



**GATE
2025**

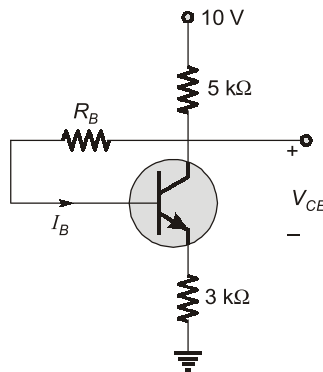
Electronics Engineering

Memory based
Questions & Solutions

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

ANALOG CIRCUITS

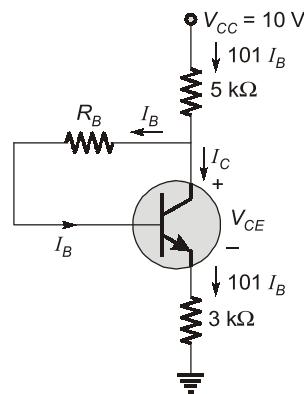
Q.1 Consider the following circuit:



If $I_B = 10 \mu\text{A}$ and $\beta = 100$, then V_{CE} is _____.

Ans. (1.92)

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



By KVL:

$$I_B = 0.01 \text{ mA}$$

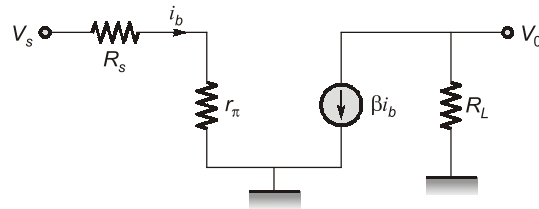
$$10 = 5 \times 101 I_B + V_{CE} + 3 \times 101 I_B$$

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

$$V_{CE} = 1.92 \text{ V}$$

End of Solution

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



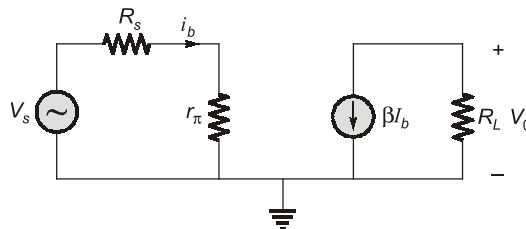
(a) $\frac{\beta R_L}{R_s + r_\pi}$

(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)

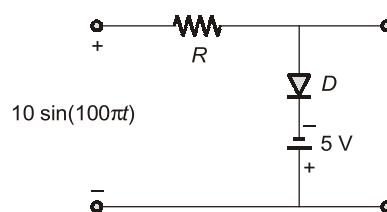


$$\frac{V_0}{V_s} = \frac{-\beta I_b \times R_L}{I_b (R_s + r_\pi)}$$

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

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,

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

$$f = 50 \text{ Hz}$$

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

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

$$\alpha = 100\pi t$$

Diode conducts if $V_i > -5 \text{ V}$

Diode is OFF if $V_i < -5 \text{ V}$



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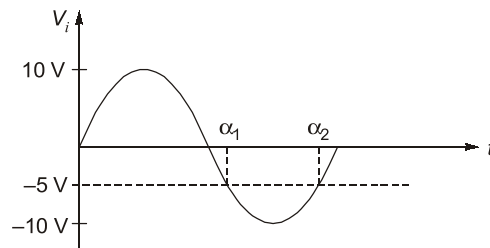
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$$10 \sin \alpha = -5$$

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

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

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

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

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

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

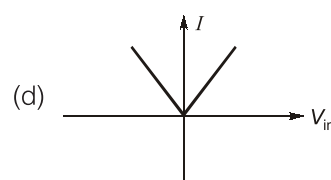
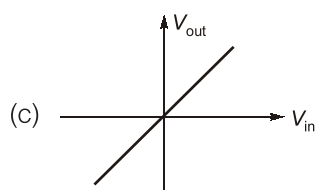
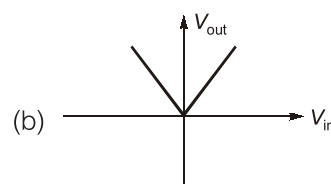
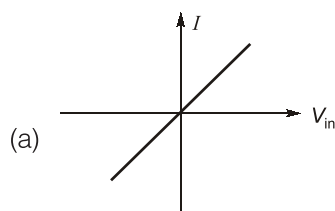
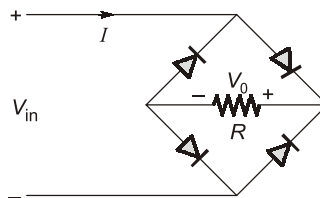
Diode is OFF from t_1 to t_2

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

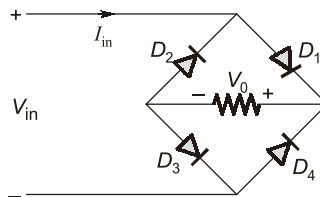
$$t_{\text{ON}} = T_0 - T_{\text{OFF}} = 13.33 \text{ msec}$$

