Q.1- Q.25 carry one mark each.

Q.1 If $A = 0$ in logic expression $Z = [A + EF + \overline{BC} + D]\,[A + \overline{DE} + \overline{BC} + \overline{DE}]$, then

(A) $Z = 0$ (B) $Z = 1$

(C) $Z = \overline{BC}$ (D) $Z = B\overline{C}$

Q.2 A card is drawn at random from an ordinary deck of 52 playing cards. If we are told that card is heart, then information is

(A) 2.12 bits   (B) 2 bits

(C) 3.46 bits   (D) 31.36 bits

Q.3 A DS/BPSK spread spectrum signal has a processing gain of 500. If the desired error probability is 10^{5} and (ε_b/J_0) required to obtain an error probability of 10^{5} for binary PSK is 9.5 dB, then the Jamming margin against a containers tone jammer is

(A) 23.6 dB   (B) 17.5 dB

(C) 117.4 dB   (D) 109.0 dB

Q.4 A $60\,\Omega$ coaxial cable feeds a $75 + j25\,\Omega$ dipole antenna. The voltage reflection coefficient Γ and standing wave ratio s are respectively

(A) $0.212 \angle 48.55°, 1.538$ (B) $0.486 \angle 68.4°, 2.628$

(C) $0.486 \angle 41.45°, 2.682$ (D) $0.212 \angle 68.4°, 1.538$

Q.5 The directive gain of an antenna is 36 dB. It the antenna radiates 15 kW at a distance of 60 km, the time average power density at that distance is

(A) $9.42\ \mu\text{W/m}^2$ (B) $6.83\ \text{mW/m}^2$

(C) $1.32\ \text{mW/m}^2$ (D) $10.46\ \text{mW/m}^2$

Q.6 If $\mathbf{A}$ is a 3-rowed square matrix such that $|\mathbf{A}| = 2$, then $|\text{adj}\,(\text{adj}\,\mathbf{A}^2)|$ is equal to

(A) 2^4 (B) 2^8

(C) 2^{16} (D) None of these

Q.7 $\int_0^{\frac{\pi}{2}} \log \tan x\, dx$ is equal to

(A) $-\dfrac{\pi}{2}\log_e 2$ (B) $-\pi \log_e 2$

(C) $\dfrac{\pi}{2}\log_e 2$ (D) None of these

Q.8 An anti-aircraft gun can take a maximum of 4 shots at an enemy plane moving away from it. The probabilities of hitting the plane at the first, second, third and fourth shot are 0.4, 0.3, 0.2 and 0.1 respectively. The probability that the gun hits the plane is

(A) 0.76

(B) 0.4096

(C) 0.6976

(D) None of these

Q.9 The following fields exist in charge free regions

$$\mathbf{P} = 60\sin\left(\omega t + 10x\right)\mathbf{u}_z \qquad\qquad \mathbf{Q} = \frac{10}{\rho}\cos\left(\omega t - 2\rho\right)\mathbf{u}_\phi$$

$$\mathbf{R} = 3\rho^2\cot\phi\,\mathbf{u}_\rho + \frac{1}{\rho}\cos\phi\,\mathbf{u}_\phi \qquad\qquad \mathbf{S} = \frac{1}{r}\sin\theta\sin\left(\omega t - 6r\right)\mathbf{u}_\theta$$

The possible electromagnetic fields are

(A) $\mathbf{P},\mathbf{Q}$

(B) $\mathbf{R},\mathbf{S}$

(C) $\mathbf{P},\mathbf{R}$

(D) $\mathbf{Q},\mathbf{S}$

Q.10 A random process has the power density spectrum $\rho_{XX}(\omega) = \dfrac{6\omega^2}{\left[1+\omega^2\right]^3}$. The average power in process is

