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

Q.1 The unit impulse response of a second order system is $\frac{1}{6}e^{-0.8t}\sin 0.6t$. The natural frequency and damping ratio of the system are respectively

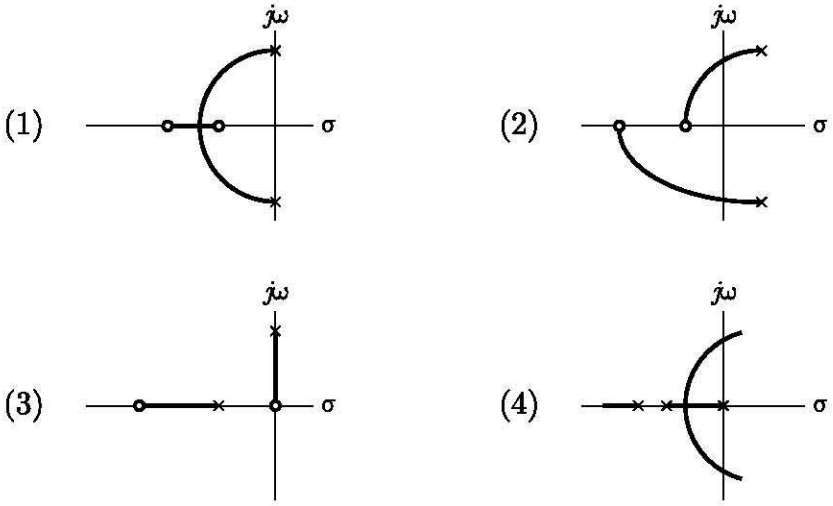
(A) 1 rad/s, 0.8

(B) 0.8 rad/s, 1

(C) 0.64 rad/s, 1.25

(D) 1.25 rad/s, 0.64

Q.2 Consider the sketch shown below



The root locus can be

(A) (1) and (3)

(B) (2) and (3)

(C) (2) and (4)

(D) (1) and (4)

Q.3 A PD controller is used to compensate a system. Compared to the uncompensated system, the compensated system has

(A) a higher type number

(B) reduced damping

(C) higher noise amplification

(D) larger transient overshoot

Q.4 The surface $\rho = 2, \rho = 4, \phi = 45^\circ, \phi = 135^\circ, z = 3$ and $z = 4$ define a closed surface. The total area of the enclosing surface is

(A) 34.29

(B) 20.7

(C) 32.27

(D) 16.4

Q.5 A conducting circular loop of radius 20 cm lies in the $z = 0$ plane in a field $\mathbf{B} = 20\cos 277t\mathbf{u}_z$ mWb/m^2. The induced voltage in the loop is

(A) $-0.95\sin 377t$ V

(B) $0.95\sin 377t$ V

(C) $-0.95\cos 377t$ V

(D) $0.95\cos 377t$ V

Q.6 For a Hertz dipole antenna, the half power beam width (HPBW) in the E-plane is

(A) 360° (B) 180°

(C) 90° (D) 45°

Q.7 The residue of $z\cos\frac{1}{z}$ at $z = 0$ is

(A) $1/2$ (B) $-1/2$

(C) $1/3$ (D) $-1/3$

Q.8 A die is thrown 100 times. Getting an even number is considered a success. The variance of the number of successes is

(A) 50 (B) 25

(C) 10 (D) None

Q.9 Integrating factor of $\frac{dy}{dx} + 2y\tan x = \sin x$ is

(A) $\cos^2 x$ (B) $\sin^2 x$

(C) $\sec^2 x$ (D) $2\tan x$

Q.10 If $\mathbf{A}_{n\times n}$ is a triangular matrix then det $\mathbf{A}$ is

(A) $\prod_{i\ 1}^{n}(-1)\,a_{ii}$ (B) $\prod_{i\ 1}^{n} a_{ii}$

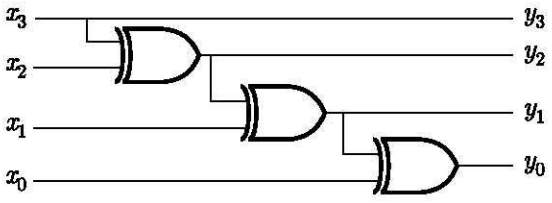
(C) $\sum_{i\ 1}^{n}(-1)\,a_{ii}$ (D) $\sum_{i\ 1}^{n} a_{ii}$

