GATE EC 2005

Question 1 - 30 Carry One Mark Each

MCQ 1.1 The following differential equation has

$$3\left(\frac{d^2y}{dt^2}\right)+4\left(\frac{dy}{dt}\right)^3+y^2+2=x$$

(A) degree $=2$, order $=1$

(B) degree $=1$, order $=2$

(C) degree $=4$, order $=3$

(D) degree $=2$, order $=3$

SOL 1.1 Order is the highest derivative term present in the equation and degree is the power of highest derivative term.

Order $=2$, degree $=1$

Hence (B) is correct answer.

MCQ 1.2 Choose the function $f(t)$; $-\infty<t<\infty$ for which a Fourier series cannot be defined.

(A) $3\sin(25t)$

(B) $4\cos(20t+3)+2\sin(710t)$

(C) $\exp(-|t|)\sin(25t)$

(D) 1

SOL 1.2 Fourier series is defined for periodic function and constant.

$3\sin(25t)$ is a periodic function.

$4\cos(20t+3)+2\sin(710t)$ is sum of two periodic function and also a periodic function.

$e^{-|t|}\sin(25t)$ is not a periodic function, so FS can't be defined for it.

1 is constant

Hence (C) is correct option.

MCQ 1.3 A fair dice is rolled twice. The probability that an odd number will follow an even number is

(A) 1/2

(B) 1/6

(C) 1/3

(D) 1/4

SOL 1.3 Probability of coming odd number is $\frac{1}{2}$ and the probability of coming even number is $\frac{1}{2}$. Both the events are independent to each other, thus probability of coming odd number after an even number is $\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}$.

Hence (D) is correct answer.

MCQ 1.4 A solution of the following differential equation is given by $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$

(A) $y = e^{2x} + e^{-3x}$
(B) $y = e^{2x} + e^{3x}$
(C) $y = e^{-2x} + 3^{3x}$
(D) $y = e^{-2x} + e^{-3x}$

SOL 1.4 Hence (B) is correct answer.

We have $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$

The $A.E.$ is $m^2 - 5m + 6 = 0$

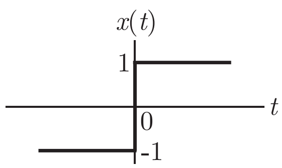
$m = 3, 2$

The CF is $y_c = C_1e^{3x} + C_2e^{2x}$

Since $Q = 0$, thus $y = C_1e^{3x} + C_2e^{2x}$

Thus only (B) may be correct.

MCQ 1.5 The function $x(t)$ is shown in the figure. Even and odd parts of a unit step function $u(t)$ are respectively,



(A) $\frac{1}{2}, \frac{1}{2}x(t)$
(B) $-\frac{1}{2}, \frac{1}{2}x(t)$
(C) $\frac{1}{2}, -\frac{1}{2}x(t)$
(D) $-\frac{1}{2}, -\frac{1}{2}x(t)$

SOL 1.5 Hence (A) is correct answer.

$$\text{Ev}\{g(t)\} = \frac{g(t) + g(-t)}{2}$$

$$\text{odd}\{g(t)\} = \frac{g(t) - g(-t)}{2}$$

Here $g(t) = u(t)$

Thus $u_e(t) = \frac{u(t) + u(-t)}{2} = \frac{1}{2}$

$$u_o(t) = \frac{u(t) - u(-t)}{2} = \frac{x(t)}{2}$$

MCQ 1.6 The region of convergence of $z-$ transform of the sequence $\left(\frac{5}{6}\right)^n u(n) - \left(\frac{6}{5}\right)^n u(-n-1)$ must be

(A) $|z| < \frac{5}{6}$
(B) $|z| > \frac{5}{6}$

(C) $\frac{5}{6} < |z| < \frac{6}{5}$ (D) $\frac{6}{5} < |z| < \infty$

SOL 1.6 Hence (C) is correct answer.

Here $x_1(n) = \left(\frac{5}{6}\right)^n u(n)$

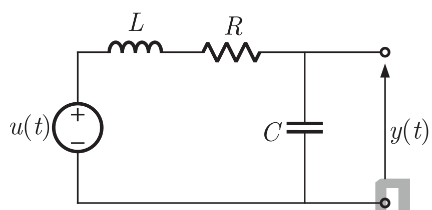
$$X_1(z) = \frac{1}{1 - \left(\frac{5}{6}z^{-1}\right)} \qquad \text{ROC} : R_1 \to |z| > \frac{5}{6}$$

$$x_2(n) = -\left(\frac{6}{5}\right)^n u(-n-1)$$

$$X_1(z) = 1 - \frac{1}{1 - \left(\frac{6}{5}z^{-1}\right)} \qquad \text{ROC} : R_2 \to |z| < \frac{6}{5}$$

Thus ROC of $x_1(n) + x_2(n)$ is $R_1 \cap R_2$ which is $\frac{5}{6} < |z| < \frac{6}{5}$

MCQ 1.7 The condition on R, L and C such that the step response $y(t)$ in the figure has no oscillations, is



(A) $R \geq \frac{1}{2}\sqrt{\frac{L}{C}}$ (B) $R \geq \sqrt{\frac{L}{C}}$

(C) $R \geq 2\sqrt{\frac{L}{C}}$ (D) $R = \frac{1}{\sqrt{LC}}$

SOL 1.7 Transfer function is

$$\frac{Y(s)}{U(s)} = \frac{\frac{1}{sC}}{R + sL + \frac{1}{sC}} = \frac{1}{s^2 LC + scR + 1} = \frac{\frac{1}{LC}}{s^2 + \frac{R}{L}s + \frac{1}{LC}}$$

Comparing with $s^2 + 2\xi\omega_n s + \omega_n^2 = 0$ we have

Here $2\xi\omega_n = \frac{R}{L}$,

and $\omega_n = \frac{1}{\sqrt{LC}}$

Thus $\xi = \frac{R}{2L}\sqrt{LC} = \frac{R}{2}\sqrt{\frac{C}{L}}$

For no oscillations, $\xi \geq 1$

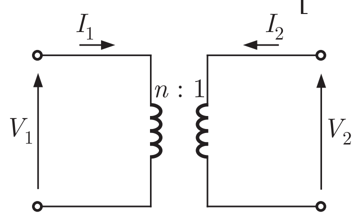
Thus $\frac{R}{2}\sqrt{\frac{C}{L}} \geq 1$

or $R \geq 2\sqrt{\frac{L}{C}}$

Hence (C) is correct option.

MCQ 1.8 The $ABCD$ parameters of an ideal $n{:}1$ transformer shown in the figure are

$$\begin{bmatrix} n & 0 \\ 0 & x \end{bmatrix}$$



The value of x will be

(A) n

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

(C) n^2

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

SOL 1.8 For given transformer

$$\frac{I_2}{I_1} = \frac{V_1}{V_2} = \frac{n}{1}$$

or $$I_1 = \frac{I_2}{n} \text{ and } V_1 = nV_2$$

Comparing with standard equation

$$V_1 = AV_2 + BI_2$$
$$I_1 = CV_2 + DI_2$$
$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} n & 0 \\ 0 & \frac{1}{n} \end{bmatrix}$$

Thus $$x = \frac{1}{n}$$

Hence (B) is correct option.

MCQ 1.9 In a series RLC circuit, $R = 2\ \text{k}\Omega$, $L = 1$ H, and $C = \frac{1}{400}\ \mu\text{F}$ The resonant frequency is

(A) 2×10^4 Hz

(B) $\frac{1}{\pi} \times 10^4$ Hz

(C) 10^4 Hz

(D) $2\pi \times 10^4$ Hz

SOL 1.9 Hence (B) is correct option.

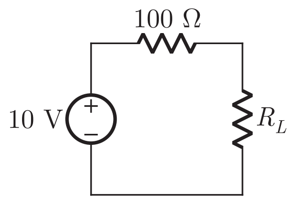
We have $L = 1H$ and $C = \frac{1}{400} \times 10^{-6}$

Resonant frequency

$$f_0 = \frac{1}{2\pi\sqrt{LC}} = = \frac{1}{2\pi\sqrt{1 \times \frac{1}{400} \times 10^{-6}}}$$

$$= \frac{10^3 \times 20}{2\pi} = \frac{10^4}{\pi} \text{ Hz}$$

MCQ 1.10 The maximum power that can be transferred to the load resistor R_L from the voltage source in the figure is



(A) 1 W (B) 10 W

(C) 0.25 W (D) 0.5 W

SOL 1.10 Maximum power will be transferred when $R_L = R_s = 100\Omega$

In this case voltage across R_L is 5 V, therefore

$$P_{\max} = \frac{V^2}{R} = \frac{5\times5}{100} = 0.25 \text{ W}$$

Hence (C) is correct option.

MCQ 1.11 The bandgap of Silicon at room temperature is

(A) 1.3 eV (B) 0.7 eV

(C) 1.1 eV (D) 1.4 eV

SOL 1.11 For silicon at 0 K,

$$E_{g0} = 1.21 \text{ eV}$$

At any temperature

$$E_{gT} = E_{g0} - 3.6\times10^{-4}\,T$$

At $T = 300$ K,

$$E_{g300} = 1.21 - 3.6\times10^{-4}\times300 = 1.1 \text{ eV}$$

This is standard value, that must be remembered.

Hence option (C) is correct.

MCQ 1.12 A Silicon PN junction at a temperature of 20° C has a reverse saturation current of 10 pico - Ameres (pA). The reserve saturation current at 40°C for the same bias is approximately

(A) 30 pA (B) 40 pA

(C) 50 pA (D) 60 pA

SOL 1.12 The reverse saturation current doubles for every 10°C rise in temperature as follows

$$I_0(T) = I_{01}\times 2^{(T-T_1)/10}$$

Thus at 40° C, $I_0 = 40$ pA

Hence option (B) is correct.

MCQ 1.13 The primary reason for the widespread use of Silicon in semiconductor device technology is

(A) abundance of Silicon on the surface of the Earth.

(B) larger bandgap of Silicon in comparison to Germanium.

(C) favorable properties of Silicon - dioxide (SiO_2)

(D) lower melting point

SOL 1.13 Silicon is abundant on the surface of earth in the from of SiO_2.
Hence option (A) is correct.

MCQ 1.14 The effect of current shunt feedback in an amplifier is to

(A) increase the input resistance and decrease the output resistance

(B) increases both input and output resistance

(C) decrease both input and output resistance

(D) decrease the input resistance and increase the output resistance

SOL 1.14 The effect of current shunt feedback in an amplifier is to decrease the input resistance and increase the output resistance as :

$$R_{if} = \frac{R_i}{1 + A\beta}$$

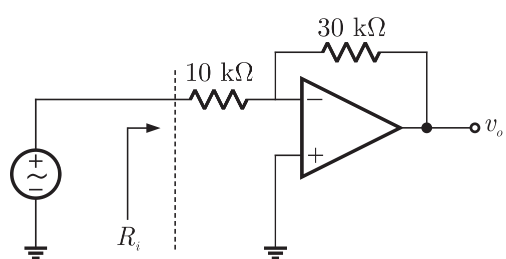
$$R_{of} = R_0(1 + A\beta)$$

where $R_i \rightarrow$ Input resistance without feedback

$R_{if} \rightarrow$ Input resistance with feedback.

Hence (D) is correct option.

MCQ 1.15 The input resistance R_i of the amplifier shown in the figure is



(A) $\frac{30}{4}$ kΩ (B) 10 kΩ

(C) 40 kΩ (D) infinite

SOL 1.15 Since the inverting terminal is at virtual ground, the current flowing through the voltage source is

$$I_s = \frac{V_s}{10\text{k}}$$

or $$\frac{V_s}{I_s} = 10\text{ k}\Omega = R_{in}$$

Hence (B) is correct option.