(A) 1/4

(B) 3/8

(C) 5/8
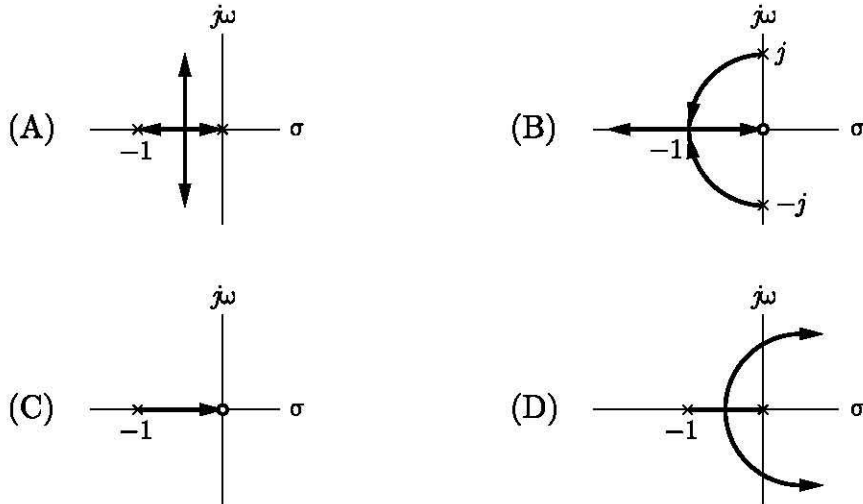
(D) 1/2

Q.11 The Bode plot shown below represent
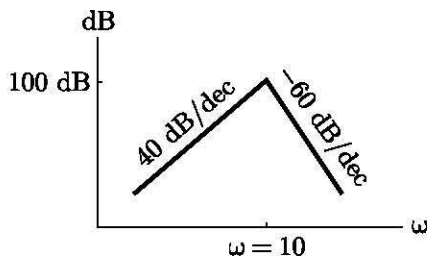
(A) $\dfrac{100s^2}{(1+0.1s)^3}$

(B) $\dfrac{1000s^2}{(1+0.1s)^3}$

(C) $\dfrac{100s^2}{(1+0.1s)^5}$

(D) $\dfrac{1000s^2}{(1+0.1s)^5}$

Q.12 The forward transfer function of a *ufb* system is $G(s) = \dfrac{K(s^2+1)}{(s+1)(s+2)}$. The system is stable for
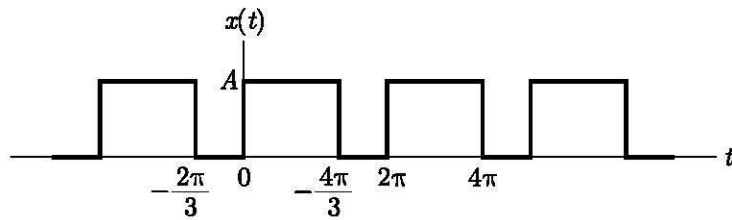
(A) $K < -1$

(B) $K > -1$

(C) $K < -2$

(D) $K > -2$

Q.13 Consider the *ufb* system shown below

The root-loci, as α is varied, will be

(A)

(B)

(C)

(D)
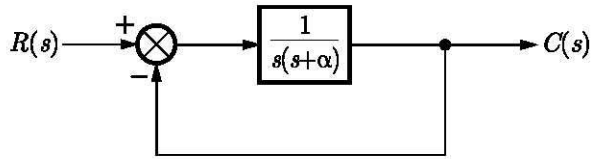
Q.14 The Fourier series coefficient for the periodic signal shown below is