Q.11 A computer has the following negative numbers stored in binary form as shown. The wrongly stored number is

(A) -37 as 1101 1011 (B) -89 as 1010 0111

(C) -48 as 1110 1000 (D) -32 as 1110 0000

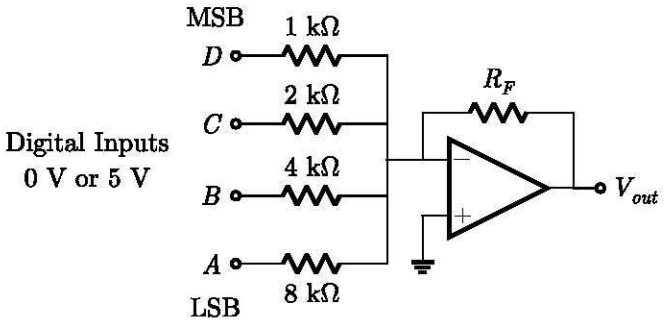
Q.12 Which of the following conversion is performed by the circuit shown in figure



(A) Binary to gray code conversion (B) Gray code to binary conversion

(C) BCD conversion (D) None of these

Q.13 The step size of the following DAC 0.5 V. The value of R_F is



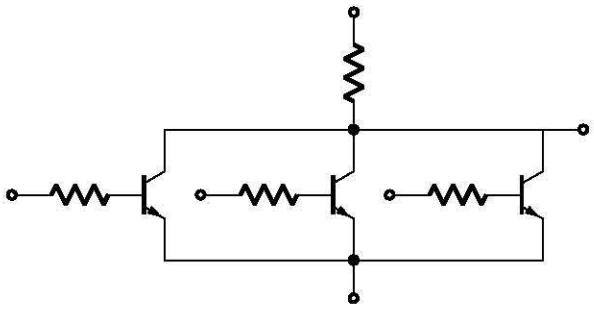
(A) 1.6 kΩ

(B) 8 kΩ

(C) 800 Ω

(D) 1 kΩ

Q.14 For the circuit shown in fig. the minimum number of isolation regions are



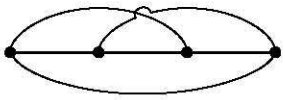
(A) 2

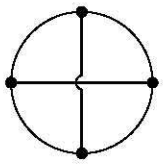
(B) 3

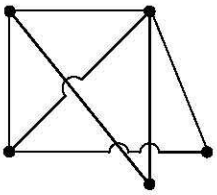
(C) 4

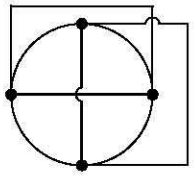
(D) 7

Q.15 Consider the following graphs

(1) 

(2) 

(3) 

(4) 

Non-planner graphs are

(A) 1 and 3

(B) 4 only

(D) 3 only

(D) 3 and 4

Q.16 A silicon pn junction at $T = 300\,\text{K}$ has $N_d = 10^{14}\,\text{cm}^{-3}$ and $N_a = 10^{17}\,\text{cm}^{-3}$. The built-in voltage is

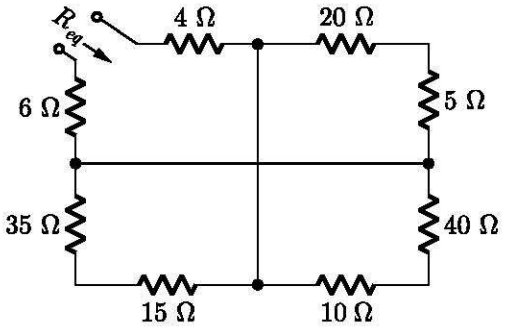
(A) 0.63 V

(B) 0.93 V

(C) 0.026 V

(D) 0.038 V

Q.17 In the circuit of figure the value of resistor R_{eq} is



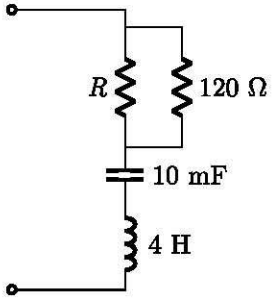
(A) 100 Ω

(B) 22.5 Ω

(C) 60 Ω

(D) 28.75 Ω

Q.18 The circuit shown below is critically damped. The value of R is



(A) 40 Ω

(B) 60 Ω

(C) 120 Ω

(D) 180 Ω

Q.19 The impulse response of an LTI system is $h(t) = \delta^{(2)}(t)$. The step response is