End of Solution

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



Ans. (a, b)



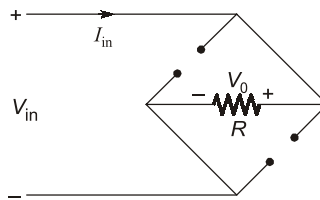
Given, V_{in} is steep of $-M$ to $+M$

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,



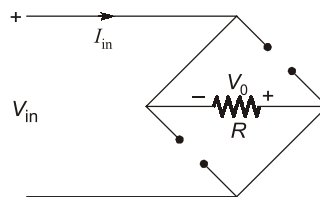
$$\therefore V_{in} - V_0 = 0 \Rightarrow V_{in} = V_0$$

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

Let $V_{IN} = -M$

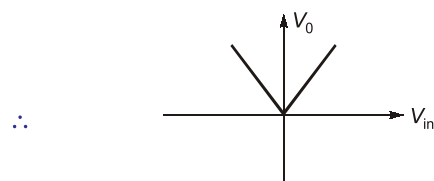
diodes, D_1 and D_3 are reverse bias,

D_2 and D_4 are forward bias.



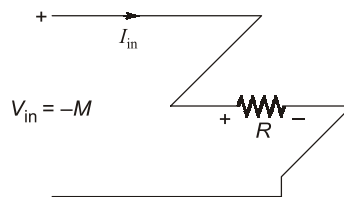
$$\therefore V_{in} + V_0 = 0$$

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



For I_{in} Versus V_{in} :

Let $V_{in} = +M$



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



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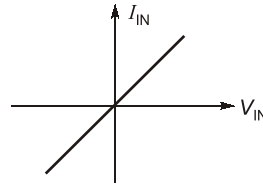
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$$\therefore \text{if } V_{in} = M \Rightarrow I_{IN} = \frac{M}{R}$$

$$\text{Let } V_{in} = -M$$

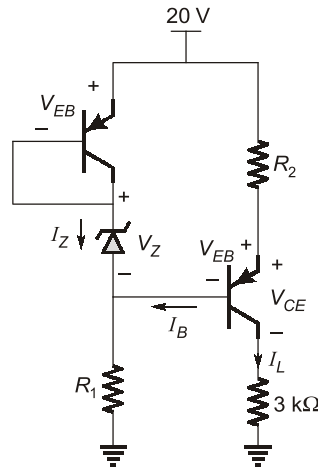
$$\begin{aligned} \therefore V_{in} - I_{NR} &= 0 \\ V_{in} &= I_{IN} R \\ -M &= I_{IN} R \end{aligned}$$

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



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.



- (a) 1.2 k Ω and 0.8 k Ω
(c) 0.6 k Ω and 0.4 k Ω

- (b) 0.5 k Ω and 0.7 k Ω
(d) 0.8 k Ω and 0.6 k Ω

Ans. (c)

$$I_{C2} = I_L = 12 \text{ mA}$$

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

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

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

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

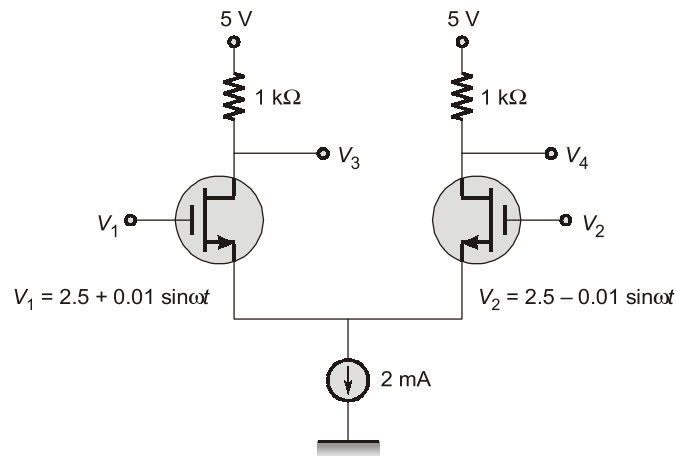
$$I_2 = I_{E2} = (1 + \beta) I_{B2} = 12.1 \text{ mA}$$

KVL: $20 = I_2 R_2 + 0.7 + I_1 \times R_1$

$$R_2 = \frac{20 - 0.7 - 14.3}{12.1} = 0.4 \text{ k}\Omega$$

End of Solution

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



- (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)

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

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

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

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

$$g_m = 5 \text{ ms}$$

Given,

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

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

$$V_o = -0.05 \sin \omega t$$

AC voltage,

DC voltage,

$$V_o = 5 - 1 \times I_{DS} = 4 \text{ V}$$

In given circuit,

$$A_{CM} = 0$$

Hence, common mode input effect is cancelled.