MCQ 1.16 The first and the last critical frequency of an RC-driving point impedance function must respectively be

(A) a zero and a pole (B) a zero and a zero

(C) a pole and a pole (D) a pole and a zero

SOL 1.16 For stability poles and zero interlace on real axis. In RC series network the driving point impedance is

$$Z_{ins} = R + \frac{1}{Cs} = \frac{1 + sRC}{sC}$$

Here pole is at origin and zero is at $s = -1/RC$, therefore first critical frequency is a pole and last critical frequency is a zero.

For RC parallel network the driving point impedance is

$$Z_{inp} = \frac{R\frac{1}{Cs}}{R + \frac{1}{Cs}} = \frac{R}{1 + sRC}$$

Here pole is $s = -1/RC$ and zero is at ∞, therefore first critical frequency is a pole and last critical frequency is a zero.

Hence (C) is correct option.

MCQ 1.17 The cascade amplifier is a multistage configuration of

(A) CC – CB (B) CE – CB

(C) CB – CC (D) CE – CC

SOL 1.17 The CE configuration has high voltage gain as well as high current gain. It performs basic function of amplifications. The CB configuration has lowest R_i and highest R_o. It is used as last step to match a very low impedance source and to drain a high impedance load

Thus cascade amplifier is a multistage configuration of CE-CB

Hence (B) is correct option

MCQ 1.18 Decimal 43 in Hexadecimal and BCD number system is respectively

(A) B2, 0100 011 (B) 2B, 0100 0011

(C) 2B, 0011 0100 (D) B2, 0100 0100

SOL 1.18 Dividing 43 by 16 we get

$$16\overline{)43}\ \ 2$$
$$\underline{32}$$
$$11$$

11 in decimal is equivalent is B in hexamal.

Thus $43_{10} \longleftrightarrow 2B_{16}$

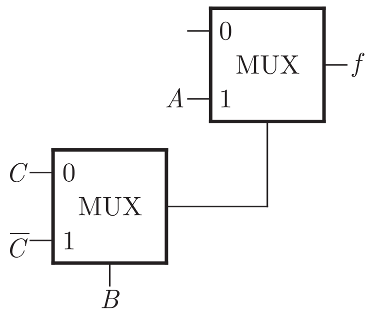
Now $4_{10} \longleftrightarrow 0100_2$

$3_{10} \longleftrightarrow 0011_2$

Thus $43_{10} \longleftrightarrow 01000011_{BCD}$

Hence (B) is correct answer.

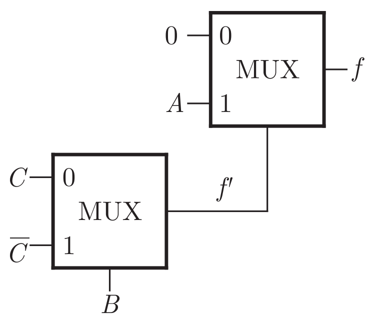
MCQ 1.19 The Boolean function f implemented in the figure using two input multiplexes is



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

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

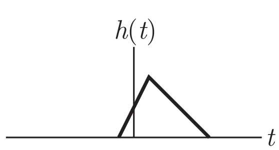
SOL 1.19 The diagram is as shown in fig

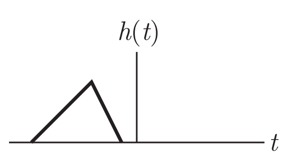


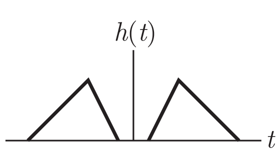
$$f' = B\overline{C} + \overline{B}C$$
$$f = f'A + \overline{f'}0$$
$$= f'A = AB\overline{C} + A\overline{B}C$$

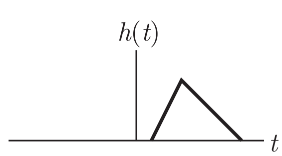
Hence (A) is correct answer.

MCQ 1.20 Which of the following can be impulse response of a causal system ?

(A)


(B)


(C)


(D)


SOL 1.20 For causal system $h(t) = 0$ for $t \leq 0$. Only (D) satisfy this condition.
Hence (D) is correct answer.

MCQ 1.21 Let $x(n) = (\frac{1}{2})^n u(n), y(n) = x^2(n)$ and $Y(e^{j\omega})$ be the Fourier transform of $y(n)$ then $Y(e^{j0})$

(A) $\frac{1}{4}$ (B) 2

(C) 4 (D) $\frac{4}{3}$

SOL 1.21 Hence (D) is correct answer.

$$x(n) = \left(\frac{1}{2}\right)^n u(n)$$

$$y(n) = x^2(n) = \left(\frac{1}{2}\right)^{2n} u^2(n)$$

or $$y(n) = \left[\left(\frac{1}{2}\right)^2\right]^n u(n) = \left(\frac{1}{4}\right)^n u(n) \quad ...(1)$$

$$Y(e^{j\omega}) = \sum_{n=-\infty}^{n=\infty} y(n)\, e^{-j\omega n} = \sum_{n=0}^{n=\infty}\left(\frac{1}{4}\right)^n e^{-j\omega n}$$

or $$Y(e^{j0}) = \sum_{n=0}^{n=\infty}\left(\frac{1}{4}\right)^n = 1 + \left(\frac{1}{4}\right)^1 + \left(\frac{1}{4}\right) + \left(\frac{1}{4}\right)^3 + \left(\frac{1}{4}\right)^4$$

or $$Y(e^{j0}) = \frac{1}{1-\frac{1}{4}} = \frac{4}{3}$$

Alternative :

Taking z transform of (1) we get

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

Substituting $z = e^{j\omega}$ we have

$$Y(e^{j\omega}) = \frac{1}{1-\frac{1}{4}e^{-j\omega}}$$

$$Y(e^{j0}) = \frac{1}{1-\frac{1}{4}} = \frac{4}{3}$$

MCQ 1.22 Find the correct match between group 1 and group 2.

Group 1	Group 2
P. $\{1 + km(t) A\sin(\omega_c t)\}$	W. Phase modulation
Q. $km(t) A\sin(\omega_c t)$	X. Frequency modulation
R. $A\sin\{\omega_c t + km(t)\}$	Y. Amplitude modulation
S. $A\sin\left[\omega_c t + k\int_{-\infty}^{t} m(t)\,dt\right]$	Z. DSB-SC modulation

(A) P – Z, Q – Y, R – X, S – W

(B) P – W, Q – X, R – Y, S – Z

(C) P – X, Q – W, R – Z, S – Y

(D) P – Y, Q – Z, R – W, S – X

SOL 1.22 Hence (D) is correct option.

$\{1 + km(t)\} A\sin(\omega_c t)$ $\longrightarrow$ Amplitude modulation

$dm(t)\, A_{\sin}(\omega_c t) \longrightarrow$ DSB-SC modulation
$A\sin\{\cos t + km(t)\} \longrightarrow$ Phase Modulation
$A\sin[\omega_c^t + k]_{-\infty}^{t} m(t)\, dt \longrightarrow$ Frequency Modulation

MCQ 1.23 The power in the signal $s(t) = 8\cos(20\pi - \frac{\pi}{2}) + 4\sin(15\pi t)$ is

(A) 40 (B) 41
(C) 42 (D) 82

SOL 1.23 Hence (A) is correct answer.

$$s(t) = 8\cos\left(\frac{\pi}{2} - 20\pi t\right) + 4\sin 15\pi t$$
$$= 8\sin 20\pi t + 4\sin 15\pi t$$

Here $A_1 = 8$ and $A_2 = 4$. Thus power is

$$P = \frac{A_1^2}{2} + \frac{A_2^2}{2} = \frac{8^2}{2} + \frac{4^2}{2} = 40$$

MCQ 1.24 Which of the following analog modulation scheme requires the minimum transmitted power and minimum channel bandwidth ?

(A) VSB (B) DSB-SC
(C) SSB (D) AM

SOL 1.24 Hence (C) is correct option.

$$\text{VSB} \longrightarrow f_m + f_c$$
$$\text{DSB - SC} \longrightarrow 2f_m$$
$$\text{SSB} \longrightarrow f_m$$
$$\text{AM} \longrightarrow 2f_m$$

Thus SSB has minimum bandwidth and it require minimum power.

MCQ 1.25 A linear system is equivalently represented by two sets of state equations :

$$\dot{X} = AX + BU \text{ and } \dot{W} = CW + DU$$

The eigenvalues of the representations are also computed as $[\lambda]$ and $[\mu]$. Which one of the following statements is true ?

(A) $[\lambda] = [\mu]$ and $X = W$ (B) $[\lambda] = [\mu]$ and $X \neq W$
(C) $[\lambda] \neq [\mu]$ and $X = W$ (D) $[\lambda] = [\mu]$ and $X \neq W$

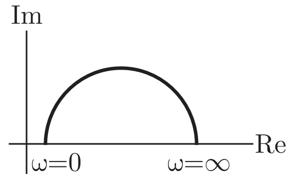
SOL 1.25 Hence (C) is correct option

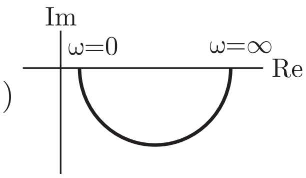
We have $\dot{X} = AX + BU$ where λ is set of Eigen values
and $\dot{W} = CW + DU$ where μ is set of Eigen values

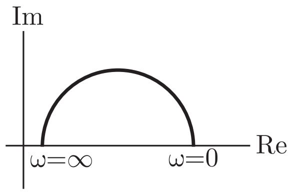
If a liner system is equivalently represented by two sets of state equations, then for both sets, states will be same but their sets of Eigne values will not be same i.e.

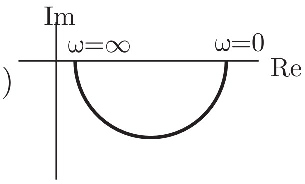
$$X = W \text{ but } \lambda \neq \mu$$

MCQ 1.26 Which one of the following polar diagrams corresponds to a lag network ?

(A) 

(B) 

(C) 

(D) 

SOL 1.26 The transfer function of a lag network is

$$T(s) = \frac{1+sT}{1+s\beta T} \qquad \beta > 1; T > 0$$

$$|T(j\omega)| = \frac{\sqrt{1+\omega^2 T^2}}{\sqrt{1+\omega^2 \beta^2 T^2}}$$

and $\angle T(j\omega) = \tan^{-1}(\omega T) - \tan^{-1}(\omega \beta T)$

At $\omega = 0, |T(j\omega)| = 1$

At $\omega = 0, \angle T(j\omega) = -\tan^{-1} 0 = 0$

At $\omega = \infty, |T(j\omega)| = \frac{1}{\beta}$

At $\omega = \infty, \angle T(j\omega) = 0$

Hence (D) is correct option.

MCQ 1.27 Despite the presence of negative feedback, control systems still have problems of instability because the

(A) Components used have non- linearities

(B) Dynamic equations of the subsystem are not known exactly.

(C) Mathematical analysis involves approximations.

(D) System has large negative phase angle at high frequencies.

SOL 1.27 Despite the presence of negative feedback, control systems still have problems of instability because components used have nonlinearity. There are always some variation as compared to ideal characteristics.

Hence (A) is correct option.

MCQ 1.28 The magnetic field intensity vector of a plane wave is given by

$$\overline{H}(x, y, z, t) = 10 \sin(50000t + 0.004x + 30)\, \hat{a}_y$$

where $\hat{a}_y$, denotes the unit vector in y direction. The wave is propagating with a phase velocity.

