MADE EASY

# GATE 2025

# Electronics Engineering

## Memory based
## **Questions** & **Solutions**

**Exam held on**
**15/02/2025 (Afternoon Session)**

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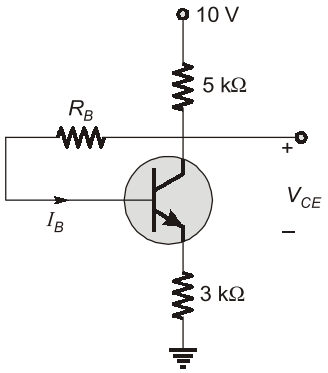
## ANALOG CIRCUITS

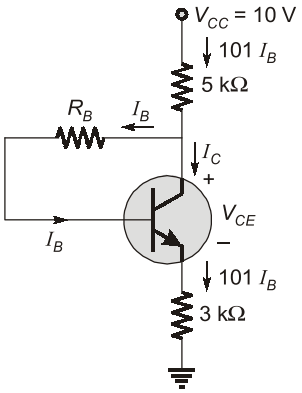
**Q.1** Consider the following circuit:




If $I_B$ = 10 μA and β = 100, then $V_{CE}$ is _____.

**Ans.** (1.92)

Since, $I_C = \beta I_B = 100 I_B$; $I_E = 101 I_B$,




$I_B = 0.01$ mA

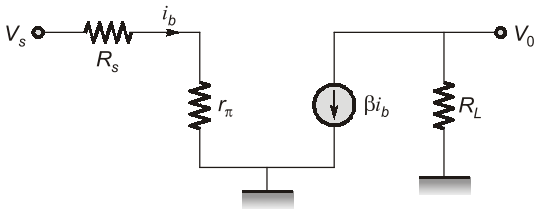
By KVL: $10 = 5 \times 101 I_B + V_{CE} + 3 \times 101 I_B$

$V_{CE} = 10 - 808 \times 0.01$

$V_{CE} = 1.92$ V

*End of Solution*

**Q.2** Calculate the value of $\frac{V_0}{V_S}$.



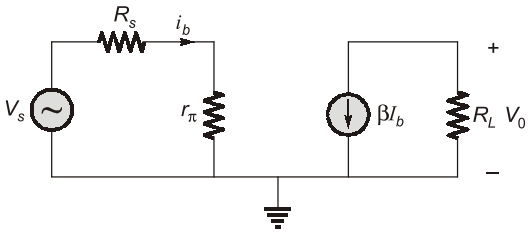

(a) $\frac{\beta R_L}{R_s + r_\pi}$

(b) $\frac{-\beta R_L}{R_s + r_\pi}$

(c) $\frac{\beta}{R_s + r_\pi}$

(d) $\frac{-R_L}{R_s + r_\pi}$

**Ans.** (b)

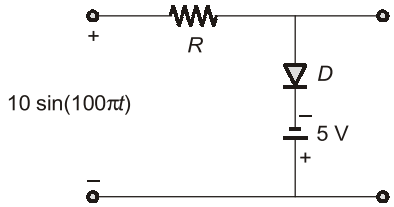



$$\frac{V_0}{V_s} = \frac{-\beta I_b \times R_L}{I_b(R_s + r_\pi)}$$

$$\frac{V_0}{V_s} = \frac{-\beta R_L}{R_s + r_\pi}$$

*End of Solution*

**Q.3** For the circuit of diode shown in figure below, the ON-time of the diode is _____ msec.




**Ans.** (13.33)

Given, $2\pi ft = 100\pi t$

$f = 50$ Hz

$T_0 = \frac{1}{f} = 20$ msec

$V_i = 10 \sin(100\pi t) = 10 \sin\alpha$,

$\alpha = 100\pi\, t$

Diode conducts if $V_i > -5$ V

Diode is OFF if $V_i < -5$ V

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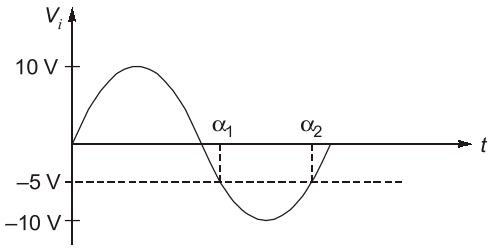



$$10 \sin \alpha = -5$$

$$\alpha = \sin^{-1}\left(\frac{-5}{10}\right)$$

$$\alpha = \frac{7\pi}{6}, \frac{11\pi}{6}$$

$$100\pi\, t_1 = \frac{7\pi}{6}$$

$$t_1 = 11.66 \text{ msec}$$

$$\alpha_2 = 100\pi t_2 = \frac{11\pi}{6}$$

$$t_2 = 18.33 \text{ msec}$$

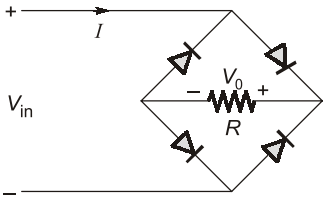
Diode is OFF from $t_1$ to $t_2$

$$t_{OFF} = t_2 - t_1 = 6.66 \text{ msec}$$

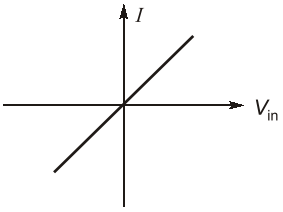
$$t_{ON} = T_0 - T_{OFF} = 13.33 \text{ msec}$$

*End of Solution*

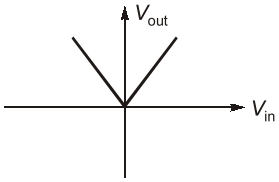
**Q.4** For the circuit show which of the following is correct?



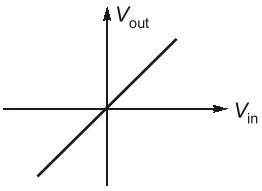

(a)



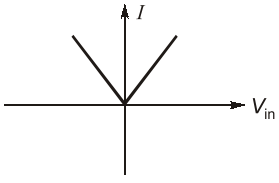

(b)



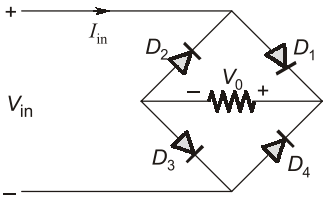

(c)




(d)



Ans. (a, b)

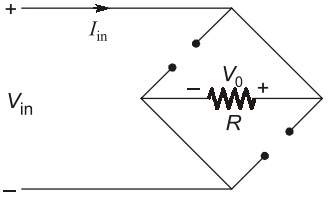



Given, $V_{in}$ is steep of $-M$ to $+M$

For $V_0$ versus $V_{IN}$:

Let $V_{IN} = +M$

In the bridge rectifier, $D_1$ and $D_3$ are forward bias, and $D_2$ and $D_4$ are reverse bias,



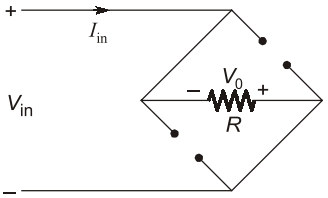

$\therefore \quad V_{in} - V_0 = 0 \Rightarrow V_{in} = V_0$

$\therefore$ For $V_{in} = +M \Rightarrow V_0 = M$

Let $V_{IN} = -M$

diodes, $D_1$ and $D_3$ are reverse bias,

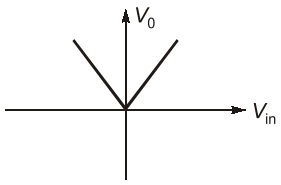
$D_2$ and $D_4$ are forward bias.




