PAPER -1

Questions Q1. to Q20. carry one mark each.

Q1. If $\mathbf{A} = \begin{bmatrix} 0 & 1 & -2 \\ -1 & 0 & 3 \\ 2 & -2 & \lambda \end{bmatrix}$ is a singular matrix, then λ is

(A) 0 (B) –2
(C) 2 (D) –1

Q2. Let $f(x) = e^x$ in [0, 1]. Then, the value of c of the mean-value theorem is

(A) 0.5 (B) $(e-1)$
(C) $\log(e-1)$ (D) None

Q3. If $\mathbf{D} = xy\mathbf{u}_x + yz\mathbf{u}_y + zx\mathbf{u}_z$, then the value of $\oiint \mathbf{A} \cdot d\mathbf{S}$ is, where S is the surface of the cube defined by $0 \le x \le 1, 0 \le y \le 1, 0 \le z \le 1$

(A) 0.5 (B) 3
(C) 0 (D) 1.5

Q4. The gradient of field $f = y^2 x + xyz$ is

(A) $y(y+z)\mathbf{u}_x + x(2y+z)\mathbf{u}_y + xy\mathbf{u}_z$

(B) $y(2x+z)\mathbf{u}_x + x(x+z)\mathbf{u}_y + xy\mathbf{u}_z$

(C) $y^2\mathbf{u}_x + 2yx\mathbf{u}_y + xy\mathbf{u}_z$

(D) $y(2y+z)\mathbf{u}_x + x(2y+z)\mathbf{u}_y + xy\mathbf{u}_z$

Q5. In the circuit of fig. Q5 the value of R_1 will be

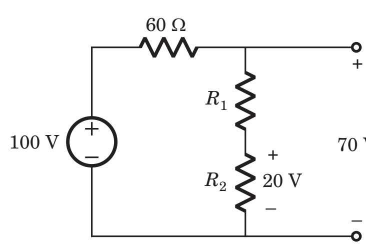


Fig Q5

(A) 25 Ω (B) 50 Ω
(C) 100 Ω (D) 2000 Ω

Q6. The voltage v_o in fig. Q6 is always equal to

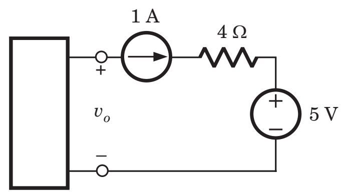


Fig Q6

(A) 1 V
(B) 5 V
(C) 9 V
(D) None of the above

Q7. Epitaxial growth is used in integrated circuit

(A) because it produces low parasitic capacitance
(B) because it yields back-to-back isolating junctions
(C) to grow single crystal $n-$doped silicon on a single-crystal $p-$type substrate
(D) to grow selectively single-crystal $p-$doped silicon of one resistivity on $p-$type substrate of a different resistivity.

Q8. The chemical reaction involved in epitaxial growth in IC chips takes place at a temperature of about

(A) 500° C
(B) 800° C
(C) 1200° C
(D) 2000° C

Q9. In the circuit of fig. Q9 the output voltage v_o is

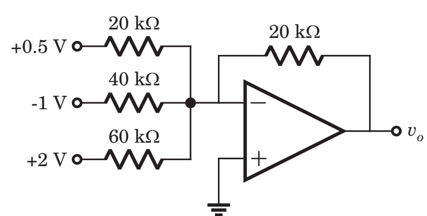


Fig Q9

(A) 2.67 V
(B) –2.67 V
(C) –6.67 V
(D) 6.67 V

Q10. **Assertion (A)** In the self bias CE transistor amplifier a single battery is used.
Reason (R) The collector base junction is forward biased by V_{CC}.

Chose the correct option:
(A) Both A and R individually true and R is the correct explanation of A.
(B) Both A and R individually true and but R is not the correct explanation of A.
(C) A is true but R is false
(D) A is false

Q11. The address bus width of a memory of size 1024×8 bits is

(A) 10 bits (B) 13 bits

(C) 8 bits (D) 18 bits

Q12. Consider the TTL circuit in fig Q12. The value of V_H and V_L are respectively

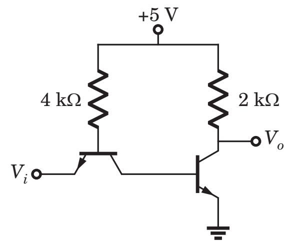


Fig Q12

(A) 5 V, 0 V (B) 4.8 V, 0 V

(C) 4.8 V, 0.2 V (D) 5 V, 0.2 V

Q13. Consider a discrete-time system S whose response to a complex exponential input $e^{j\pi n/2}$ is specified as $S : e^{j\pi n/2} \Rightarrow e^{j\pi 3n/2}$ .The system is

(A) definitely LTI (B) definitely not LTI

(C) may be LTI (D) information is not sufficient.

Q14. The DTFT of signal $2\delta[4-2n]$ is

(A) $2e^{-j2\Omega}$ (B) $2e^{j2\Omega}$

(C) 1 (D) None of the above

Q15. Consider the List I and List II

List I	List II
P. Derivative control	1. Improved overshoot response
Q. Integral control	2. Less steady state errors
R. Rate feed back control	3. Less stable
S. Proportional control	4. More damping

The correct match is

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

Q16. The pole–zero plot given in fig.Q16 is that of a

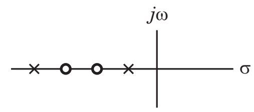


Fig Q16

(A) PID controller
(B) PD controller
(C) Integrator
(D) Lag–lead compensating network

Q17. In TDM non essential frequency components of the modulating signal are removed by

(A) sampler
(B) attenuator
(C) pre-alias filter
(C) modulator

Q18. Coherent demodulation of FSK signal can be affected using

(A) correlation receiver
(B) bandpass filter and envelope detectors
(C) discriminator detection
(C) above all

Q19. Two dissimilar antennas having their maximum directivities equal,

(A) must have their beamwidths also equal.
(B) can not have their beamwidths equal because they are dissimilar antenna.
(C) may not necessarily have their maximum power gain equal.
(D) must have their effective aperture areas (capture areas) also equal.