(A) 5×10^4 m/s

(B) -3×10^8 m/s

(C) -1.25×10^7 m/s

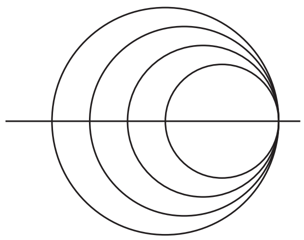
(D) 3×10^8 m/s]

SOL 1.28 Hence (C) is correct option.

$$\omega = 50,000 \quad \text{and} \quad \beta = -0.004$$

Phase Velocity is $v_P = \frac{\omega}{\beta} = \frac{5\times10^4}{-4\times10^{-3}} = 1.25\times10^7$ m/s

MCQ 1.29 Many circles are drawn in a Smith Chart used for transmission line calculations. The circles shown in the figure represent



(A) Unit circles

(B) Constant resistance circles

(C) Constant reactance circles

(D) Constant reflection coefficient circles.

SOL 1.29 The given figure represent constant reactance circle.
Hence (C) is correct option.

MCQ 1.30 Refractive index of glass is 1.5. Find the wavelength of a beam of light with frequency of 10^{14} Hz in glass. Assume velocity of light is 3×10^8 m/s in vacuum

(A) 3 μm (B) 3 mm

(C) 2 μm (D) 1 mm

SOL 1.30 Refractive index of glass $\mu = 1.5$

Frequency $f = 10^{14}$ Hz

$$c = 3\times10^8 \text{ m/sec}$$

$$\lambda = \frac{c}{f} = \frac{3\times10^8}{10^{14}} = 3\times10^{-6}$$

wavelength in glass is

$$\lambda_g = \frac{\alpha}{\mu} = \frac{3\times10^{-6}}{1.5} = 2\times10^{-6} \text{ m}$$

Hence (C) is correct option.

Question 31 - 80 Carry Two Marks Each

MCQ 1.31 In what range should Re(s) remain so that the Laplace transform of the function $e^{(a+2)t+5}$ exits.

(A) $\text{Re}(s) > a+2$ (B) $\text{Re}(s) > a+7$

(C) $\text{Re}(s) < 2$ (D) $\text{Re}(s) > a+5$

SOL 1.31 Hence (A) is correct answer.

We have $f(t) = e^{(a+2)t+5} = e^5 . e^{(a+2)t}$

Taking laplace transform we get

$$F(s) = e^5\left[\frac{1}{s-(a+2)}\right] \qquad \text{Thus } \text{Re}(s) > (a+2)$$

MCQ 1.32 Given the matrix $\begin{bmatrix} -4 & 2 \\ 4 & 3 \end{bmatrix}$, the eigenvector is

(A) $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$ (B) $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$

(C) $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$ (D) $\begin{bmatrix} -1 \\ 2 \end{bmatrix}$

SOL 1.32 Hence (C) is correct answer.

We have $A = \begin{bmatrix} -4 & 2 \\ 4 & 3 \end{bmatrix}$

Characteristic equation is

$$|A - \lambda I| = 0$$

or $$\begin{vmatrix} 4-\lambda & 2 \\ 4 & 3-\lambda \end{vmatrix} = 0$$

or $$(-4-\lambda)(3-\lambda) - 8 = 0$$

or $$-12 + \lambda + \lambda^2 - 8 = 0$$

or $$\lambda^2 + \lambda - 20 = 0$$

or $$\lambda = -5, 4 \qquad \text{Eigen values}$$

Eigen vector for $\lambda = -5$

$$(A - \lambda I) X_i = 0$$

$$\begin{bmatrix} 1-(-5) & 2 \\ 4 & 8-4 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 \\ 0 & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \qquad R_2 - 4R_1$$

$$x_1 + 2x_2 = 0$$

Let $-x_1 = 2 \Rightarrow x_2 = -1$,

Thus $$X = \begin{bmatrix} 2 \\ -1 \end{bmatrix} \qquad \text{Eigen vector}$$

MCQ 1.33 Let, $A = \begin{bmatrix} 2 & -0.1 \\ 0 & 3 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} \frac{1}{2} & a \\ 0 & b \end{bmatrix}$. Then $(a+b) =$

(A) 7/20 (B) 3/20

(C) 19/60 (D) 11/20

SOL 1.33 We have

$$A = \begin{bmatrix} 2 & -0.1 \\ 0 & 3 \end{bmatrix} \text{ and } A^{-1} = \begin{bmatrix} \frac{1}{2} & a \\ 0 & b \end{bmatrix}$$

Now $$AA^{-1} = I$$

or $$\begin{bmatrix} 2 & -0.1 \\ 0 & 3 \end{bmatrix}\begin{bmatrix} \frac{1}{2} & a \\ 0 & b \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

or $$\begin{bmatrix} 1 & 2a - 0.1b \\ 0 & 3b \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

or $$2a - 0.1 = 0 \text{ and } 3b = 1$$

Thus solving above we have $b = \frac{1}{3}$ and $a = \frac{1}{60}$

Therefore $$a + b = \frac{1}{3} + \frac{1}{60} = \frac{7}{20}$$

Hence (A) is correct option.

MCQ 1.34 The value of the integral $I = \frac{1}{\sqrt{2\pi}} \int_0^\infty \exp\left(-\frac{x^2}{8}\right) dx$ is

(A) 1 (B) π

(C) 2 (D) 2π

SOL 1.34 Gaussian PDF is

$$f(x) = \frac{1}{\sqrt{2\pi}\,\sigma} \int_{-\infty}^{\infty} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx \qquad \text{for } -\infty \le x \le \infty$$

and $\int_{-\infty}^{\infty} f(x)\, dx = 1$

Substituting $\mu = 0$ and $\sigma = 2$ in above we get

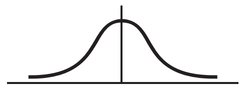
$$\frac{1}{\sqrt{2\pi}\,2} \int_{-\infty}^{\infty} e^{-\frac{x^2}{8}} dx = 1$$

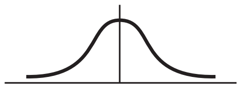
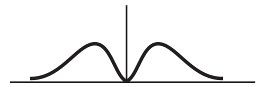
or $$\frac{1}{\sqrt{2\pi}\,2} 2\int_0^{\infty} e^{-\frac{x^2}{8}} dx = 1$$

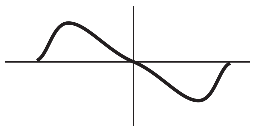
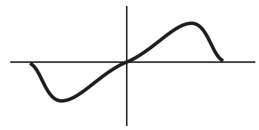
or $$\frac{1}{\sqrt{2\pi}} \int_0^{\infty} e^{-\frac{x^2}{8}} dx = 1$$

Hence (A) is correct option.

MCQ 1.35 The derivative of the symmetric function drawn in given figure will look like



(A)  (B) 

(C)  (D) 

SOL 1.35 For $x > 0$ the slope of given curve is negative. Only (C) satisfy this condition. Hence (C) is correct answer.

MCQ 1.36 Match the following and choose the correct combination:

Group I	Group 2
E. Newton-Raphson method	1. Solving nonlinear equations
F. Runge-kutta method	2. Solving linear simultaneous equations
G. Simpson's Rule	3. Solving ordinary differential equations
H. Gauss elimination	4. Numerical integration
	5. Interpolation
	6. Calculation of Eigenvalues

(A) $\text{E}-6, \text{F}-1, \text{G}-5, \text{H}-3$ (B) $\text{E}-1, \text{F}-6, \text{G}-4, \text{H}-3$

(C) $\text{E}-1, \text{F}-3, \text{G}-4, \text{H}-2$ (D) $\text{E}-5, \text{F}-3, \text{G}-4, \text{H}-1$

SOL 1.36 Hence (C) is correct option.

Newton - Raphson → Method-Solving nonlinear eq.
Runge - kutta Method → Solving ordinary differential eq.
Simpson's Rule → Numerical Integration
Gauss elimination → Solving linear simultaneous eq.

MCQ 1.37 Given an orthogonal matrix

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

$[AA^T]^{-1}$ is

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

(C) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

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

SOL 1.37 Hence (C) is correct option.

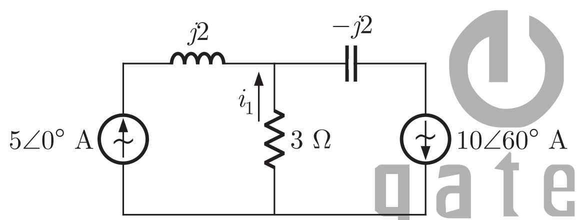
From orthogonal matrix

$$[AA^T] = I$$

Since the inverse of I is I, thus

$$[AA^T]^{-1} = I^{-1} = I$$

MCQ 1.38 For the circuit shown in the figure, the instantaneous current $i_1(t)$ is



(A) $\frac{10\sqrt{3}}{2}\angle 90^\circ$ A

(B) $\frac{10\sqrt{3}}{2}\angle -90^\circ$ A

(C) $5\angle 60^\circ$ A

(D) $5\angle -60^\circ$ A

SOL 1.38 Applying KCL we get

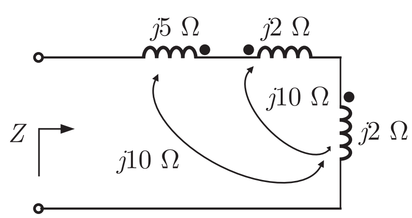
$$i_1(t) + 5\angle 0^\circ = 10\angle 60^\circ$$

or $\quad i_1(t) = 10\angle 60^\circ - 5\angle 0^\circ = 5 + 5\sqrt{3}j - 5$

or $\quad i_1(t) = 5\sqrt{3}\angle 90^\circ = \frac{10}{2}\sqrt{3}\angle 90^\circ$

Hence (A) is correct option.

MCQ 1.39 Impedance Z as shown in the given figure is



(A) $j29\,\Omega$

(B) $j9\,\Omega$

(C) $j19\,\Omega$

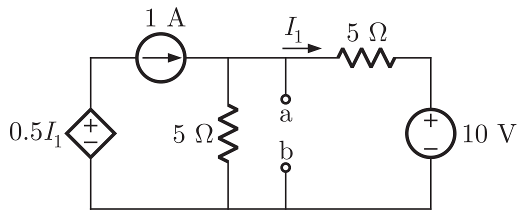
(D) $j39\,\Omega$

SOL 1.39 If $L_1 = j5\Omega$ and $L_3 = j2\Omega$ the mutual induction is subtractive because current enters from dotted terminal of $j2\Omega$ coil and exit from dotted terminal of $j5\Omega$. If $L_2 = j2\Omega$ and $L_3 = j2\Omega$ the mutual induction is additive because current enters from dotted terminal of both coil.

Thus $$Z = L_1 - M_{13} + L_2 + M_{23} + L_3 - M_{31} + M_{32}$$
$$= j5 + j10 + j2 + j10 + j2 - j10 + j10 = j9$$

Hence (B) is correct option.