(A) $\frac{A}{2\pi k}\left(e^{j\left(\frac{4\pi k}{3}\right)}-1\right)$

(B) $j\frac{A}{2\pi k}\left(e^{j\left(\frac{4\pi k}{3}\right)}-1\right)$

(C) $-j\frac{A}{2\pi k}\left(e^{j\left(\frac{4\pi k}{3}\right)}-1\right)$

(D) $\frac{-A}{2\pi k}\left(e^{j\left(\frac{4\pi k}{3}\right)}-1\right)$

Q.15 The z transform of $3^n u[-n-1]$ is

(A) $\frac{z}{3-z}, |z|>3$

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

(C) $\frac{3}{3-z}, |z|>3$

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

**Q.16** Consider $x[n]=\{1,2,-1\}$ and $h[n]=x[n]$. The convolution $y[n]=x[n]*h[n]$ is

(A) $\{1, 4, 1\}$

(B) $\{1, 4, 2, -4, 1\}$

(C) $\{1, 2, -1\}$

(D) $\{2, 4, -2\}$

Q.17 The signal $x(t) = e^{j(2t+\frac{\pi}{4})}$ is a

(A) power signal with $P_\infty = 1$

(B) power signal with $P_\infty = 2$

(C) energy signal with $E_\infty = 2$

(D) energy signal with $E_\infty = 1$

Q.18 A 12-bit (3-digit) DAC that uses the BCD input code has a full scale output of 9.99 V. The value of v_{out} for an input code of 0110 1001 0101 is

(A) 4.11 V

(B) 6.95 V

(C) 7.38 V

(D) 7.88 V

Q.19 In shown below initially $A = 1$ and $B = 1$, the input B is now replaced by a sequence 1 0 1 0 1 0 ... the outputs X and Y will be
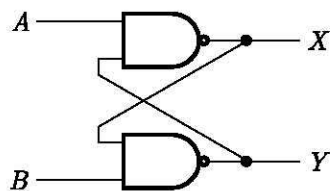
(A) Fixed at 0 and 1, respectively

(B) Fixed at 1 and 0, respectively

(C) $X = 1\ 0\ 1\ 0$ ... while $Y = 1\ 0\ 1\ 0$ ...

(D) $X = 1\ 0\ 1\ 0$ ... while $Y = 0\ 1\ 0\ 1$ ...

Q.20 The simplified form of a logic function $Y = A(B + C(\overline{AB + AC}))$ is

(A) $\overline{A}\,\overline{B}$

(B) AB

(C) $\overline{A}B$

(D) $A\overline{B}$

Q.21 In the following circuit of figure, the region of operation of M_1 is ($V_{TH} = 0.4$ V)
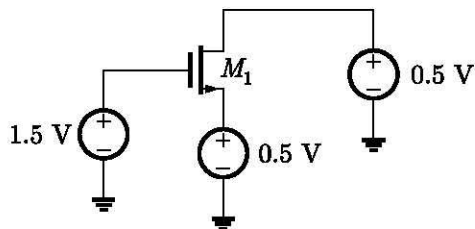
(A) Linear

(B) Saturation

(C) M_1 is off

(D) Cannot be determined

Q.22 If the input to the following ideal comparator is a sinusoidal signal of 8 V (peak to peak) without any DC component., the output of the comparator has a duty cycle of
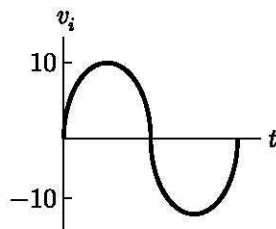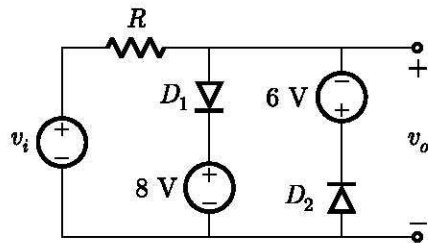
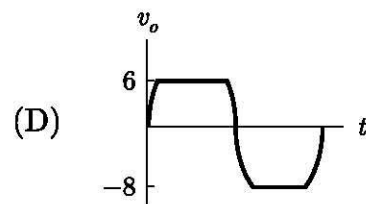**Input** ○———[+ amplifier -]———○ **Output**