$\therefore \quad V_{in} + V_0 = 0$

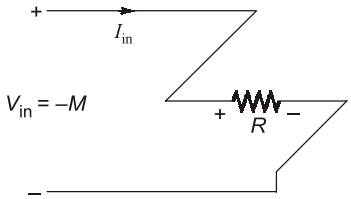
$V_D = -V_{in} = -[-M] = M$

$\therefore$




For $I_{in}$ Versus $V_{in}$:

Let $V_{in} = +M$




$\therefore \quad V_{in} - I_{IN} R = 0$

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$\therefore$ if $V_{in} = M \Rightarrow I_{IN} = \frac{M}{R}$

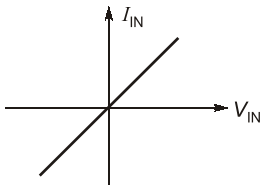
Let $V_{in} = -M$

$\therefore$ $V_{in} - I_{NR} = 0$

$Vin = I_{IN}R$

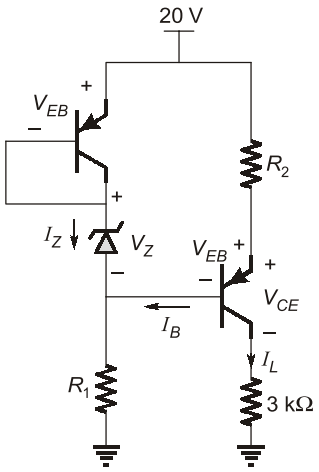
$-M = I_{IN} R$

$\therefore$ $I_{IN} = -\frac{M}{R}$




End of Solution

**Q.5** Find $R_1$ and $R_2$. If $V_{BE1} = V_{BE2} = 0.7$ V, $\beta = 120$, $V_Z = 5$ V, $I_Z = 25$ mA, $I_L = 12$ mA.




**Ans.** (0.413)

$I_{C2} = I_L = 12$ mA

$I_{B2} = \frac{I_{C2}}{\beta} = \frac{12}{120}\text{mA} = 0.1\,\text{mA}$

KCL: $I_1 = I_Z + I_{B2} = 25.1$ mA

KVL: $20 = 0.7 + 5 + I_1 \times R_1$

$R_1 = 0.5697\ \text{k}\Omega \cong 0.6\ \text{k}\Omega$

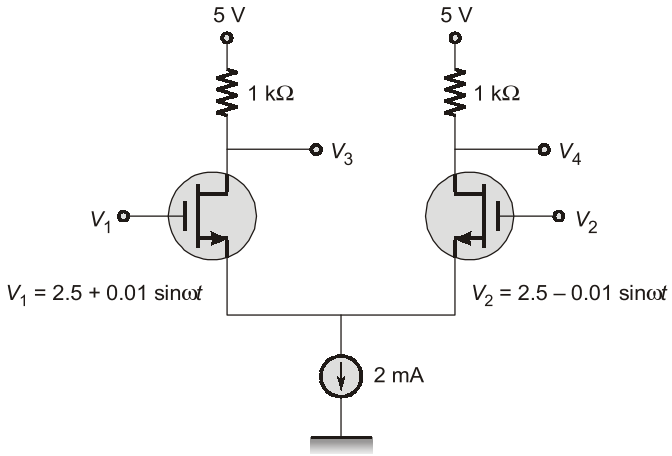
$I_2 = I_{E2} = (1 + \beta)\, I_{B2} = 12.1$ mA

KVL: $20 = I_2R_2 + 0.7 + I_1 \times R_1$

$R_1 = \frac{20 - 0.7 - 14.3}{12.1} = 0.4\ \text{k}\Omega$

End of Solution

**Q.6** In the given differential amplifier output $V_3$ is equal to
(Given $g_m$ = 5 mS)




(a) $4 - 0.01 \sin \omega t$
(b) $3 - 0.05 \sin \omega t$
(c) $2 - 0.01 \sin \omega t$
(d) $4 - 0.05 \sin \omega t$

**Ans.** (d)

$$I_{DS} = \frac{2}{2} = 1\,\text{mA}$$

$$\frac{V_d}{2} = 0.01 \sin \omega t$$

$$V_d = 0.02 \sin \omega t$$

$$V_{CM} = 2.5\ \text{V}$$

Given, $g_m = 5$ ms

$$A_{DM} = \frac{V_0}{V_d} = -\frac{g_m \times R_D}{2} = -\frac{5 \times 1}{2} = -2.5$$

$$V_0 = -2.5 \times V_d = -2.5 \times 0.02 \sin \omega t$$

AC voltage, $V_0 = -0.05 \sin \omega t$

DC voltage, $V_0 = 5 - 1 \times I_{DS} = 4\ \text{V}$

In given circuit, $A_{CM} = 0$

Hence, common mode input effect is cancelled.

$$V_0 = -0.05 \sin \omega t + 4$$

*End of Solution*

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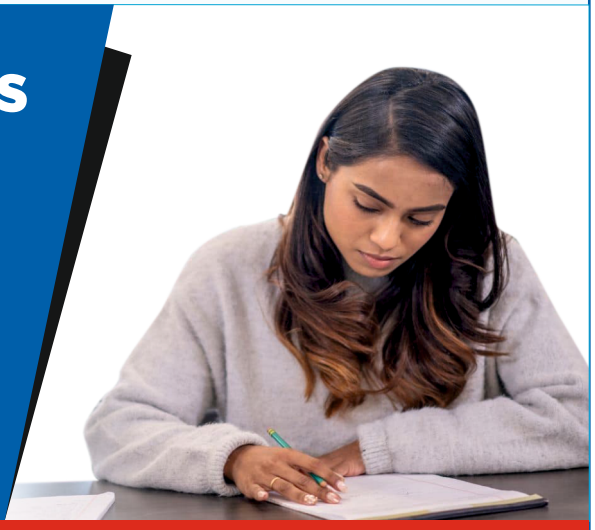

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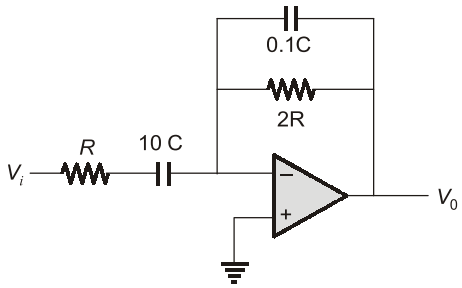
**Q.7** Find high frequency ($f_H$), if $f_L$ = 1 MHz.




**Ans.** (50)

We know that, $f_L = \dfrac{1}{2\pi R_1 C_1}$

$$10^6 = \frac{1}{2\pi \times R \times 10C}$$

$$\frac{1}{RC} = 2\pi \times 10^7$$

$$f_H = \frac{1}{2\pi R_2 C_2} = \frac{1}{2\pi \times 2R \times 0.1C}$$

$$= \frac{1}{0.4\pi} \times \frac{1}{RC} = \frac{2\pi \times 10^7}{0.4\pi}$$

$$f_H = 5 \times 10^7 \text{ Hz} = 50 \text{ MHz}$$

*End of Solution*

**Q.8** Identify correct statement regarding ideal op-amp.

(a) Output impedance is infinite.
(b) Input impedance is infinite.
(c) Open loop common mode gain is infinity.
(d) Open loop differential mode gain is infinite.