(A) 1

(B) $u(t)$

(C) $\delta^{(3)}(t)$

(D) $\delta(t)$

Q.20 Power of signal $u[n]$ is

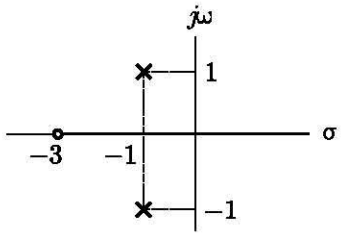
(A) n

(B) 1

(C) 1/2

(D) ∞

Q.21 The driving point impedance $Z(s)$ of a network has the pole zero location as shown below. If $Z(0) = 3$, the $Z(s)$ is



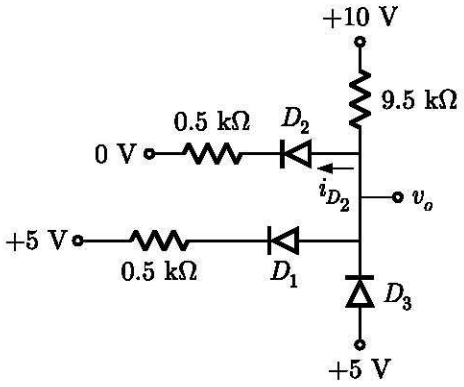
(A) $\dfrac{4(s+3)}{s^2+s+1}$

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

(C) $\dfrac{2(s+3)}{s^2+2s+2}$

(D) $\dfrac{4(s-3)}{s^2+s+2}$

Q.22 The diodes in the circuit shown below has parameters $V_\gamma = 0.6$ V and $r_f = 0$. The current i_{D_2} is



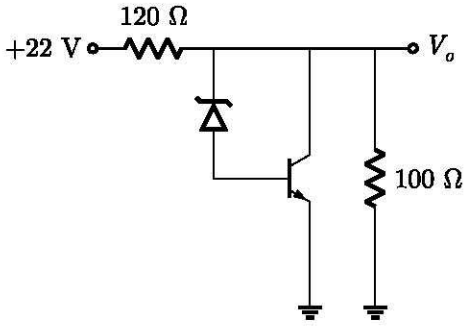
(A) 8.4 mA

(B) 10 mA

(C) 7.6 mA

(D) 0 mA

Q.23 In the shunt regulator shown below, the $V_Z = 8.2$ V and $V_{BE} = 0.7$ V. The regulated output voltage V_o is



(A) 11.8 V

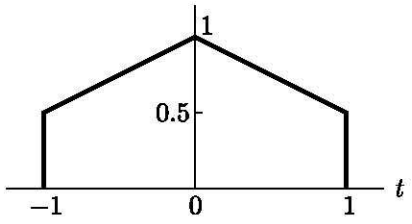
(B) 7.5 V

(C) 12.5 V

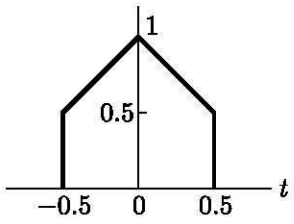
(D) 8.9 V

Q.24 Consider the signal $x(t) = \text{rect}\,(t)\,\text{tri}\,(t)$. The graph of $x(t)$ is

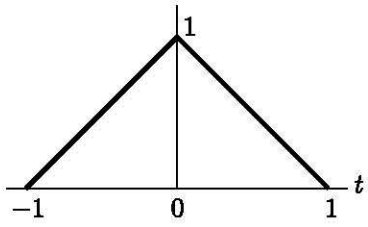
(A)



