GATE 2026

Electronics Engineering

Forenoon Session

Memory Based
Questions & Solutions

Exam held on 15-02-2026

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REASONING AND APTITUDE

1. $\left(\log_p^{1/n} y\right)\left(\log_y^{1/n} p\right) = 16$, where n, p, y are positive integers then the value of n is

(a) 16 (b) 8
(c) 4 (d) 2

Ans. (c)

$$\log_{p^{1/n}} y \times \log_{y^{1/n}} p = 16$$

$$\frac{\log y}{\frac{1}{n}\log p} \times \frac{\log p}{\frac{1}{n}\log y} = 16$$

$$\frac{1}{\frac{1}{n^2}} = 16$$

$$n^2 = 16$$

$$n = 4$$

End of Solution

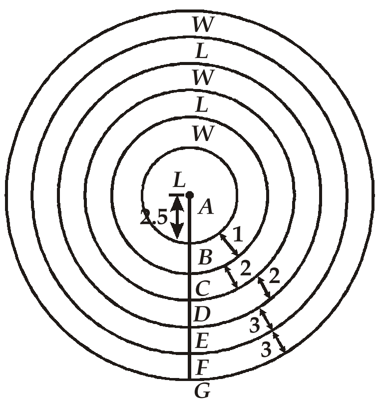
2. P_k = Perimeter of square and length of side is k, then $P_1 + P_2 + P_3 + \ldots\ldots P_{10}$ is

Ans. (220)

$$P_1 = 4$$
$$P_2 = 8$$
$$P_3 = 12$$
$$P_1 + P_2 + P_3 + \ldots + P_{10} = 4 + 8 + 12 + \ldots + 40$$
$$= 4(1 + 2 + 3 + \ldots + 10)$$
$$= 4 \times \frac{10 \times 11}{2} = 220$$

End of Solution

3. Consider the following circuit.



If $AB = 2.5$, $BC = 1$, $CD = DE = 2$ and $EF = FC = 3$, then the ratio of area of land (L) and to water (W) is _______

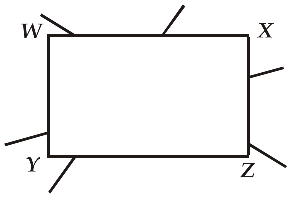
(a) 0.75 (b) 0.25
(c) 0.45 (d) 1.00

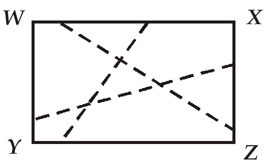
Ans. (a)

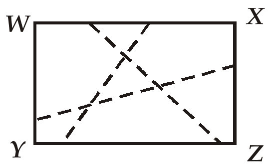
$$AB = r_1 = 2.5, \qquad AC = r_2 = 3.5$$
$$AD = r_3 = 5.5, \qquad AE = r_4 = 7.5$$
$$AF = r_5 = 10.5, \qquad AG = r_6 = 13.5$$
$$L = L_1 + L_2 + L_3$$
$$= \pi r_1^2 + \pi\left(r_3^2 - r_2^2\right) + \pi\left(r_5^2 - r_4^2\right)$$
$$= \pi(2.5)^2 + \pi(5.5^2 - 3.5^2) + \pi(10.5^2 - 7.5^2)$$
$$= 78.25\pi$$
$$W = W_1 + W_2 + W_3$$
$$= \pi\left(r_2^2 - r_1^2\right) + \pi\left(r_4^2 - r_3^2\right) + \pi\left(r_6^2 - r_5^2\right)$$
$$= \pi(3.5^2 - 2.5^2) + \pi(7.5^2 - 5.5^2) + \pi(13.5^2 - 10.5^2)$$
$$= 104\pi$$
$$\frac{L}{W} = \frac{78.25\pi}{104\pi} = 0.75$$

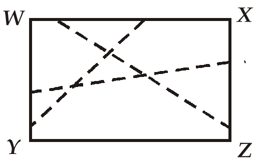
End of Solution

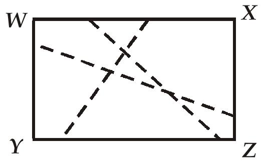
4. Find the remaining part of the given diagram:



(a)


(b)


(c)


(d)


Ans. (a)

End of Solution

GENERAL ENGLISH

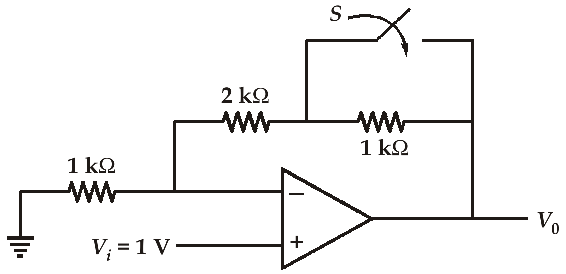
5. Find the antonym of nocturnal.

(a) normal
(b) abnormal
(c) diurnal
(d) exceptional

Ans. (c)

ANALOG CIRCUITS

6. Consider the op-amp shown in figure below:



If V_0 is 'x' when switch is open after closed the switch, the output V_0 is

(a) x
(b) $\frac{3x}{4}$
(c) $\frac{x}{2}$
(d) $2x$

Ans. (b)

Given, $V_{01} = x$

$$\text{Switch open} = V_{01} = \left(1+\frac{3}{1}\right)\times 1 = 4\text{ V} = x$$

$$\text{Switch open} = V_{02} = \left(1+\frac{2}{1}\right)\times 1 = 3\text{ V}$$

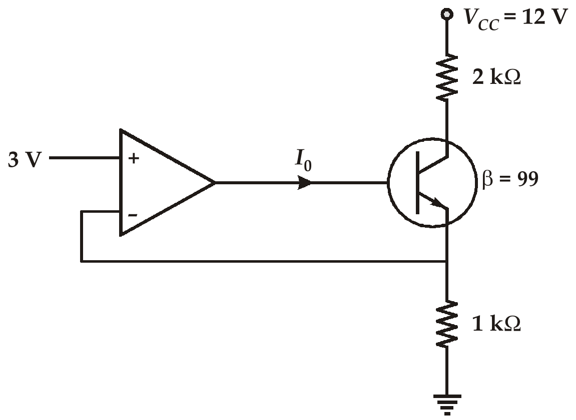
$$\frac{V_{02}}{V_{01}} = \frac{3}{4}$$

$$V_{02} = \frac{3}{4}\times V_{01}$$

$$V_{02} = \frac{3}{4}x$$

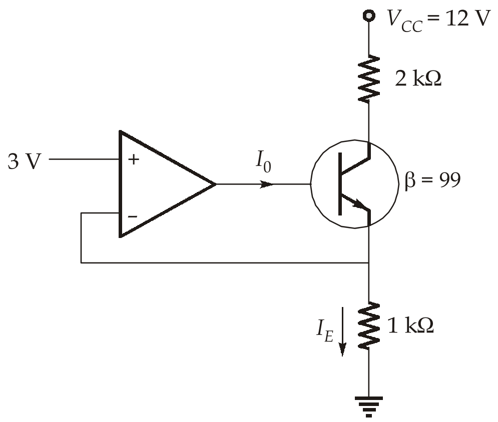
End of Solution

7. For transistor shown below, if β is 99, then the value of I_0 is



(a) 3 μA (b) 30 mA
(c) 3 mA (d) 30 μA

Ans. (d)