**Ans.** (b, d)

*End of Solution*

**Q.9** Identify the correct statements.

(a) Common source amplifiers have infinite input resistance.
(b) Common gate amplifiers have infinite input resistance.
(c) $V_{in}$ and $V_0$ of common drain amplifier are in-phase.
(d) $V_{in}$ and $V_0$ of common source amplifier are in-phase.

**Ans.** (a, c)

*End of Solution*

## COMMUNICATION SYSTEMS

**Q.10** Maximum peak frequency deviation of a frequency modulated signal

$$S(t) = A_c \cos[\omega_c t + 3 \sin 2\pi f_1 t + 4 \sin 6\pi f_1 t]$$

is

(a) $f_1$ (b) $12f_1$

(c) $15f_1$ (d) $2f_1$

**Ans.** (c)

$$S(t) = A_c \cos[\omega_c t + 3 \sin 2\pi f_1 t + 4 \sin 6\pi f_1 t]$$

Maximum frequency, $\Delta f = \left|\frac{1}{2\pi}\frac{d}{dt}\phi(t)\right|_{max}$

$$S_{Fm}(t) = A_c \cos[\omega_c t + \phi(t)]$$

From comparison, $\phi(t) = 3 \sin 2\pi f_1 t + 4 \sin 6\pi f_1 t$

$$\Delta f = \left|\frac{1}{2\pi}[3 \times 2\pi f_1 \cos 2\pi f_1 t + 4 \times 6\pi f_1 \cos 6\pi f_1 t]\right|_{max}$$

$$= |3f_1 \cos 2\pi f_1 t + 12 f_1 \cos 6\pi f_1 t|_{max}$$

$$= 3f_1 + 12f_1$$

$$= 15f_1$$

*End of Solution*

**Q.11** Find minimum hamming distance $d_{min}$

$$G = \begin{bmatrix} 100101 \\ 010011 \\ 001110 \end{bmatrix}$$

**Ans.** (3)

Minimum number of columns of G matrix that sum to zero equals to $d_{min}$

For given 'G', sum of 3 columns equals to zero

i.e. sum of 1st , 2nd , 6th columns

(or) sum of 2nd, 3rd and 5th columns

(or) sum of 4th, 5th, 6th columns equal to zero.

So that $d_{min}$ equal to 3.

*End of Solution*

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## CONTROL SYSTEM

**Q.12** Characteristics equation of a system is given by

$s^5 + 7s^4 + 3s^3 - 33s^2 + 2s - 40 = 0$

$L$ is define as number of roots on negative real axis.

I is define as number of roots lie on imaginary axis.

$R$ is define as number of roots lies on positive real axis.

then, which of the following option is correct?

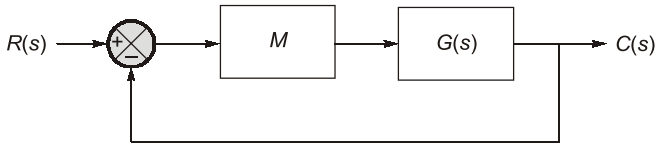
(a) $P = 3, I = 2, R = 0$ (b) $P = 2, I = 2, R = 1$

(c) $P = 0, I = 2, R = 3$ (d) $P = 1, I = 4, R = 0$

**Ans.** (b)

*End of Solution*

**Q.13** Consider the system shown below:




where $G(s) = \frac{10}{s^2}$

(i) $R(s) = \frac{K_I}{s}$ then system will never be stable.

(ii) $R(s) = (K_P + sK_D)$ then there is atleast one value of $K_P$ and $K_D$ where system become stable.

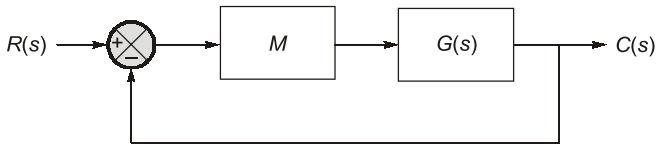
Which of the above statement(s) is/are true?

(a) (i) is true (b) (ii) is true

(c) (i) and (ii) both are true (d) (i) and (ii) both are false

**Ans.** (c)

Given,




and $G(s) = \frac{1}{s^2}$

(i) Given, $M = \frac{K}{s}$, then closed loop system,

$$\frac{C(s)}{R(s)} = \frac{M\,G(s)}{1+M\,G(s)} = \frac{\frac{K}{s}\times\frac{1}{s^2}}{1+\frac{K}{s}+\frac{1}{s^2}} = \frac{K}{s^3+K}$$

$\therefore$ For all values of '$K$', the closed loop system is unstable.

(ii) For controller, $M = K_P + K_D s$

Let, $M = 1 + s$

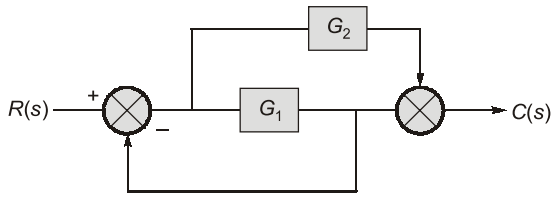
$$\therefore \quad \frac{C(s)}{R(s)} = \frac{(1+s)\times\frac{1}{s^2}}{1+\frac{s+1}{s^2}} = \frac{(s+1)}{s^2+s+1}$$

$\therefore$ Closed loop system is stable.

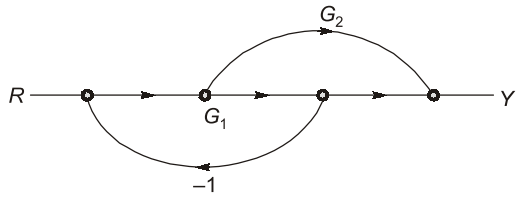
$\therefore$ Both statements are correct.

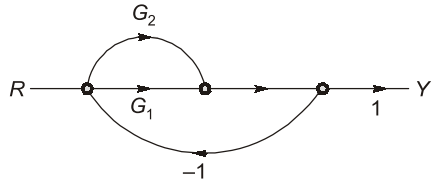
*End of Solution*

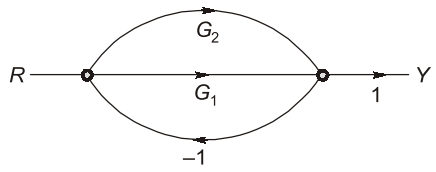
**Q.14** Consider the system having block diagram given as

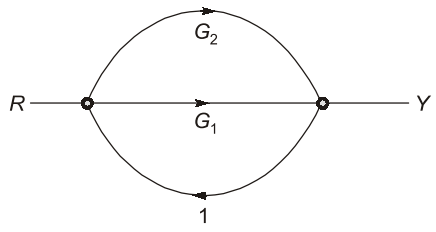



The equivalent signal flow graph for the given block diagram is/are

(a)



(b)



(c)



(d)


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**Ans.** (a)

From given block diagram,

$$\frac{C(s)}{R(s)} = \frac{G_1 + G_2}{1 - G_1}$$

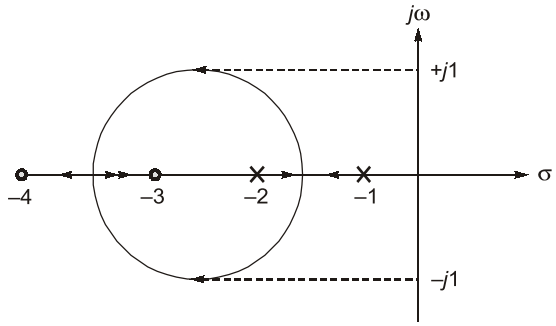
and in options, from option (a),

$$\frac{Y(s)}{R(s)} = \frac{G_1 + G_2}{1 - G_1}$$

$\therefore$ Option (a) only satisfies.

