Q.No.1 – 25 Carry One Mark Each

1. Two independent random variables X and Y are uniformly distributed in the interval [-1, 1]. The probability that max [X, Y] is less than ½ is

(A) 3/4 (B) 9/16 (C) 1/4 (D) 2/3

Answer:- (B)

2. If $x = \sqrt{-1}$, then the value of x' is

(A) $e^{-\pi/2}$ (B) $e^{\pi/2}$ (C) x (D) 1

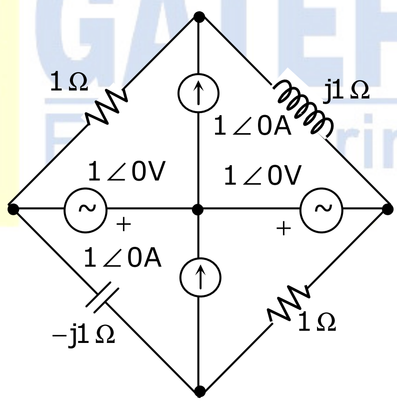
Answer:- (A)

3. Given, $f(z) = \frac{1}{z+1} - \frac{2}{z+3}$. If C is a counterclock wise path in the z-plane such that $|z+1| = 1$, the value of $\frac{1}{2\pi j}\oint_C f(z)\,dz$ is

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

Answer:- (C)

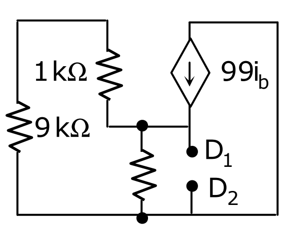
4. In the circuit shown below, the current through the inductor is



(A) $\frac{2}{1+j}$ A (B) $\frac{-1}{1+j}$ A (C) $\frac{1}{1+j}$ A (D) 0 A

Answer:- (C)

5. The impedance looking into nodes 1 and 2 in the given circuit is



(A) 50 Ω (B) 100 Ω (C) 5 KΩ (D) 10.1 kΩ

Answer:- (A)

6. A system with transfer function

$$G(s) = \frac{(s^2+9)(s+2)}{(s+1)(s+3)\ (s+4)}$$

is excited by sin (ωt). The steady-state output of the system is zero at

(A) $\omega = 1 rad/s$ (B) $\omega = 2 rad/s$
(C) $\omega = 3 rad/s$ (D) $\omega = 4 rad/s$

Answer:- (C)

7. In the sum of product function f(X,Y,Z) = $\sum(2,3,4,5)$, the prime implicants are

(A) $\overline{X}Y, X\overline{Y}$ (B) $\overline{X}Y, X\overline{Y}\,\overline{Z}, X\overline{Y}Z$
(C) $\overline{X}Y\overline{Z}, \overline{X}YZ, X\overline{Y}$ (D) $\overline{X}\,Y\,\overline{Z}, \overline{X}\,Y\,Z, X\overline{Y}\,\overline{Z}, X\overline{Y}\,Z$

Answer:- (A)

8. If x[n] = $(1/3)^{|n|}$ - $(1/2)^n$ u[n], then the region of convergence (ROC) of its Z-transform in the Z-plane will be

(A) $\frac{1}{3} < |z| < 3$ (B) $\frac{1}{3} < |z| < \frac{1}{2}$
(C) $\frac{1}{2} < |z| < 3$ (D) $\frac{1}{3} < |z|$

Answer:- (C)

9. The radiation pattern of an antenna in spherical co-ordinates is given by

$$F(\theta) = \cos^4 \theta;\ 0 \le \theta \le \pi/2$$

The directivity of the antenna is

(A) 10dB (B) 12.6dB (C) 11.5dB (D) 18 dB

Answer:- (A)

10. A coaxial cable with an inner diameter of 1mm and outer diameter of 2.4 mm is filled with a dielectric of relative permittvity 10.89. Given $\mu_0 = 4\pi \times 10^{-7}\,H/m$, $\varepsilon_0 = \frac{10^{-9}}{36\pi}F/m$, the characteristic impedance of the cable is