$$V^- = V^+ = 3\text{ V}$$

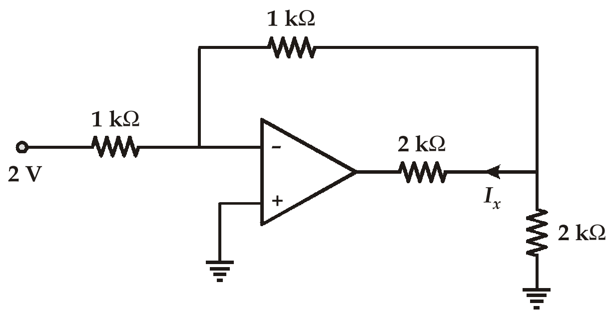
$$I_E = \frac{3}{1k} = 3\text{ mA}$$

$$I_0 = I_B - \frac{I_E}{1+\beta} = \frac{3}{100} = 0.03\text{ mA}$$

Hence, $I_0 = 30\ \mu\text{A}$

End of Solution

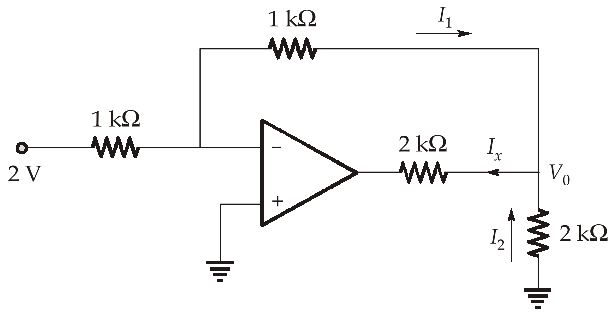
8. Consider the op-amp shown below:



For V_{in} = 2 V, the current I_x is

(a) 3 mA (b) x
(c) x (d) x

Ans. (a)



$$V_0 = \frac{-1}{1}\times 2 = -2\text{ V}$$

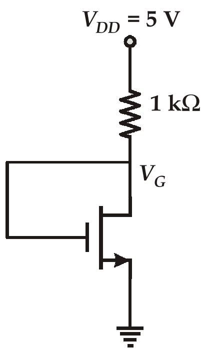
KCL : $I_x = I_1 + I_2$

$$I_x = \frac{0-V_0}{1}+\frac{0-V_0}{2}$$

$$I_x = \frac{2}{1}+\frac{2}{2} = 3\text{ mA}$$

End of Solution

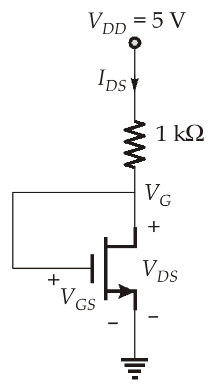
9. Consider the MOSFET shown below:



If $V_T = 1$ V; $\mu_n C_{ox}\left(\frac{W}{L}\right) = 2\text{ mA/V}^2$ then find V_G.

(a) 3 V (b) 2 V
(c) 1 V (d) 0 V

Ans. (a)



$$V_{GS} = V_{DS} = 5 - 1 \times I_{DS}$$

$$I_{DS} = 5 - V_{GS} \quad \text{...(1)}$$

$$I_{DS} = \frac{\mu_N C_{ox}}{2} \times \frac{W}{L}(V_{GS} - V_T)^2$$

$$5 - V_{GS} = \frac{2}{2}(V_{GS} - 1)^2$$

$$10 - 5V_{GS} = V_{GS}^2 + 1 - 2V_{GS}$$

$$V_{GS}^2 - V_{GS} - 4 = 4$$

$\Rightarrow$ $V_{GS} = 2.56$ V

Hence, $V_G = V_{GS} = 2.56$ V

End of Solution

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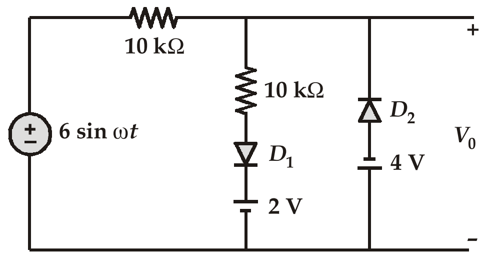
10. **Find maximum V_0.**

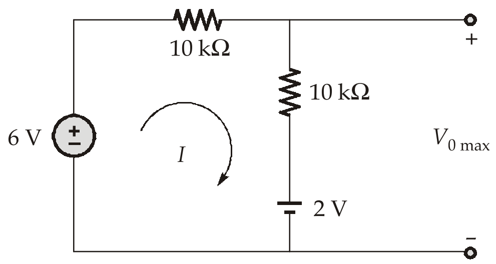


(a) 4 V
(b) 3 V
(c) 2 V
(d) 1 V

Ans. (a)

For maximum V_0

D_1 ON and D_2 OFF

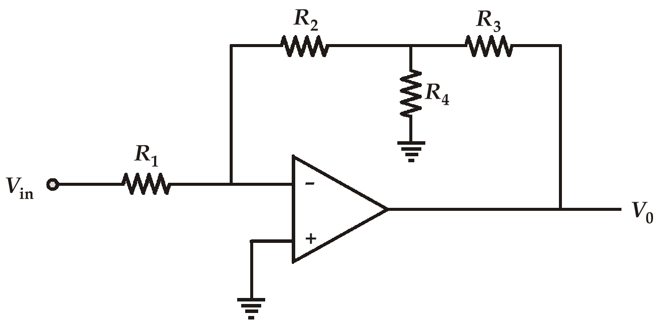


$$I = \frac{6-2}{20\text{ K}} = \frac{4}{20\text{ K}} = 0.2\text{ mA}$$

$$V_{0\,max} = I \times 10\text{ K} + 2\text{ V}$$
$$= 0.2\text{ mA} \times 10\text{ K} + 2\text{ V}$$
$$= 4\text{ V}$$

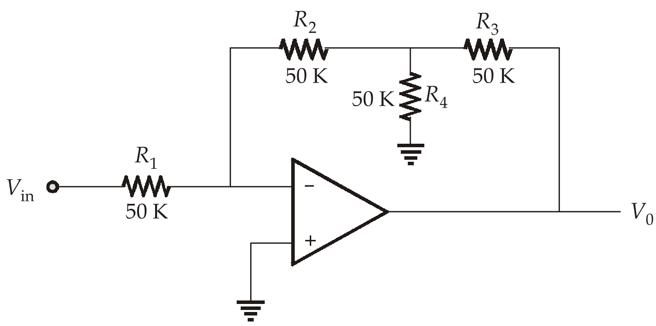
End of Solution

11. Consider the op-amp circuit shown below:



If $R_1 = R_2 = R_3 = R_4 = 50$ kΩ, then the magnitude of gain is ________.