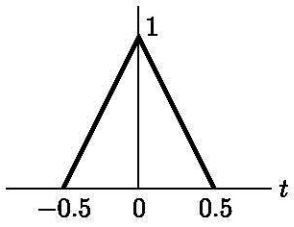
(B)



(C)



(D)



Q.25 In a certain frequency range, the magnitude of the network function can be approximated as $H(\omega) = 1/\omega^2$. The slope of the Bode plot in this range is

(A) 40 dB/decade

(B) -40 dB/decade

(C) 20 dB/decade

(D) -20 dB/decade

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

Q.26 If $X(t)$ is a stationary process having a mean value $E[X(t)] = 3$ and auto correlation function $R_{XX}(\tau) = 9 + 2e^{-|\tau|}$.The variance of random variable $Y = \int_0^2 X(t)\,dt$ will be

(A) 1

(B) 2.31

(C) 4.54

(D) 0

Q.27 A resistor $R = 1000\,\Omega$ is maintained at 290 K and is shunted by a $10\,\mu$H inductor. The rms noise voltage across the inductor over a frequency bandwidth of 159 kHz is

(A) 6.4×10^{-6}V

(B) 9.2×10^{-8}V

(C) 10.4×10^{-10}V

(D) 18.4×10^{-12}V

Q.28 An angle modulated signal is $s(t) = \cos 2\pi\,[2 \times 10^6 t + 30 \sin 150t + 40 \cos 150t]$ The maximum frequency and phase deviations of $s(t)$ are

(A) 10.5 kHz, 140π rad

(B) 6 kHz, 80π rad

(C) 10.5 kHz, 100π rad

(D) 7.5 kHz, 100π rad

Q.29 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

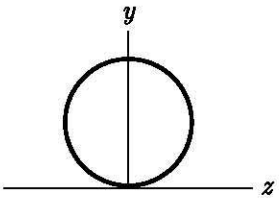
Q.30 In a material the magnetic field intensity is $H = 1200$ A/m when $B = 2\,\text{Wb/m}^2$. When H is reduced to 400 A/m, $B = 1.4\,\text{Wb/m}^2$. The change in the magnetization M is

(A) 164 kA/m (B) 326 kA/m

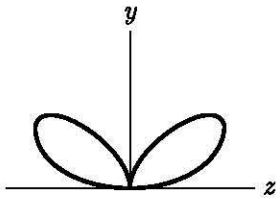
(C) 476 kA/m (D) 238 kA/m

Q.31 A $\lambda/2$ dipole is kept horizontally at a height of $\lambda_0/2$ above a perfectly conducting infinite ground plane. The radiation pattern in the lane of dipole ($\vec{E}$ plane) looks approximately as

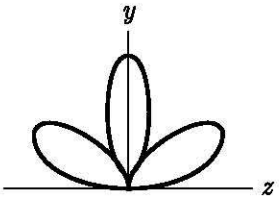
(A)



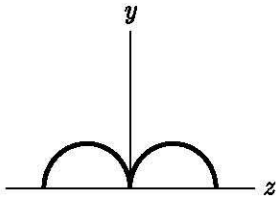
(B)



(C)



(D)



Q.32 If $u = \phi\left(\frac{y}{x}\right) + x\Psi\left(\frac{y}{x}\right)$, then the value of $x^2\frac{\partial^2 u}{dx^2} + 2xy\frac{\partial^2 u}{dxdy} + y^2\frac{\partial^2 u}{\partial y^2}$, is

(A) 0 (B) u

(C) $2u$ (D) $-u$

Q.33 $\int \frac{dx}{1+\sin x}$ is equal to

(A) $-\cot x + \operatorname{cosec} x + c$ (B) $\cot x + \operatorname{cosec} x + c$

(C) $\tan x - \sec x + c$ (D) $\tan x + \sec x + c$

Q.34 $f(z_0) = \int\limits_c \frac{3z^2+7z+1}{(z-z_0)}dz$, where c is the circle $x^2 + y^2 = 4$ The value of $f'(1-i)$ is