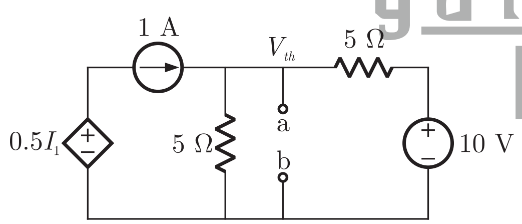
MCQ 1.40 For the circuit shown in the figure, Thevenin's voltage and Thevenin's equivalent resistance at terminals a – b is



(A) 5 V and 2 Ω (B) 7.5 V and 2.5 Ω

(C) 4 V and 2 Ω (D) 3 V and 2.5 Ω

SOL 1.40 Open circuit at terminal ab is shown below

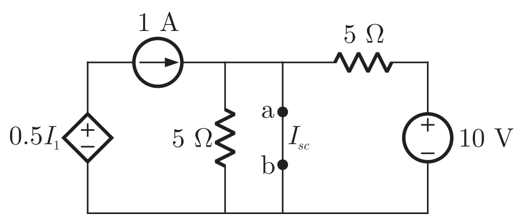


Applying KCL at node we get

$$\frac{V_{ab}}{5} + \frac{V_{ab} - 10}{5} = 1$$

or $$V_{ab} = 7.5 = V_{th}$$

Short circuit at terminal ab is shown below



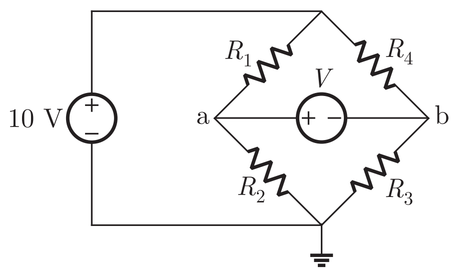
Short circuit current from terminal ab is

$$I_{sc} = 1 + \frac{10}{5} = 3 \text{ A}$$

Thus $$R_{th} = \frac{V_{th}}{I_{sc}} = \frac{7.5}{3} = 2.5\,\Omega$$

Here current source being in series with dependent voltage source make it ineffective. Hence (B) is correct option.

MCQ 1.41 If $R_1 = R_2 = R_4 = R$ and $R_3 = 1.1R$ in the bridge circuit shown in the figure, then the reading in the ideal voltmeter connected between a and b is



(A) 0.238 V
(B) 0.138 V
(C) -0.238 V
(D) 1 V

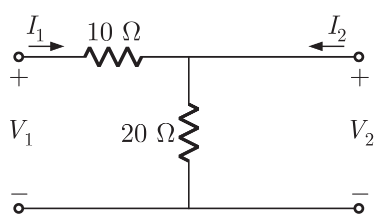
SOL 1.41 Here $V_a = 5$ V because $R_1 = R_2$ and total voltage drop is 10 V.

Now $$V_b = \frac{R_3}{R_3 + R_4} \times 10 = \frac{1.1}{2.1} \times 10 = 5.238 \text{ V}$$

$$V = V_a - V_b = 5 - 5.238 = -0.238 \text{ V}$$

Hence (C) is correct option.

MCQ 1.42 The h parameters of the circuit shown in the figure are



(A) $\begin{bmatrix} 0.1 & 0.1 \\ -0.1 & 0.3 \end{bmatrix}$
(B) $\begin{bmatrix} 10 & -1 \\ 1 & 0.05 \end{bmatrix}$
(C) $\begin{bmatrix} 30 & 20 \\ 20 & 20 \end{bmatrix}$
(D) $\begin{bmatrix} 10 & 1 \\ -1 & 0.05 \end{bmatrix}$

SOL 1.42 For h parameters we have to write V_1 and I_2 in terms of I_1 and V_2.

$$V_1 = h_{11} I_1 + h_{12} V_2$$
$$I_2 = h_{21} I_1 + h_{22} V_2$$

Applying KVL at input port

$$V_1 = 10 I_1 + V_2$$

Applying KCL at output port

$$\frac{V_2}{20} = I_1 + I_2$$

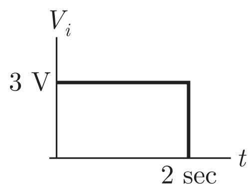
or $$I_2 = -I_1 + \frac{V_2}{20}$$

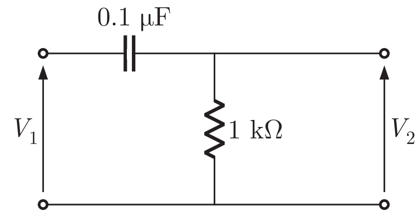
Thus from above equation we get

$$\begin{bmatrix} h_{11} & h_{12} \\ h_{12} & h_{22} \end{bmatrix} = \begin{bmatrix} 10 & 1 \\ -1 & 0.05 \end{bmatrix}$$

Hence (D) is correct option.

MCQ 1.43 A square pulse of 3 volts amplitude is applied to $C-R$ circuit shown in the figure. The capacitor is initially uncharged. The output voltage V_2 at time $t=2$ sec is



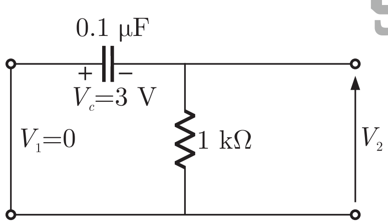


(A) 3 V
(B) −3 V
(C) 4 V
(D) −4 V

SOL 1.43 Hence (B) is correct option.

Time constant $RC = 0.1 \times 10^{-6} \times 10^{3} = 10^{-4}$ sec

Since time constant RC is very small, so steady state will be reached in 2 sec. At $t=2$ sec the circuit is as shown in fig.



$$V_c = 3 \text{ V}$$
$$V_2 = -V_c = -3 \text{ V}$$

MCQ 1.44 A Silicon sample A is doped with 10^{18} atoms/cm³ of boron. Another sample B of identical dimension is doped with 10^{18} atoms/cm³ phosphorus. The ratio of electron to hole mobility is 3. The ratio of conductivity of the sample A to B is

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

SOL 1.44 Hence option (B) is correct.

$$\sigma_n = nq\mu_n$$
$$\sigma_p = pq\mu_p \qquad (n = p)$$
$$\frac{\sigma_p}{\sigma_n} = \frac{\mu_p}{\mu_n} = \frac{1}{3}$$

MCQ 1.45 A Silicon PN junction diode under reverse bias has depletion region of width 10 μ m. The relative permittivity of Silicon, $\varepsilon_r = 11.7$ and the permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m. The depletion capacitance of the diode per square meter is

(A) 100 μF (B) 10 μF

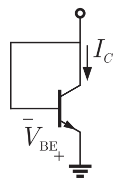
(C) 1 μF (D) 20 μF

SOL 1.45 Hence option (B) is correct.

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d}$$

or $$\frac{C}{A} = \frac{\varepsilon_0 \varepsilon_r}{d} = \frac{8.85 \times 10^{-12} \times 11.7}{10 \times 10^{-6}} = 10.35\,\mu\text{F}$$

MCQ 1.46 For an npn transistor connected as shown in figure $V_{BE} = 0.7$ volts. Given that reverse saturation current of the junction at room temperature 300 K is 10^{-13} A, the emitter current is



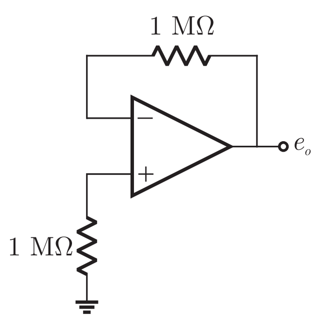
(A) 30 mA (B) 39 mA

(C) 49 mA (D) 20 mA

SOL 1.46 Hence (C) is correct option.

$$I_E = I_s\left(e^{\frac{V_{BE}}{nV_T}} - 1\right) = 10^{-13}\left(\frac{0.7}{e^{1 \times 26 \times 10^{-3}}} - 1\right) = 49 \text{ mA}$$

MCQ 1.47 The voltage e_0 is indicated in the figure has been measured by an ideal voltmeter. Which of the following can be calculated ?



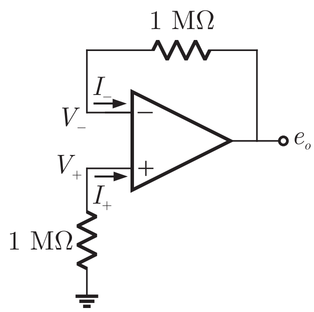
(A) Bias current of the inverting input only

(B) Bias current of the inverting and non-inverting inputs only

(C) Input offset current only

(D) Both the bias currents and the input offset current

SOL 1.47 The circuit is as shown below



Writing equation for I_- have

$$\frac{e_0 - V_-}{1\text{M}} = I_-$$

or $$e_0 = I_-(1\text{M}) + V_- \qquad ...(1)$$

Writing equation for I_+ we have

$$\frac{0 - V_+}{1\text{M}} = I_+$$

or $$V_+ = - I_+(1\text{M}) \qquad ...(2)$$

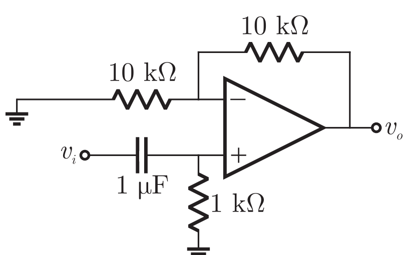
Since for ideal OPAMP $V_+ = V_-$, from (1) and (2) we have

$$e_0 = I_-(1\text{M}) - I_+(1\text{M})$$
$$= (I_- - I_+)(1\text{M}) = I_{OS}(1\text{M})$$

Thus if e_0 has been measured, we can calculate input offset current I_{OS} only.

Hence (C) is correct option.

MCQ 1.48 The Op-amp circuit shown in the figure is filter. The type of filter and its cut. Off frequency are respectively



(A) high pass, 1000 rad/sec. (B) Low pass, 1000 rad/sec

(C) high pass, 1000 rad/sec (D) low pass, 10000 rad/sec

SOL 1.48 At low frequency capacitor is open circuit and voltage acr s non-inverting terminal is zero. At high frequency capacitor act as short circuit and all input voltage appear at non-inverting terminal. Thus, this is high pass circuit.

The frequency is given by

$$\omega = \frac{1}{RC} = \frac{1}{1 \times 10^3 \times 1 \times 10^{-6}} = 1000 \text{ rad/sec}$$

Hence (C) is correct option.

MCQ 1.49 In an ideal differential amplifier shown in the figure, a large value of (R_E).
(A) increase both the differential and common - mode gains.
(B) increases the common mode gain only.
(C) decreases the differential mode gain only.
(D) decreases the common mode gain only.

SOL 1.49 Common mode gain

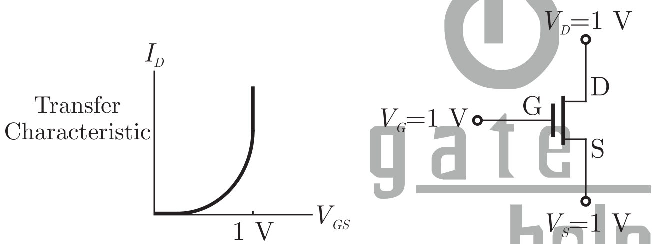
$$A_{CM} = -\frac{R_C}{2R_E}$$

And differential mode gain

$$A_{DM} = -g_m R_C$$

Thus only common mode gain depends on R_E and for large value of R_E it decreases.
Hence (D) is correct option.

MCQ 1.50 For an n-channel MOSFET and its transfer curve shown in the figure, the threshold voltage is



(A) 1 V and the device is in active region
(B) -1 V and the device is in saturation region
(C) 1 V and the device is in saturation region
(D) -1 V and the device is an active region

SOL 1.50 From the graph it can be easily seen that $V_{th} = 1$ V

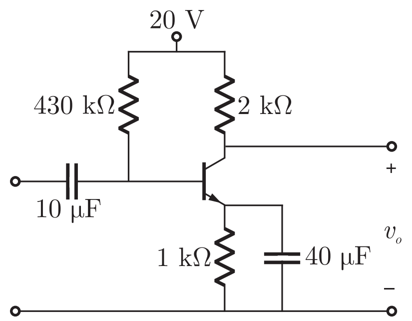
Now $V_{GS} = 3 - 1 = 2$ V

and $V_{DS} = 5 - 1 = 4$ V

Since $V_{DS} > V_{GS} \longrightarrow V_{DS} > V_{GS} - V_{th}$

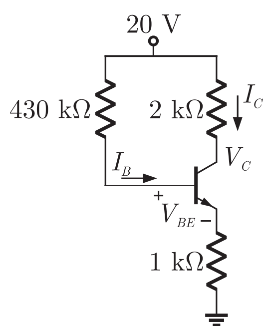
Thus MOSFET is in saturation region.
Hence option (C) is correct.