Ans. (3)



$$\frac{V_0}{V_i} = \frac{-R_2}{R_1}\left[1+\frac{R_3}{R_2}+\frac{R_3}{R_4}\right]$$

$$= \frac{-50\text{ K}}{50\text{ K}}\left[1+\frac{50\text{ K}}{50\text{ K}}+\frac{50\text{ K}}{50\text{ K}}\right]$$

$$= -1[1+1+1]$$
$$= -3$$

Hence, $\left|\frac{V_0}{V_i}\right| = 3$

End of Solution

COMMUNICATION SYSTEMS

12. **For a 16 QAM system bit rate R_b = 4 Mbps. Find minimum BW (in MHz) of the system is ________.**

Ans. (1)

$$\text{Minimum transmission BW} = \frac{R_b}{\log_2 M}$$

$$\text{Minimum BW} = \frac{4\times 10^6}{\log_2^{16}} = 10^6 \text{ Hz} = 1\,\text{MHz}$$

End of Solution

13. **If $\frac{E_b}{N_0} = 8.4\text{ dB}$, find probability of error for QPSK modulation.**

(a) 10^{-4}
(b) 10^{-6}
(c) 10^{-2}
(d) 10^{-3}

Ans. (c)

Given, $\frac{E_b}{N_0} = 8.4$ dB

We know that, $\text{erfc}(u) = \frac{e^{-u^2}}{u\sqrt{\pi}}$

$$P_e = Q\left(\sqrt{\frac{2E_b}{N_o}}\right)$$

$$= \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E_b}{N_o}}\right) = \frac{1}{2}\text{erfc}\left(\sqrt{10^{-0.84}}\right)$$

$$= \frac{1}{2}\text{erfc}(6.91) = \frac{1}{2}\frac{e^{-(6.91)^2}}{6.91\times\sqrt{\pi}} = 0.01 = 10^{-2}$$

End of Solution

14. **Find the channel capacity of a system using Shannon Hartley Law of a signal whose bandwidth is 1 MHz, signal power is –80 dBm, kT = –174 dBm/Hz.**

(a) $C = B$
(b) $C = 2B$
(c) $C > 3B$
(d) $C < B$

Ans. (c)

Given, B = 1 MHz, $C = B\log_2\left[1+\frac{10^{-8}\times 10^{-3}}{KTB}\right]$ $(\because\ S = -80\text{ dBm} = 10^{-8}\times 10^{-3})$

$$= B\log_2\left[1+\frac{10^{-8}\times 10^{-3}}{KTB}\right] = B\log_2\left[1+\frac{10^{-11}}{10^{-17.4}\times 10^{-3}\times 10^{6}}\right]$$

$$= B\log_2\left[1+\frac{10^{-11}}{10^{-14.4}}\right]$$

$$= 1\,M\log_2\left[1+\frac{10^{-11}}{10^{-14.4}}\right] = 1\,\text{M}\log_2[1+10^{3.4}]$$

$$= 11.29 \text{ Mbps}$$

$\therefore$ $C > 3B$ would satisfy the above result.

End of Solution

15. Given, (7, 4, 1) Hamming code and BER = 0.1
Prove that decoder will fail to decode received codeword properly will be

Ans. (0.15)

Hamming code can correct upto one error only.

Probability of decoding received code word properly will be

$\Rightarrow$ $$P_c = P\text{ (no error)} + P\text{(1-bit error)}$$

$$= {}^7C_0(0.1)^0(0.9)^7 + {}^7C_1(0.1)^1(0.9)^6$$

$\because$ When n-bits transmitted, probability of getting error in r-bits will be ${}^nC_r\, P^r(1-P)^{n-r}$

$\therefore$ $$P_c \cong 0.85$$

Probability of decoder failed to decode received codeword properly will be

$$P_e = 1 - P_c$$
$$= 1 - 0.85$$
$$= 0.15$$

End of Solution

COMPUTER ORGANIZATION

16. If the starting address of a 256KB memory is 2500H, then find the address of the final location.

Ans. (424FFH)

Given, Memory capacity = 256 kB
Starting address = 2500 H
Final address = ?

Final address – Initial address + 1 = Capacity of memory

$$x - 2500\text{ H} + 1 = 40000\text{ H}$$
$$x = 40000\text{ H} - 1 + 2500\text{ H}$$

$$x = \begin{array}{r} 3FFFFH \\ +2500H \\ \hline 424FFH \end{array}$$

Hence, the final address location is 424FFH.

End of Solution

17. **Find the 10's complement of $(47)_{10}$.**

Ans. **(53)**

Using r's complement = $(r - 1)$'s complement + 1

$\therefore$ 9's compliment of $(47)_{10}$

$$\begin{array}{r} 99 \\ -47 \\ \hline 52 \\ \hline \end{array} \quad \text{i.e., (9's complement)}$$

$\therefore$ 10's complement

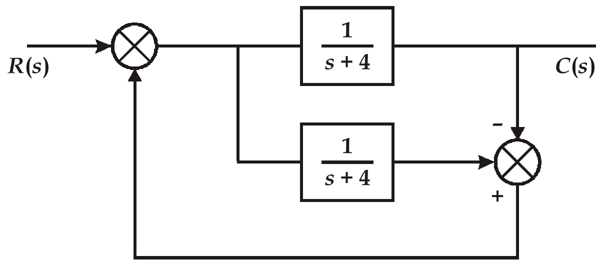
$$\begin{array}{r} 52 \\ +1 \\ \hline 53 \\ \hline \end{array}$$

Hence, the 10's complement of $(47)_{10}$ is 53.

End of Solution

CONTROL SYSTEMS

18. **Consider the closed loop system as shown in figure below:**



The transfer function, $\dfrac{C(s)}{R(s)}$ of the system is

(a) $\dfrac{1}{s+4}$

(b) $\dfrac{s+4}{s+5}$

(c) $\dfrac{1}{s^2+8s}$

(d) $\dfrac{2}{s+4}$

Ans. **(a)**

Using Mason's gain formula, we get

$$\frac{C(s)}{R(s)} = \frac{\dfrac{1}{s+4}}{1-\left[-\dfrac{1}{s+4}+\dfrac{1}{s+4}\right]} = \frac{1}{s+4}$$

End of Solution

19. If $\dot{X} = \begin{bmatrix} -4 & -1.5 \\ 4 & 0 \end{bmatrix} X + \begin{bmatrix} 2 \\ 0 \end{bmatrix} U;\ Y = [1.5 \quad 0.625] X$.

The $\frac{Y(s)}{U(s)}$ of the system is

(a) $\frac{3s}{s^2 + 4s + 6}$

(b) $\frac{3s + 5}{s^2 + 4s - 6}$

(c) $\frac{3s}{s^2 + 4s - 6}$

(d) $\frac{3s + 5}{s^2 + 4s + 6}$

Ans. (d)

We know that,

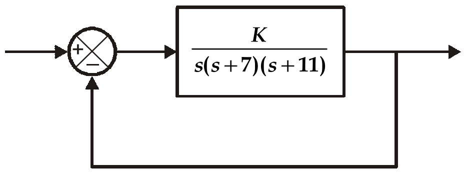
Transfer Function of system, TF = $C[(sI - A)^{-1} B] + D$

On solving, we get

$$\text{TF} = \frac{3s + 5}{s^2 + 4s + 6}$$

End of Solution

20. **Consider the closed loop system shown below,**



Find 'K' for marginal stability.