$v_{ref}= 2$ V ○
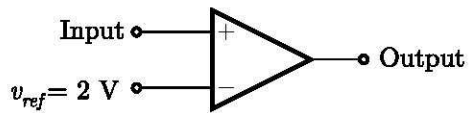
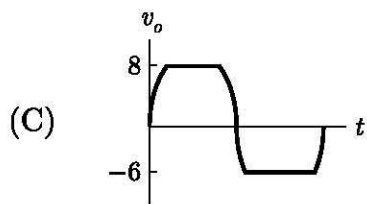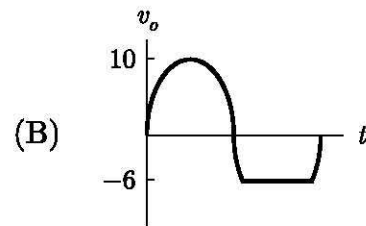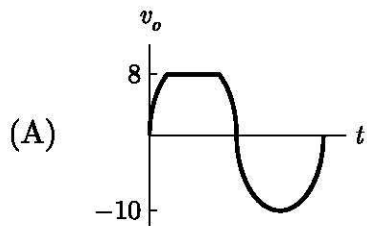(A) $\frac{1}{2}$

(B) $\frac{1}{3}$

(C) $\frac{1}{6}$
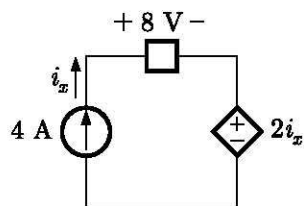
(D) $\frac{1}{12}$

Q.23 Consider the given circuit and a waveform for the input voltage. The diode in circuit has cutin voltage $V_\gamma = 0$.

The waveform of output voltage v_o is

(A)

(B)

(C)

(D)

Q.24 For the circuit shown in figure the dependent source


(A) supplies 16 W

(B) absorbs 16 W

(C) supplies 32 W

(D) absorbs 32 W

Q.25 Increasing the yield of an IC

(A) reduces individual circuit cost

(B) increases the cost of each good circuit

(C) results in a lower number of good chips per wafer

(D) means that more transistor can be fabricated on the same size wafer.

Q.26- Q.55 carry two mark each.

Q.26 Two p^+n silicon junction is reverse biased at $V_R = 5\,\text{V}$. The impurity doping concentration in junction A are $N_a = 10^{18}\,\text{cm}^{3}$ and $N_d = 10^{15}\,\text{cm}^{3}$, and those in junction B are $N_a = 10^{18}\,\text{cm}^{3}$ and $N_d = 10^{16}\,\text{cm}^{3}$. The ratio of the space charge width is

(A) 4.36   (B) 9.8

(C) 19   (D) 3.13

Q.27 Consider the NMOS common-gate circuit shown below. The parameter are $g_m = 2$ mS and $r_o = \infty$. The voltage gain A_v is
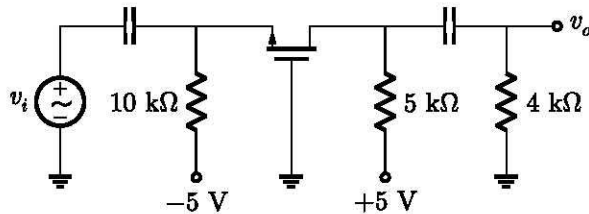

(A) 4.44   (B) -4.44

(C) 2.22   (D) -2.22

Q.28 In the circuit shown below the PMOS transistor has parameter $V_{TP} = -1.5\,\text{V}$, $k'_p = 25\,\mu\text{A/V}^2$, $L = 4\,\mu\text{m}$ and $\lambda = 0$. If $I_D = 0.1\,\text{mA}$ and $V_{SD} = 2.5\,\text{V}$, then value of W will be

(A) 15 µm   (B) 1.6 µm
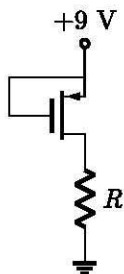
(C) 32 µm   (D) 3.2 µm

Q.29 The input to full-wave rectifier shown below is $v_i = 120 \sin 2\pi 60t$ V. The diode cutin voltage is 0.7 V. If the output voltage cannot drop below 100 V, the required value of the capacitor is