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

End of Solution



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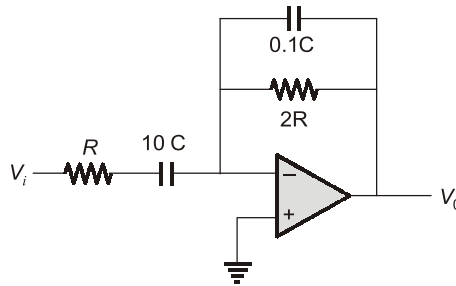
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Q.7 Find high frequency (f_H), if $f_L = 1$ MHz.



Ans. (50)

We know that,

$$f_L = \frac{1}{2\pi R_1 C_1}$$

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

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

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

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

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

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_o of common drain amplifier are in-phase.
- (d) V_{in} and V_o 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, $\phi(t) = 3 \sin 2\pi f_1 t + 4 \sin 6\pi f_1 t$

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

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

$$= 3f_1 + 12f_1$$

$$= 15f_1$$

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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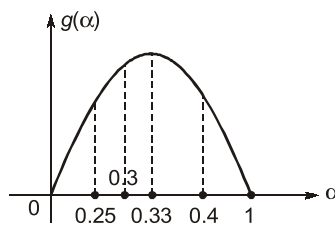
Q.12 A source has $\{-1, 0, 1\}$ symbols with probability of symbols '1' and '0' is ' α ' and probability of '1' is ' $(1 - 2\alpha)$ '. Let $g(\alpha)$ be the entropy.

Which of the following conditions are true?

- | | |
|------------------------|------------------------|
| (a) $g(0.25) > g(0.3)$ | (b) $g(0.25) < g(0.3)$ |
| (c) $g(0.4) > g(0.3)$ | (d) $g(0.4) < g(0.3)$ |

Ans. (b, d)

$$\begin{aligned}
 g(\alpha) &= -\sum_i P_i \log_2 P_i \\
 &= -\alpha \log_2 \alpha - \alpha \log_2 \alpha - (1 - 2\alpha) \log_2 (1 - 2\alpha) \\
 g(\alpha) &= -[+2\alpha \log_2 \alpha + (1 - 2\alpha) \log_2 (1 - 2\alpha)]
 \end{aligned}$$



From graph $g(0.3) > g(0.4) > g(0.25)$

Options (b) and (d) are correct

Method 2:

$$\begin{aligned}
 g(0.3) &= 1.5709 \\
 g(0.4) &= 1.521 \\
 g(0.25) &= 1.5 \\
 g(0.3) &> g(0.4) > g(0.25)
 \end{aligned}$$

Options (b) and (d) are correct.

End of Solution

CONTROL SYSTEM

Q.13 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.

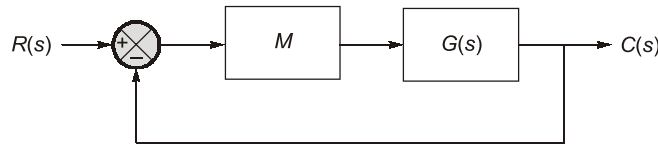
then, which of the following option is correct?

- (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.14 Consider the system shown below:



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

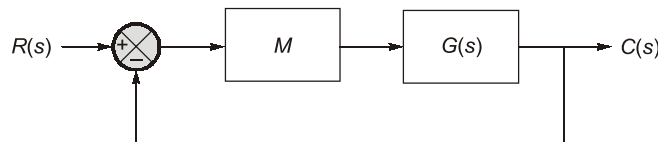
- (i) $R(s) = \frac{K_I}{s}$ then system will never be stable.
 (ii) $R(s) = (K_P + sK_D)$ then there is atleast one value of K_P and K_D where system become stable.

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,



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

∴ For all values of 'K', the closed loop system is unstable.

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

Let, $M = 1 + s$

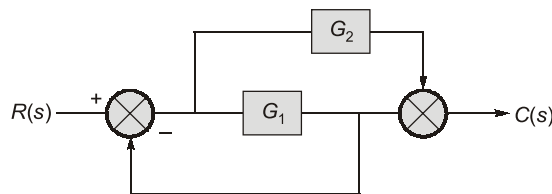
$$\therefore \frac{C(s)}{R(s)} = \frac{(1+s) \times \frac{1}{s^2}}{1 + \frac{s+1}{s^2}} = \frac{(s+1)}{s^2 + s + 1}$$

∴ Closed loop system is stable.