Q20. The dominant mode in a rectangular waveguide is TE_{10} because this mode has

(A) no attenuation
(B) no cut-off
(C) no magnetic field component
(D) the highest cut-off wavelength

Problem

10. $v_1 = ?$

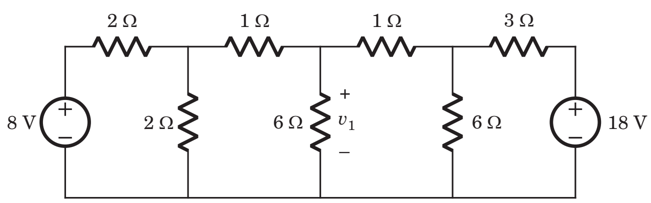


Fig. P.1.4.10

(A) 6 V
(B) 7 V
(C) 8 V
(D) 10 V

Solution

10. (A) By changing the LHS and RHS in Thevenin equivalent

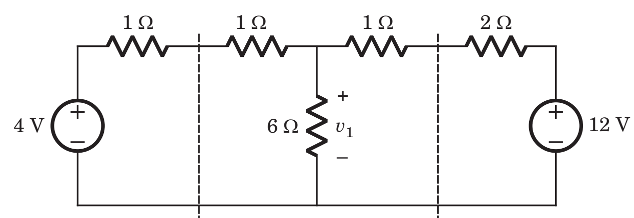


Fig. S1.4.10

$$v_1 = \frac{\frac{4}{1+1} + \frac{12}{1+2}}{\frac{1}{1+1} + \frac{1}{6} + \frac{1}{1+2}} = 6\text{ V}$$

Questions Q21. to Q75. carry two marks each.

Q21. If the rank of the matrix, $\mathbf{A} = \begin{bmatrix} 2 & -1 & 3 \\ 4 & 7 & \lambda \\ 1 & 4 & 5 \end{bmatrix}$ is 2, then the value of λ is

(A) -13

(B) 13

(C) 3

(D) None of these

Q22. If $u = e^{xyz}$, then $\dfrac{\partial^3 u}{\partial x \partial y \partial z}$ is equal to

(A) $e^{xyz}\,[1 + xyz + 3x^2y^2z^2]$

(B) $e^{xyz}\,[1 + xyz + x^3y^3z^3]$

(C) $e^{xyz}\,[1 + 3xyz + x^2y^2z^2]$

(D) $e^{xyz}\,[1 + 3xyz + x^3y^3z^3]$

Q23. The value of $\int e^x \left(\dfrac{1 + \sin x}{1 + \cos x} \right) dx$ is

(A) $e^x \tan \dfrac{x}{2} + c$

(B) $e^x \cot \dfrac{x}{2} + c$

(C) $e^x \tan x + c$

(D) $e^x \cot x + c$

Q24. The solution of the differential equation $(x - y^2)dx + 2xydy = 0$ is

(A) $ye^{2/x} = A$

(B) $xe^{y^2/x} = A$

(C) $xe^{x/y^2} = A$

(D) $ye^{x/y^2} = A$

Q25. The Taylor's series expansion of $f(z) = \sin z$ about $z = \dfrac{\pi}{4}$ is

(A) $\dfrac{1}{\sqrt{2}} \left[1 + \left(z - \dfrac{\pi}{4} \right) - \dfrac{1}{2!} \left(z - \dfrac{\pi}{4} \right)^2 - \ldots\ldots. \right]$

(B) $\dfrac{1}{\sqrt{2}} \left[1 + \left(z - \dfrac{\pi}{4} \right) + \dfrac{1}{2!} \left(z - \dfrac{\pi}{4} \right)^2 + \ldots\ldots. \right]$

(C) $\dfrac{1}{\sqrt{2}} \left[1 - \left(z - \dfrac{\pi}{4} \right) - \dfrac{1}{2!} \left(z - \dfrac{\pi}{4} \right)^2 - \ldots\ldots. \right]$

(D) None of the above

Q26. Consider the following table

Diameter of heart (in mm)	Number of persons
120	5
121	9
122	14
123	8
124	5
125	9

The median of the above frequency distribution is

(A) 122 mm
(B) 123 mm
(C) 122.5 mm
(D) 122.75 mm

Q27. For $\frac{dy}{dx} = x + y^2$, given that $y = 0$ at $x = 0$, using Picard's method up to third order of approximation the solution of the differential equation is

(A) $\frac{x^2}{2} + \frac{x^5}{40} + \frac{x^8}{480} + \frac{x^{11}}{1600}$

(B) $\frac{x^2}{2} + \frac{x^5}{20} + \frac{x^8}{160} + \frac{x^{11}}{4400}$

(C) $\frac{x^2}{2} + \frac{x^5}{20} + \frac{x^8}{160} + \frac{x^{11}}{2400}$

(D) $\frac{x^2}{2} + \frac{x^5}{40} + \frac{x^8}{480} + \frac{x^{11}}{2400}$

Q28. The bilateral laplace transform of $\cos 3t\, u(-t) * e^{-t} u(t)$ is

(A) $\frac{-s}{(s+1)(s^2+9)}$, $\quad$ $\text{Re}(s) > 0$

(B) $\frac{-s}{(s+1)(s^2+9)}$, $\quad$ $-1 < \text{Re}(s) < 0$

(C) $\frac{s}{(s+1)(s^2+9)}$, $\quad$ $-1 < \text{Re}(s) < 0$

(D) $\frac{s}{(s+1)(s^2+9)}$, $\quad$ $\text{Re}(s) > 0$

Q29. The z-transform of $x[n]=\left(\frac{2}{3}\right)^{|n|}$ is

(A) $\frac{-5z}{(2z-3)(3z-2)}, \ -\frac{3}{2}<z<-\frac{2}{3}$

(B) $\frac{-5z}{(2z-3)(3z-2)}, \ \frac{2}{3}<|z|<\frac{3}{2}$

(C) $\frac{5z}{(2z-3)(3z-2)}, \ \frac{2}{3}<|z|<\frac{2}{3}$

(D) $\frac{5z}{(2z-3)(3z-2)}, \ -\frac{3}{2}<z<-\frac{2}{3}$

Q30. Consider the graph shown in fig. Q30 in which twigs are solid line and links are dotted line.