*End of Solution*

**Q.15** Consider an open loop system with root locus as shown below:




Then the value of '$K$' for which $(-1 + j)$ lies on the root locus is _____.

**Ans.** (0.2)

From the given, Rootlocus plot,

Openloop transfer function,

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

Given, $(-1 + j)$ is on Rootolcus,

$$\therefore \quad \left|\frac{k(s+3)(s+4)}{(s+1)(s+2)}\right| = 1$$

$$s = (-1 + j)$$

$$\left|\frac{k(3-1+j)(4-1+j)}{(2-1+j)}\right| = 1$$

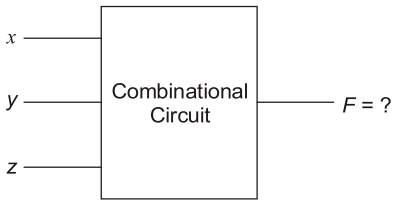
$$\frac{k\left(\sqrt{4+1}\times\sqrt{9+1}\right)}{\sqrt{1+1}} = 1$$

$$\therefore \quad k = \frac{\sqrt{2}}{\sqrt{5}\times\sqrt{10}} = \sqrt{\frac{2}{50}} = \frac{1}{5}$$

*End of Solution*

## DIGITAL CIRCUITS

**Q.16** The following figure represents a combinational circuit having input variables as $x$, $y$ and $z$. The combinational circuit's output is 'high' for majority of the input bits 'high' and output is 'low' for majority of the input bits are 'low'. Then the output logic expression can be




(a) $x \oplus y \oplus z$

(b) $x + y + z$

(c) $xy + yz + zx$

(d) $xyz$

**Ans.** (c)

Given inputs are,

| $X$ | $Y$ | $Z$ | $F$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

From 3-variable k-map:

| x′ | $\bar{y}\bar{z}$ | $\bar{y}z$ | $yz$ | $y\bar{z}$ |
|---|---|---|---|---|
| $\bar{x}$ | | | (1) | |
| $x$ | | (1) | (1) | (1) |

$\therefore \quad F = yz + xy + xz$

*End of Solution*

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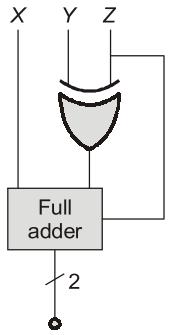
**Q.17** In the given circuit, if $Z$ is connected as carry to the full adder if $Z = 1$, the below circuit with respect to inputs $X$, $Y$ acts as

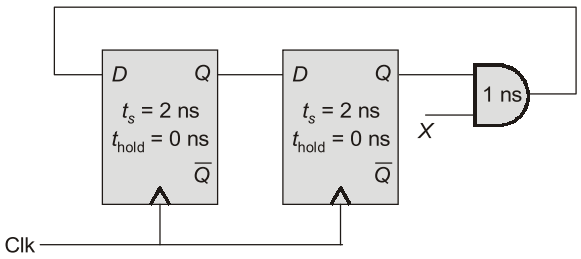



(a) a subtractor
(b) an adder
(c) binary to grey code
(d) multiplication

**Ans.** (a)

*End of Solution*

**Q.18** What is the maximum frequency for Clk in MHz if clock to Q delay of each flip-flop is 2 nsec.




**Ans.** (200)

Given,

$$t_{pd} = 2n \text{ sec}$$
$$t_{setup}\ (t_s) = 2n \text{ sec}$$
$$t_{comb} = 1n \text{ sec}$$
$$T_{clk_{D1}} = t_p + t_s + t_{comb} = 2 + 2 + 1 = 5n \text{ sec}$$
$$T_{clk_{D2}} = t_s + t_p = 2 + 2 = 4n \text{ sec}$$

$\therefore$ Time required for clock,

$$T_{clk} = \text{Max}\{T_{clk_{D1}}, T_{clk_{D1}}\}$$
$$= \text{Max}\ [5\text{ns}, 4\text{ ns}]$$
$$= 5 \text{ ns}$$

Maximum frequency, $f_{mx} = \dfrac{1}{T_{clk}} = \dfrac{1}{5ns} = 200$ MHz.

*End of Solution*

## ELECTROMAGNETICS

**Q.19** In a transmission line whose characteristic impedance is ($Z_o$ = 50 Ω) and is terminated with a load of $Z_L = (50 - j75)\Omega$. The average input power is $P_{in}$ = 10 mW, then the average power delivered to the load is _____mW.

**Ans.** (6.4)

$$Z_0 = 50\ \Omega, \quad Z_L = 50 - j75\ \Omega; \quad P_{in} = 10\ \text{mW}$$

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{50 - j75 - 50}{50 - j75 + 50}$$

$$= \frac{-j75}{100 - j75} = \frac{-j3}{4 - j3}$$

$$\Rightarrow \quad |\Gamma| = \frac{3}{5} = 0.6$$

$$\therefore \quad P_{\text{del}} = \left\{1 - |\Gamma|^2\right\} P_i$$

$$= [1 - (0.6)^2] * 10\ \text{mW} = 6.4\ \text{mW}$$

*End of Solution*

## ELECTRONIC DEVICES AND CIRCUITS

**Q.20** Which of the following impurities can be called is n-type dopant?

(a) Gallium (b) Phosphorus
(c) Boron (d) Arsenic

**Ans.** (b, d)

*End of Solution*

**Q.21** $n_i = 2.5 \times 10^{16}\ \text{m}^{-3}$; $\mu_n = 0.15\ \text{m}^2/\text{V-sec}$; $\mu_p = 0.05\ \text{m}^2/\text{V-sec}$
Find intrinsic resistivity in kΩ-m.

**Ans.** (1.25)

Intrinsic resistivity, $\rho_i = \dfrac{1}{n_i q(\mu_p + \mu_n)}$

$$= \frac{1}{2.5 \times 10^{16} \times 1.6 \times 10^{-19}(0.15 + 0.05)}$$

$$= \frac{1}{2.5 \times 10^{16} \times 1.6 \times 10^{-19}(0.2)}$$

$$\rho_i = 1.25\ \text{k}\Omega\text{-m}$$

*End of Solution*

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**Q.22** An electric field of 0.01 V/m is applied along the length of a copper wire of a circular cross-section with a diameter of 1 mm conductivity of copper is $5.8 \times 10^7$ s/m. Current flowing through wire is _____ A.