(A) $7(\pi + i2)$ (B) $6(2 + i\pi)$

(C) $2\pi(5 + i13)$ (D) 0

Q.35 For $dy/dx = x^2 + y^2$ given that $y = 0$ at $x = 0$. The solution of differential equation for $x = 0.4$ using picard's method is

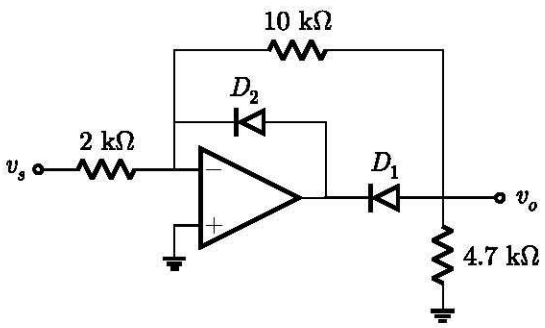
(A) 0.02193

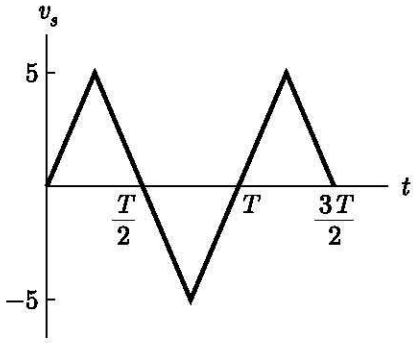
(B) 0.02145

(C) 0.02135

(D) 0.02199

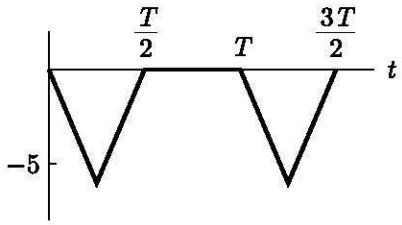
Q.36 Consider the following circuit and input voltage to it.



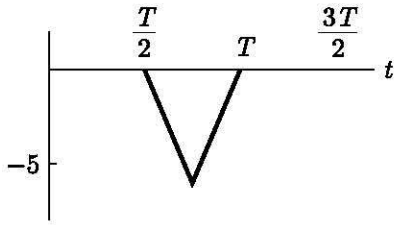


If op-amp and diodes are ideal, the output voltage waveform is

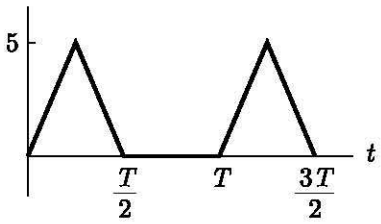
(A)



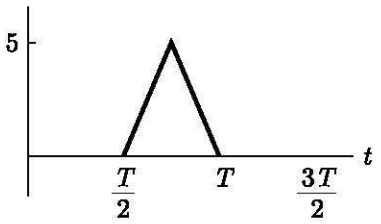
(B)



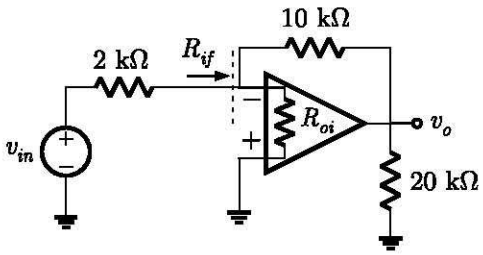
(C)



(D)



Q.37 Consider an op-amp circuit shown in figure, with an open loop gain of $A_{OL} = 10^5$ and open loop input impedance $R_{oi} = 10\,\text{k}\Omega$. If output resistance of op-amp is zero, than closed loop input impedance (R_{if}) at the inverting terminal of op-amp is



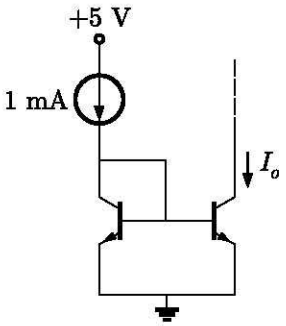
(A) $R_{if} = 10\,\text{k}\Omega$

(B) $R_{if} = 1\,\Omega$

(C) $R_{if} = 40\,\text{k}\Omega$

(D) $R_{if} = 0.1\,\Omega$

Q.38 In the current mirror circuit shown below 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