(A) $330\,\Omega$ (B) $100\,\Omega$ (C) 143.3Ω (D) $43.4\,\Omega$

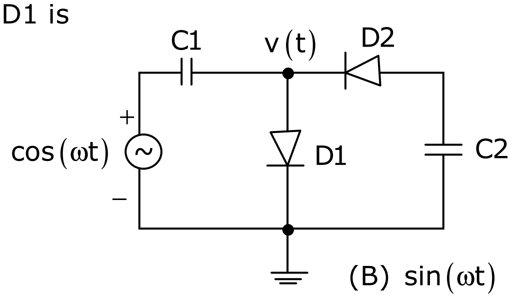
Answer:- (B)

11. A source alphabet consists of N symbols with the probability of the first two symbols being the same. A source encoder increases the probability of the first symbol by a small amount ε and decreases that of the second by ε. After encoding, the entropy of the source

(A) increases (B) remains the same
(C) increases only if N = 2 (D) decreases

Answer:- (D)

12. The diodes and capacitors in the circuit shown are ideal. The voltage v(t) across the diode D1 is

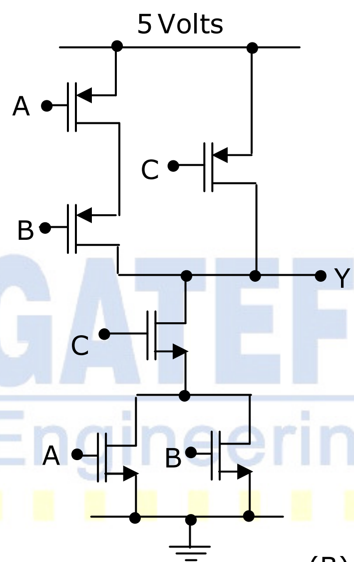


(A) $\cos(\omega t)-1$ (B) $\sin(\omega t)$

(C) $1-\cos(\omega t)$ (D) $1-\sin(\omega t)$

Answer:- (C)

13.



(A) $Y=\overline{A}\,\overline{B}+\overline{C}$ (B) $Y=(A+B)c$

(C) $Y=(\overline{A}+\overline{B})\overline{C}$ (D) $Y=AB+C$

Answer:- (A)

14. With initial condition x(1) = 0.5, the solution of the differential equation, $t\dfrac{dx}{dt}+x=t$ is

(A) $x=t-\dfrac{1}{2}$ (B) $x=t^2-\dfrac{1}{2}$ (C) $x=\dfrac{t^2}{2}$ (D) $x=\dfrac{t}{2}$

Answer:- (D)

15. The unilateral Laplace transform of f(t) is $\dfrac{1}{s^2+s+1}$. The unilateral Laplace transform of (t)f(t) is

(A) $-\dfrac{s}{\left(s^2+s+1\right)^2}$ (B) $-\dfrac{2s+1}{\left(s^2+s+1\right)^2}$

(C) $\frac{s}{(s^2+s+1)^2}$ (D) $\frac{2s+1}{(s^2+s+1)^2}$

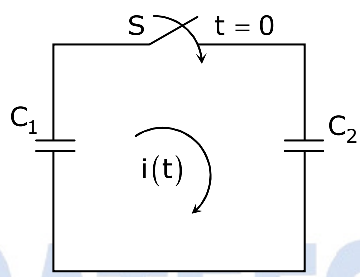
Answer:- (D)

16. The average power delivered to an impedance $(4-j3)\,\Omega$ by a current $5\cos(100\pi t+100)$ A is

(A) 44.2W (B) 50W (C) 62.5W (D) 125W

Answer:- (B)

17. In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charged to 12 V before the ideal switch S is closed at t = 0. The current i(t) for all t is

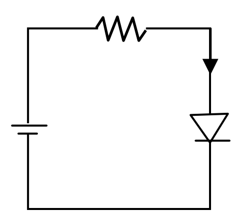


(A) zero (B) a step function
(C) an exponentially decaying function (D) an impulse function

Answer:- (D)

18. The i-v characteristics of the diode in the circuit given below are

$$i=\begin{cases}\frac{\upsilon-0.7}{500}\text{ A}, & \upsilon\ge 0.7\text{V}\\ 0\text{ A}, & \upsilon<0.7\text{V}\end{cases}$$