MCQ 1.51 The circuit using a BJT with $\beta = 50$ and $V_{BE} = 0.7V$ is shown in the figure. The base current I_B and collector voltage by V_C and respectively



(A) 43 μA and 11.4 Volts
(B) 40 μA and 16 Volts
(C) 45 μA and 11 Volts
(D) 50 μA and 10 Volts

SOL 1.51 The circuit under DC condition is shown in fig below



Applying KVL we have

$$V_{CC} - R_B I_B - V_{BE} - R_E I_E = 0$$

or $V_{CC} - R_B I_B - V_{BE} - R_E(\beta+1) I_B = 0$ Since $I_E = I_B + \beta I_B$

or $$I_B = \frac{V_{CC} - V_{BE}}{R_B + (\beta+1) R_E}$$

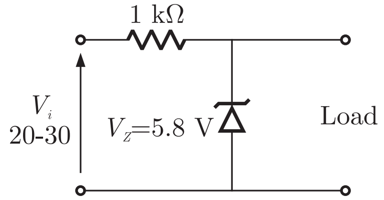
$$= \frac{20 - 0.7}{430\text{k} + (50+1)1\text{k}} = 40\mu\text{A}$$

Now $$I_C = \beta I_B = 50 \times 40\mu = 2 \text{ mA}$$

$$V_C = V_{CC} - R_C I_C = 20 - 2\text{m} \times 2\text{k} = 16 \text{ V}$$

Hence (B) is correct option.

MCQ 1.52 The Zener diode in the regulator circuit shown in the figure has a Zener voltage of 5.8 volts and a zener knee current of 0.5 mA. The maximum load current drawn from this current ensuring proper functioning over the input voltage range between 20 and 30 volts, is



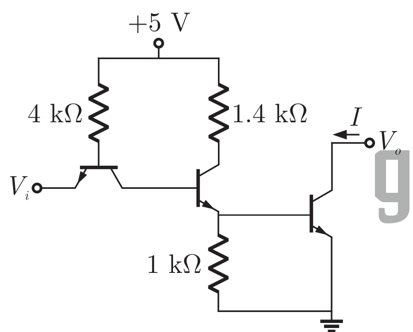
(A) 23.7 mA (B) 14.2 mA
(C) 13.7 mA (D) 24.2 mA

SOL 1.52 The maximum load current will be at maximum input voltage i.e.

$$V_{max} = 30 \text{ V i.e.}$$
$$\frac{V_{max} - V_Z}{1\text{k}} = I_L + I_Z$$
or $$\frac{30 - 5.8}{1\text{k}} = I_L = 0.5 \text{ m}$$
or $$I_L = 24.2 - 0.5 = 23.7 \text{ mA}$$

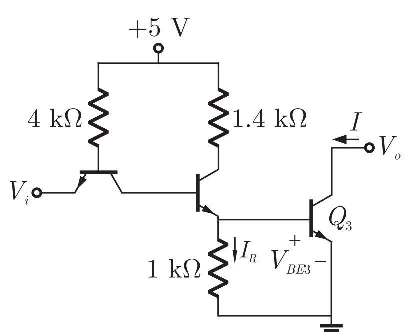
Hence (A) is correct option.

MCQ 1.53 The transistors used in a portion of the TTL gate show in the figure have $\beta = 100$. The base emitter voltage of is 0.7 V for a transistor in active region and 0.75 V for a transistor in saturation. If the sink current $I = 1$ A and the output is at logic 0, then the current I_R will be equal to



(A) 0.65 mA (B) 0.70 mA
(C) 0.75 mA (D) 1.00 mA

SOL 1.53 The circuit is as shown below



If output is at logic 0, the we have $V_0 = 0$ which signifies BJT Q_3 is in saturation and applying KVL we have

$$V_{BE3} = I_R \times 1k$$
or $$0.75 = I_R \times 1k$$
or $$I_R = 0.75 \text{ mA}$$

Hence (C) is correct answer.

MCQ 1.54 The Boolean expression for the truth table shown is

A	B	C	D
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

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

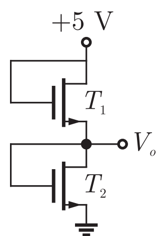
(C) $\overline{B}(A+\overline{C})(\overline{A}+C)$ (D) $\overline{B}(A+C)(\overline{A}+\overline{C})$

SOL 1.54 Hence (A) is correct answer.

We have $f = \overline{A}BC + AB\overline{C}$

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

MCQ 1.55 Both transistors T_1 and T_2 show in the figure, have a $\beta = 100$, threshold voltage of 1 Volts. The device parameters K_1 and K_2 of T_1 and T_2 are, respectively, 36 $\mu A/V^2$ and 9 μA/V². The output voltage V_o i s



(A) 1 V (B) 2 V

(C) 3 V (D) 4 V

SOL 1.55 Hence (D) is correct option.

MCQ 1.56 The present output Q_n of an edge triggered JK flip-flop is logic 0. If $J = 1$, then Q_{n+1}

(A) Cannot be determined (B) Will be logic 0

(C) will be logic 1 (D) will rave around

SOL 1.56 Characteristic equation for a jk flip-flop is written as

$Q_{n+1} = J\overline{Q}_n + \overline{K}Q_n$

Where Q_n is the present output

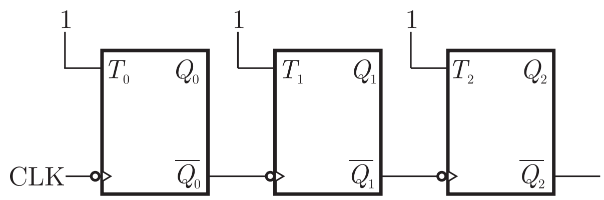
Q_{n+1} is next output

So, $Q_{n+1} = 1\overline{0} + \overline{K}\cdot 0$ $Q_n = 0$

$$Q_{n+1} = 1$$

Hence (C) is correct answer.

MCQ 1.57 The given figure shows a ripple counter using positive edge triggered flip-flops. If the present state of the counter is $Q_2 Q_1 Q_0 = 001$ then is next state $Q_2 Q_1 Q$ will be



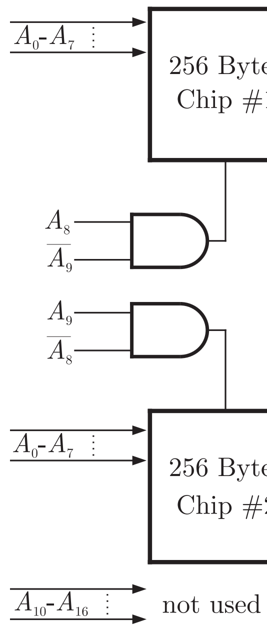
(A) 010 (B) 111

(C) 100 (D) 101

SOL 1.57 Since $T_2 T_1 T_0$ is at 111, at every clock $Q_2 Q_1 Q_0$ will be changes. Ir present state is 011, the next state will be 100.

Hence (C) is correct answer.

MCQ 1.58 What memory address range is NOT represents by chip # 1 and chip # 2 in the figure A_0 to A_{15} in this figure are the address lines and CS means chip select.



(A) 0100 - 02FF (B) 1500 - 16FF

(C) F900 - FAFF (D) F800 - F9FF

SOL 1.58 Hence (D) is correct answer.

MCQ 1.59 The output $y(t)$ of a linear time invariant system is related to its input $x(t)$ by the following equations

$$y(t) = 0.5x(t - t_d + T) + x(t - t_d) + 0.5x(t - t_d + T)$$

The filter transfer function $H(\omega)$ of such a system is given by

(A) $(1+\cos\omega T)\,e^{-j\omega t_d}$ (B) $(1+0.5\cos\omega T)\,e^{-j\omega t_d}$

(C) $(1-\cos\omega T)\,e^{-j\omega t_d}$ (D) $(1-0.5\cos\omega T)\,e^{-j\omega t_d}$

SOL 1.59 Hence (A) is correct answer.

$$y(t) = 0.5x(t-t_d+T) + x(t-t_d) + 0.5x(t-t_d-T)$$

Taking Fourier transform we have

$$Y(\omega) = 0.5e^{-j\omega(-t_d+T)}X(\omega) + e^{-j\omega t_d}X(\omega) + 0.5e^{-j\omega(-t_d-T)}X(\omega)$$

or $$\frac{Y(\omega)}{X(\omega)} = e^{-j\omega t_d}[0.5e^{j\omega T} + 1 + 0.5e^{-j\omega T}]$$

$$= e^{-j\omega t_d}[0.5\,(e^{j\omega T} + e^{-j\omega T}) + 1] = e^{-j\omega t_d}[\cos\omega T + 1]$$

or $$H(\omega) = \frac{Y(\omega)}{X(\omega)} = e^{-j\omega t_d}(\cos\omega T + 1)$$

MCQ 1.60 Match the following and choose the correct combination.

Group 1

E. Continuous and aperiodic signal

F. Continuous and periodic signal

G. Discrete and aperiodic signal

H. Discrete and periodic signal

Group 2

1. Fourier representation is continuous and aperiodic
2. Fourier representation is discrete and aperiodic
3. Fourier representation is continuous and periodic
4. Fourier representation is discrete and periodic

(A) E – 3, F – 2, G – 4, H – 1

(B) E – 1, F – 3, G – 2, H – 4

(C) E – 1, F – 2, G – 3, H – 4

(D) E – 2, F – 1, G – 4, H – 3

SOL 1.60 For continuous and aperiodic signal Fourier representation is continuous and aperiodic.

For continuous and periodic signal Fourier representation is discrete and aperiodic.

For discrete and aperiodic signal Fourier representation is continuous and periodic.

For discrete and periodic signal Fourier representation is discrete and periodic.

Hence (C) is correct answer.

MCQ 1.61 A signal $x(n) = \sin(\omega_0 n + \phi)$ is the input to a linear time- invariant system having a frequency response $H(e^{j\omega})$. If the output of the system $Ax(n-n_0)$ then the most general form of $\angle H(e^{j\omega})$ will be

(A) $-n_0\omega_0+\beta$ for any arbitrary real

(B) $-n_0\omega_0+2\pi k$ for any arbitrary integer k

(C) $n_0\omega_0+2\pi k$ for any arbitrary integer k

(D) $-n_0\omega_0\phi$

SOL 1.61 Hence (B) is correct answer.

$$y(n) = Ax(n-n_o)$$

Taking Fourier transform

$$Y(e^{j\omega}) = Ae^{-j\omega_o n_o}X(e^{j\omega})$$

or $$H(e^{j\omega}) = \frac{Y(e^{j\omega})}{X(e^{j\omega})} = Ae^{-j\omega_o n_o}$$

Thus $\angle H(e^{j\omega}) = -\omega_o n_o$

For LTI discrete time system phase and frequency of $H(e^{j\omega})$ are periodic with period 2π. So in general form

$$\theta(\omega) = -n_o\omega_o + 2\pi k$$

MCQ 1.62 For a signal $x(t)$ the Fourier transform is $X(f)$. Then the inverse Fourier transform of $X(3f+2)$ is given by

(A) $\frac{1}{2}x\left(\frac{t}{2}\right)e^{j3\pi t}$

(B) $\frac{1}{3}x\left(\frac{t}{3}\right)e^{-\frac{j4\pi t}{3}}$

(C) $3x(3t)\,e^{-j4\pi t}$

(D) $x(3t+2)$

SOL 1.62 Hence (B) is correct answer.