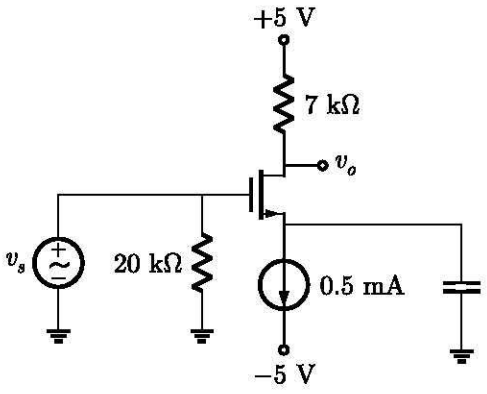
(A) 1.04 mA

(B) 1.68 mA

(C) 962 μA

(D) 432 μA

Q.39 Consider the common-source circuit with source bypass capacitor. The signal frequency is sufficiently large. The transistor parameters are $V_{TN} = 0.8$ V, $K_n = 1$ mA/V^2 and $\lambda = 0$. The voltage gain is



(A) −15.6

(B) −9.9

(C) −6.8

(D) −3.2

Q.40 For a particular semiconductor material following parameters are observed:
$\mu_n = 1000$ cm^2/V-s, $\mu_p = 600$ cm^2/V-s and $N_c = N_v = 10^{19}$ cm ^{3}.
These parameters are independent of temperature. The measured conductivity of the intrinsic material is $\sigma = 10\ ^6(\Omega\text{-cm})\ ^1$ at $T = 300$ K. The conductivity at $T = 500$ K is

(A) $2 \times 10\ ^4\ (\Omega\text{-cm})\ ^1$

(B) $4 \times 10\ ^5\ (\Omega\text{-cm})\ ^1$

(C) $2 \times 10\ ^5\ (\Omega\text{-cm})\ ^1$

(D) $6 \times 10\ ^3\ (\Omega\text{-cm})\ ^1$

Q.41 The parameters of n-channel depletion mode MOSFET are $V_{TN} = -2$ V and

$k_n' = 80\,\mu A/V^2$. The drain current is $I_D = 1.5\,mA$ at $V_{GS} = 0$ and $V_{DS} = 3$ V. The ratio W/L is

(A) 7.78 mA

(B) 15.56 mA

(C) 9.375 mA

(D) 4.69 mA

Q.42 A uniformly doped silicon epitaxial *npn* bipolar transistor is fabricated with a base doping of $N_B = 3 \times 10^{16}\,cm^{-3}$ and a heavily doped collector region with $N_C = 5 \times 10^{17}\,cm^{-3}$. The neutral base width is $x_B = 0.7\,\mu m$ when $V_{BE} = V_{BC} = 0$. The V_{BC} at punch-through is

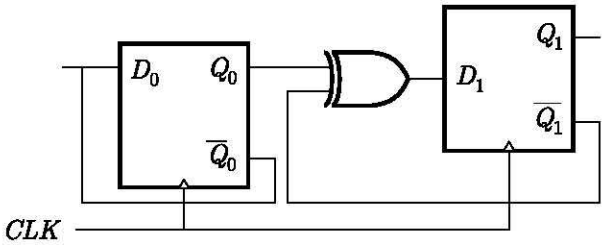
(A) 26.3 V

(B) 18.3 V

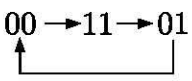
(C) 12.2 V

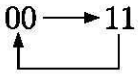
(D) 6.3 V

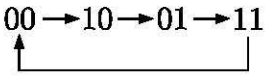
Q.43 Consider the following circuit

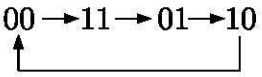


The flip-flop are positive edge trigger red D FFs. Each state is designated as a two bit string $Q_0\,Q_1$. Let the initial state be 00. The state transition sequence is