The current in the circuit is

(A) 10mA (B) 9.3mA (C) 6.67mA (D) 6.2mA

Answer:- (D)

19. The output Y of a 2-bit comparator is logic 1 whenever the 2-bit input A is greater than the 2-bit input B. The number of combinations for which the output is logic 1, is

(A) 4 (B) 6 (C) 8 (D) 10

Answer:- (B)

20. Consider the given circuit

Draw a fig

In this circuits, the race around
(A) does not occur
(B) occurs when CLK = 0
(C) occur when CLK = 1 and A = B = 1
(D) occurs when CLK = 1 and A = B = 0

Answer:- (A)

21. The electric field of a uniform plane electromagnetic wave in free space, along the positive x direction, is given by $\vec{E} = 10\left(\hat{a}_y + j\hat{a}_z\right)e^{-j25x}$. The frequency and polarization of the wave, respectively, are
(A) 1.2 GHz and left circular
(B) 4 Hz and left circular
(C) 1.2 GHz and right circular
(D) 4 Hz and right circular

Answer:- (A)

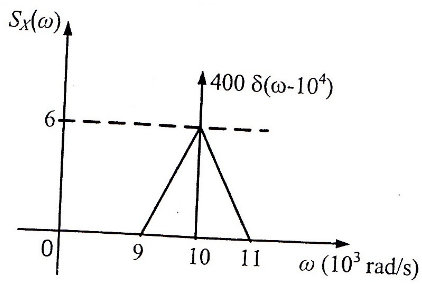
22. A plane wave propagating in air with $\vec{E} = \left(8\hat{a}_x + 6\hat{a}_y - 5\hat{a}_z\right)e^{j(\omega t+3x+4y)}\, V/m$ is incident on a perfectly conducting slab positioned at $x \le 0$. The $\bar{E}$ field of the reflected wave is
(A) $\left(-8\hat{a}_x - 6\hat{a}_y - 5\hat{a}_z\right)e^{j(\omega t+3x+4y)}\, V/m$
(B) $\left(-8\hat{a}_x - 6\hat{a}_y - 5\hat{a}_z\right)e^{j(\omega t+3x+4y)}\, V/m$
(C) $\left(-8\hat{a}_x + 6\hat{a}_y - 5\hat{a}_z\right)e^{j(\omega t-3x-4y)}\, V/m$
(D) $\left(-8\hat{a}_x - 6\hat{a}_y - 5\hat{a}_z\right)e^{j(\omega t-3x-4y)}\, V/m$

Answer:-

23. In a baseband communications link, frequencies upto 3500 Hz are used for signaling. Using a raised cosine pulse with 75% excess bandwidth and for no inter-symbol interference, the maximum possible signaling rate in symbols per seconds is
(A) 1750
(B) 2625
(C) 4000
(D) 5250

Answer:- (C)

24. The power spectral density of a real process X(t) for positive frequencies is shown below. The values of $E\left[X^2(t)\right]$ and $\left[E\left[X(t)\right]\right]$, respectively, are

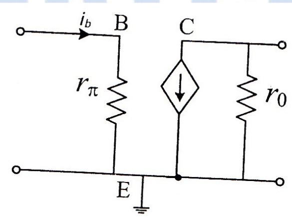


(A) $6000/\pi, 0$ (B) $6400/\pi, 0$

(C) $6400/\pi, 20/\left(\pi\sqrt{2}\right)$ (D) $6000/\pi,\ 20/\left(\pi\sqrt{2}\right)$

Answer:- (B)

25. The current i_b through the base of a silicon npn transistor is $1+0.1\cos(10000\,\pi t)$ mA. At 300 K, the r_π in the small signal model of the transistor is



(A) $250\,\Omega$ (B) $27.5\,\Omega$ (C) $25\,\Omega$ (D) $22.5\,\Omega$

Answer:- (C)

Q.No.26 – 55 Carry Two Marks Each

26. Given that

$A = \begin{bmatrix} -5 & -3 \\ 2 & 0 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, the value of A^3 is