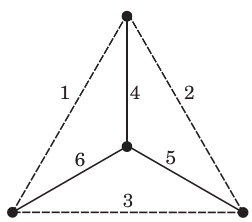
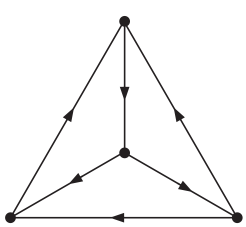


Fig Q30

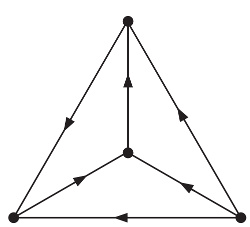
A fundamental loop matrix for this tree is given as below

$$\mathbf{B}_F = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & -1 & -1 & 0 \\ 0 & 0 & 1 & 0 & 1 & -1 \end{bmatrix}$$

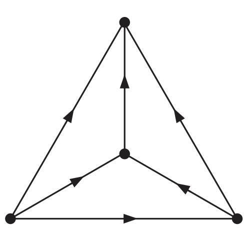
The oriented graph will be



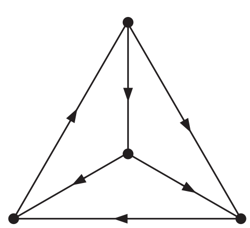
(A)



(B)



(C)



(D)

Q31. The value of the current measured by the ammeter in Fig. Q31 is

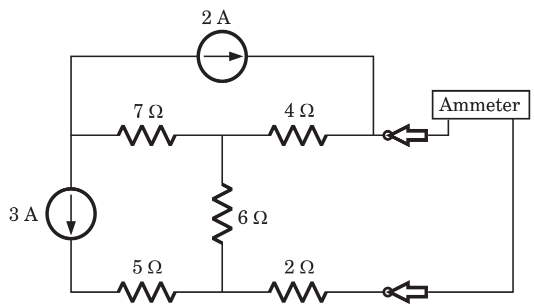


Fig Q31

(A) $\frac{2}{3}$ A

(B) $\frac{5}{3}$ A

(C) $-\frac{5}{6}$ A

(D) $\frac{2}{9}$ A

Q32. In the circuit of fig. Q32 the equivalent resistance seen by the capacitor is

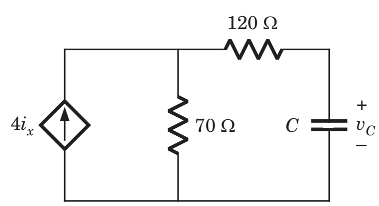


Fig Q32

(A) –470 Ω

(B) 470 Ω

(C) –90 Ω

(D) $v_C(0)$ is required

Q33. In the circuit of fig. Q33 switch is moved from position a to b at $t=0$. The $i_L(t)$ for $t > 0$ is

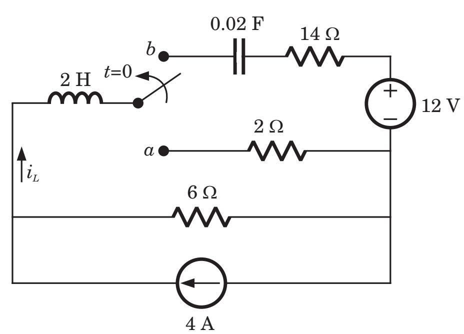


Fig Q33

(A) $(4-6t)e^{4t}$ A

(B) $(3-6t)e^{-4t}$ A

(C) $(3-9t)e^{-5t}$ A

(D) $(3-8t)e^{-5t}$ A

Q34. In the circuit of fig. Q34 the $i(t)$ will be

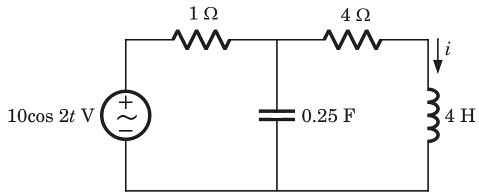


Fig Q34

(A) $2\sin(2t+5.77°)$ A

(B) $\cos(2t-84.23°)$ A

(C) $2\sin(2t-5.77°)$ A

(D) $\cos(2t+84.23°)$ A

Q35. In the circuit of fig. Q35 L_{eq} will be

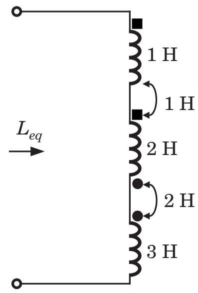


Fig Q35

(A) 1 H

(B) 2 H

(C) 3 H

(D) 4 H

Q36. The maximum voltage across capacitor would be

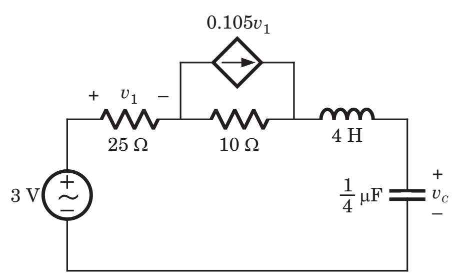


Fig Q36

(A) 3200 V

(B) 3 V

(C) −3 V

(D) 1600 V

Q37. Three scattering mechanism exist in a semiconductor. If only the first mechanism were present, the mobility would be 500 $\mathrm{cm}^2/\mathrm{V-s}$. If only the second mechanism were present, the mobility would be 750 $\mathrm{cm}^2/\mathrm{V-s}$. If only third mechanism were present, the mobility would be 1500 $\mathrm{cm}^2/\mathrm{V-s}$. The net mobility is