**Ans.** **(0.45)**

Given, $E = 0.01$ V/m,

$\sigma = 5.8 \times 10^7$ s/m

$\therefore$ $I = \sigma EA$

$$= 5.8\times10^7 \times 0.01 \times \frac{\pi(10^{-3})^2}{4}$$

$I = 0.45$ A

*End of Solution*

**Q.23** In a semiconductor, mobility of electrons, $\mu_n = 0.38$ m$^2$/V-sec at temperature 300 K, then the diffusion coefficient of electrons at temperature 300 K is _____ cm$^2$/V-sec (upto two decimal places)

**Ans.** **(98.26)**

Given, $\mu_n = 0.38$ m$^2$/V-sec

$$D_n = \mu_n V_T$$

$$= 0.38 \times \frac{T}{11600}$$

$$= 0.38 \times \frac{300}{11600}$$

$$= 0.02586 \times 0.38$$

$$= 0.09826 \text{ m}^2/\text{sec}$$

$D_n = 98.26$ cm$^2$/sec

*End of Solution*

## ENGINEERING MATHEMATICS

**Q.24** The condition for which rank of matrix should be at least 3 is/are :

$$A = \begin{bmatrix} 2 & 3 & 4 & 5 \\ 0 & 6 & 7 & 8 \\ 0 & 0 & \alpha & \beta \\ 0 & 0 & 0 & \gamma \end{bmatrix}$$

(a) $\alpha = 0, \beta = \gamma \neq 0$ (b) $\alpha = \beta = \gamma = 0$

(c) $\beta = \gamma = 0, \alpha \neq 0$ (d) $\alpha = \beta = \gamma \neq 0$

**Ans.** **(a, c, d)**

*End of Solution*

**Q.25** For the given function :

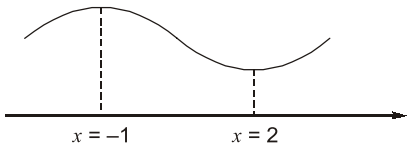
$$f(x) = 2x^3 - 3x^2 - 12x + 1$$

(a) Local maxima at $x = 2$ (b) Local minima at $x = -1$

(c) Global maxima does not exist (d) Global minima does not exist

**Ans.** **(c, d)**

$$f(x) = 2x^3 - 3x^2 - 12x + 1$$
$$f'(x) = 6x^2 - 6x - 12$$
$$f'(x) = 0$$
$$6x^2 - 6x - 12 = 0$$
$$6(x^2 - x - 2) = 0$$
$$6(x - 2)(x + 1) = 0$$
$$x = 2$$
$$x = -1$$
$$f''(x) = 12x - 6$$
$$f''(x)\big|_{x=2} = 12 \times 2 - 6$$
$$= 18 > 0$$
$x = 2 \Rightarrow$ local minima
$$f''(x)\big|_{x=-1} = 12 \times -1 - 6$$
$$= -12 - 6$$
$$= -18 < 0$$
$x = -1 \Rightarrow$ local maxima




So function has neither global maxima nor global minima.

*End of Solution*

# ESE 2025 Prelims
# Offline Test Series

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## Total 22 Tests

### Paper-I : 11 Tests
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### Paper-II : 11 Tests
**Engineering Discipline**

- 8 Multiple Subject Tests of 75 Questions (**600 Ques**) *Time : 90 minutes*
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**Q.26** Two fair dices are rolled and random variable $X$ denotes the sum of out comes then expected value of $X$ = ?

**Ans.** **(7)**

Sum of two dice = {2, 3, 4, 5, ....., 12}

| $x$ | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P(x)$ | $\frac{1}{36}$ | $\frac{2}{36}$ | $\frac{3}{36}$ | $\frac{4}{36}$ | $\frac{5}{36}$ | $\frac{6}{36}$ | $\frac{5}{36}$ | $\frac{4}{36}$ | $\frac{3}{36}$ | $\frac{2}{36}$ | $\frac{1}{36}$ |

$$E(X) = \sum x \cdot P(x)$$

$$= 2\times\frac{1}{36}+3\times\frac{2}{36}+4\times\frac{3}{36}+5\times\frac{4}{36}+6\times\frac{5}{36}+7\times\frac{6}{36}$$

$$+8\times\frac{5}{36}+9\times\frac{4}{36}+10\times\frac{3}{36}+11\times\frac{2}{36}+12\times\frac{1}{36}$$

$$= \frac{252}{36} = 7$$

*End of Solution*

**Q.27** Contour integral evaluated over counter clockwise on the unit circle '$c$' in the complex plane, then choose the correct one?

(a) $\oint_c \cos z\, dz = 0$

(b) $\oint_c z^n\, dz = 0$, $n$ = even positive integer

(c) $\oint_c \sec z\, dz \neq 0$

(d) $\oint e^z\, dz = 0$

**Ans.** **(b, d)**

*End of Solution*

**Q.28** For $a = \begin{bmatrix}1\\1\end{bmatrix}$ and $b = \begin{bmatrix}0\\3\sqrt{2}\end{bmatrix}$ the value of $\min_x \|ax-b\|$ is _____.

**Ans.** **(3)**

$$ax - b = \begin{bmatrix}x\\x-3\sqrt{2}\end{bmatrix}$$

$$\left\|\begin{matrix}x\\x-3\sqrt{2}\end{matrix}\right\| = f(x) = \text{norm}$$

$$f(x) = \sqrt{x^2+(x-3\sqrt{2})^2}$$

$$= \sqrt{x^2+x^2+18-6\sqrt{2}\,x}$$

$$f(x) = \sqrt{\underbrace{2x^2-6\sqrt{2}x+18}_{g(x)}}$$

$$g(x) = 2x^2 - 6\sqrt{2}x + 18$$

$$g'(x) = 4x - 6\sqrt{2} = 0$$

$$x = \frac{6\sqrt{2}}{4} = \frac{3\sqrt{2}}{2} = \frac{3}{\sqrt{2}}$$

$$\text{Point of minima} = \frac{3}{\sqrt{2}}$$

$$f(x)\big|_{x=\frac{3}{\sqrt{2}}} = \sqrt{2\left(\frac{3}{\sqrt{2}}\right)^2 - 6\sqrt{2}\times\frac{3}{\sqrt{2}} + 18}$$

$$= \sqrt{9 - 18 + 18}$$

$$= 3$$

*End of Solution*

**Q.29** If $t^2y''(t) - 2ty'(t) + 2y(t) = 0$, $y'(0) = 1$, $y'(1) = -1$, then maximum value of $y(t)$ over $[0, 1]$ is

(a) 0.1 (b) 0.5

(c) 0.75 (d) 0.25

**Ans.** **(d)**

Cauchy's Euler differential equation,

$$x = e^t$$

$$t = e^u$$

$$\ln t = u$$

$$t^2y''(t) - 2ty'(t) + 2y(t) = 0$$

$$D(D-1)y - 2Dy + 2y = 0$$

$$(D^2 - D - 2D + 2)y = 0$$

$$(D^2 - 3D + 2)y = 0$$

A.E.

$$m^2 - 3m + 2 = 0$$

$$m = 1, 2$$

$$y = C_1e^u + C_2e^{2u}$$

$$y = C_1t + C_2t^2$$

$$\frac{dy}{dt} = C_1 + C_2 \times 2t$$

at $t = 0$, $\frac{dy}{dt} = 1$

$\Rightarrow$ $C_1 = 1$

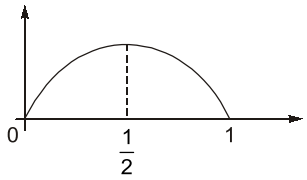
at $t = 1$, $\frac{dy}{dt} = -1$

$$-1 = 1 + C_2 \times 2 \times 1$$

$$-1 = 1 + 2C_2$$

$$-2 = 2C_2$$

$$C_2 = -1$$
$$y = C_1 t + C_2 t^2$$
$$y = t - t^2$$
$$\frac{dy}{dt} = 1 - 2t = 0$$
$$t = \frac{1}{2}$$




$$\frac{d^2y}{dt^2} = -2 < 0$$
$$t = \frac{1}{2} \Rightarrow \text{maxima point}$$
$$y\left(\frac{1}{2}\right) = \frac{1}{2} - \left(\frac{1}{2}\right)^2$$
$$= \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$