Ans. (1386)

We know that the characteristics equation is given as,

$$1 + G(s)\,H(s) = 1 + \frac{K}{s(s+7)(s+11)}$$

or $\quad s(s^2 + 18s + 77) + K = 0$

or $\quad s^3 + 18s^2 + 77s + K = 0$

Now using RH criteria we get

s^3	1	77
s^2	18	L
s^1	$\frac{18 \times 77 - K}{1s}$	
s^0	K	

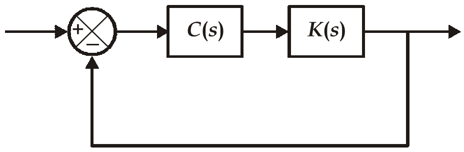
For marginally stable system

$$18 \times 77 - K = 0$$

$$K = 18 \times 77 = 1386$$

End of Solution

21. Consider the system shown below,



Where, $C(s) = K(s + \alpha)$, $K(s) = \dfrac{1}{(s+1)(s+2)}$ and CL poles location is at $S = -3 \pm j\sqrt{5}$.

Find K and α value?

(a) $K = 3$ and $\alpha = 4$
(b) $K = 3$ and $\alpha = 3$
(c) $K = 4$ and $\alpha = 4$
(d) $K = 4$ and $\alpha = 3$

Ans. (a)

We know that the characteristics equation is given as,

$$1 + G(s)\,H(s) = 1 + \frac{K(s+\alpha)}{(s+1)(s+2)}$$

or characteristics equation,

$$q(s) = s^2 + s(K + 3) + (2 + \alpha K) \qquad ...(1)$$

For $S = -3 \pm j\sqrt{5}$,

$$q(s) = (s+3)^2 + \left(\sqrt{5}\right)^2 \qquad ...(2)$$

$$= s^2 + 14 + 6s$$

On comparing (1) and (2) we get,

$$K = 3 \text{ and } \alpha = 4$$

End of Solution

22. $\dot{W} = AW$,

$W(t = 0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$,

$W(t) = e^{t}\hat{u}_x + e^{-2t}\hat{u}_y$

Find A?

(a) $\begin{bmatrix} 1 & 0 \\ 0 & -2 \end{bmatrix}$
(b) $\begin{bmatrix} 0 & 2 \\ -1 & 0 \end{bmatrix}$
(c) $\begin{bmatrix} 0 & -2 \\ 1 & 0 \end{bmatrix}$
(d) $\begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}$

Ans. (a)

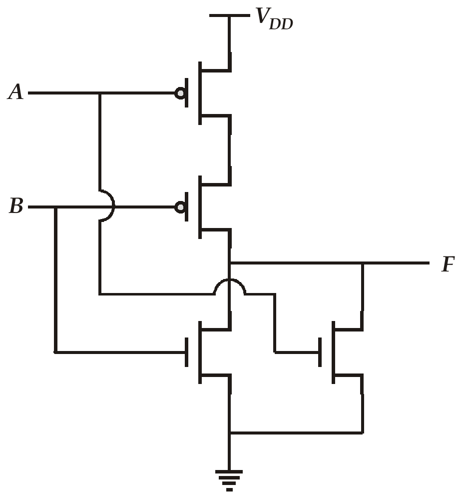
On comparison we get eigen values, $\lambda = 1$ and $\lambda = -2$

And $\lambda = 1$ and $\lambda = -2$ only option (a) is satisfying.

End of Solution

DIGITAL CIRCUITS

23. Find the logic function performed by the below circuit:



(a) NAND
(b) NOR
(c) AND
(d) OR

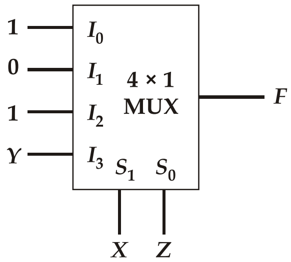
Ans. (b)

A	B	F
0	0	1
0	1	0
1	0	0
1	1	0

∴ The given circuit performs NOR operation.

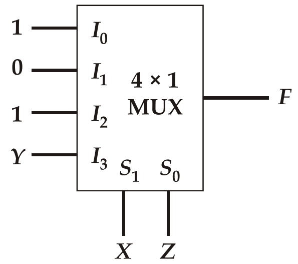
End of Solution

24. Find the output of the following logic circuit.



Ans. $(XY + \overline{Z})$

Given,



$$F = \overline{S}_1\,\overline{S}_0\,I_0 + \overline{S}_1\,S_0\,I_1 + S_1\,\overline{S}_0\,I_2 + S_1\,S_0\,I_3$$

$$= \overline{X}\,\overline{Z}(1) + \overline{X}Z(0) + X\overline{Z}(1) + XZY$$

$$= \overline{X}\,\overline{Z} + X\overline{Z} + XZY$$

$$= \overline{Z}[X + \overline{X}] + XYZ$$

$$F = \overline{Z} + XYZ$$

$$F = XY + \overline{Z}$$

End of Solution

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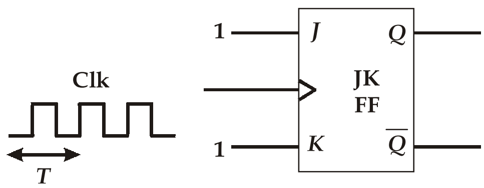
25. **Consider the *JK* flip-flop shown below,**



where, T = 10 clocks per second. Find the output frequency (in Hz) of flip-flop.

Ans. **(5)**

When, $J = K = 1,$

Then, JK-FF operate in toggle mode.

$\therefore$ $$f_{out} = \frac{f_{in}}{2} = 5\text{ Hz}$$

End of Solution

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26. **The number of flip-flops required to design MOD-64 ripple counter using**

(a) 4 **(b)** 5

(c) 6 **(d)** 7

[MSQ]

Ans. (c, d)

Number flip-flops required should be

$$n \geq \log_2 M$$

where, M = Number of states.

Here, $M = 64$

Hence, $n \geq \log_2^{64}$

$$n \geq \log_2^{2^6}$$

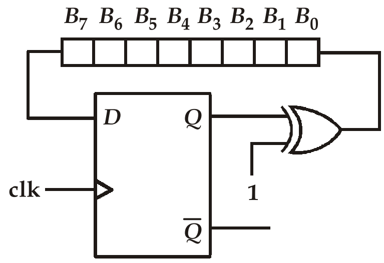
$$n \geq 6$$

$$n = 6 \text{ and } 7$$

Hence, number of flip-flops required should be 6 or 7.

End of Solution

27. The logic circuit shown below is composed of Left Shift Register (LSR) and D flip-flop.



Assuming all the circuits initially relaxed.

Find the output after 5 clock pulse.

Ans. (00011111)

CLK	Q	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
0	0	0	0	0	0	0	0	0	0
1st	0	0	0	0	0	0	0	0	1
2nd	0	0	0	0	0	0	0	1	1
3rd	0	0	0	0	0	0	1	1	1
4th	0	0	0	0	0	1	1	1	1
5th	0	0	0	0	1	1	1	1	1

Hence, the output after 5 clock pulses is 0 0 0 1 1 1 1 1.