(A) 2750 $\mathrm{cm}^2/\mathrm{V-s}$

(B) 1114 $\mathrm{cm}^2/\mathrm{V-s}$

(C) 818 $\mathrm{cm}^2/\mathrm{V-s}$

(D) 250 $\mathrm{cm}^2/\mathrm{V-s}$

Q38. In a silicon ($n_i = 1.5\times10^{10}\ \mathrm{cm}^{-3}$, $D_n = 35\ \mathrm{cm}^2/\mathrm{s}$) sample the electron concentration drops linearly from $10^{18}\ \mathrm{cm}^{-3}$ to $10^{16}\ \mathrm{cm}^{-3}$ over a length of 2.0 μm. The current density due to the electron diffusion current is

(A) $9.3\times10^4\ \mathrm{A/cm}^2$

(B) $2.8\times10^4\ \mathrm{A/cm}^2$

(C) $9.3\times10^9\ \mathrm{A/cm}^2$

(D) $2.8\times10^9\ \mathrm{A/cm}^2$

Q39. A *pn* junction diode is operating in reverse bias region. The applied reverse voltage, at which the ideal reverse current reaches 90% of its reverse saturation current, is

(A) –59.6 mV

(B) 2.7 mV

(C) 4.8 mV

(D) 42.3 mV

Q40. In bipolar transistor biased in the forward-active region the base current is $I_B = 50\,\mu\mathrm{A}$ and the collector currents is $I_C = 2.7$ mA. The α is

(A) 0.949

(B) 54

(C) 0.982

(D) 0.018

Q41. An $n-$channel silicon ($n_i = 1.5 \times 10^{10}$ cm^{-3}) JFET at $T = 300$ K has doping concentration of $N_d = 8 \times 10^{16}$ cm^{-3} and $N_a = 3 \times 10^{18}$ cm^{-3}. The channel thickness dimensions is $a = 0.5$ μm. If the undepleted channel has to be 0.2 μm, the required gate voltage is

(A) 2.73 V

(B) –2.73 V

(C) 4.66 V

(D) –4.66 V

Q42. In the circuit shown in fig. Q42 voltage $V_E = 4$ V. The value of α and β are respectively

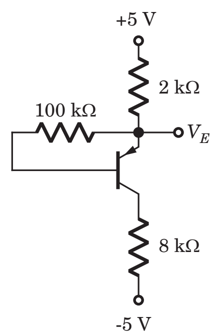


Fig Q42

(A) 0.943, 17.54

(B) 0.914, 17.54

(C) 0.914, 10.63

(D) 0.914, 11.63

Q43. In the current mirror circuit of fig. Q43 the transistor parameters are $V_{BE} = 0.7$ V, $\beta = 50$ and the Early voltage is infinite. Assume transistor are matched. The output current I_o is

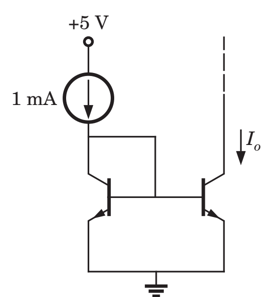


Fig Q43

(A) 1.04 mA

(B) 1.68 mA

(C) 962 μA

(D) 432 μA

Q44. The parameter of the transistor in fig. Q44 are $V_{TN} = 1.2\,\text{mA} / \text{V}^2$, $K_n = 0.5\,\text{mA} / \text{V}^2$, and $\lambda = 0$. The voltage V_{DS} is

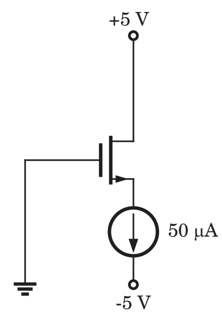


Fig Q44

(A) 2.83 V

(B) 6.52 V

(C) 3.48 V

(D) 4.98 V

Q45. In the circuit shown in fig. Q45 the op-amp is ideal. If transistor has $\beta = 60$, then the total current supplied by the 15 V source is

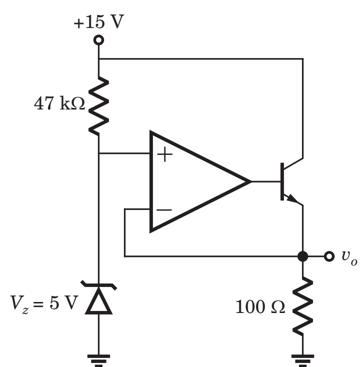


Fig Q45

(A) 123.1 mA

(B) 98.3 mA

(C) 49.4 mA

(D) 168 mA

Q46. Consider the statements below:

1. If the output waveform from an OR gate is the same as the waveform at one of its inputs, the other input is being held permanently LOW.
2. If the output waveform from an OR gate is always HIGH, one of its input is being held permanently HIGH.

The statement, which is always true, is

(A) Both 1 and 2

(B) Only 1

(C) Only 2

(D) None of the above

Q47. A logic circuit consist of two 2×4 decoder as shown in fig. Q47.

