sample and hold circuit is

(A) a unity gain inverting amplifier

(B) a unity gain non-inverting amplifier

(C) an inverting amplifier with a gain of 10

(D) an inverting amplifier with a gain of 100

72. The input to a channel is a band-pass signal. It is obtained by linearly modulating a sinusoidal carrier with a single-tone signal. The output of the channel due to this input is given by

$$Y(t)=\left(\frac{1}{100}\right)\cos(100t-10^{-6})\cos(10^{6}t-1\cdot56)$$

The group delay (t_g) and the phase delay (t_p) in seconds, of the channel are

(A) $t_g = 1\cdot56,\ t_p = 10^{-6}$

(B) $t_g = 1\cdot56(10^8),\ t_p = 10^{-6}$

(C) $t_g = 10^8,\ t_p = 1\cdot56(10^{-6})$

(D) $t_g = 10^{-6},\ t_p = 1\cdot56$

73. The characteristic equation of a feedback control system is given by

$$S^3+5S^2+(K+6)S+K=0$$

where $K>0$ is a scalar variable parameter. In the root-loci diagram of system, the asymptotes of the root-locus for larger value of K meet at a point in the s-plane, whose coordinates are

(A) (–2, 0)

(B) (–3, 0)

(C) (–1, 0)

(D) (3, 0)

74. Let $g(t)=e^{-\pi t^2}$, and $h(t)$ is a filter matched to $g(t)$. The $g(t)$ is applied as input to filter. The output of the filter in frequency domain is

(A) $|e^{-\pi f^2}|^2$

(B) $e^{-2\pi|f|}$

(C) $e^{-\pi f^2}$

(D) None of the above

75. An amplifier has an open-loop gain of 200, an input impedance of 2 kΩ and an output impedance of 200 Ω. If a feedback network with a feedback factor 0·99 is connected in a voltage series feedback mode, then new input impedance and output impedance are

(A) 398 kΩ and 1 kΩ

(B) 398 kΩ and 1 Ω

(C) 398 Ω and 1 kΩ

(D) 398 Ω and 1 Ω

76. The Laplace transform of $i(t)$ is given by

$$I(s) = \frac{2}{s(1+s)}$$

At $t \to \infty$, the value of $i(t)$ tends to

(A) 0 (B) 1^0

(C) 2 (D) ∞^0

77. For a MOS capacitor fabricated on a p-type semiconductor, strong inversion occurs when

(A) surface potential is equal to Fermi potential

(B) surface potential is positive and equal to twice the Fermi potential

(C) surface potential is negative and equal to Fermi potential in magnitude

(D) surface potential is zero

78. The phenomenon known as 'Early Effect' in a bipolar transistor refers to a reduction of the effective base-width caused by

(A) the reverse biasing of the base-collector junction

(B) the early removal of stored base charge during saturation-to-cutoff switching

(C) the forward biasing of emitter-base junction

(D) electron-hole recombination at the base

79. In the design of a single-mode step index optical fibre close to upper cutoff, the single-mode operation is ***not*** preserved if

(A) radius as well as operating wavelength are halved

(B) radius as well as operating wavelength are doubled

(C) radius is halved and operating wavelength is doubled

(D) radius is doubled and operating wavelength is halved

80. The electric field component of a time harmonic plane EM wave traveling in a non-magnetic lossless dielectric medium has an amplitude of 1 V/m. If the relative permittivity of the medium is 4, the magnitude of the time-average power density vector (in W/m^2) is

(A) $1/30\pi$

(B) $1/60\pi$

(C) $1/120\pi$

(D) $1/240\pi$