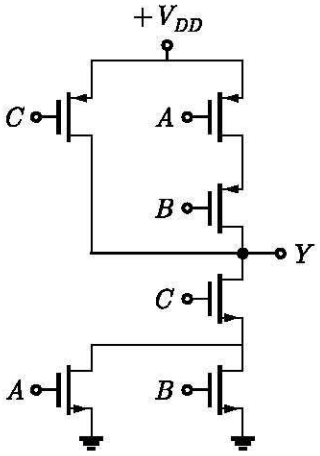
(A) 

(B) 

(C) 

(D) 

Q.44 In the CMOS circuit shown below the output Y is

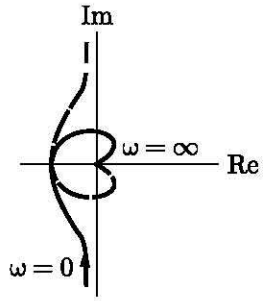


(A) $\overline{(A+C)B}$ (B) $\overline{(A+B)C}$

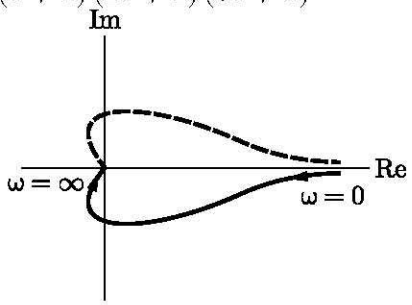
(C) $AB+C$ (D) $AB+\overline{C}$

Q.45 For the certain ufb system $G(s)=\dfrac{K}{s(s+1)(2s+1)(3s+1)}$ The Nyquist plot is

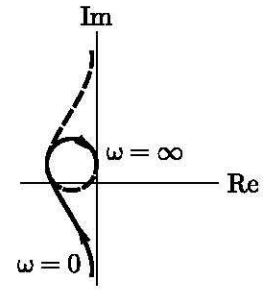
(A)



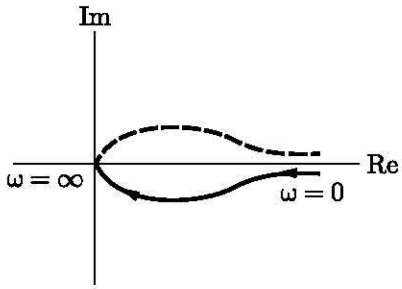
(B)



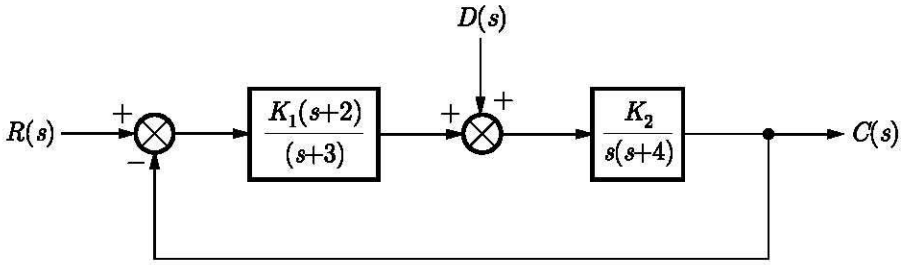
(C)



(D)



Q.46 For the system shown below the steady state error component due to unit step disturbance is 0.000012 and steady state error component due to unit ramp input is 0.003. The value of K_1 and K_2 are respectively



(A) 16.4, 1684 (B) 1250, 2.4

(C) 125×10^3, 0.016 (D) 463, 3981

Q.47 Following is the segment of a 8085 assembly language program

```
        LXI SP, EFFF H
        CALL 3000 H
        :
        :
3000 H  LXI H, 3CF 4
```

PUSH PSW
SPHL
POP PSW
RET

On completion of RET execution, the contents of SP is

(A) 3CF0 H (B) 3CF8 H

(C) EFFD H (D) EFFF H

Common Data for Q 48-49 :

The discrete Fourier transform of a discrete sequence $x[n]$ is $X_{DFT}[k] = \{1,2,3,4\}$