$$x(t) \overset{F}{\longleftrightarrow} X(f)$$

Using scaling we have

$$x(at) \overset{F}{\longleftrightarrow} \frac{1}{|a|}X\left(\frac{f}{a}\right)$$

Thus $$x\left(\frac{1}{3}f\right) \overset{F}{\longleftrightarrow} 3X(3f)$$

Using shifting property we get

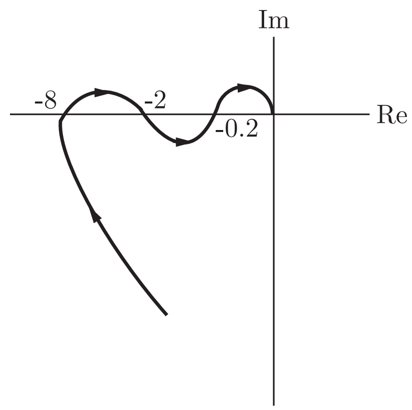
$$e^{-j2\pi f_0 t}x(t) = X(f+f_0)$$

Thus $$\frac{1}{3}e^{-j\frac{4}{3}\pi t}x\left(\frac{1}{3}t\right) \overset{F}{\longleftrightarrow} X(3f+2)$$

$$e^{-j2\pi\frac{2}{3}t}x\left(\frac{1}{3}t\right) \overset{F}{\longleftrightarrow} 3X(3(f+\tfrac{2}{3}))$$

$$\frac{1}{3}e^{-j\pi\frac{4}{3}t}x\left(\frac{1}{3}t\right) \overset{F}{\longleftrightarrow} X[3(f+\tfrac{2}{3})]$$

MCQ 1.63 The polar diagram of a conditionally stable system for open loop gain $K=1$ is shown in the figure. The open loop transfer function of the system is known to be stable. The closed loop system is stable for



(A) $K < 5$ and $\frac{1}{2} < K < \frac{1}{8}$

(B) $K < \frac{1}{8}$ and $\frac{1}{2} < K < 5$

(C) $K < \frac{1}{8}$ and $5 < K$

(D) $K > \frac{1}{8}$ and $5 > K$

SOL 1.63 Hence (B) is correct option

MCQ 1.64 In the derivation of expression for peak percent overshoot

$$M_p = \exp\left(\frac{-\pi\xi}{\sqrt{1-\xi^2}}\right) \times 100\%$$

Which one of the following conditions is NOT required ?

(A) System is linear and time invariant

(B) The system transfer function has a pair of complex conjugate poles and no zeroes.

(C) There is no transportation delay in the system.

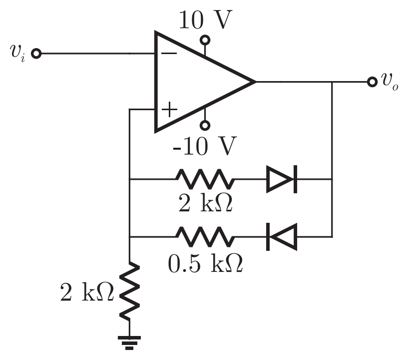
(D) The system has zero initial conditions.

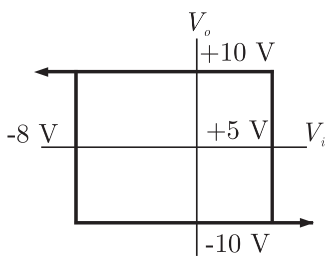
SOL 1.64 The peak percent overshoot is determined for LTI second order closed loop system with zero initial condition. It's transfer function is

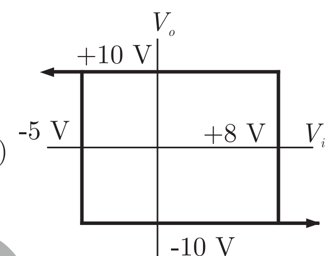
$$T(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

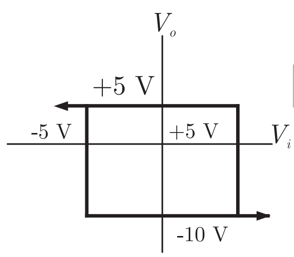
Transfer function has a pair of complex conjugate poles and zeroes.
Hence (C) is correct option.

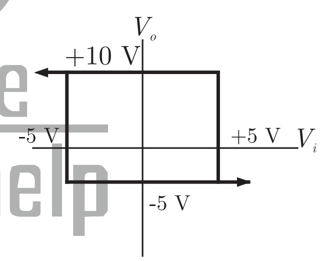
MCQ 1.65 Given the ideal operational amplifier circuit shown in the figure indicate the correct transfer characteristics assuming ideal diodes with zero cut-in voltage.



(A)


(B)


(C)


(D)


SOL 1.65 Only one diode will be in ON conditions

When lower diode is in ON condition, then

$$V_u = \frac{2\text{k}}{2.5\text{k}} V_{sat} = \frac{2}{2.5} 10 = 8 \text{ V}$$

when upper diode is in ON condition

$$V_u = \frac{2\text{k}}{2.5\text{k}} V_{sat} = \frac{2}{4}(-10) = -5 \text{ V}$$

Hence (B) is correct option.

MCQ 1.66 A ramp input applied to an unity feedback system results in 5% steady state error. The type number and zero frequency gain of the system are respectively

(A) 1 and 20 (B) 0 and 20

(C) 0 and $\frac{1}{20}$ (D) 1 and $\frac{1}{20}$

SOL 1.66 For ramp input we have $R(s) = \frac{1}{s^2}$

Now $$e_{ss} = \lim_{s \to 0} sE(s)$$

$$= \lim_{s \to 0} s \frac{R(s)}{1 + G(s)} = \lim_{s \to 0} \frac{1}{s + sG(s)}$$

or $$e_{ss} = \lim_{s \to 0} \frac{1}{sG(s)} = 5\% = \frac{1}{20} \text{ Finite}$$

But $$k_v = \frac{1}{e_{ss}} = \lim_{s \to 0} sG(s) = 20$$

k_v is finite for type 1 system having ramp input.
Hence (A) is correct option.

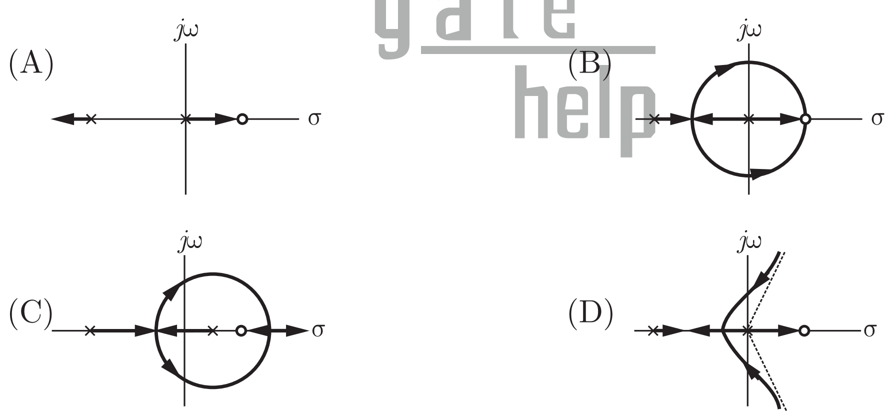
MCQ 1.67 A double integrator plant $G(s) = K/s^2, H(s) = 1$ is to be compensated to achieve the damping ratio $\zeta = 0.5$ and an undamped natural frequency, $\omega_n = 5$ rad/sec which one of the following compensator $G_e(s)$ will be suitable ?

(A) $\frac{s+3}{s+99}$ (B) $\frac{s+99}{s+3}$

(C) $\frac{s-6}{s+8.33}$ (D) $\frac{s-6}{s}$

SOL 1.67 Hence (A) is correct option.

MCQ 1.68 An unity feedback system is given as $G(s) = \frac{K(1-s)}{s(s+3)}$.
Indicate the correct root locus diagram.



SOL 1.68 Hence (A) is correct option.

MCQ 1.69 A MOS capacitor made using p type substrate is in the accumulation mode. The dominant charge in the channel is due to the presence of

(A) holes (B) electrons

(C) positively charged icons (D) negatively charged ions

SOL 1.69 In accumulation mode for NMOS having $p-$substrate, when positive voltage is applied at the gate, this will induce negative charge near $p-$ type surface beneath the gate. When V_{GS} is made sufficiently large, an inversion of electrons is formed and this in effect forms and $n-$ channel.
Hence option (B) is correct.

MCQ 1.70 A device with input $X(t)$ and output $y(t)$ is characterized by: $Y(t) = x^2(t)$. An FM signal with frequency deviation of 90 kHz and modulating signal bandwidth of 5 kHz is applied to this device. The bandwidth of the output signal is

(A) 370 kHz (B) 190 kHz

(C) 380 kHz (D) 95 kHz

SOL 1.70 Let $x(t)$ be the input signal where

$$x(t) = \cos(\cos t + \beta_1 \cos \omega_m t)$$

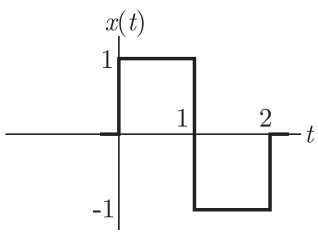
$$y(t) = x^2(t) = \frac{1}{2} + \frac{\cos(2\omega_c t + 2\beta_1 \cos \omega_m t)}{2}$$

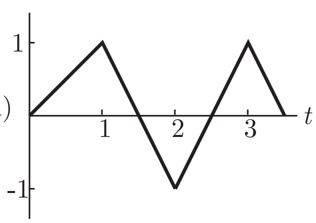
Here $\beta = 2\beta_1$ and $\beta_1 = \frac{\Delta f}{f_m} = \frac{90}{5} = 18$

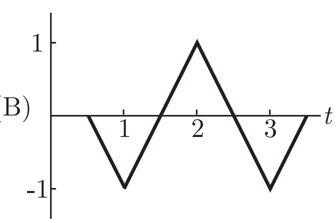
$$BW = 2(\beta + 1) f_m = 2(2 \times 18 + 1) \times 5 = 370 \text{ kHz}$$

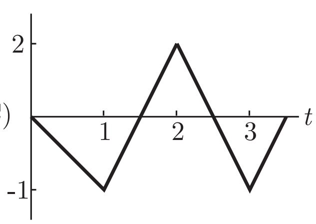
Hence (A) is correct option.

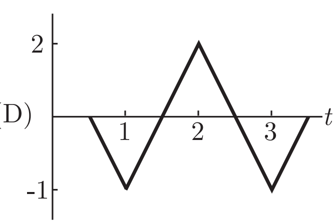
MCQ 1.71 A signal as shown in the figure is applied to a matched filter. Which of the following does represent the output of this matched filter ?



(A)


(B)


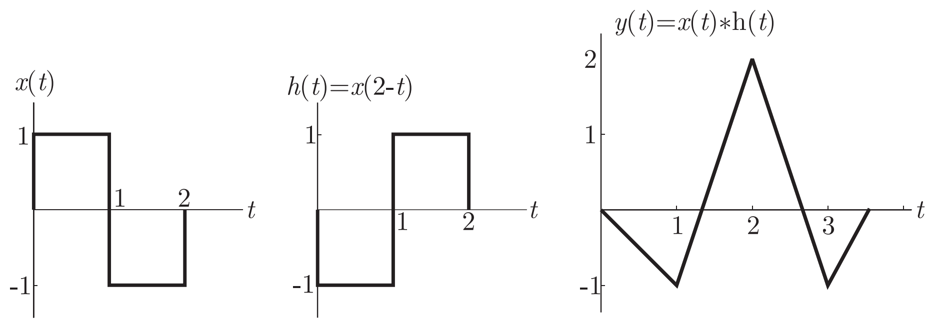
(C)


(D)


SOL 1.71 The transfer function of matched filter is

$$h(t) = x(t - t) = x(2 - t)$$

The output of matched filter is the convolution of $x(t)$ and $h(t)$ as shown below



Hence (C) is correct option.