End of Solution

## GENERAL ENGLISH

**Q.30** Had I been active as a child, I _____ a famous actor.
(a) can be (b) could have been
(c) will be (d) might be

**Ans.** (b)

End of Solution

**Q.31** Abuse : Insult : Ridicule : : _____ : Praise : Appreciate
(a) Honour (b) Extol
(c) Appropriate (d) Prize

**Ans.** (b)

End of Solution

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|---|---|---|---|---|---|
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| 2 | 27th Feb 2025 | 75 Qs | 1 Hour | Part Syllabus Test | Basics of project Management, Information and communication technologies, Ethics and values in engineering profession, intellectual property rights, Role of science and technology in daily life, recent developments in applied sciences, basics of artificial intelligence and robotics |
| 3 | 6th Mar 2025 | 75 Qs | 1 Hour | Part Syllabus Test | Green Energy, Energy conversion principles, Climate change, Disaster Management, Basics of thermodynamics, Water resources and conservation processes, Basics of measurement and instrumentation, Human health and sanitation |
| 4 | 13th Mar 2025 | 75 Qs | 1 Hour | Part Syllabus Test | General Hindi |
| 5 | 20th Mar 2025 | 75 Qs | 1 Hour | Part Syllabus Test | Indian History, Indian Polity, Geography, GK & Miscellaneous and Current Affairs |
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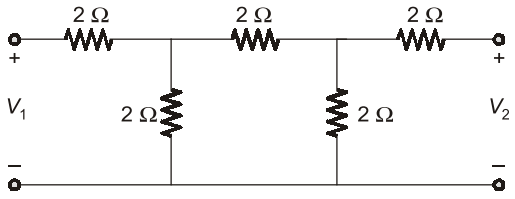
| For Non-MADE EASY Students | For MADE EASY GATE & ESE Batch Students (Old/Current) | For MADE EASY AE/JE Batch Students (Old/Current) | For UPPSC-AE Batch Students |

## NETWORK THEORY

**Q.32** Consider the following circuit.




The $Z$ parameter of the circuit is

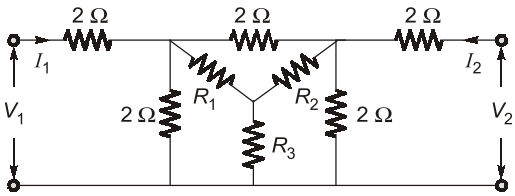
(a) $\begin{bmatrix} \frac{10}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{10}{3} \end{bmatrix}$

(b) $\begin{bmatrix} \frac{10}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{10}{3} \end{bmatrix}$

(c) $\begin{bmatrix} \frac{10}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{2}{3} \end{bmatrix}$

(d) $\begin{bmatrix} \frac{2}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{2}{3} \end{bmatrix}$

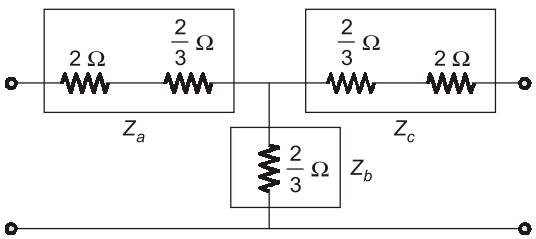
**Ans.** (a)




$$R_1 = \frac{2\times 2}{2+2+2} = \frac{2}{3}\Omega$$

$$R_1 = \frac{2}{3}\Omega$$

$$R_3 = \frac{2}{3}\Omega$$



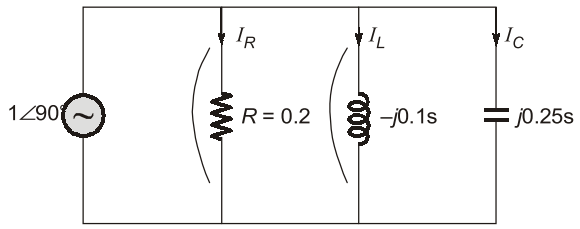

$$Z_{11} = Z_a + Z_b = \frac{10}{3}\Omega$$

$$Z_{22} = Z_b + Z_c = \frac{10}{3}\Omega$$

$$Z_{12} = Z_{21} + Z_b = \frac{2}{3}\Omega$$

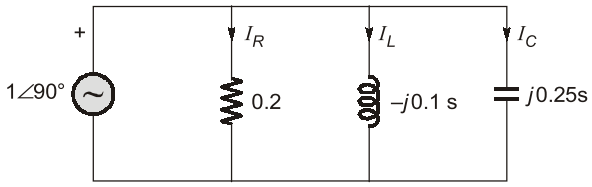
End of Solution

**Q.33** Find the value of $I_R$, $I_L$ and $I_C$?




(a) $I_C = 0.25\angle 180°$, $I_L = 0.1\angle 0°$, $I_R = 0.2\angle 90°$
(b) $I_C = 0.2\angle 180°$, $I_L = 0.1\angle 0°$, $I_R = 0.25\angle 90°$
(c) $I_C = 0.25\angle 180°$, $I_L = 0.5\angle 0°$, $I_R = 0.5\angle 90°$
(d) $I_C = 0.5\angle 180°$, $I_L = 0.25\angle 0°$, $I_R = 0.2\angle 90°$

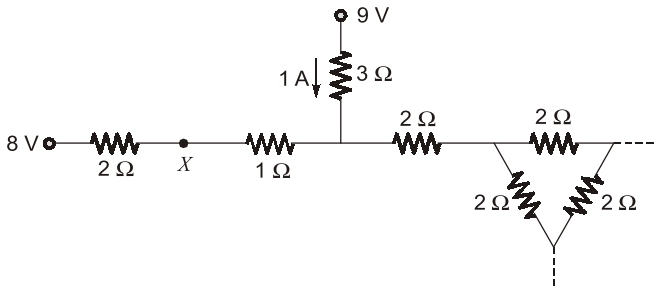
**Ans.** (a)




$I_R = 1\angle 90\ (0.2) = 0.2\angle 90°$
$I_L = 1\angle 90\ (0.1\angle -90) = 0.1\angle 0°$
$I_C = 1\angle 90\ (0.25\angle 90) = 0.25\angle 180°$

End of Solution

**Q.34** Consider the given part of a circuit given below:

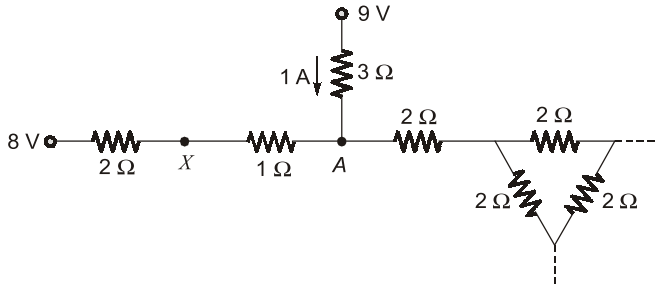



The voltage at node $X$ is _____.