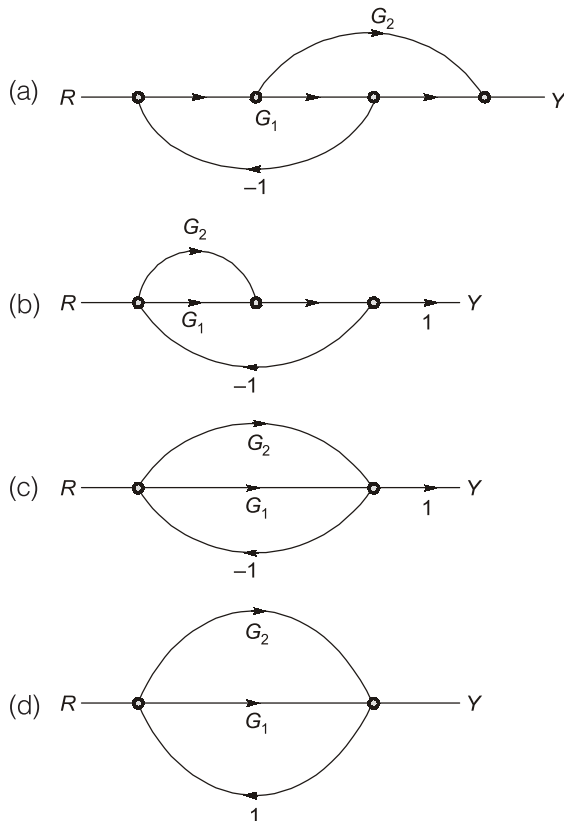
∴ Both statements are correct.

End of Solution

Q.15 Consider the system having block diagram given as



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



Ans. (a)

From given block diagram,

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

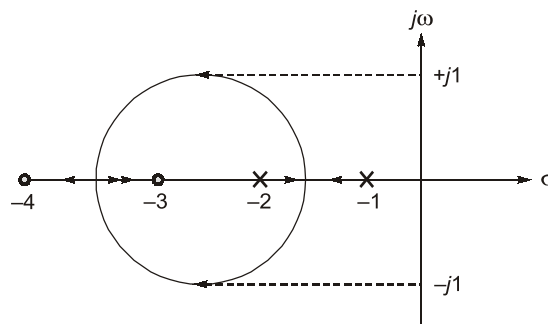
and in options, from option (a),

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

∴ Option (a) only satisfies.

End of Solution

Q.16 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 Rootlocus,

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

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

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

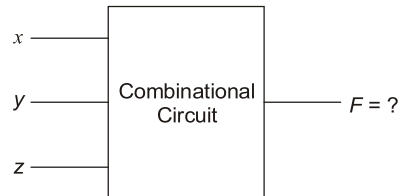
$$\frac{k(\sqrt{4+1} \times \sqrt{9+1})}{\sqrt{1+1}} = 1$$

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

End of Solution

DIGITAL CIRCUITS

Q.17 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	

$\therefore F = yz + xy + xz$

End of Solution



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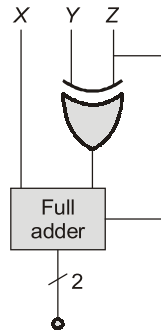
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Q.18 In the given circuit, if Z is connected as carry to the full adder if $Z = 1$, the below circuit with respect to inputs X, Y acts as

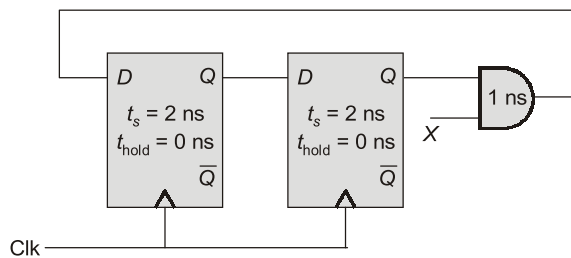


- (a) a subtractor
- (b) an adder
- (c) binary to grey code
- (d) multiplication

Ans. (a)

End of Solution

Q.19 What is the maximum frequency for Clk in MHz if clock to Q delay of each flip-flop is 2 nsec.



Ans. (200)

Given,

$$\begin{aligned}
 t_{pd} &= 2n \text{ sec} \\
 t_{\text{setup}} (t_s) &= 2n \text{ sec} \\
 t_{\text{comb}} &= 1n \text{ sec} \\
 T_{\text{clkD1}} &= t_p + t_s + t_{\text{comb}} = 2 + 2 + 1 = 5n \text{ sec} \\
 T_{\text{clkD2}} &= t_s + t_p = 2 + 2 = 4n \text{ sec}
 \end{aligned}$$

∴ Time required for clock,

$$\begin{aligned}
 T_{\text{clk}} &= \text{Max} \{ T_{\text{clkD1}}, T_{\text{clkD2}} \} \\
 &= \text{Max} [5n\text{s}, 4n\text{s}] \\
 &= 5n\text{s}
 \end{aligned}$$

Maximum frequency, $f_{\text{mx}} = \frac{1}{T_{\text{clk}}} = \frac{1}{5n\text{s}} = 200 \text{ MHz.}$