End of Solution

28. Find the simplified boolean expression for the following logic function

$f[W, X, Y, Z] = \Sigma m(0, 2, 5, 7, 8, 10, 13, 14, 15)$

(a) $XZ + WXY + W\overline{X}\overline{Z} + \overline{W}XY\overline{Z}$

(b) $\overline{X}\overline{Z} + WXY + W\overline{X}\overline{Z} + \overline{W}XY\overline{Z}$

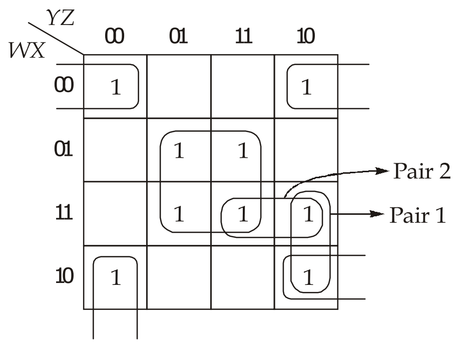
(c) $\overline{X}\overline{Z} + XZ + WY\overline{Z}$

(d) $\overline{X}\overline{Z} + XZ + WXY$

Ans. (c, d)

Given, $f(W, X, Y, Z) = \Sigma m\,(0, 2, 5, 7, 8, 10, 13, 14, 15)$

By using 4-variable K-map



By forming pair 1, $f = XZ + \bar{X}\bar{Z} + WY\bar{Z}$

If we form pair (2), $f = XZ + \bar{X}\bar{Z} + WXY$

End of Solution

ELECTROMAGNETICS

29. **Find the cut-off frequency (in GHz) of rectangular waveguide supporting TE_{10} mode having dimensions 0.28 × 0.14 inches.**

Ans. (21.09)

$$f_C\big|_{TE_{10}} = \frac{c}{2a} = \frac{3\times10^{10}}{2\times0.28\times2.54} \qquad [\because\ 1 \text{ inch} = 2.54 \text{ cm}]$$

$$= 21.09 \text{ GHz}$$

End of Solution

30. **Identify the type of polarisation for the EM value given,**

$$E = E_0\,[\cos(\omega t + kz)a_x + \sin(\omega t + kz)a_y]$$

(a) Left circularly polarised

(b) Right circularly polarised

(c) Linearly polarised

(d) Left elliptically polarised

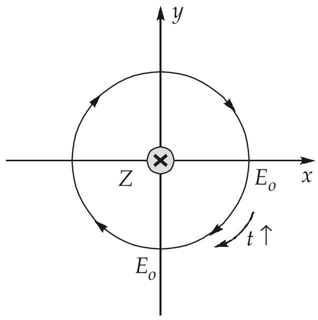
Ans. (b)

$$\bar{E} = E_0\cos(\omega t + kz)\hat{a}_x + E_0\sin(\omega t + kz)\,\hat{a}_y$$

At $z = 0$, $\bar{E} = E_0\cos\omega t + \hat{a}_x + E_0\sin\omega t\hat{a}_y$; circularly polarized

At $t = 0$, $\omega t = 0$, $\bar{E} = E_0\,\hat{a}_x$

At $t = \frac{T}{4}$, $\omega t = \frac{\pi}{4}$, $\bar{E} = E_0\hat{a}_y$



End of Solution

ELECTRONIC DEVICES AND CIRCUITS

31. If N_d decreases linearly from 2×10^{17} cm^{-3} at $x = 1$ μm to 1×10^{16} cm^{-3} at $x = 4$ μm. The region between $x = 1$ μm and $x = 4$ μm is labelled "linear". If electron mobility $\mu_n = 1400$ cm^2/v-s, thermal voltage,

$$V_t = \frac{kT}{q} = 25 \text{ mV (at T = 300 K)}$$

Then $J_{n(\text{diff})}$ ______ (in A/mm^2).

Ans. (35.47)

$$D_N = \mu_N \times V_T = 35 \text{ cm}^2/\text{sec}$$

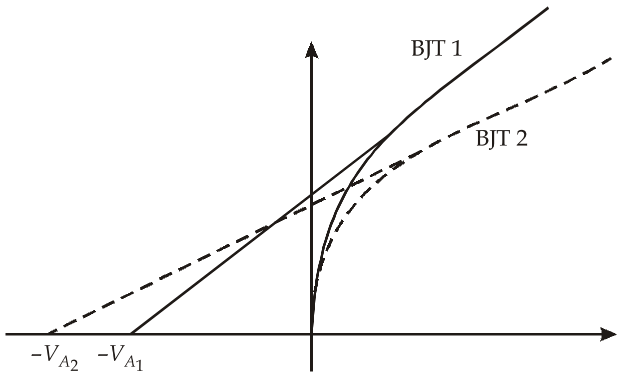
$$\frac{dn}{dx} = \frac{\Delta n}{\Delta x} = \frac{2\times10^{17} - 1\times10^{16}}{3\times10^{-4}\,\text{cm}} = 6.33\times10^{20}\,\text{cm}^{-4}$$

$$J_{\text{Diff}} = qD_N \times \frac{dn}{dx} = 1.6\times10^{-19}\times35\times6.33\times10^{20}$$

$$= 3547 \text{ A/cm}^2 = 35.47 \text{ A/mm}^2$$

End of Solution

32. The characteristics curve of two transistors are given as shown below:



If the early voltage of BJT 1 is V_{A_1} and the early voltage of BJT 2 is V_{A_2}, then which of the following options is/are correct?

(a) V_{A_2} is ∞ (b) $|V_{A_1}| < |V_{A_2}|$

(c) $|V_{A_1}| > |V_{A_2}|$ (d) V_{A_2} is finite

[MSQ]

Ans. (b, d)

BJT 2 has a smaller slope in the active region (flatter I_C vs V_{CE} curve). Hence $|V_{A2}|$ is greater than $|V_{A_1}|$, so option (b) is correct, and since BJT 2 curve shows finite slope (not perfectly flat), V_{A_2} is finite (and not ∞), so option (d) is also correct.

End of Solution

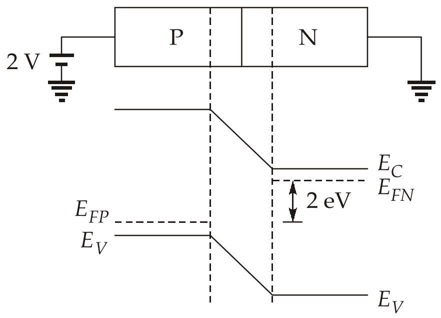
33. A *p-n* junction is forward bias with 2 volts. The magnitude of difference between quasi Fermi energy level E_{FP} and E_{FN} is

(a) 2 eV (b) 1 eV

(c) 2 V (d) 1 V

Ans. (a)

In a forward-biased *p-n* junction, the separation (magnitude of difference) between the quasi-Fermi levels E_{FN} (electron quasi-Fermi level) and E_{FP} (hole quasi-Fermi level) equals qV (i.e., applied forward bias voltage), so for V = 2 V, $|E_{FN} - E_{FP}|$ = 2 eV.