(A) $15A+12I$ (B) $19A+30I$ (C) $17A+15I$ (D) $17A+21I$

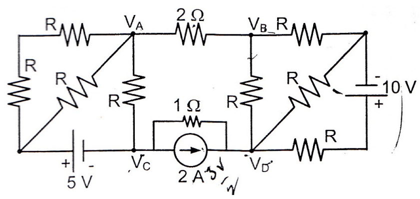
Answer:- (B)

27. The maximum value of $f(x) = x3 - 9x^2 + 24x + 5$ in the interval [1,6] is

(A) 21 (B) 25 (C) 41 (D) 46

Answer:- (B)

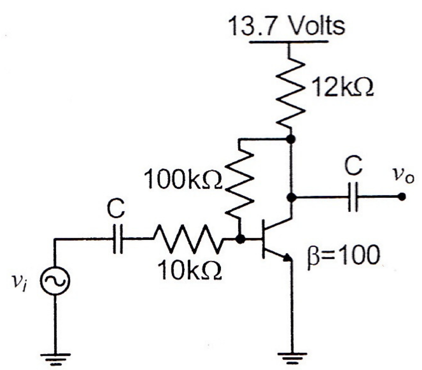
28. If $V_A - V_B = 6$ V, then $V_C - V_D$ is



(A) -5V (B) 2V (C) 3V (D) 6V

Answer:- (A)

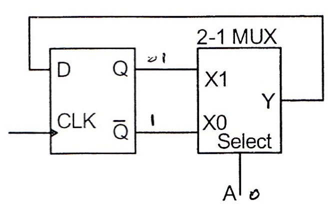
29. The voltage gain AV of the circuit shown below is

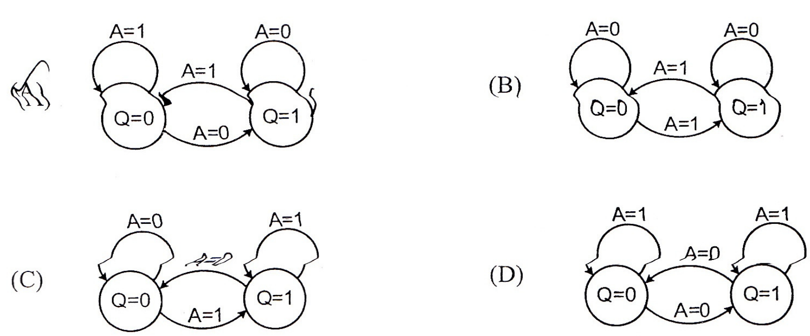


(A) $|A_V| \approx 200$ (B) $|A_V| \approx 100$ (C) $|A_V| \approx 20$ (D) $|A_V| \approx 10$

Answer:- (D)

30. The state transition diagram for the logic circuit shown is



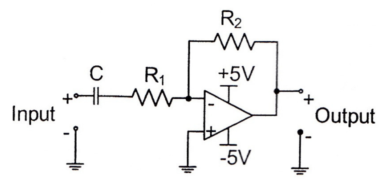


Answer:- (D)

31. Let y[n] denote the convolution of h[n] and g[n], where $h[n] = (1/2)^n u[n]$ and g[n] is a causal sequence. If y[0] = 1 and y[1] = ½, then g[1] equals
(A) 0 (B) 1/2 (C) 1 (D) 3/2

Answer:- (A)

32. The circuit shown is a



(A) low pass filter with $f_{3dB} = \frac{1}{(R_1 + R_2)C}$ rad / s

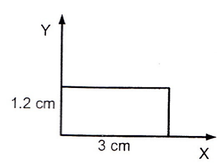
(B) high pass filter with $f_{3dB} = \frac{1}{R_1 C}$ rad / s

(C) low pass filter with $f_{3dB} = \frac{1}{R_1 C}$ rad / s

(D) high pass filter with $f_{3dB} = \frac{1}{R_1 C}$ rad / s

Answer:- (B)