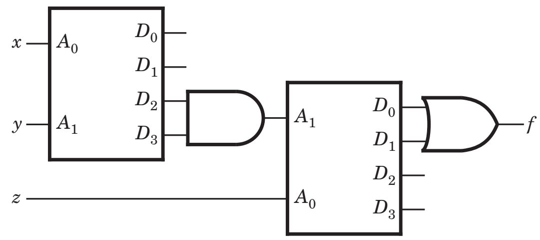


Fig Q47

The output of decoder are as follow

$D_0 = 1$ when $A_0 = 0, \quad A_1 = 0$

$D_1 = 1$ when $A_0 = 1, \quad A_1 = 0$

$D_2 = 1$ when $A_0 = 0, \quad A_1 = 1$

$D_3 = 1$ when $A_0 = 1, \quad A_1 = 1$

The value of $f(x, y, z)$ is

(A) 0

(B) z

(C) $\bar{z}$

(D) 1

Q48. The circuit shown in fig. Q48 implements the function

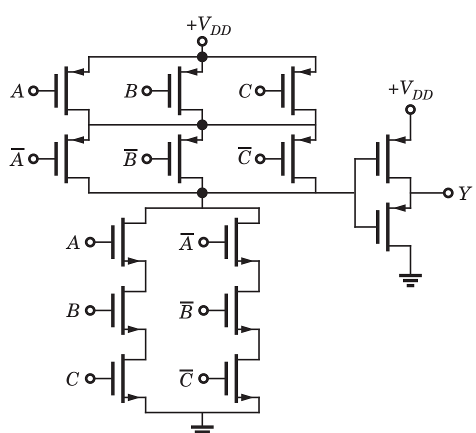


Fig Q48

(A) $ABC + \overline{ABC}$

(B) $ABC + (\overline{A + B + C})$

(C) $\overline{ABC} + (\overline{A + B + C})$

(D) None of the above

Q49. Consider the following 8085 assembly program

```
         MVI         A, DATA1
         MOV         B, A
         SUI         51H
         JC          DLT
         MOV         A, B
         SUI         82H
         JC          DSPLY
DLT :    XRA         A
         OUT PORT1
         HLT
DSPLY :  MOV         A, B
         OUT PORT2
         HLT
```

This program will display

(A) the bytes from 51H to 82H at PORT2

(B) 00H AT PORT1

(C) all byte at PORT1

(D) the bytes from 52H to 81H at PORT 2

Q50. Consider the following program

```
         MVI         A, BYTE1
         RRC
         RRC
```

If BYTE1 =32H, the contents of A after the execution of program will be

(A) 08H | (B) 8CH

(C) 12H | (D) None of the above

Q51. The response of a system S to a complex input $x(t) = e^{j5t}$ is specified as $y(t) = te^{j5t}$. The system

(A) is definitely LTI | (B) is definitely not LTI

(C) may be LTI | (D) information is insufficient

Q52. The following input output pairs have been observed during the operation of a time invariant system :

$$x_1[n]=\{\underset{\uparrow}{1},\ 0,\ 2\} \xleftrightarrow{S} y_1[n]=\{0,\ \underset{\uparrow}{1},\ 2\}$$

$$x_2[n]=\{0,\ \underset{\uparrow}{0},\ 3\} \xleftrightarrow{S} y_2[n]=\{0,\ \underset{\uparrow}{1},\ 0,\ 2\}$$

$$x_3[n]=\{0,\ \underset{\uparrow}{0},\ 0,\ 1\} \xleftrightarrow{S} y_3[n]=\{1,\ \underset{\uparrow}{2},\ 1\}$$

The conclusion regarding the linearity of the system is

(A) System is linear

(B) System is not linear

(C) One more observation is required.

(D) Conclusion cannot be drawn from observation.

Q53. The transfer function $H(s)$ of a stable system is

$$H(s)=\frac{s^2+5s-9}{(s+1)(s^2-2s+10)}$$

The impulse response is

(A) $-e^{-t}u(t)+(e^t \sin 3t+2e^t \cos 3t)u(t)$

(B) $-e^{-t}u(t)-(e^t \sin 3t+2e^t \cos 3t)u(-t)$

(C) $-e^{-t}u(t)-(e^t \sin 3t+2e^t \cos 3t)u(t)$

(D) $-e^{-t}u(t)+(e^t \sin 3t+2e^t \cos 3t)u(-t)$

Q54. The frequency response which has nonlinear phase is

(A) $\frac{1}{j\omega+1}$

(B) $\frac{1}{(j\omega+1)^2}$

(C) $\frac{1}{(j\omega+1)(j\omega+2)}$

(D) All above

Q55. Consider a discrete-time periodic signal

$$x[n] = \frac{\sin\left(\frac{11\pi}{20}n\right)}{\sin\left(\frac{\pi}{20}n\right)}$$

with a fundamental period $N = 20$. The Fourier series coefficients of this function are

(A) $\frac{1}{20}(u[k+5] - u[k-6]), |k| \le 10$

(B) $\frac{1}{20}(u[k+5] - u[k-5]), |k| \le 10$

(C) $(u[k+5] - u[k+6]), |k| \le 10$

(D) $(u[k+5] - u[k-6]), |k| \le 10$

Q56. A feedback control system shown in fig. Q56 is subjected to noise $N(s)$.