(A) 61.2 μF   (B) 41.2 μF
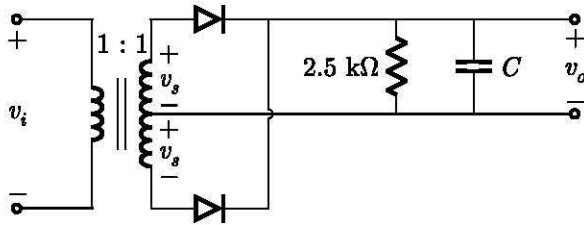
(C) 20.6 μF   (D) 30.6 μF

Q.30 Consider the RTL gate shown below. The transistor parameters are $V_{CE(sat)} = 0.2$ V and $\beta = 50$. The logic HIGH voltage is $V_H = 3.5$ V. If input drive the similar type of gate, the fan out is
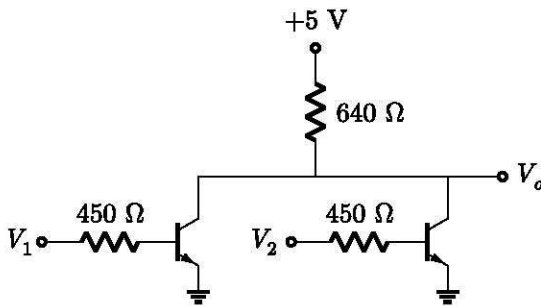
(A) 5   (B) 10

(C) 15   (D) 20

Q.31 The contents of some memory location of an 8085 μP based system are shown

Address Hex.	Contents (Hex.)
3000	02
3001	30
3002	00
3003	30

The program is as follows

    LHLD 3000H
    MOV E, M
    INX H
    MOV D, M
    LDAX D

MOV L, A
INX D
LDAX D
MOV H, A

The contents if HL pair after the execution of the program will be

(A) 0030 H   (B) 3000 H

(C) 3002 H   (D) 0230 H

Q.32 $\int_0^\pi \cos^m x \sin^n x\, dx$ is equal to zero, if
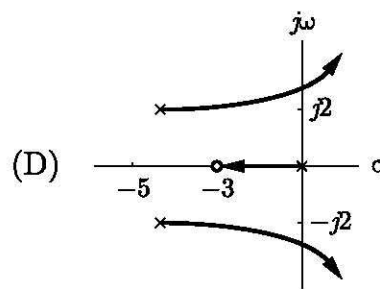
(A) m is even   (B) n is even

(C) m is odd   (D) n is odd

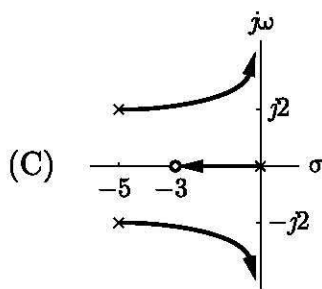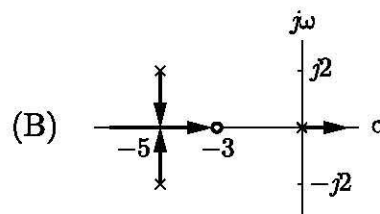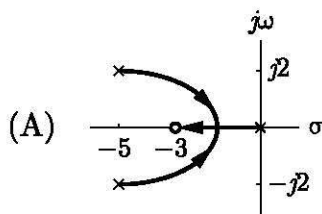**Q.33** $\int_c \dfrac{\cos \pi z}{z-1}\, dz = ?$ where c is the circle $|z| = 3$

(A) $i2\pi$ (B) $-i2\pi$

(C) $i6\pi^2$ (D) $-i6\pi^2$

Q.34 For $dy/dx = x + y^2$, 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) $\dfrac{x^2}{2} + \dfrac{x^5}{40} + \dfrac{x^8}{480} + \dfrac{x^{11}}{1600}$ (B) $\dfrac{x^2}{2} + \dfrac{x^5}{20} + \dfrac{x^8}{160} + \dfrac{x^{11}}{4400}$