MCQ 1.72 Noise with uniform power spectral density of N_0 W/Hz is passed though a filter $H(\omega) = 2\exp(-j\omega t_d)$ followed by an ideal pass filter of bandwidth B Hz. The output noise power in Watts is

(A) $2N_0B$ (B) $4N_0B$

(C) $8N_0B$ (D) $16N_0B$

SOL 1.72 Hence (B) is correct option.

We have $H(f) = 2e^{-j\omega t_d}$

$$|H(f)| = 2$$

$$G_0(f) = |H(f)|^2 G_i(f)$$

$$= 4N_o \text{ W/Hz}$$

The noise power is $= 4N_o \times B$

MCQ 1.73 A carrier is phase modulated (PM) with frequency deviation of 10 kHz by a single tone frequency of 1 kHz. If the single tone frequency is increased to 2 kHz, assuming that phase deviation remains unchanged, the bandwidth of the PM signal is

(A) 21 kHz (B) 22 kHz

(C) 42 kHz (D) 44 kHz

SOL 1.73 The phase deviation is

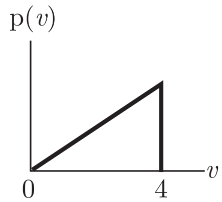
$$\beta = \frac{\Delta f}{f_m} = \frac{10}{1} = 10$$

If phase deviation remain same and modulating frequency is changed

$$BW = 2(\beta + 1)f_m' = 2(10 + 1)2 = 44 \text{ kHz}$$

Hence (D) is correct option.

MCQ 1.74 An output of a communication channel is a random variable v with the probability density function as shown in the figure. The mean square value of v is



(A) 4
(B) 6
(C) 8
(D) 9

SOL 1.74 As the area under pdf curve must be unity

$$\frac{1}{2}(4\times k) = 1 \longrightarrow k = \frac{1}{2}$$

Now mean square value is

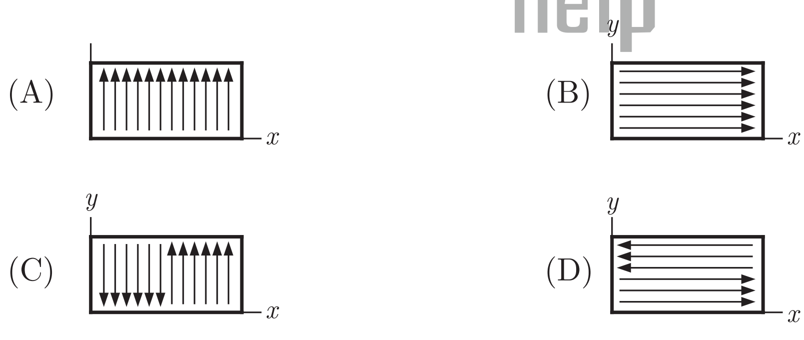
$$\sigma_v^2 = \int_{-\infty}^{+\infty} v^2 p(v)\,dv$$

$$= \int_0^4 v^2\left(\frac{v}{8}\right)dv \qquad \text{as } p(v) = \frac{1}{8}v$$

$$= \int_0^4 \left(\frac{v^3}{8}\right)dv = 8$$

Hence (C) is correct option.

MCQ 1.75 Which one of the following does represent the electric field lines for the mode in the cross-section of a hollow rectangular metallic waveguide ?



SOL 1.75 Hence (D) is correct option.

MCQ 1.76 Characteristic impedance of a transmission line is 50 Ω. Input impedance of the open-circuited line when the transmission line a short circuited, then value of the input impedance will be.

(A) 50 Ω
(B) $100 + j150\Omega$
(C) $7.69 + j11.54\Omega$
(D) $7.69 - j11.54\Omega$

SOL 1.76 Hence (D) is correct option

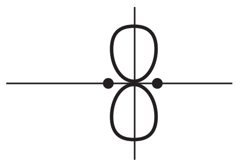
$$Z_o^2 = Z_{OC}.Z_{SC}$$

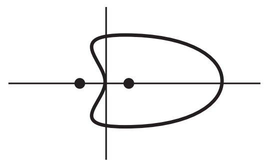
$$Z_{ZC} = \frac{Z_o^2}{Z_{OC}} = \frac{50\times 50}{100 + j150} = \frac{50}{2+3j}$$

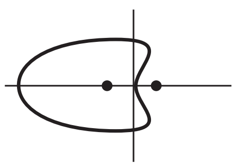
$$= \frac{50(2-3j)}{13} = 7.69 - 11.54j$$

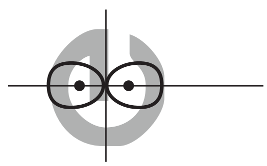
Hence (D) is correct option

MCQ 1.77 Two identical and parallel dipole antennas are kept apart by a distance of $\frac{\lambda}{4}$ in the H - plane. They are fed with equal currents but the right most antenna has a phase shift of $+90°$. The radiation pattern is given as.

(A) 

(A) 

(B) 

(B) 

SOL 1.77 The array factor is

$$A = \cos\left(\frac{\beta d \sin\theta + \alpha}{2}\right)$$

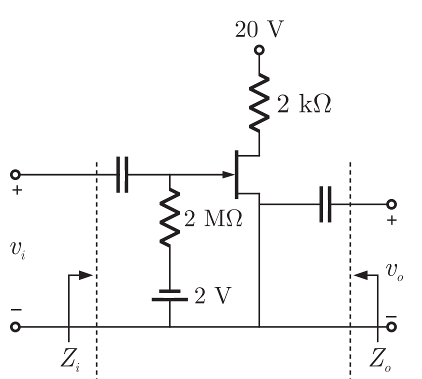
Here $\beta = \frac{2\pi}{\lambda}$, $d = \frac{\lambda}{4}$ and $\alpha = 90°$

Thus $$A = \cos\left(\frac{\frac{2\pi}{\lambda}\frac{\lambda}{4}\sin\theta + \frac{\pi}{2}}{2}\right) = \cos\left(\frac{\pi}{4}\sin\theta + \frac{\pi}{2}\right)$$

The option (A) satisfy this equation.

Common Data Questions 78, 79 and 80 :

Given, $r_d = 20k\Omega$, $I_{DSS} = 10$ mA, $V_p = -8$ V

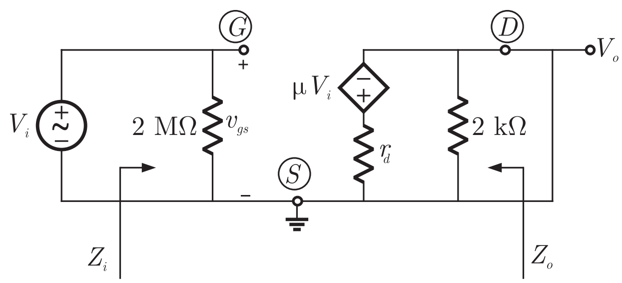


MCQ 1.78 Z_i and Z_0 of the circuit are respectively

(A) 2 MΩ and 2 kΩ (B) 2 MΩ and $\frac{20}{11}$ kΩ

(C) infinity and 2 MΩ (D) infinity and $\frac{20}{11}$kΩ

SOL 1.78 The small signal model is as shown below



From the figure we have

$$Z_{in} = 2\,\text{M}\Omega$$

and $$Z_0 = r_d \| R_D = 20\text{k} \| 2\text{k} = \frac{20}{11}\,\text{k}\Omega$$

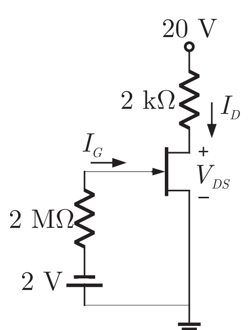
Hence (B) is correct option.

MCQ 1.79 I_D and V_{DS} under DC conditions are respectively

(A) 5.625 mA and 8.75 V (B) 1.875 mA and 5.00 V

(C) 4.500 mA and 11.00 V (D) 6.250 mA and 7.50 V

SOL 1.79 The circuit in DC condition is shown below



Since the FET has high input resistance, gate current can be neglect and we get $V_{GS} = -2$ V

Since $V_P < V_{GS} < 0$, FET is operating in active region

Now $$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 = 10\left(1 - \frac{(-2)}{(-8)}\right)^2 = 5.625 \text{ mA}$$

Now $$V_{DS} = V_{DD} - I_D R_D = 20 - 5.625\text{m}\times 2\text{k} = 8.75 \text{ V}$$

Hence (A) is correct option.

MCQ 1.80 Transconductance in milli-Siemens (mS) and voltage gain of the amplifier are respectively

(A) 1.875 mS and 3.41

(B) 1.875 ms and -3.41

(C) 3.3 mS and -6

(D) 3.3 mS and 6

SOL 1.80 The transconductance is

$$g_m = \frac{2}{|V_P|\sqrt{I_D I_{DSS}}}$$

or, $$= \frac{2}{8}\sqrt{5.625\text{mA} \times 10\text{mA}} = 1.875 \text{ mS}$$

The gain is $A = -g_m(r_d \| R_D)$

So, $$= 1.875\text{ms} \times \frac{20}{11}K = -3.41$$

Hence (B) is correct option.

Linked Answer Questions : Q. 81 to 90 Carry Two Marks Each

Consider an 8085 microprocessor system.

MCQ 1.81 The following program starts at location 0100H.

```
LXI SP, OOFF
LXI H, 0701
MVI A, 20H
SUB M
```

The content of accumulator when the program counter reaches 0109 H is

(A) 20 H

(B) 02 H

(C) 00 H

(D) FF H

SOL 1.81

```
0100H LXI SP, 00FF     ; Load SP with 00FFG
0103H LXI H, 0701      ; Load HL with 0107H
0106H MVI A, 20H       ; Move A with 20 H
0108 H SUB M           ; Subtract the contents of memory
                       ; location whose address is stored in HL
                       ; from the A and store in A
0109H ORI 40H          ; 40H OR [A] and store in A
010BH ADD M            ; Add the contents of memeory location
                       ; whose address is stored in HL to A
                       ; and store in A
```

HL contains 0107H and contents of 0107H is 20H

Thus after execution of SUB the data of A is 20H - 20H = 00

Hence (C) is correct answer.

MCQ 1.82 If in addition following code exists from 019H onwards,

```
ORI 40 H
ADD M
```

What will be the result in the accumulator after the last instruction is executed ?

(A) 40 H (B) 20 H

(C) 60 H (D) 42 H

SOL 1.82 Before ORI instruction the contents of A is 00H. On execution the ORI 40H the contents of A will be 40H

$$00H = 00000000$$
$$40H = 01000000$$
$$\text{ORI} \quad 01000000$$

After ADD instruction the contents of memory location whose address is stored in HL will be added to and will be stored in A

40H + 20 H = 60 H

Hence (C) is correct answer.