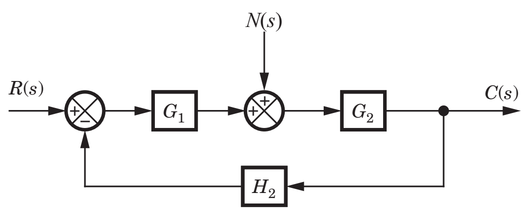


Fig Q56

The noise transfer function $\frac{C_N(s)}{N(s)}$ is

(A) $\frac{G_1 G_2}{1 + G_1 G_2 H}$

(B) $\frac{G_2}{1 + G_1 H}$

(C) $\frac{G_2}{1 + G_2 H}$

(D) None of the above

Q57. For the block diagram shown in the fig. Q57 the limiting value of K for stability of inner loop is found to be $X < K < Y$. The over all system will be stable if and only if

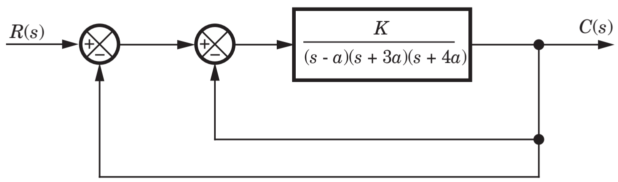


Fig Q57

(A) $4X < K < 4Y$

(B) $\frac{X}{2} < K < \frac{Y}{2}$

(C) $2X < K < 2Y$

(D) $X < K < Y$

Q58. The transfer function of a *ufb* system is

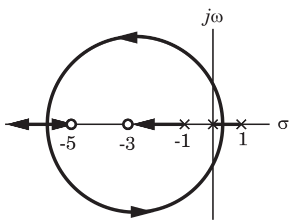
$$G(s)=\frac{10^5(s+3)(s+10)(s+20)}{s(s+25)(s+a)(s+30)}$$

The value of a to yield velocity error constant $K_v = 10^4$ is

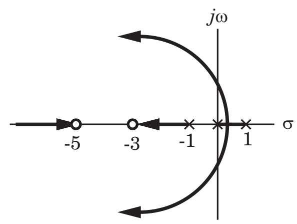
(A) 4 (B) 0

(C) 8 (D) 16

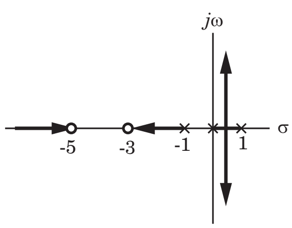
Q59. The forward-path transfer function of a *ufb* system is $G(s)=\dfrac{K(s+\alpha)(s+3)}{s(s^2-1)}$. The root-loci for $K>0$ with $\alpha = 5$ is



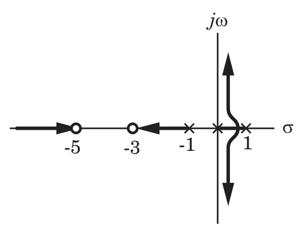
(A)



(B)



(C)



(D)

Q60. Consider the asymptotic Bode plot of a minimum phase linear system given in fig. Q60.

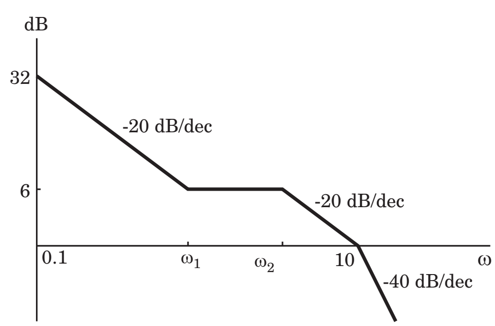


Fig Q60

The transfer function is

(A) $\dfrac{8s(s+2)}{(s+5)(s+10)}$ (B) $\dfrac{4(s+5)}{(s+2)(s+10)}$

(C) $\dfrac{4(s+2)}{s(s+5)(s+10)}$ (D) $\dfrac{8s(s+5)}{(s+2)(s+10)}$

Q61. The joint PDF of random variable x and y is shown in fig. Q61. The value of A is

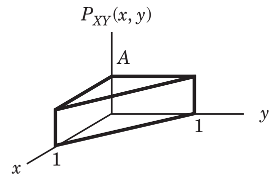


Fig Q61

(A) 1 (B) 2

(C) 4 (D) None of the above

Q62. The probability density function of a random variable X is given as $f_X(x)$. A random variable Y is defined as $y = ax + b$ where $a < 0$. The PDF of random variable Y is

(A) $bf_X\left(\frac{y-b}{a}\right)$ (B) $af_X\left(\frac{y-b}{a}\right)$

(C) $\frac{1}{a}f_X\left(\frac{y-b}{a}\right)$ (D) $\frac{1}{b}f_X\left(\frac{y-b}{a}\right)$

Q63. A carrier is amplitude modulate to 100 % by a polar rectangular signal as shown in fig. Q62. The percentage increase in signal power is

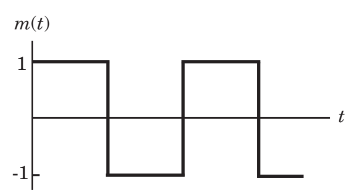


Fig Q62

(A) 83.3 % (B) 100 %

(C) 50 % (D) None of the above

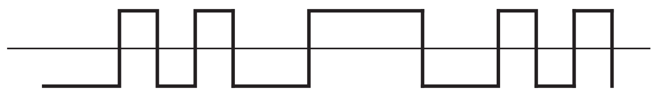
Q64. In a AM signal the received signal power is 10^{-10} W with a maximum modulating signal of 5 kHz. The noise spectral density at the receiver input is 10^{-18} W/Hz. If the noise power is restricted to the message signal bandwidth only, the signals-to-noise ratio at the input to the receiver is

(A) 43 dB (B) 66 dB

(C) 56 dB (D) 33 dB

Q65. Fig. Q65 shows a PCM signals in which amplitude level of +1 volt and –1 volt are used to represent binary symbol 1 and 0 respectively. The code word used consists of three bits.