(C) $\dfrac{x^2}{2} + \dfrac{x^5}{20} + \dfrac{x^8}{160} + \dfrac{x^{11}}{2400}$ (D) $\dfrac{x^2}{2} + \dfrac{x^5}{40} + \dfrac{x^8}{480} + \dfrac{x^{11}}{2400}$

**Q.35** The root-loci for $\alpha > 0$ with $K = 10$ is

Q.36 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

**Q.37** For the open loop system shown below location of poles on RHP, LHP, and an $j\omega$ axis are

$$R(s) \longrightarrow \boxed{\dfrac{-8}{s^6+s^5-6s^4+s^2+s-6}} \longrightarrow C(s)$$
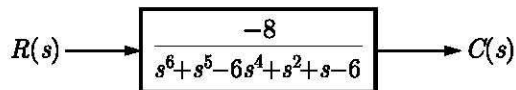
(A) 3,3,0   (B) 1,3,2

(C) 1,1,4   (D) 3,1,2

Q.38 Two signals $x_1(t)$ and $x_2(t)$ are given as $x_1(t) = 6\sin c(100t)\cos(200\pi t)$ and $x_2(t) = 10\sin c^2(100t)$ If Nyquist sampling rate for $x_1(t)$ and $x_2(t)$ are N_1 and N_2 respectively, the ratio N_1/N_2 is

(A) 2/3   (B) 1

(C) 3/2   (D) 1/2

Q.39 The exponential Fourier series of a signal $g(t)$ shown below is given as
$$x(t) = 1 + \sum_{m}^{\infty} X_m e^{jm\omega_0 t}.$$ The coefficient X_m is
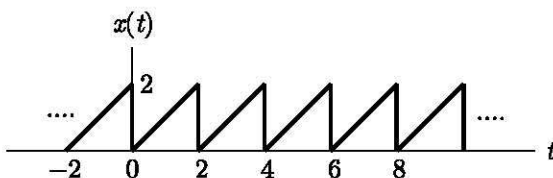

(A) $X_m = \dfrac{1}{2m\pi} e^{j\frac{\pi}{2}}$ (B) $X_m = \dfrac{1}{m\pi} e^{j\frac{\pi}{2}}$

(C) $X_m = \dfrac{2}{m\pi} e^{j\frac{\pi}{2}}$ (D) $X_m = \dfrac{1}{m\pi}$

Q.40 A CT signal is given as $x(t) = 5\text{rect}\left(\frac{t}{2}\right) * [\delta(t+1) + \delta(t)]$ then value of $x\left(\frac{1}{2}\right)$ is

(A) 5   (B) 10

(C) 0   (D) 25

Q.41 A network N feeds a resistance R as shown in circuit below. Let the power consumed by R be P. If an identical network is added as shown in figure, the power consumed by R will be
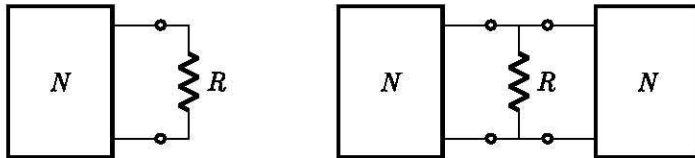
(A) equal to P (B) less than P

(C) between P and $4P$ (D) more than $4P$

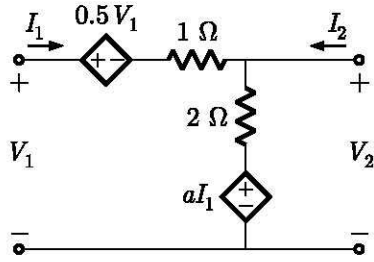**Q.42** In the circuit given below $v_{in}(t) = 10\mu(t)$, the current $i_L(t)$ is
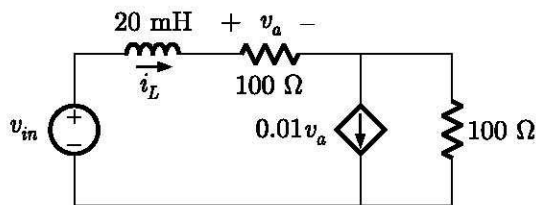
(A) $(-0.1 + 0.1e^{5000t})$ A   (B) 0.1 A