End of Solution

34. What is the dominant transport mechanism for current flow in zener break down?

(a) Drift (b) Diffusion

(c) Ballistic transport (d) Tunnelling

Ans. (d)

In Zener breakdown (heavily doped junction, low breakdown voltage), the strong electric field across the thin depletion region causes quantum mechanical tunneling of electrons from the valence band of p-side to the conduction band of n-side, dominating the current flow.

End of Solution

35. If energy gap $E_G = 1.3$ eV.
Which of the wavelength length range will not absorbed?

(a) (850 ± 20) nm
(b) (950 ± 20) nm
(c) (1000 ± 20) nm
(d) (1040 ± 20) nm

[MSQ]

Ans. **(c, d)**

Wave length is absorbed if

$$\lambda \le \frac{1.24}{E_G}\mu\text{m}$$

$$\lambda \le \frac{1.24}{1.3}\mu\text{m}$$

$$\lambda \le 0.953\ \mu\text{m}$$

$$\lambda \le 953\ \text{nm}$$

End of Solution

ENGINEERING MATHEMATICS

36. Consider the following matrix:

$A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 3 & 0 \\ -1 & a & b \end{bmatrix}$, if matrix is non singular ($|A| \neq 0$), then the value of a and b are

(a) $a = b = -\frac{1}{2}$
(b) $a = -3, b = 0$
(c)
(d)

[MSQ]

Ans. **(a, b)**

$2(3b) - 1(b) + (a + 3)$

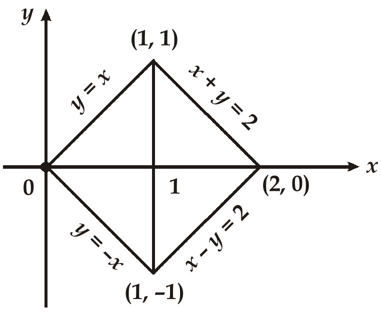
$6b - b + a + 3$

$$5b + a + 3 \neq 0$$

$$a = b = -\frac{1}{2}$$

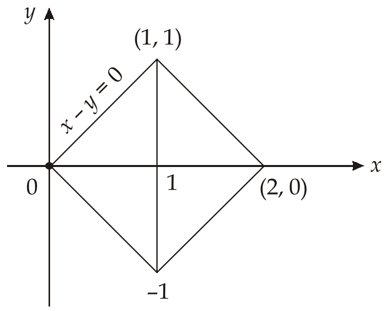
and $a = -3, b = 0$ are not correct rest two are correct.

End of Solution

37. 

The value of $\iint_R (x^2 + y^2 - 1)\,dx\,dy$ is ________.

Ans. (0.66)



$$I = \iint_R (x^2 + y^2 dx)dy - \iint_R dydx$$

$$I = I_1 - I_2$$

$$I_1 = \int_0^1 \int_{-x}^{x} (x^2 + y^2)dy\,dx + \int_1^2 \int_{-(2-x)}^{(2-x)} (x^2 + y^2)dy\,dx$$

$$= 2\int_0^1 \left(x^2 y + \frac{y^3}{3} \right)_0^x dx + 2\int_1^2 \left(x^2 y + \frac{y^3}{3} \right)_0^{(2-x)} dx$$

$$= 2\int_0^1 \frac{4}{3}x^3 + 2\int_1^2 \left(x^2(2-x) + \frac{(2-x)^3}{3} \right) dx$$

$$= \frac{8}{3}\left(\frac{1}{4}\right) + 2\left[\frac{2x^3}{3} - \frac{x^4}{4} + \frac{1}{3}\frac{(2-x)^4}{-4} \right]_1^2$$

$$= \frac{8}{12} + 2\left[\left(\frac{16}{3} - 4 - \frac{1}{2}(0) \right) - \left(\frac{2}{3} - \frac{1}{4} - \frac{1}{12} \right) \right]$$

$$= \frac{2}{3} + 2\left[\left(\frac{4}{3} - \frac{1}{3} \right) \right]$$

$$= \frac{2}{3} + 2$$

$$I_1 = \frac{8}{3}$$

$$I_2 = \text{Area of square}$$

$$\therefore \quad I = I_1 - I_2$$

$$I = \frac{8}{3} - \sqrt{2} \times \sqrt{2}$$

$$I = \frac{8}{3} - 2$$

$$I = \frac{2}{3}$$

End of Solution

38. **The value of** $\oint_c \frac{(z+4)^2}{(z-i)(z-2)} dz$

where $c : (z - 2 - i) = \frac{1}{3}$

Ans. **(0)**

$$\oint_c \frac{(z+4)^2}{(z-i)(z-2)} dz, \qquad c : |z - 2 - i| = \frac{1}{3}$$

Poles are given by,

$$(z - i)\ (z = 2) = 0$$

$\Rightarrow z = i$, 2 ae simple poles.

$z = i$

$$c : \quad |i - 2 - i| = |-2| > \frac{1}{3} \Rightarrow \text{Lies outside 'c'.}$$

$z = 2$

$$c : \quad |2 - 2 - i| = |-i| = 1 > \frac{1}{3} \Rightarrow \text{lies outside 'c'.}$$

$\because$ Both lies outside 'c'.

By Cauchy theorem,

$$\int_c f(z) dz = 0$$

End of Solution

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4 Streams 4 Toppers all 4 MADE EASY Students | **39 selections in Top 10** | **434 selections out of 458 Vacancies (95% Selections)**

CE — 9 in Top 10

AIR		
1	MOHAMMAD SHAQUIB	Live Online Foundation Course
2	PRAKHAR SHRI	Classroom Foundation Course
3	ARJUN SHARMA	Mains Online Course
4	BOLLA U NANDAN	Classroom Foundation Course
5	KESHAV	Test Series & IGP
7	TUSHAR AGGARWAL	Classroom Foundation Course
8	AYUSH JAIN	Classroom Foundation Course
9	ADITYA P SINGH	Test Series & IGP
10	PUSHPENDRA RATHORE	Test Series & IGP

ME — 10 in Top 10

AIR		
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3	HARI SINGH	Mains Online Course
4	SIDDESH RAO	GS Online Course
5	GOLLANGI SATEESH	Mains Online Course
6	AVINASH VERMA	Mains Online Course
7	PRASHANT SINGH	Mains Offline Course
8	MONU KUMAR	Classroom Foundation Course
9	NIKHIL KUMAR SAHA	Test Series & IGP
10	AMIT KUMAR SINGH	Classroom Foundation Course