Statement for Linked Answer Question 83 and 84 :

The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{3e^{-2s}}{s(s+2)}$$

MCQ 1.83 The gain and phase crossover frequencies in rad/sec are, respectively

(A) 0.632 and 1.26 (B) 0.632 and 0.485

(C) 0.485 and 0.632 (D) 1.26 and 0.632

SOL 1.83 Hence (D) is correct option

$$G(s) = \frac{3e^{-2s}}{s(s+2)}$$

or $$G(j\omega) = \frac{3e^{-2j\omega}}{j\omega(j\omega+2)}$$

$$|G(j\omega)| = \frac{3}{\omega\sqrt{\omega^2+4}}$$

Let at frequency ω_g the gain is 1. Thus

$$\frac{3}{\omega_g\sqrt{(\omega_g^2+4)}} = 1$$

or $$\omega_g^4 + 4\omega_g^2 - 9 = 0$$

or $$\omega_g^2 = 1.606$$

or $$\omega_g = 1.26 \text{ rad/sec}$$

Now $$\angle G(j\omega) = -2\omega - \frac{\pi}{2} - \tan^{-1}\frac{\omega}{2}$$

Let at frequency ω_ϕ we have $\angle GH = -180^\circ$

$$-\pi = -2\omega_\phi - \frac{\pi}{2} - \tan^{-1}\frac{\omega_\phi}{2}$$

or $$2\omega_\phi + \tan^{-1}\frac{\omega_\phi}{2} = \frac{\pi}{2}$$

or $$2\omega_\phi + \left(\frac{\omega_\phi}{2} - \frac{1}{3}\left(\frac{\omega_\phi}{2}\right)^3\right) = \frac{\pi}{2}$$

or $$\frac{5\omega_\phi}{2} - \frac{\omega_\phi^3}{24} = \frac{\pi}{2}$$

$$\frac{5\omega_\phi}{2} \approx \frac{\pi}{2}$$

or $$\omega_\phi = 0.63 \text{ rad/sec}$$

MCQ 1.84 Based on the above results, the gain and phase margins of the system will be

(A) -7.09 dB and 87.5° (B) 7.09 dB and 87.5°

(C) 7.09 dB and -87.5° (D) -7.09 and -87.5°

SOL 1.84 The gain at phase crossover frequency ω_ϕ is

$$|G(j\omega_g)| = \frac{3}{\omega_\phi\sqrt{(\omega_\phi^2 + 4)}} = \frac{3}{0.63(0.63^2+4)^{\frac{1}{2}}}$$

or $$|G(j\omega_g)| = 2.27$$

$$\text{G.M.} = -20\log|G(j\omega_g)|$$

$$-20\log 2.26 = -7.08 \text{ dB}$$

Since G.M. is negative system is unstable.

The phase at gain corss over frequency is

$$\angle G(j\omega_g) = -2\omega_g - \frac{\pi}{2} - \tan^{-1}\frac{\omega_g}{2}$$

$$= -2\times 1.26 - \frac{\pi}{2} - \tan^{-1}\frac{1.26}{2}$$

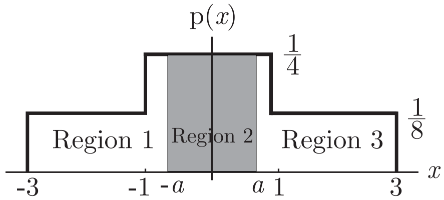
or $$= -4.65 \text{ rad or } -266.5^\circ$$

$$\text{PM} = 180^\circ + \angle G(j\omega_g) = 180^\circ - 266.5^\circ = -86.5^\circ$$

Hence (D) is correct option.

Common Data for Question 85 and 86 :

Asymmetric three-level midtread quantizer is to be designed assuming equiprobable occurrence of all quantization levels.



MCQ 1.85 If the probability density function is divide into three regions as shown in the figure, the value of a in the figure is

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$

(C) $\frac{1}{2}$ (D) $\frac{1}{4}$

SOL 1.85 As the area under pdf curve must be unity and all three region are equivaprobable. Thus are under each region must be $\frac{1}{3}$.

$$2a\times\frac{1}{4} = \frac{1}{3} \longrightarrow a = \frac{2}{3}$$

Hence (B) is correct option.

MCQ 1.86 The quantization noise power for the quantization region between $-a$ and $+a$ in the figure is

(A) $\frac{4}{81}$ (B) $\frac{1}{9}$

(C) $\frac{5}{81}$ (D) $\frac{2}{81}$

SOL 1.86 Hence (A) is correct option.

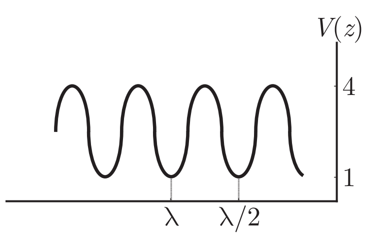
$$N_q = \int_{-a}^{+a} x^2 p(x)\,dx = 2\int_0^a x^2\cdot\frac{1}{4}\,dx = \frac{1}{2}\left[\frac{x^3}{3}\right]_0^a = \frac{a^3}{6}$$

Substituting $a = \frac{2}{3}$ we have

$$N_q = \frac{4}{81}$$

Statement of Linked Answer Questions 87 & 88 :

Voltage standing wave pattern in a lossless transmission line with characteristic impedance 50 and a resistive load is shown in the figure.



MCQ 1.87 The value of the load resistance is

(A) 50 Ω (B) 200 Ω

(C) 12.5 Ω (D) 0

SOL 1.87 From the diagram, VSWR is

$$s = \frac{V_{\max}}{V_{\min}} = \frac{4}{1} = 4$$

When minima is at load $Z_O = s.Z_L$

or $$Z_L = \frac{Z_o}{s} = \frac{50}{4} = 12.5\Omega$$

Hence (C) is correct option.

MCQ 1.88 reflection coefficient is given by

(A) -0.6 (B) -1

(C) 0.6 (D) 0

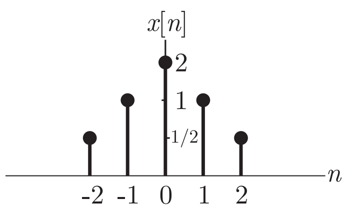
SOL 1.88 The reflection coefficient is

$$\Gamma = \frac{Z_L - Z_O}{Z_L + Z_O} = \frac{12.5 - 50}{125. + 50} = -0.6$$

Hence (A) is correct option.

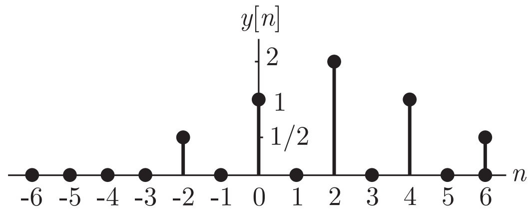
Statement of linked answer question 89 and89:

A sequence $x(n)$ has non-zero values as shown in the figure.

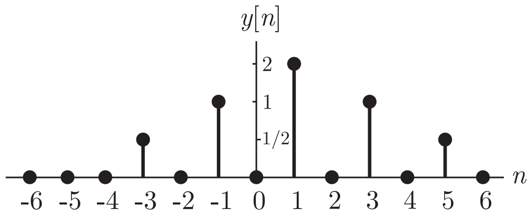


MCQ 1.89 The sequence $y(n) = \begin{cases} x(\frac{n}{2} - 1), & \text{For } n \text{ even} \\ 0, & \text{For } n \text{ odd} \end{cases}$ will be

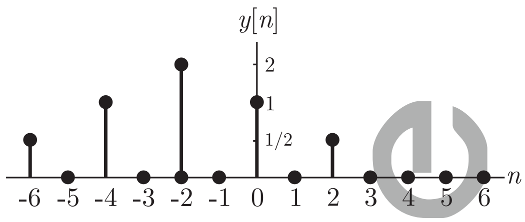
(A)



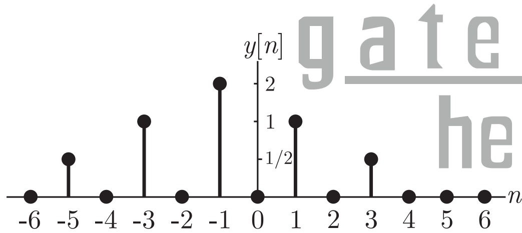
(B)



(C)



(D)



SOL 1.89 Thus (A) is correct option.

From $x(n) = [\frac{1}{2}, 1, 2, 1, 1, \frac{1}{2}]$

$y(n) = x(\frac{n}{2} - 1), n$ even

$= 0$, for n odd

$n = -2$, $y(-2) = x(\frac{-2}{2} - 1) = x(-2) = \frac{1}{2}$

$n = -1$, $y(-1) = 0$

$n = 0$, $y(0) = x(\frac{0}{2} - 1) = x(-1) = 1$

$n = 1$, $y(1) = 0$

$n = 2$ $y(2) = x(\frac{2}{2} - 1) = x(0) = 2$

$n = 3$, $y(3) = 0$

$n = 4$ $y(4) = x(\frac{4}{2} - 1) = x(1) = 1$

$n = 5$, $y(5) = 0$

$n = 6$ $y(6) = x(\frac{6}{2} - 1) = x(2) = \frac{1}{2}$

Hence $y(n) = \frac{1}{2}\delta(n+2) + \delta(n) + 2\delta(n-2) + \delta(n-4) + \frac{1}{2}\delta(n-6)$

MCQ 1.90 The Fourier transform of $y(2n)$ will be

(A) $e^{-j2\omega}[\cos 4\omega + 2\cos 2\omega + 2]$ (B) $\cos 2\omega + 2\cos\omega + 2$

(C) $e^{-j\omega}[\cos 2\omega + 2\cos\omega + 2]$ (D) $e^{-j2\omega}[\cos 2\omega + 2\cos + 2]$

SOL 1.90 Here $y(n)$ is scaled and shifted version of $x(n)$ and again $y(2n)$ is scaled version of $y(n)$ giving

$$z(n) = y(2n) = x(n-1)$$
$$= \frac{1}{2}\delta(n+1) + \delta(n) + 2\delta(n-1) + \delta(n-2) + \frac{1}{2}\delta(n-3)$$

Taking Fourier transform.

$$Z(e^{j\omega}) = \frac{1}{2}e^{j\omega} + 1 + 2e^{-j\omega} + e^{-2j\omega} + \frac{1}{2}e^{-3j\omega}$$
$$= e^{-j\omega}\left(\frac{1}{2}e^{2j\omega} + e^{j\omega} + 2 + e^{-j\omega} + \frac{1}{2}e^{-2j\omega}\right)$$
$$= e^{-j\omega}\left(\frac{e^{2j\omega} + e^{-2j\omega}}{2} + e^{j\omega} + 2 + e^{-j\omega}\right)$$

or $Z(e^{j\omega}) = e^{-j\omega}[\cos 2\omega + 2\cos\omega + 2]$

Hence (C) is correct answer

Answer Sheet

1.	(B)	19.	(A)	37.	(C)	55.	(D)	73.	(D)
2.	(C)	20.	(D)	38.	(A)	56.	(C)	74.	(C)
3.	(D)	21.	(D)	39.	(B)	57.	(C)	75.	(D)
4.	(B)	22.	(D)	40.	(B)	58.	(D)	76.	(D)
5.	(A)	23.	(A)	41.	(C)	59.	(A)	77.	(A)
6.	(C)	24.	(C)	42.	(D)	60.	(C)	78.	(B)
7.	(C)	25.	(C)	43.	(B)	61.	(B)	79.	(A)
8.	(B)	26.	(D)	44.	(B)	62.	(B)	80.	(B)
9.	(B)	27.	(A)	45.	(B)	63.	(B)	81.	(C)
10.	(C)	28.	(C)	46.	(C)	64.	(C)	82.	(C)
11.	(C)	29.	(C)	47.	(C)	65.	(B)	83.	(D)
12.	(B)	30.	(C)	48.	(C)	66.	(A)	84.	(D)
13.	(A)	31.	(A)	49.	(D)	67.	(A)	85.	(B)
14.	(D)	32.	(C)	50.	(C)	68.	(A)	86.	(A)
15.	(B)	33.	(A)	51.	(B)	69.	(B)	87.	(C)
16.	(C)	34.	(A)	52.	(A)	70	(A)	88.	(A)
17.	(B)	35.	(C)	53.	(C)	71	(C)	89.	(A)
18.	(B)	36.	(C)	54.	(A)	72	(B)	90.	(C)