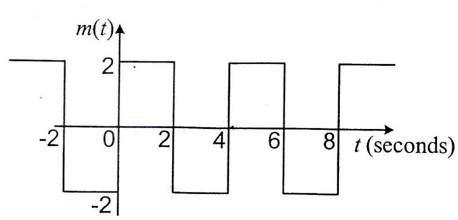
33. The magnetic field along the propagation direction inside a rectangular waveguide with the cross section shown in the figure is
$H_z = 3\cos\left(2.094 \times 10^2 x\right)\cos\left(2.618 \times 10^2 y\right)\cos\left(6.283 \times 10^{10} t - \beta z\right)$



The phase velocity V_F of the wave inside the waveguide satisfies
(A) $v_p > c$ (B) $v_p = c$ (C) $0 < v_p = c$ (D) $v_p = 0$

Answer:- (A)

34. The signal m(t) as shown is applied both to a phase modulator (with kp as the phase constant) and a frequency modulator (with k_f as the frequency constant) having the same carrier frequency



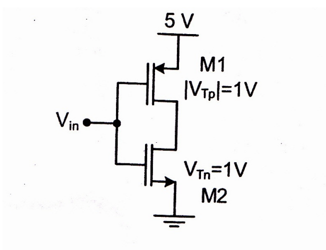
The ratio k_p/k_f (in rad/Hz) for the same maximum phase deviation is
(A) 8π (B) 4π (C) 2π (D) π

Answer:- (B)

35. A binary symmetric channel (BSC) has a transition probability of 1/8. If the binary transmit symbol X is such that PX = 0) = 9/10, then the probability of error for an optimum receiver will be
(A) 7/80 (B) 63/80 (C) 9/10 (D) 1/10

Answer:-

36. In the CMOS circuit shown, electron and hole mobilities are equal, and M1 and M2 are equally



(A) $V_{in} < 1.875V$ (B) $1.87V < V_{in} < 3.125V$
(C) $V_{in} > 3.125V$ (D) $0 < V_{in}, 5V$

Answer:- (A)

37. A fair coin is tossed till a head appears for the first time. The probability that the number of required tosses is odd, is
(A) 1/3 (B) 1/2 (C) 2/3 (D) ¾

Answer:- (C)

38. The direction of vector A is radially outward from the origin, with $|A| = kr^n$ where $r^2 = x^2 + y^2 + z^2$ and k is a constant. The value of n for which $\nabla.A = 0$ is
(A) -2 (B) 2 (C) 1 (D) 0

Answer:- (D)

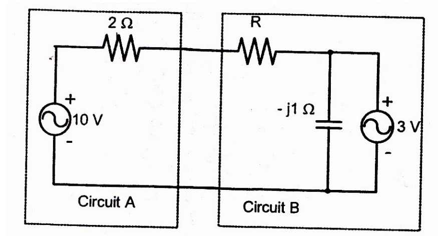
39. Consider the differential equation

$$\frac{d^2y(t)}{dt^2} 2\frac{dy(t)}{dt} + y(t) = \delta(t) \text{with } y(t)\Big|_{t=0^-} = -2 \text{ and } \frac{dy}{dt}\Big|_{t=0} = 0$$

The numerical value of $\left.\frac{dy}{dt}\right|_{t=0}$ is
(A) -2 (B) -1 (C) 0 (D) 1

Answer:- (D)

40. Assuming both the voltage sources are in phase, the value of R for which maximum power is transferred from circuit A to circuit B is



(A) 0.8 Ω (B) 1.4 Ω (C) 2 Ω (D) 2.8 Ω

Answer:-

41. The state variable description of an LTI system is given by

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} 0 & a_1 & 0 \\ 0 & 0 & a_2 \\ a_3 & 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u$$

$$y = \begin{pmatrix} 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

where y is the output and u is the input. The system is controllable for

(A) $a_1 \neq 0, a_2 = 0, a_3 \neq 0$ (B) $a_1 = 0, a_2 \neq 0, a_3 \neq 0$
(C) $a_1 = 0, a_2 \neq 0, a_3 = 0$ (D) $a_1 \neq 0, a_2 \neq 0, a_3 = 0$

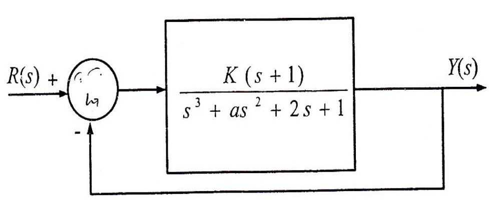
Answer:- (D)