End of Solution

ELECTROMAGNETICS

Q.20 In a transmission line whose characteristic impedance is ($Z_0 = 50 \Omega$) 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)

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

$$\begin{aligned} \Gamma &= \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{50 - j75 - 50}{50 - j75 + 50} \\ &= \frac{-j75}{100 - j75} = \frac{-j3}{4 - j3} \end{aligned}$$

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

$$\begin{aligned} \therefore P_{del} &= \{1 - |\Gamma|^2\} P_i \\ &= [1 - (0.6)^2] * 10 \text{ mW} = 6.4 \text{ mW} \end{aligned}$$

End of Solution

ELECTRONIC DEVICES AND CIRCUITS

Q.21 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.22 $n_i = 2.5 \times 10^{16} \text{ m}^{-3}$; $\mu_n = 0.15 \text{ m}^2/\text{V-sec}$; $\mu_p = 0.05 \text{ m}^2/\text{V-sec}$
Find intrinsic resistivity in $\text{k}\Omega\text{-m}$.

Ans. (1.25)

$$\begin{aligned} \text{Intrinsic resistivity, } \rho_i &= \frac{1}{n_i q (\mu_p + \mu_n)} \\ &= \frac{1}{2.5 \times 10^{16} \times 1.6 \times 10^{-19} (0.15 + 0.05)} \\ &= \frac{1}{2.5 \times 10^{16} \times 1.6 \times 10^{-19} (0.2)} \\ \rho_i &= 1.25 \text{ k}\Omega\text{-m} \end{aligned}$$

End of Solution

Q.23 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 5.8×10^7 s/m. Current flowing through wire is _____ A.

Ans. (0.45)

Given,

$$E = 0.01 \text{ V/m,}$$

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

\therefore

$$I = \sigma EA$$

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

$$I = 0.45 \text{ A}$$

End of Solution

Q.24 In a semiconductor, mobility of electrons, $\mu_n = 0.38 \text{ m}^2/\text{V-sec}$ at temperature 300 K, then the diffusion coefficient of electrons at temperature 300 K is _____ $\text{cm}^2/\text{V-sec}$ (upto two decimal places)

Ans. (98.26)

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

$$D_n = \mu_n V_T$$

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

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

$$= 0.02586 \times 0.38$$

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

$$D_n = 98.26 \text{ cm}^2/\text{sec}$$

End of Solution



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ENGINEERING MATHEMATICS

Q.25 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

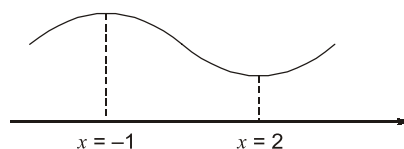
Q.26 For the given function :

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

- | | |
|----------------------------------|----------------------------------|
| (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)

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



So function has neither global maxima nor global minima.

End of Solution

Q.27 Two fair dice 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
$P(x)$	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

$$\begin{aligned}
 E(X) &= \sum x \cdot P(x) \\
 &= 2 \times \frac{1}{36} + 3 \times \frac{2}{36} + 4 \times \frac{3}{36} + 5 \times \frac{4}{36} + 6 \times \frac{5}{36} + 7 \times \frac{6}{36} \\
 &\quad + 8 \times \frac{5}{36} + 9 \times \frac{4}{36} + 10 \times \frac{3}{36} + 11 \times \frac{2}{36} + 12 \times \frac{1}{36} \\
 &= \frac{252}{36} = 7
 \end{aligned}$$

End of Solution

Q.28 Contour integral evaluated over counter clockwise on the unit circle 'c' in the complex plane, then choose the correct one?

- | | |
|--|---|
| <p>(a) $\oint_c \cos z \, dz = 0$</p> <p>(c) $\oint_c \sec z \, dz \neq 0$</p> | <p>(b) $\oint_c z^n \, dz = 0, n = \text{even positive integer}$</p> <p>(d) $\oint_c e^z \, dz = 0$</p> |
|--|---|

Ans. (a, b, d)

End of Solution

Q.29 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)

$$\begin{aligned}
 ax - b &= \begin{bmatrix} x \\ x - 3\sqrt{2} \end{bmatrix} \\
 \left\| \begin{bmatrix} x \\ x - 3\sqrt{2} \end{bmatrix} \right\| &= f(x) = \text{norm} \\
 f(x) &= \sqrt{x^2 + (x - 3\sqrt{2})^2} \\
 &= \sqrt{x^2 + x^2 + 18 - 6\sqrt{2}x}
 \end{aligned}$$

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

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

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

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

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

$$\begin{aligned} f(x)\Big|_{x=\frac{3}{\sqrt{2}}} &= \sqrt{2\left(\frac{3}{\sqrt{2}}\right)^2 - 6\sqrt{2} \times \frac{3}{\sqrt{2}} + 18} \\ &= \sqrt{9 - 18 + 18} \\ &= 3 \end{aligned}$$

End of Solution

Q.30 If $t^2 y''(t) - 2ty'(t) + 2y(t) = 0$, $y(0) = 1$, $y'(1) = -1$, 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,

$$x = e^t$$

$$t = e^u$$

$$\ln t = u$$

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

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

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

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

A.E.