EE — 10 in Top 10

AIR		
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3	OMPRAKASH RAJPUT	Classroom Foundation Course
4	TUSHAR CHAUDHARY	Classroom Foundation Course
5	RAM KUMAR	Test Series & IGP
6	PUNIT MEENA	Classroom Foundation Course
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4	PRADEEP SHUKLA	Mains Online Course
5	ASHISH SINGH PATEL	Classroom Foundation Course
6	TANYA TYAGI	Mains Online Course
7	PALAK MISHRA	Mains Online Course
8	HAYAT ALI	Classroom Foundation Course
9	VIDHU SHREE	Live Online Foundation Course
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1	EE	Pradip Chauhan	Test Series
1	IN	Kailash Goyal	Classroom Course
1	ES	Yash Jain	Classroom Course
2	CE	Harshvardhan Singh	Classroom Course
2	ME	Gollangi Sateesh	Online Course
2	EE	Kailash Goyal	Classroom Course
2	EC	Ankush Philip John	Postal Package & Test Series
2	IN	S. Bhattacharya	Test Series
2	ES	Jitesh Choudhary	Classroom Course
2	ES	Tarun Yadav	Classroom Course
3	CE	Pankaj Meena	Classroom Course
3	ME	Nimesh Chandra	Classroom Course
3	PI	Aditya Kr. Prasad	Classroom Course
3	XE	Rohan Kr. Biswal	Test Series
5	CE	Kartik Pokhriyal	Classroom Course
5	PI	Kuldeep Singh Naruka	Classroom Course
5	IN	Sachin Yadav	Test Series
5	EC	M. M. Nafeez	Test Series
5	ES	Sachin Kumar	Classroom Course
6	PI	Kaushal Kr. Kaushik	Online Course
6	CE	Shivanand Chaurasia	Online Course
6	CE	Nimish Upadhyay	Online Course
6	EE	Puneet Soni	Test Series
6	EE	Shivam Kr. Gupta	Test Series
6	EC	Pentela J. Bhavani	Test Series
6	IN	Utkarsh P. Patil	Classroom Course
7	PI	Waleed Shaikh	Test Series
7	ME	Abhinn	Online Course
7	IN	Dev J. Patel	Test Series
7	ES	Ankit Kumar	Classroom Course
8	ME	Goutam Kumar	Test Series
9	CE	Tarun Yadav	Classroom Course
9	CS	Omhari	Test Series
9	EC	Chilukuri S. Charan	Test Series
9	XE	Apar Harsh Chandra	Classroom Course
10	CE	Adnan Quasain	Classroom Course
10	CE	Rahul Singh	Online Course
10	ME	Ashutosh Kumar	Classroom Course
10	ME	Jetti Ganateja	Test Series
10	ME	Muhammed Sinan K	Test Series
10	ME	Pitchika Kr. Vasu	Online Course
10	PI	M Gopu Ganesh	Test Series
10	EE	Neelava Mukherjee	Postal Package & Test Series

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39. S_A. $\sum_{n=1}^{\infty}\left(\frac{n^2}{2^n}\right)$

S_B. $S_n = 1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+...+\frac{1}{512}$

Convergent (or) divergent?

(a) S_A and S_B both are convergent
(b) S_A convergent and S_B not convergent
(c) S_A not convergent abd S_B convergent
(d) S_A and S_B are not convergent

Ans. **(a)**

By n^{th} root test

$$= \lim_{n\to\infty}\left(\frac{n^2}{2^n}\right)^{1/n}$$

$$= \lim_{n\to\infty}\frac{n^{2/n}}{2}$$

∴ Given series is convergent

$1+\frac{1}{2}+\frac{1}{4}+....+\frac{1}{512}$

$$S_n = \frac{a(1-r^n)}{1-r}, \qquad r = \frac{1}{2}$$

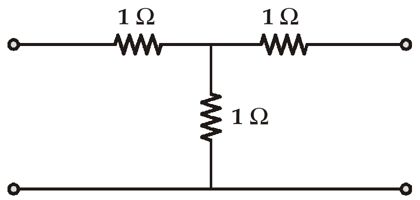
$$S_g = \frac{1\left(1-\left(\frac{1}{2}\right)^g\right)}{1-\frac{1}{2}} = \frac{1-\frac{1}{512}}{\frac{1}{2}} = \frac{511}{256}$$

∴ It is also convergent.

End of Solution

NETWORK THEORY

40. Find the *ABCD* parameter of the following two port network

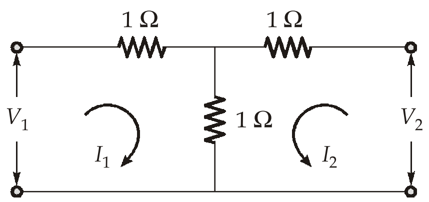


(a) $\begin{bmatrix} -2 & 3 \\ 1 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} 2 & -3 \\ 1 & -2 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} -2 & 3 \\ -1 & 2 \end{bmatrix}$

Ans. **(c)**

Given, network



For *ABCD* parameter,

$$V_1 = AV_2 - BI_2$$
$$I_1 = CV_2 - DI_2$$

From the loop 1:

$$V_1 = 2I_1 + I_2 \quad ...(1)$$
$$V_2 = I_1 + 2I_2 \quad ...(2)$$
$$I_1 = V_2 - 2I_2 \quad ...(3)$$

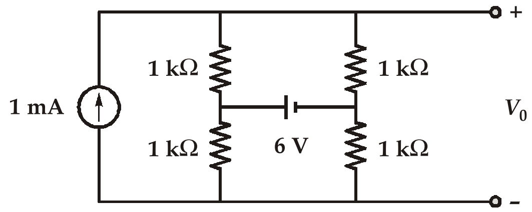
$\therefore$
$$V_1 = 2(V_2 - 2I_2) + I_2$$
$$V_1 = 2V_2 - 3V_2 \quad ...(4)$$

From equation (3) and (4)

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 2 & +3 \\ 1 & +2 \end{bmatrix}$$

End of Solution

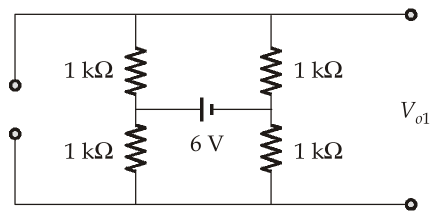
41. **Find V_0 (in Volts).**



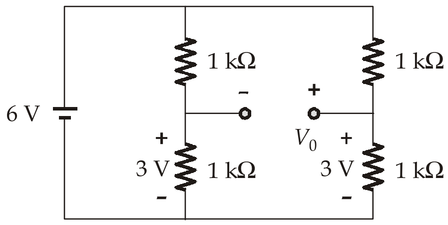
Ans. **(1)**

By using superposition theorem.

If 6 V source is active and 1 mA current source is open circuit.

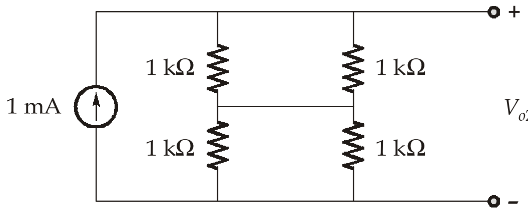


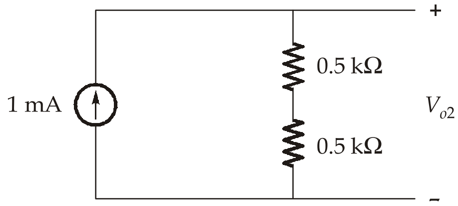
or



∴ $V_{o1} = 3 - 3 = 0$ V

If 1 mA current source is active and 6 V voltage source is short circuited.