(a) $\frac{20}{3}$ (b) $\frac{10}{3}$

(c) $\frac{3}{20}$ (d) $\frac{2}{3}$

Ans. (a)



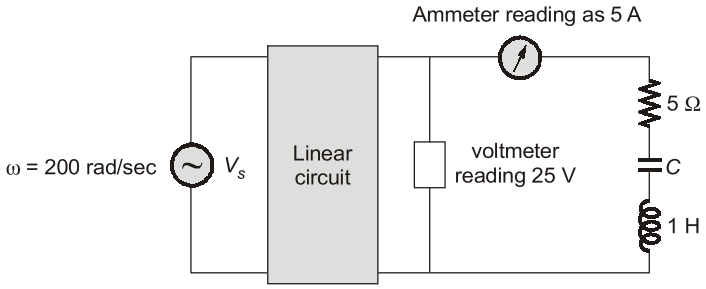

Voltage at node $A$ is $= 9 - (3 \times 1) = 6$ V

$$I_D = \frac{8-6}{2+1} = \frac{2}{3} \text{ V}$$

$$V_x = 8 - \left(2 \times \frac{2}{3}\right) = \frac{20}{3} \text{ V}$$

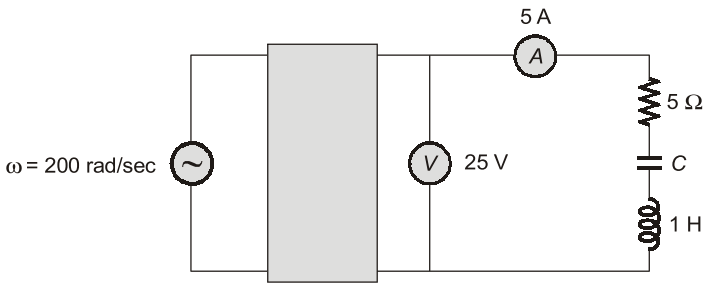
End of Solution

Q.35 Consider the circuit shown below,




Then the value of capacitor '$C$' is _____ μF.

Ans. (25)




$$X_L = \omega L = 200 \times 1 = 200\ \Omega$$

$$Z = \frac{V}{I} = \frac{25}{5} = 5\Omega$$

$$Z = R + j(X_L - X_C)$$

$$X_L = X_C$$

$$X_L = X_C = 200\ \Omega$$

$$\frac{1}{\omega C} = 200$$

# RRB-JE
## CBT-2 | 2024 Exam
## Online Test Series

MADE EASY

Launching

# 10 Full Syllabus Tests (Total 1500 Questions)

Commencing from **11th FEB 2025** | **Stream : CE, ME, EE, EC**

**Paper Pattern:**

- Each question carries 1 Mark.
- There will be a negative marking of 1/3rd Mark for every wrong answer.

**Test Series Features:**

- Questions crafted to align with the RRB-JE syllabus and exam format.
- Comprehensive, step-by-step solutions for tough questions.
- Detailed performance analysis report to track your progress.

**RRB JE CBT 2 Exam Pattern 2024**

| Subject | No. of Questions | Marks | Duration |
|---|---|---|---|
| General Awareness | 15 | 15 | 120 Mins |
| Physics & Chemistry | 15 | 15 | |
| Basics of Computers and Applications | 10 | 10 | |
| Basics of Environment and Pollution Control | 10 | 10 | |
| **Technical Abilities (CE/ME/EE/EC)** | **100** | **100** | |
| **Total** | **150** | **150** | |

**Test Series Schedule**

| Test No. | Activate Date | Total Marks | Total Questions | Total Time |
|---|---|---|---|---|
| 1 | 11th Feb 2025 | 150 Marks | 150 Qs | 2 Hours |
| 2 | 14th Feb 2025 | 150 Marks | 150 Qs | 2 Hours |
| 3 | 18th Feb 2025 | 150 Marks | 150 Qs | 2 Hours |
| 4 | 21st Feb 2025 | 150 Marks | 150 Qs | 2 Hours |
| 5 | 25th Feb 2025 | 150 Marks | 150 Qs | 2 Hours |
| 6 | 28th Feb 2025 | 150 Marks | 150 Qs | 2 Hours |
| 7 | 4th Mar 2025 | 150 Marks | 150 Qs | 2 Hours |
| 8 | 7th Mar 2025 | 150 Marks | 150 Qs | 2 Hours |
| 9 | 11th Mar 2025 | 150 Marks | 150 Qs | 2 Hours |
| 10 | 14th Mar 2025 | 150 Marks | 150 Qs | 2 Hours |

Fee: ₹500/-

$$\frac{1}{200\times C} = 200$$

$$C = \frac{1}{200\times 200} = 25\mu F$$

*End of Solution*

## REASONING AND APTITUDE

**Q.36** A pot has 4 balls, 2 red and 2 blue. Probability that 2 balls are drawn randomly without replacement which are of different colour?

(a) $\frac{2}{3}$ (b) $\frac{1}{3}$

(c) $\frac{1}{2}$ (d) None of the above

**Ans.** **(a)**

4 → Total balls

2 → Red balls

2 → Blue balls

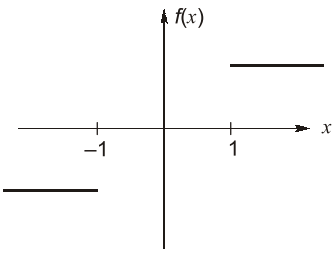
Probability that 2 balls drawn randomly which are of different colour is,

$$P = \frac{{}^2C_1\times {}^2C_1}{{}^4C_2} = \frac{4}{6} = \frac{2}{3}$$ [∵ without replacement]

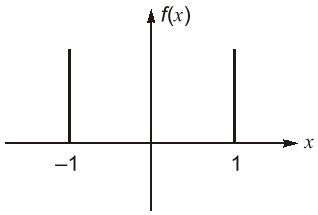
*End of Solution*

**Q.37** Which of the following is the correct representation for the function $f(x) = \frac{-|x|}{x}$?

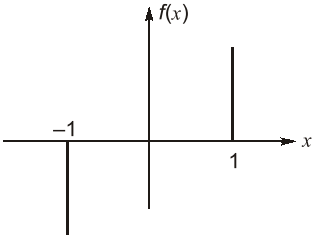
(a)



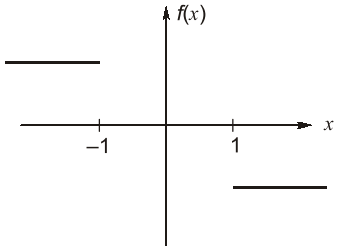

(b)




(c)




(d)



**Ans.** (d)

Given, $f(x) = -\dfrac{|x|}{x}$

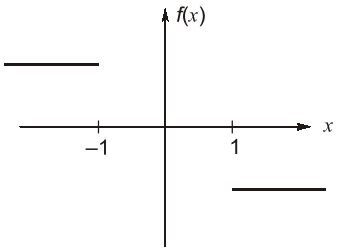
We know, $|x| = \begin{cases} x; & x \geq 0 \\ -x; & x < 0 \end{cases}$

$f(1) = \dfrac{-1}{1} = -1$ $\qquad$ $f(2) = \dfrac{-2}{2} = -1$

$f(-1) = \dfrac{-1}{-1} = 1$ $\qquad$ $f(-2) = \dfrac{-2}{-2} = 1$

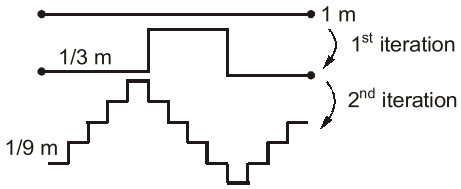
$\therefore$ If $x > 0$; $\quad f(x) = -\dfrac{x}{x} = -1$