(C) $(-0.1 - 0.1e^{5000t})$ A   (D) 0.2 A

Q.43 In the following circuit the voltage gain v_{out}/v_{in} is zero at $\omega = 333.33$ rad/s. The value of C is
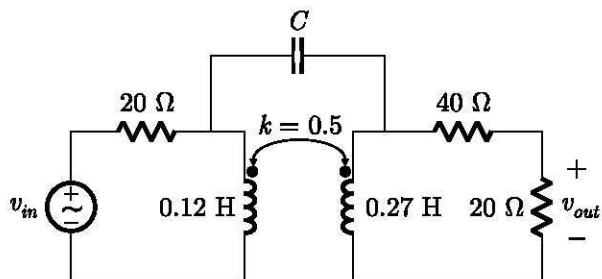
(A) 3.33 mF   (B) 33.33 mF

(C) 3.33 μF   (D) 33.33 μF

Q.44 The circuit shown below is reciprocal if a is


(A) 2

(B) -2

(C) 1

(D) -1

Q.45 Air craft of Jet Airways at Ahmedabad airport arrive according to a poisson process at a rate of 12 per hour. All aircraft are handled by one air traffic controller. If the controller takes a 2- minute coffee break, what is the probability that he will miss one or more arriving aircraft?

(A) 0.33

(B) 0.44

(C) 0.55

(D) 0.66

Q.46 An AM modulator has output $x(t) = 40\cos 400\pi t + 4\cos 360\pi t + 4\cos 440\pi t$. The modulation efficiency is
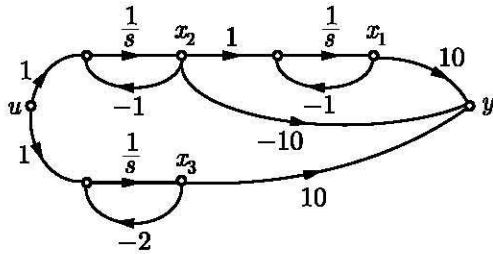
(A) 0.01

(B) 0.02

(C) 0.03

(D) 0.04

Q.47 The circulation of $\mathbf{F} = x^2\mathbf{u}_x - xz\mathbf{u}_y - y^2\mathbf{u}_z$ around the path shown below is
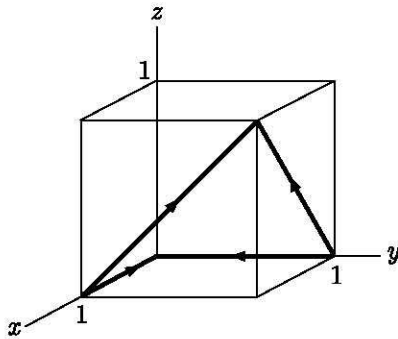
(A) $-\dfrac{1}{3}$

(B) $\dfrac{1}{6}$

(C) $-\dfrac{1}{6}$

(D) $\dfrac{1}{3}$

Common Data Q. 48-49:

Consider the system shown below

Q.48 The controllability matrix for this system is

(A) $\begin{bmatrix} 10 & -10 & 10 \\ -10 & 0 & -20 \\ 10 & -20 & 40 \end{bmatrix}$

(B) $\begin{bmatrix} 0 & 1 & -2 \\ 1 & -1 & 1 \\ 1 & -2 & 4 \end{bmatrix}$

(C) $\begin{bmatrix} 10 & -10 & 10 \\ -10 & 0 & 20 \\ 10 & -20 & -40 \end{bmatrix}$