∴ $V_{o2} = |\text{max}|\ 1\text{ k}\Omega = 1$ V

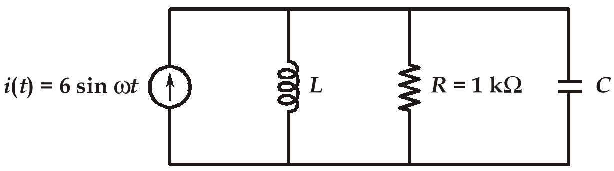
By superposition theorem,

$$V_0 = V_{o1} + V_{o2}$$

∴ $V_0 = 0 + 1 = 1$ V

End of Solution

42.



Find Average power (in kW) at resonance.

Ans. **(18)**

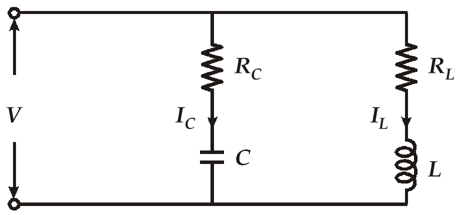
Since the given circuit is in resonance, $I_L + I_C = 0$ A

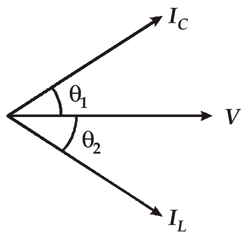
$$\text{Power} = I_{\text{rms}}^2 \times R$$

$$= \left(\frac{6^2}{\sqrt{2}}\right) \times 1\text{ k}\Omega$$

$$= \frac{36}{2} \times 1\text{ k}\Omega = 18\text{ kW}$$

End of Solution

43. 



$\theta_1 + \theta_2 = 90°$ at $f = 159.15$ Hz
$L = 1\ \mu H$, $C = 1\ \mu F$
Find $R_L \times R_C$

Ans. (1)

$$\theta_1 = \tan^{-1}\left(\frac{X_C}{R_C}\right) + \tan^{-1}\left(\frac{X_L}{R_L}\right) = 90°$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

Here, $\tan A \cdot \tan B = 1$

i.e. $$\tan^{-1}\left(\frac{X_C}{R_C}\right) \cdot \tan\left(\frac{X_L}{R_L}\right) = 1$$

$$\frac{X_C}{R_C} \cdot \frac{X_L}{R_L} = 1$$

$$\frac{1}{\omega C R_C} \cdot \frac{\omega L}{R_L} = 1$$

i.e. $$R_L \cdot R_C = \frac{L}{C}$$

$\therefore$ $$R_L \cdot R_C = 1$$

End of Solution

SIGNALS AND SYSTEMS

44. If $x(t)$ has energy E, then the ratio of energy of $\frac{E[x(t)]}{E[3x(-3t+5)]}$.

(a) 9
(b) $\frac{1}{3}$
(c) $\frac{1}{9}$
(d) 3

Ans. (b)

Energy of signal, $x(t)$ = E joule

$$x(-3t+5) \rightarrow \frac{E}{3} \text{ joule}$$

$$3x[-3t+5] \rightarrow 3^2 \times \frac{E}{3} = 3E \text{ joule}$$

$$\frac{E[x(t)]}{E[3x(-3t+5)]} = \frac{E}{3E} = \frac{1}{3}$$

End of Solution

45. **If input-output relation of the LTI system is $y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n)$. The above system is**

(a) Stable if causal
(b) Unstable if anti-causal
(c) Stable if non-causal
(d) Unstable if non-causal

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

$$Y(z) = \frac{5}{6}z^{-1}Y(z) - \frac{1}{6}z^{-2}Y(z) + X(z)$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{1}{1-\frac{5}{6}z^{-1}+\frac{1}{6}z^{-2}} = \frac{1}{\left(1-\frac{1}{3}z^{-1}\right)\left(1-\frac{1}{2}z^{-1}\right)}$$

If ROC $|Z| < \frac{1}{3}$: system is anti-causal and unstable

If ROC $\frac{1}{3} < |Z| < \frac{1}{2}$: system is non-causal and unstable

If ROC $|Z| > \frac{1}{2}$: system is causal and stable

End of Solution

46. **Find the Laplace transform of $x_1(t) * x_2(t)$.**
where, $x_1(t) = u(t-2)$, $x_2(t) = t\,u(t)$.

(a) $\frac{1}{s^3}$
(b) $\frac{e^{-s}}{s^3}$
(c) $\frac{e^{-2s}}{s^3}$
(d) $\frac{1}{(s-2)^3}$

Ans. **(c)**

$$x(t) = r(t) * u(t-2) = p(t-2) = \frac{(t-2)^2}{2}u(t-2) \quad \text{...(i)}$$

$$p(t) = \frac{t^2}{2}u(t) \rightleftharpoons P(s) = \frac{1}{s^3}$$

From (i), $X(s) = P(s)e^{-2s} = \frac{1}{s^3}\cdot e^{-2s}$

End of Solution

47. The impulse-response of an LTI-system is given as $h(t) = e^{-2t}\,u(t)$. The system is

(a) causal and unstable
(b) causal and stable
(c) non-causal and unstable
(d) non-causal and stable

Ans. (b)

$\because$ $h(t) = 0, \; t < 0$

$\therefore$ System is causal.

Since, $h(t)$ is absolutely, integrable. Therefore, system is stable.

End of Solution

48. Consider a signal $x(t)$ given by

$$x(t) = e^{-2t}u(t)$$

If 99% of energy of $x(t)$ lies within 'B' Hz then the value of B is _______ Hz.

(a) $\frac{126}{\pi} < B < \frac{128}{\pi}$
(b) $\frac{63}{\pi} < B < \frac{64}{\pi}$
(c) $B < \frac{63}{\pi}$
(d) None of these

Ans. (b)

$$x(t) \rightleftharpoons X(w) = \frac{1}{2 + jw}$$

$$|X(w)| = \frac{1}{\sqrt{4 + w^2}}$$

For $x(t)$: Energy $\quad \frac{1}{2\times 2} = \frac{1}{4}$

Given that energy contained in the frequency range "$2\pi B$" rad/sec is 99% of energy of $x(t)$.

i.e. $$\frac{1}{2\pi}\int_{-2\pi B}^{2\pi B} |X(w)|^2\, dw = \frac{0.99}{4}$$

$$\Rightarrow \quad \frac{1}{2\pi}\times 2\times \int_{0}^{2\pi B} \frac{1}{4 + w^2}\, dw = \frac{0.99}{4}$$

$$\Rightarrow \quad \frac{1}{\pi}\left[\frac{1}{2}\tan^{-1}\left(\frac{w}{2}\right)\right]_0^{2\pi B} = \frac{0.99}{4}$$

$$\frac{1}{\pi}\tan^{-1}\left[\frac{2\pi B}{2}\right] = \frac{0.99}{2}$$

$$\Rightarrow \quad \tan^{-1}(\pi B) = \frac{0.99\pi}{2}$$

$$\Rightarrow \quad \pi B = \tan\left(\frac{0.99\pi}{2}\right) = 63.56$$

$$\Rightarrow \quad B = \frac{63.56}{\pi} = 20.26 \text{ Hz}$$

End of Solution

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