Fig Q65



The sampled version of analog signal from which this PCM signal is derived is

(A) 4 5 2 1 3

(B) 8 4 3 1 2

(C) 6 4 3 1 7

(D) 1 2 3 4 5

Q66. The flux of $\mathbf{D} = \rho^2 \cos^2 \phi \, \mathbf{u}_\rho + 3 \sin\phi \, \mathbf{u}_\phi$ over the closed surface of the cylinder $0 \le z < 3, \quad \rho = 3$ is

(A) 324

(B) 81π

(C) 81

(D) 64π

Q67. In a certain region $\mathbf{J} = (4y\mathbf{u}_x + 2xz\mathbf{u}_y + z^3\mathbf{u}_z)\sin(10^4 t)$ A/m. If volume charge density ρ_v in $z = 0$ plane is zero, then ρ_v is

(A) $3z^2 \cos(10^4 t)\,\mathrm{mC/m^3}$

(B) $0.3z^2 \cos(10^4 t)\,\mathrm{mC/m^3}$

(C) $-3z^2 \cos(10^4 t)\,\mathrm{mC/m^3}$

(D) $-0.3z^2 \cos(10^4 t)\,\mathrm{mC/m^3}$

Q68. Two $\lambda/4$ transformer in tandem are to connect a $50\,\Omega$ line to a $75\,\Omega$ load as shown in fig. Q68. If $Z_{o2} = 30\Omega$ and there is no reflected wave to the left of A, then the characteristic impedance Z_{o1} is

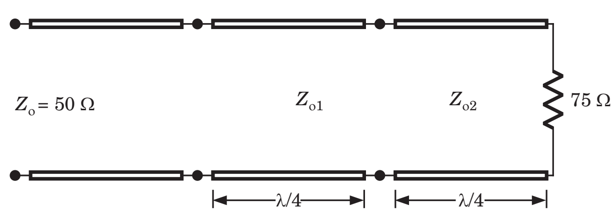


Fig Q68

(A) $28\,\Omega$

(B) $56\,\Omega$

(C) $49\,\Omega$

(D) $24.5\,\Omega$

Q69. The cross section of a waveguide is shown in fig. Q69. It has dielectric discontinuity as shown in fig. If the guide operate at 8 GHz in the dominant mode, the standing wave ratio is

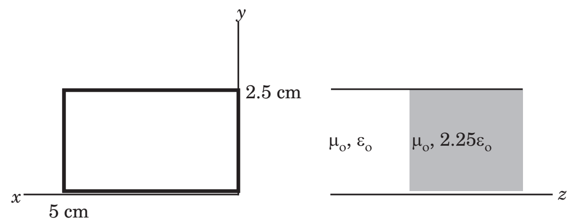


Fig Q69

(A) –3.911

(B) 2.468

(C) 1.564

(D) 4.389

Q70. An antenna consists of 4 identical Hertizian dipoles uniformly located along the z–axis and polarized in the z-direction. The spacing between the dipole is $\frac{\lambda}{4}$. The group pattern function is

(A) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\cos\left(\frac{\pi}{2}\cos\theta\right)$

(B) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\cos\left(\frac{\pi}{8}\cos\theta\right)$

(C) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\sin\left(\frac{\pi}{2}\cos\theta\right)$

(D) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\sin\left(\frac{\pi}{8}\cos\theta\right)$

Common Data Questions

Common Data for Questions Q71-73:

In the voltage regulator circuit in fig. Q71-73 the Zener diode current is to be limited to the range $5 \le i_z \le 100$ mA.

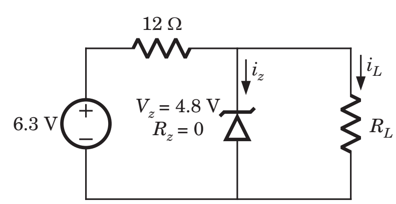


Fig Q71-73

Q71. The range of possible load current is

(A) $5 \le i_L \le 130$ mA

(B) $25 \le i_L \le 120$ mA

(C) $10 \le i_L \le 110$ mA

(D) None of the above

Q72. The range of possible load resistance is

(A) $60 \le R_L \le 372\,\Omega$

(B) $60 \le R_L \le 200\,\Omega$

(C) $40 \le R_L \le 192\,\Omega$

(D) $40 \le R_L \le 360\,\Omega$

Q73. The power rating required for the load resistor is

(A) 576 mW

(B) 360 μW

(C) 480 mW

(D) 75 μW

Common Data for Questions Q74-75:

The state-space representation of a system is given by $\dot{\mathbf{x}}(t) = \mathbf{A} \cdot \mathbf{x}(t) + \mathbf{B} \cdot \mathbf{u}(t)$, where

$$\mathbf{A} = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

If $\mathbf{x}(0)$ is the initial state vector, and the component of the input vector $\mathbf{u}(t)$ are all unit step function, then the state transition equation is given by $\dot{\mathbf{x}}(t) = \Phi(t)\mathbf{x}(0) + \theta(t)$, where $\Phi(t)$ is a state transition matrix and $\theta(t)$ is a vector matrix.

Q74. The $\Phi(t)$ is

(A) $\begin{bmatrix} \cos 2t & \sin 2t \\ -\sin 2t & \cos 2t \end{bmatrix}$

(B) $\begin{bmatrix} \cos 2t & -\sin 2t \\ \sin 2t & \cos 2t \end{bmatrix}$

(C) $\begin{bmatrix} \sin 2t & \cos 2t \\ -\cos 2t & \sin 2t \end{bmatrix}$

(D) $\begin{bmatrix} \sin 2t & -\cos 2t \\ \cos 2t & \sin 2t \end{bmatrix}$

Q75. The $\theta(t)$ is

(A) $\begin{bmatrix} 0.5(1-\sin 2t) \\ 0.5\cos 2t \end{bmatrix}$

(B) $\begin{bmatrix} \sin 2t \\ \cos 2t \end{bmatrix}$

(C) $\begin{bmatrix} 0.5(1-\cos 2t) \\ 0.5\sin 2t \end{bmatrix}$

(D) $\begin{bmatrix} \cos 2t \\ \sin 2t \end{bmatrix}$

Linked Answer Questions: Q76. to Q85. carry two marks each.