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

$$m = 1, 2$$

$$y = C_1 e^u + C_2 e^{2u}$$

$$y = C_1 t + C_2 t^2$$

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

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

$\Rightarrow C_1 = 1$

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

ESE 2025 Prelims

Offline Test Series



Commencing from
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Paper-I : 11 Tests

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- 8 Multiple Subject Tests of 50 Questions (**400 Ques**)
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- +
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Time : 120 minutes
- +
- **2 Anubhav Tests**
Full Syllabus

Paper-II : 11 Tests

Engineering Discipline

- 8 Multiple Subject Tests of 75 Questions (**600 Ques**)
Time : 90 minutes
- +
- 1 Full Syllabus Test of 150 Questions (**450 Ques**)
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$$-1 = 1 + C_2 \times 2 \times 1$$

$$-1 = 1 + 2C_2$$

$$-2 = 2C_2$$

$$C_2 = -1$$

$$y = C_1 t + C_2 t^2$$

$$y = t - t^2$$

$$\frac{dy}{dt} = 1 - 2t = 0$$

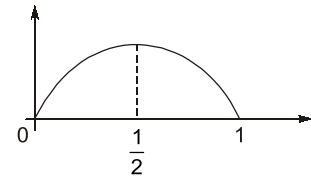
$$t = \frac{1}{2}$$

$$\frac{d^2y}{dt^2} = -2 < 0$$

$$t = \frac{1}{2} \Rightarrow \text{maxima point}$$

$$y\left(\frac{1}{2}\right) = \frac{1}{2} - \left(\frac{1}{2}\right)^2$$

$$= \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$



End of Solution

GENERAL ENGLISH

- Q.31** 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

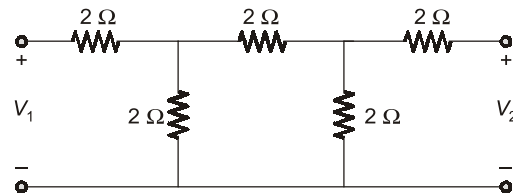
- Q.32** Abuse : Insult : Ridicule : : _____ : Praise : Appreciate
 (a) Honour (b) Extol
 (c) Appropriate (d) Prize

Ans. (b)

End of Solution

NETWORK THEORY

Q.33 Consider the following circuit.



The Z parameter of the circuit is

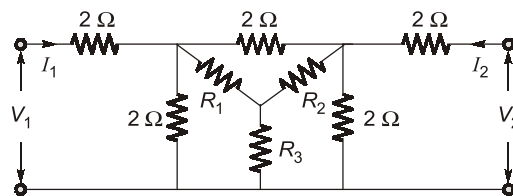
(a) $\begin{bmatrix} \frac{10}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{10}{3} \end{bmatrix}$

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

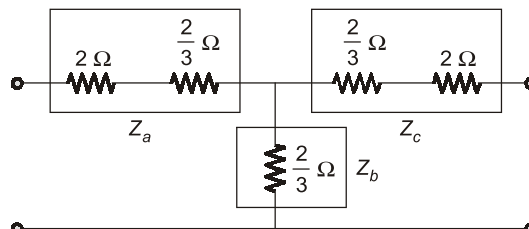
Ans. (a)



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

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

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



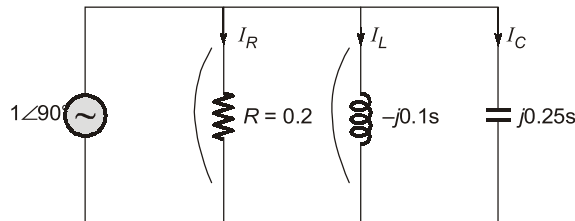
$$Z_{11} = Z_a + Z_b = \frac{10}{3} \Omega$$

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

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

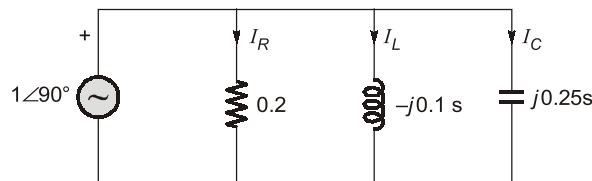
End of Solution

Q.34 Find the value of I_R , I_L and I_C ?