42. The fourier transform of a signal h(t) is $H(j\omega) = (2\cos\omega)(\sin 2\omega)/\omega$. The value of $h(0)$ is

(A) 1/4 (B) 1/2 (C) 1 (D) 2

Answer:- (C)

43. The feedback system shown below oscillates at 2 rad/s when



(A) K = 2 and a = 0.75 (B) K = 3 and a = 0.75
(C) K = 4 and a = 0.5 (D) K = 2 and a = 0.5

Answer:- (A)

44. The input x(t) and output y(t) of a system are related as $y(t) = \int_{-\infty}^{t} x(\tau)\cos(3\tau)\,d\tau$. The system is

(A) time-invariant and stable
(B) stable and not time-invariant
(C) time-invariant and not stable
(D) not time-invariant and not stable

Answer:- (B)

45. A transmission line with a characteristic impedance of $100\,\Omega$ is used to match a $50\,\Omega$ section to a $200\,\Omega$ section. If the matching is to be done both at 429 MHz and 1 GHz, the length of the transmission= line can be approximately

(A) 82.5 cm (B) 1.05 m
(C) 1.58 cm (D) 1.75 m

Answer:-

46. A BPSK scheme operating over an AWGN channel with noise power spectral density of $N_0/2$, uses equiprobable signals $s_1(t) = \sqrt{\frac{2E}{T}}\sin(\omega_c t)$ and $s_2(t) = -\sqrt{\frac{2E}{T}}\sin(\omega_c t)$ over the symbol interval $(0, T)$. If the local oscillator in a coherent receiver a head in phase by 45^{O} with respect to the received signal, the probability of error in the resulting system is

(A) $Q\left(\sqrt{\frac{2E}{N_0}}\right)$ (B) $Q\left(\sqrt{\frac{E}{N_0}}\right)$
(C) $Q\left(\sqrt{\frac{E}{2N_0}}\right)$ (D) $Q\left(\sqrt{\frac{E}{4N_0}}\right)$

Answer:- (B)

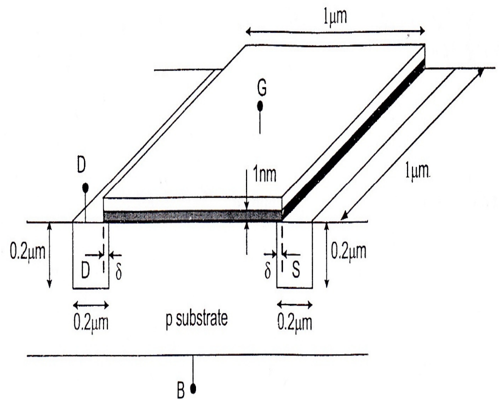
47. The source of a silicon $\left(n_i = 10^{10} \text{ per cm}^3\right)$ n-channel MOS transistor has an area of 1 sq μm and a depth of $1\,\mu$m. If the dopant density in the soured is $10^{19}/\text{cm}^3$, the number of holes in the source region with the above volume is approximately

(A) 10^7 (B) 100
(C) 10 (D) 0

Answer:- (D)

Common Data for Questions: 48 & 49

In the three dimensional view of a silicon n-channel MOS transistor shown below, $\delta = 20$ nm
The transistor is of width $1\,\mu$m.
The depletion width formed at every p-n junction is 10nm. The relative permitivities of Si and SiO_2, respectively, are 11.7 and 3.9, and $\varepsilon_0 = 8.9\times10^{-12}$ F/m



48. The source-body junction capacitance is approximately
(A) 2fF (B) 7fF (C) 2pF (D) 7pF

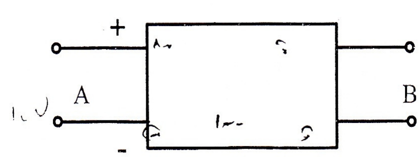
Answer:- (A)

49. The gate-source overlap capacitance is approximately
(A) 0.7fF (B) 0.7pF (C) 0.35fF (D) 0.24pF

Answer:- (A)