(D) $\begin{bmatrix} 0 & 1 & -1 \\ 1 & 6 & -1 \\ 1 & -4 & -4 \end{bmatrix}$

Q.49 The observability matrix is

(A) $\begin{bmatrix} 10 & -10 & 10 \\ -10 & 0 & -20 \\ 10 & -10 & -40 \end{bmatrix}$
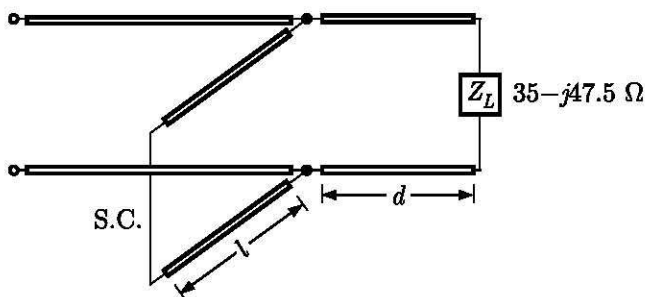
(B) $\begin{bmatrix} 0 & 1 & -2 \\ 1 & -1 & 1 \\ 1 & -2 & 4 \end{bmatrix}$

(C) $\begin{bmatrix} 10 & -10 & 10 \\ -10 & 0 & 20 \\ 10 & 10 & -40 \end{bmatrix}$

(D) $\begin{bmatrix} 0 & 1 & 2 \\ 1 & -1 & 1 \\ 1 & -2 & 4 \end{bmatrix}$

Common Data Q. 50-51 :

For the transmission line shown below the $Z_0 = 100\,\Omega$.

Q.50 If $Z_L = 0$ the Z_{in} is

(A) $94.11 - j76.45\,\Omega$

(B) $94.11 + j76.45\,\Omega$

(C) $48.23 - j68.2\,\Omega$

(D) $48.23 + j68.2\,\Omega$

Q.51 If $Z_L = \infty$, then Z_{in} is

(A) $39 + j183\,\Omega$

(B) $39 - j183\,\Omega$

(C) $64 + j148\,\Omega$

(D) $64 - j148\,\Omega$

Statement for Linked Answer Q. 52-53 :

In a fast FH spread spectrum system, the information is transmitted via FSK with non coherent detection. Suppose there are $N = 3$ hops/bit with hard decision decoding of the signal in each hop. The channel in AWGN with power spectral density $1/2\mathcal{N}_0$ and an SNR 20-13 dB (total SNR over the three hops)

Q.52 The probability of error for this system is

(A) 0.013

(B) 0.0013

(C) 0.049

(D) 0.0049

Q.53 In case of one hop per bit the probability of error is

(A) $1.96 \times 10^{\,5}$

(B) $1.96 \times 10^{\,7}$

(C) $2.27 \times 10^{\,5}$

(D) $2.27 \times 10^{\,7}$

Statement for Linked Answer Q. 54-55 :

Consider the JFET amplifier circuit shown in figure.
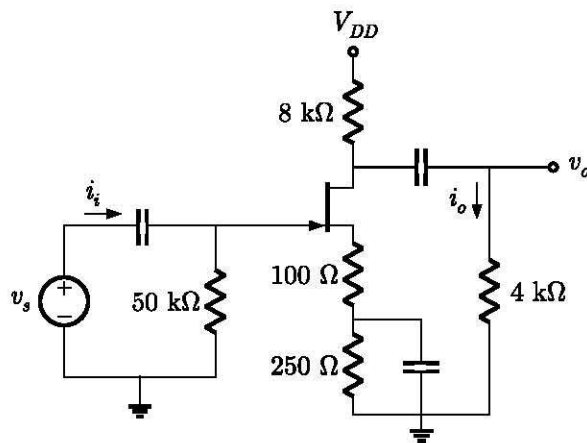
Transistors parameters are $I_{DSS} = 2$ mA, $V_P = -2, \lambda = 0$

Q.54 Transconductance is

(A) 1.57 mA/V

(B) 0.785 mA/V

(C) 11.28 mA/V

(D) 13.81 mA/V