Q.48 DFT of the sequence $g[n] = x[n-2]$ is

(A) $\{1,2,-3,4\}$ (B) $\{1,-2,3,-4\}$

(C) $\{3,-4,1,-2\}$ (D) $\{-2,1,-4,3\}$

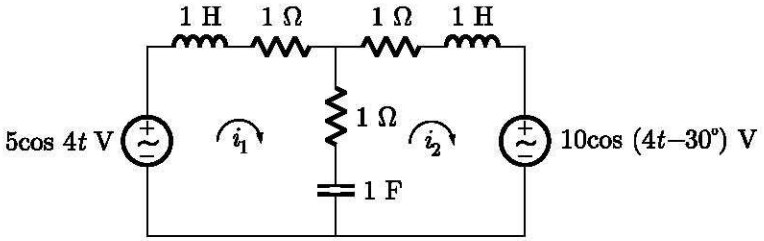
Q.49 The discrete Fourier transform of $x[-n]$ is

(A) $\{-1,-2,-3,-4\}$ (B) $\{1,-2,3,-4\}$

(C) $\{4,3,2,1\}$ (D) $\{1,4,3,2\}$

Common Data for Q. 50-51 :

The circuit is as shown below



Q.50 In the circuit below the current $i_1(t)$ is

(A) $2.36\cos(4t-41.07^\circ)$ A (B) $2.36\cos(4t+41.07^\circ)$ A

(C) $1.37\cos(4t-41.07^\circ)$ A (D) $2.36\cos(4t+41.07^\circ)$ A

Q.51 In the circuit shown below the current $i_2(t)$ is

(A) $2.04\sin(4t+92.13^\circ)$ A (B) $-2.04\sin(4t+2.13^\circ)$ A

(C) $2.04\cos(4t+2.13^\circ)$ A (D) $-2.04\cos(4t+92.13^\circ)$ A

Statement for Linked Answer Q. 52-53

Determine the state-space representation for the transfer function given in question. Choose the state variable as follows

$x_1 = c = y,\ x_2 = \dfrac{dc}{dt} = \dot{c},\ x_3 = \dfrac{d^2c}{dt^2} = \ddot{c},\ x_4 = \dfrac{d^3c}{dt^2} = \dddot{c}$

Q.52 $\dfrac{C(s)}{R(s)} = \dfrac{24}{s^3 + 9s^2 + 26s + 24}$

(A) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -24 & -26 & -9\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 24\end{bmatrix} r$

(B) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 24 & 26 & 9\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 24\end{bmatrix} r$

(C) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 9 & 26 & 24\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 24\end{bmatrix} r$

(D) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -9 & -26 & -24\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 24\end{bmatrix}$

Q.53 $\dfrac{C(s)}{R(s)} = \dfrac{100}{s^4 + 20s^3 + 10s^2 + 7s + 100}$

(A) $\dot{x} = \begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ 100 & 7 & 10 & 20\end{bmatrix} x + \begin{bmatrix}0\\ 0\\ 0\\ 100\end{bmatrix} r,\ y = \begin{bmatrix}1 & 0 & 0 & 0\end{bmatrix} x$

(B) $\dot{x} = \begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ -100 & -7 & -10 & -20\end{bmatrix} x + \begin{bmatrix}0\\ 0\\ 0\\ 100\end{bmatrix} r\ \ y = \begin{bmatrix}1 & 0 & 0 & 0\end{bmatrix} x$

(C) $\dot{x} = \begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ 20 & 10 & 7 & 100\end{bmatrix} x + \begin{bmatrix}0\\ 0\\ 0\\ 1\end{bmatrix} r\ \ y = \begin{bmatrix}100 & 0 & 0 & 0\end{bmatrix} x$

(D) $\dot{x} = \begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ -20 & -10 & -7 & -100\end{bmatrix} x + \begin{bmatrix}0\\ 0\\ 0\\ 1\end{bmatrix} r\ \ y = \begin{bmatrix}100 & 0 & 0 & 0\end{bmatrix} x$

Statement for Linked Answer Q. 54-55:

A 6 cm $\times$ 4 cm rectangular wave guide is filled with dielectric of refractive index 1.25.

Q.54 The range of frequencies over which single mode operation will occur is

(A) 2.24 GHz $< f <$ 3.33 GHz

(B) 2 GHz $< f <$ 3 GHz

(C) 4.48 GHz $< f <$ 7.70 GHz

(D) 4 GHz $< f <$ 6 GHz