Common Data Questions: 50 & 51

With 10V dc connected at port A in the linear nonreciprocal two-port network shown below, the following were observed:
(i) 1Ω connected at port B draws a current of 3 A
(ii) 2.5Ω connected at port B draws a current of 2 A



50. For the same network, with 6V dc connected at port A, 1Ω connected at port B draws 7/3 A. If 8V dc is connected to port A, the open circuit voltage at port B is
(A) 6V (B) 7V (C) 8V (D) 9V

Answer:-

51. With 10V dc connected at port A, the current drawn by 7Ω connected at port B is
(A) 3/7A (B) 5/7A (C) 1 A (D) 9/7A

Answer:- (C)

Statement for linked Answer Questions: 52 & 53

The transfer function of a compensator is given as $G_C(s) = \frac{s+a}{s+b}$

52. $G_C(S)$ is a lead compensator if

(A) a = 1, b = 2 (B) a = 3, b = 2
(C) a = -3, b = -1 (D) a = 3, b = 1

Answer:- (A)

53. The phase of the above lead compensator is maximum at

(A) $\sqrt{2}$ rad/s (B) $\sqrt{3}$ rad/s
(C) $\sqrt{6}$ rad/s (D) $1/\sqrt{3}$ rad/s

Answer:- (A)

Statement for Linked Answer Questions: 54 & 55

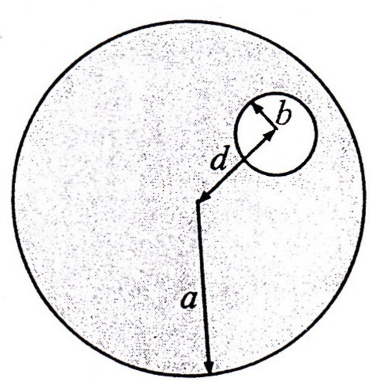
An infinitely long uniform solid wire of radius a carries a uniform dc current of density.

54. The magnetic field at a distance r from the center of the wire is proportional to

(A) r for $r < a$ and $1/r^2$ for $r > a$ (B) 0 for $r < a$ and $1/r$ for $r > a$
(C) r for $r < a$ and $1/r$ for $r > a$ (D) 0 for $r < a$ and $1/r^2$ for $r > a$

Answer:- (C)

55. A hole radius b(b < a) is now drilled along the length of the wire at a distance d from the centre of the wire as shown below.



The magnetic field inside the hole is

(A) uniform and depends only on d (B) uniform and depends only on b
(C) uniform and depends on both b and d (D) non uniform

Answer:- (B)

Q. No. 56 –60 Carry One Mark Each

56. Which one of the following options is the closest in meaning to the word given below?
Latitude
(A) Eligibility (B) Freedom
(C) Coercion (D) Meticulousness

Answer:- (B)

57. One of the parts (A, B, C, D) in the sentence given below contains an ERROR. Which one the following is **INCORRECT**?
I requested that the should be given the driving test today instead of tomorrow.
(A) requested that (B) should be given
(C) the driving test (D) instead of tomorrow

Answer:- (B)

58. If $(1.001)^{1259} = 3.52$ and $(1.001)^{2062} = 7.85$, then $(1.001)^{3321} =$
(A) 2.23 (B) 4.23 (C) 11.37 (D) 27.64

Answer:- (D)
Exp:- let 1.001 = x
$x^{1259} = 3.52$ and $x^{2062} = 7.85$
$x^{3321} = x^{1259}.x^{2062} = 3.52 \times 7.85 = 27.64$

59. Choose the most appropriate alternative from the options given below to complete the following sentence:

If the tried soldier wanted to lie down, he __________ the mattress out on the balcony
(A) should take
(B) shall take
(C) should have taken
(D) will have taken

Answer:- (C)

60. Choose the most appropriate word from the options given below to comlete the following sentence:

Given the seriousness of the situation that he had to face, his __ was impressive.
(A) beggary
(B) nomenclature
(C) jealousy
(D) nonchalance

Answer:- (D)