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

Ans. (a)



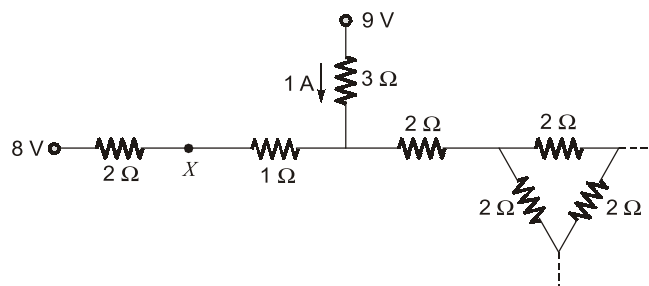
$$I_R = 1 \angle 90 (0.2) = 0.2 \angle 90^\circ$$

$$I_L = 1 \angle 90 (0.1 \angle -90) = 0.1 \angle 0^\circ$$

$$I_C = 1 \angle 90 (0.25 \angle 90) = 0.25 \angle 180^\circ$$

End of Solution

Q.35 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) $\frac{2}{3}$



Total 10 Tests (Total 1125 Questions)
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Test Series Schedule

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1	20 th Feb 2025	75 Qs	1 Hour	Part Syllabus Test	General Principles of Design and Drawing, Industrial Safety and Safety Standards, Engineering Materials, Quality Control, Types of Machinery and Maintenance, Production and Construction, Handling and Storage of Products
2	27 th 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	6 th 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	13 th Mar 2025	75 Qs	1 Hour	Part Syllabus Test	General Hindi
5	20 th Mar 2025	75 Qs	1 Hour	Part Syllabus Test	Indian History, Indian Polity, Geography, GK & Miscellaneous and Current Affairs
6	27 th Mar 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
7	3 rd Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
8	5 th Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
9	8 th Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
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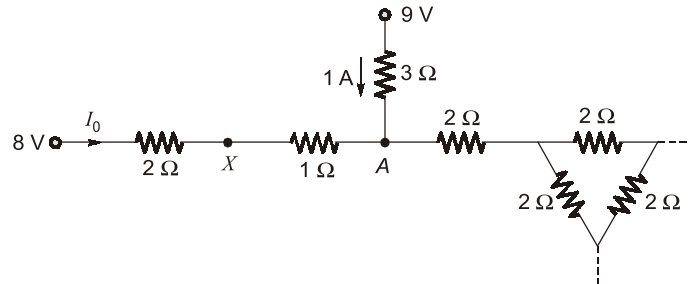


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Ans. (a)



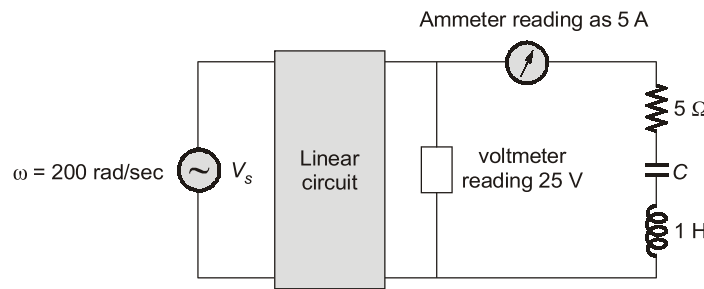
Voltage at node A is $9 - (3 \times 1) = 6 \text{ V}$

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

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

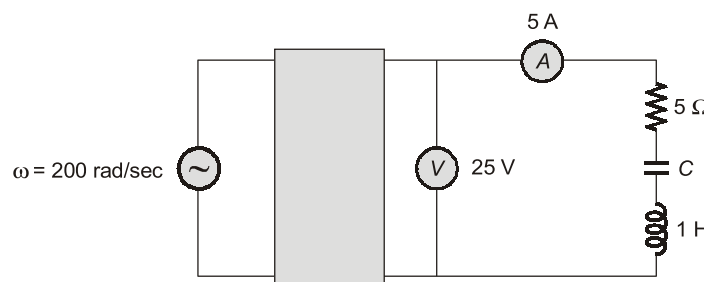
End of Solution

Q.36 Consider the circuit shown below,



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

Ans. (25)



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

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

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

$$X_L = X_C$$

$$X_L = X_C = 200 \Omega$$

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

End of Solution

REASONING AND APTITUDE

Q.37 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,

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

End of Solution

RRB-JE CBT-2 | 2024 Exam

Online Test Series



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.
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	Subject	No. of Questions	Marks	Duration
RRB JE CBT 2 Exam Pattern 2024	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 No.	Activate Date	Total Marks	Total Questions	Total Time
Test Series Schedule	1	11 th Feb 2025	150 Marks	150 Qs	2 Hours
	2	14 th Feb 2025	150 Marks	150 Qs	2 Hours
	3	18 th Feb 2025	150 Marks	150 Qs	2 Hours
	4	21 st Feb 2025	150 Marks	150 Qs	2 Hours
	5	25 th Feb 2025	150 Marks	150 Qs	2 Hours
	6	28 th Feb 2025	150 Marks	150 Qs	2 Hours
	7	4 th Mar 2025	150 Marks	150 Qs	2 Hours
	8	7 th Mar 2025	150 Marks	150 Qs	2 Hours
	9	11 th Mar 2025	150 Marks	150 Qs	2 Hours
	10	14 th Mar 2025	150 Marks	150 Qs	2 Hours