If $x < 0$; $\quad f(x) = -\dfrac{(-x)}{x} = 1$




*End of Solution*

**Q.38** Consider the following iterations for which the length of the wire as given:

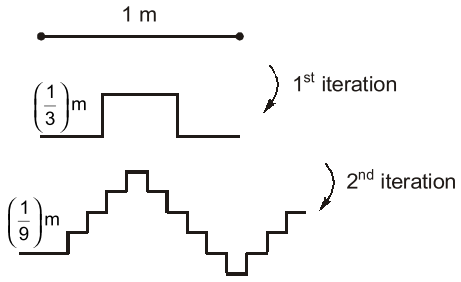



After $n^{th}$ interation, the length of the wire is

(a) $\left(\dfrac{1}{3}\right)^n$ $\qquad$ (b) $\left(\dfrac{1}{9}\right)^n$

(c) $\left(\dfrac{5}{3}\right)^n$ $\qquad$ (d) $\left(\dfrac{5}{3}\right)^{2n}$

**Ans.** (c)




| Iteration | | Length |
|---|---|---|
| 0 | → | 1 |
| 1 | → | $\left(\frac{1}{3}\right)\times 5$ |
| 2 | → | $\left(\frac{1}{9}\right)\times 25$ |
| $n^{th}$ | → | $\left(\frac{1}{3}\right)^n \times (5)^n = \left(\frac{5}{3}\right)^n$ |

*End of Solution*

**Q.39** A company charges consultation fee if its 5,00,000 then overhead is 20% of it. If consultation fee is greater than 5,00,000 then overhead is 10% of the difference by which consultation fee is greater than 5,00,000 plus 1,00,000 and a tax of 18% is charged on total of consultation fee + overhead from client. If client can pay only 10,00,000 then maximum consultation fee an employee can pay is

**Ans.** (725000)

Let, consultation fee = $X$

**Case (i):** If $X \le 500000$

Overhead = 20% of $X$ = $0.2X$

Total cost = $X + 0.2X = 1.2X$

$$\text{Tax} = 18\% \text{ of } 1.2X = \left(\frac{18}{100}\right)1.2X = 0.216X$$

Total amount paid by client = $1.2X + 0.216X = 1.416X$

Given that, the client can only pay 1000000

$\Rightarrow \quad 1.416X = 1000000$

$\Rightarrow \quad X \approx 706215$

**Case (ii):** If $X > 500000$

Overhead = $100000 + 10\% [X - 500000]$

$= 100000 + 0.1 [X - 500000]$

Total cost = $X + 100000 + 0.1 [X - 500000]$

$= 1.1X + 50000$

$$\text{Tax} = \frac{18}{100}(1.1X + 50000) = 0.198X + 9000$$

Total amount paid by client $= 1.1X + 50000 + 0.198X + 9000$

$= 1.298X + 59000$

Given that, the client can only pay 1000000

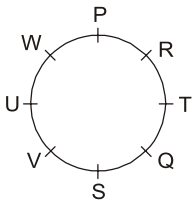
$\Rightarrow \quad 1.298X + 59000 = 1000000$

$\Rightarrow \quad X \approx 725000$

$\therefore$ Maximum consultation fee that the client can afford = 725000

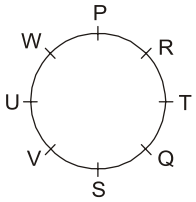
*End of Solution*

**Q.40** In dance chair game, after first round behind P, 4th person left.
After 2nd round behind Q 3rd person is left.
After 3rd round behind V 3rd person is left.
After 4th round behind U 4th person is left.
Then at the end of the 4th round who will left in the game?




(a) P, T, Q, U
(b) P, T, S, U
(c) P, W, Q, S
(d) W, T, Q, V

**Ans.** (a)




After 1st round – Behind P, 4th person left

$\Rightarrow$ S eliminated

Remaining players: P, R, T, Q, V, U, W

After 2nd round – Behind Q, 3rd person left

$\Rightarrow$ W eliminated

Remaining players: P, R, T, Q, V, U

After 3rd round – Behind V, 3rd person left

$\Rightarrow$ R eliminated

Remaining players: P, T, Q, V, U

After 4th round – Behind U, 4th person left

$\Rightarrow$ V eliminated

$\therefore$ Remaining players: P, T, Q, U

*End of Solution*

# Check Your Expected

# Rank & GATE Score

*by*

## MADE EASY
## Rank Predictor

Once GATE releases the Response Sheet.

The link will be live
on the homepage of **www.madeeasy.in**
on the day of the response sheet release.

**Q.41** The music has notes C, D, #D, E, #E, F #F, G, #G, H. The note "C" has frequency 1.038 Hz. Each frequency note has frequency $\sqrt[12]{2}$ times the previous note. The ratio of frequencies of #F to C is _____.

(a) $\sqrt[2]{2}$ (b) $\sqrt{2}$

(c) 1 (d) $\sqrt[6]{2}$

**Ans.** **(b)**

Given, Common ratio = $\sqrt[12]{2} = (2)^{1/12}$

#F $\rightarrow$ $7^{th}$ term

C $\rightarrow$ $1^{st}$ term

$$\Rightarrow \quad \frac{7^{th}\text{ term}}{1^{st}\text{ term}} = \frac{1.038\times\left[(2)^{1/12}\right]^6}{1.038} = (2)^{1/2} = \sqrt{2}$$

*End of Solution*

## SIGNALS AND SYSTEMS

**Q.42** If $f(t)$ has Fourier series coefficient $C_k$ and $y(t)$ has Fourier series coefficient $d_k$, then which of the following is/are true for $y(t) = f(\alpha t)$?

where,
$$f(t) = \sum_{n=-\infty}^{\infty} C_k\, e^{-jn\frac{2\pi}{T_0}t}$$

$$y(t) = \sum_{n=-\infty}^{\infty} d_k \cdot e^{-jn\frac{2\pi}{T_0}\alpha t}$$

(a) $C_k = d_k \ \forall K$

(b) $C_k = \alpha d_k$

(c) If time period of $f(t)$ is $T_o$, then time period of $f(\alpha T) = \dfrac{T_o}{\alpha}$

(d) If time period of $f(t)$ is $T_o$, then time period of $f(\alpha T) = \alpha T_o$

**Ans.** **(a, c)**

$$f(t) = \sum_{n=-\infty}^{\infty} C_k\, e^{-jn\frac{2\pi}{T_0}t}$$

Put $t = \alpha t$:

$$f(\alpha t) = \sum_{n=-\infty}^{\infty} C_k\, e^{-jn\frac{2\pi}{T_0}(\alpha t)}$$

$$\Rightarrow \quad y(t) = \sum_{n=-\infty}^{\infty} C_k\, e^{-jn\left(\frac{2\pi}{\left(\frac{T_0}{\alpha}\right)}\right)t}$$

$$y(t) = \sum_{n=-\infty}^{\infty} d_k\, e^{-jn\frac{2\pi}{T_0'}t}$$

$$= \sum_{n=-\infty}^{\infty} d_k \cdot e^{-jn\omega_0' t}$$

For $y(t)$: $d_k = C_k$, $\omega_0' = \alpha\omega_0$ or $T_0' = \dfrac{T_0}{\alpha}$

where $T_0'$ = Fundamental period of $y(t)$

$\omega_0'$ = Fundamental frequency of $y(t)$

*End of Solution*

**Q.43** Consider the following statements:
(a) The ROC of $\delta[n]$ contains entire z-plane.
(b) DTFT exists for all the signals for which z-transform exists.
(c) DTFT of a signal exists only if ROC of a signal contains unit circle.
(d) The ROC of signal may include both poles and zeros.
Which of the above statements are true for a discrete time signal?

**Ans.** (a, c)

*End of Solution*

■■■■