Q. No. 61 –65 Carry Two Marks Each

61. The data given in the following table summarizes the monthly budget of an average household.

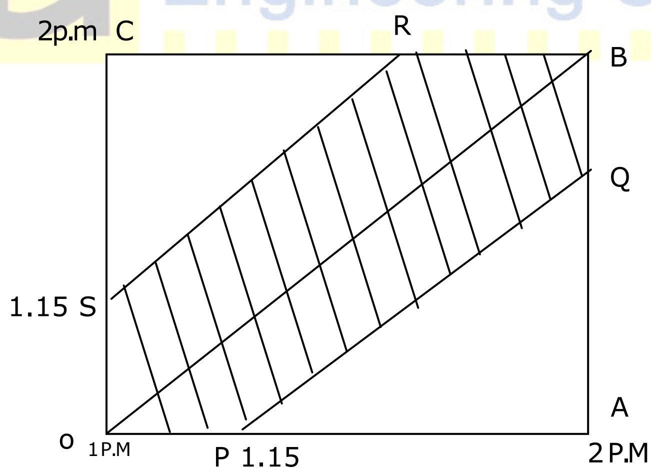
Category	Amount (Rs)
Food	4000
Clothing	1200
Rent	2000
Savings	1500
Other expenses	1800

The approximate percentage of the monthly budget **NOT** spent on saving is
(A) 10% (B) 14% (C) 81% (D) 86%

Answer:- (D)
Exp:- Total budget = 10,500
Expenditure other than savings = 9000
Hence, $\frac{9000}{10500} = 86\%$

62. A and B are friends. They decide to meet between 1 PM and 2 PM on a given day. There is a condition that whoever arrives first will not wait for the other for more than 15 minutes. The probability that they will meet on that day is
(A) 1/4 (B) 1/16 (C) 7/16 (D) 9/16

Answer:- (C)



OB is the line when both A and B arrive at same time.
Total sample space = 60 x 60 = 3600
Favourable cases = Area of OABC – Area of PQRS

$$= 3600 - 2\times\left(\frac{1}{2}\times 45\times 45\right) = 1575$$

$\therefore$ The required probability = $\frac{1575}{3600} = \frac{7}{16}$

63. **One of the legacies of the Roman legions was discipline. In the legions, military law prevailed and discipline was brustal. Discipline on the battlefield kept units obedient, intact and fighting, even when the odds and conditions were against them.**

Which one of the following statements best sums up the meaning of the above passage?

(A) Through regimentation was the main reason for the efficiency of the Roman legions even in adverse circumstances.
(B) The legions were treated inheritance from their seniors.
(C) Discipline was the armies' inheritance from their seniors.
(D) The harsh discipline to which the legions were subjected to led to the odds and conditions being against them.

Answer:- (A)

64. Raju has 14 currency notes in his pocket consisting of only Rs.20 notes and Rs. 10 notes. The total money value of the notes is Rs.230. The number of Rs. 10 notes that Raju has is

(A) 5 (B) 6 (C) 9 (D) 10

Answer:- (A)

Exp:- Let the number of Rs. 20 notes be x and Rs. 10 notes be y

$20x + 10y = 230$

$x + y = 14$

$x=9$ and $y=5$

Hence the numbers of 10 rupee notes are 5

65. There are eight bags of rice looking alike, seven of which have equal weight and one is slightly heavier. The weighting balance is of unimited capacity. Using this balance, the minimum number of weighings required to identify the heavier bag is

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

Answer:- (A)

Let us categorize the bags in three groups as

$A_1\ A_2\ A_3$ $B_1\ B_2\ B_3$ $C_1\ C_2$

1st weighing A vs B

Case -1	**Case -2**
$A_1\ A_2\ A_3 = B_1\ B_2\ B_3$	$A_1\ A_2\ A_3 \neq B_1\ B_2\ B_3$
Then either C_1 or C_2 is heavier	Either A or B would be heavier(Say A >B)

2nd weighing

C_1 vs C_2	A_1 vs A_2
If $C_1 > C_2$, then C_1	If $A_1 = A_2$, then A_3
If $C_1 < C_2$, then C_2	If $A_1 > A_2$, then A_1
If $A_1 < A_2$, then A_2	