Fee: ₹500/-

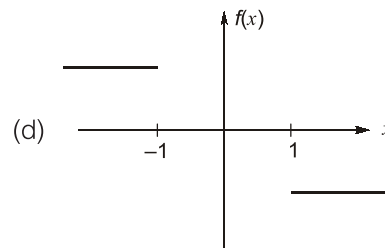
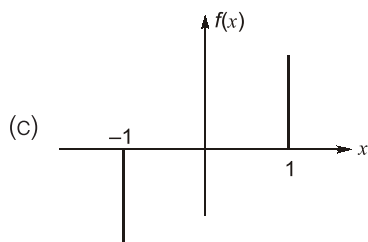
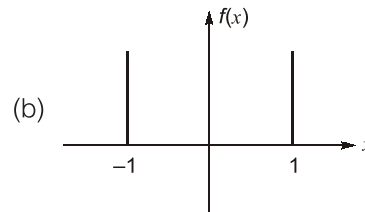
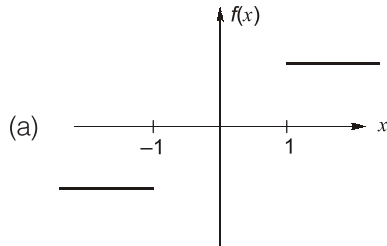


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Q.38 Which of the following is the correct representation for the function $f(x) = \frac{-|x|}{x}$?



Ans. (d)

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

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

$$f(1) = \frac{-1}{1} = -1$$

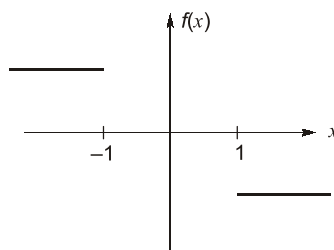
$$f(2) = \frac{-2}{2} = -1$$

$$f(-1) = \frac{-1}{-1} = 1$$

$$f(-2) = \frac{-2}{-2} = 1$$

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

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



End of Solution

Q.40 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 $X \leq 500000$

$$\text{Overhead} = 20\% \text{ of } X = 0.2X$$

$$\text{Total cost} = X + 0.2X = 1.2X$$

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

$$\text{Total amount paid by client} = 1.2X + 0.216X = 1.416X$$

Given that, the client can only pay 1000000

$$\Rightarrow 1.416X = 1000000$$

$$\Rightarrow X \approx 706215$$

Case (ii): If $X > 500000$

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

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

$$\text{Total cost} = X + 100000 + 0.1 [X - 500000]$$

$$= 1.1X + 50000$$

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

$$\text{Total amount paid by client} = 1.1X + 50000 + 0.198X + 9000$$

$$= 1.298X + 59000$$

Given that, the client can only pay 1000000

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

$$\Rightarrow X \approx 725000$$

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

End of Solution

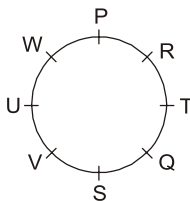
Q.41 In dance chair game, after first round behind P, 4th person left.

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

Check Your Expected Rank & GATE Score

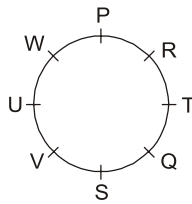
by

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.

Ans. (a)



After 1st round – Behind P, 4th person left
 ⇒ S eliminated
 Remaining players: P, R, T, Q, V, U, W
 After 2nd round – Behind Q, 3rd person left
 ⇒ W eliminated
 Remaining players: P, R, T, Q, V, U
 After 3rd round – Behind V, 3rd person left
 ⇒ R eliminated
 Remaining players: P, T, Q, V, U
 After 4th round – Behind U, 4th person left
 ⇒ V eliminated
 ∴ Remaining players: P, T, Q, U

End of Solution

Q.42 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 → 7th term
 C → 1st term

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

End of Solution

SIGNALS AND SYSTEMS

Q.43 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) $C_k = d_k \quad \forall K$
- (b) $C_k = \alpha d_k$
- (c) If time period of $f(t)$ is T_o , then time period of $f(\alpha T) = \frac{T_o}{\alpha}$
- (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 $t = \alpha t$:

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

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

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

$$= \sum_{n=-\infty}^{\infty} d_k \cdot e^{-jn\omega'_0 t}$$

For $y(t)$: $d_k = C_k$, $\omega'_0 = \alpha\omega_0$ or $T'_0 = \frac{T_0}{\alpha}$

where T'_0 = Fundamental period of $y(t)$

ω'_0 = Fundamental frequency of $y(t)$

End of Solution

- Q.44** 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

■■■■