Statement for Linked Answer Questions: Q76. and Q77:

A silicon Hall device at $T = 300$ K has the geometry $d = 10^{-3}$ cm , $W = 10^{-2}$ cm, $L = 10^{-1}$ cm. The following parameters are measured: $I_x = 0.75$ mA, $V_x = 15$ V, $V_H = +5.8$ mV, $B_z = 0.1$ tesla.

Q76. The majority carrier concentration is

(A) 8×10^{15} cm^{-3}, $n-$type

(B) 8×10^{15} cm^{-3}, $p-$type

(C) 4×10^{15} cm^{-3}, $n-$type

(D) 4×10^{15} cm^{-3}, $p-$type

Q77. The majority carrier mobility is

(A) 430 cm^2/V $-$ s

(B) 215 cm^2/V $-$ s

(C) 390 cm^2/V $-$ s

(D) 195 cm^2/V $-$ s

Statement for Linked Answer Questions: Q78 and Q79:

Consider the circuit shown in fig. Q78-79.

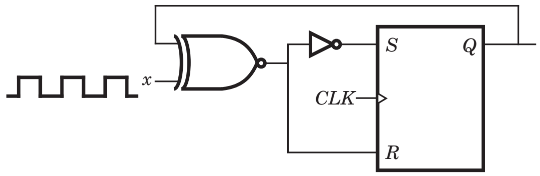


Fig Q78-79

Q78. The expression for the next state Q^+ is

(A) xQ

B) $x\overline{Q}$

(C) $x \oplus Q$

(D) $x \odot Q$

Q79. Let the clock pulses be numbered 1, 2, 3... after the point at which the FF is reset ($Q_0 = 0$). The circuit is a

(A) even parity checker

(B) odd parity generator

(C) Both A and B

(D) None of the above

Statement for Linked Answer Questions: Q80 and Q81:

A causal and stable LTI system has the property that $\left(\frac{2}{3}\right)^n u[n] \quad \Rightarrow \quad n\left(\frac{2}{3}\right)^n u[n]$.

Q80. The frequency response $H(e^{j\Omega})$ for this system is

(A) $\frac{2e^{j\Omega}}{2-3e^{j\Omega}}$

(B) $\frac{2e^{-j\Omega}}{2-3e^{-j\Omega}}$

(C) $\frac{2e^{j\Omega}}{3-2e^{j\Omega}}$

(D) $\frac{2e^{-j\Omega}}{3-2e^{j\Omega}}$

Q81. The difference equation for this system relating any input $x[n]$ and the corresponding output $y[n]$ is

(A) $3y[n]-2y[n-1]=2x[n]$

(B) $3y[n]-2y[n-1]=2x[n-1]$

(C) $3y[n]-2y[n+1]=2x[n+1]$

(D) $3y[n]-2[y+1]=2x[n]$

Statement for Linked Answer Questions: Q82 and Q83:

In a certain frequency–modulation experiment conducted with $f_m = 1$ kHz and increasing amplitude (starting from 0 V), it is found that the carrier component of the FM signal is reduced to zero for the first time when $A_m = 2$ V. Given that Bessel function $J_0(x)$ is zero for $x = 2.44$, 5.52, 8.65, 11.8 and so on.

Q82. The frequency sensitivity of the modulator is

(A) 1.38 kHz/V

(B) 0.61 kHz/V

(C) 2.76 kHz/V

(D) 1.22 kHz/V

Q83. The carrier components is reduced to zero for the second time for the value of A_m

(A) 4.52 V

(B) 3.38 V

(C) 2.68 V

(D) 1.39 V

Statement for Linked Answer Questions: Q84 and Q85:

The amplitude of a wave traveling through a lossy nonmagnetic medium reduces by 18% every meter. The wave operates at 10 MHz and the electric field leads the magnetic field by 24°.

Q84. The propagation constant is

(A) $0.198 + j0.448$ per meter

`(B) $0.346 + j0.713$ per meter

(C) $0.448 + j0.198$ per meter

(D) $0.713 + j0.346$ per meter

Q85. The skin depth is

(A) 2.52 m

(B) 5.05 m

(C) 8.46 m

(D) 4.23 m

Answers Paper-1

1.	(B)	2.	(C)	3.	(D)	4.	(A)	5.	(C)
6.	(D)	7.	(C)	8.	(C)	9.	(B)	10.	(A)
11.	(A)	12.	(D)	13.	(B)	14.	(A)	15.	(D)
16.	(D)	17.	(C)	18.	(A)	19.	(C)	20.	(D)
21.	(B)	22.	(C)	23.	(A)	24.	(B)	25.	(A)
26.	(A)	27.	(B)	28.	(B)	29.	(B)	30.	(D)
31.	(C)	32.	(B)	33.	(C)	34.	(B)	35.	(D)
36.	(A)	37.	(D)	38.	(B)	39.	(A)	40.	(C)
41.	(D)	42.	(C)	43.	(C)	44.	(B)	45.	(C)
46.	(D)	47.	(D)	48.	(B)	49.	(A)	50.	(B)
51.	(B)	52.	(B)	53.	(D)	54.	(D)	55.	(A)
56.	(A)	57.	(B)	58.	(A)	59.	(A)	60.	(C)
61.	(B)	62.	(C)	63.	(B)	64.	(A)	65.	(D)
66.	(B)	67.	(B)	68.	(D)	69.	(C)	70.	(A)
71.	(B)	72.	(C)	73.	(A)	74.	(A)	75.	(C)
76.	(B)	77.	(C)	78.	(C)	79.	(D)	80.	(D)
81.	(B)	82.	(D)	83.	(A)	84.	(A)	85.	(B)