BYJU'S EXAM PREP

GATE 2023

Electronics Engineering

Questions & Solutions

Memory Based

GATE 2023 Electronics & Communication Engineering: Major Highlights

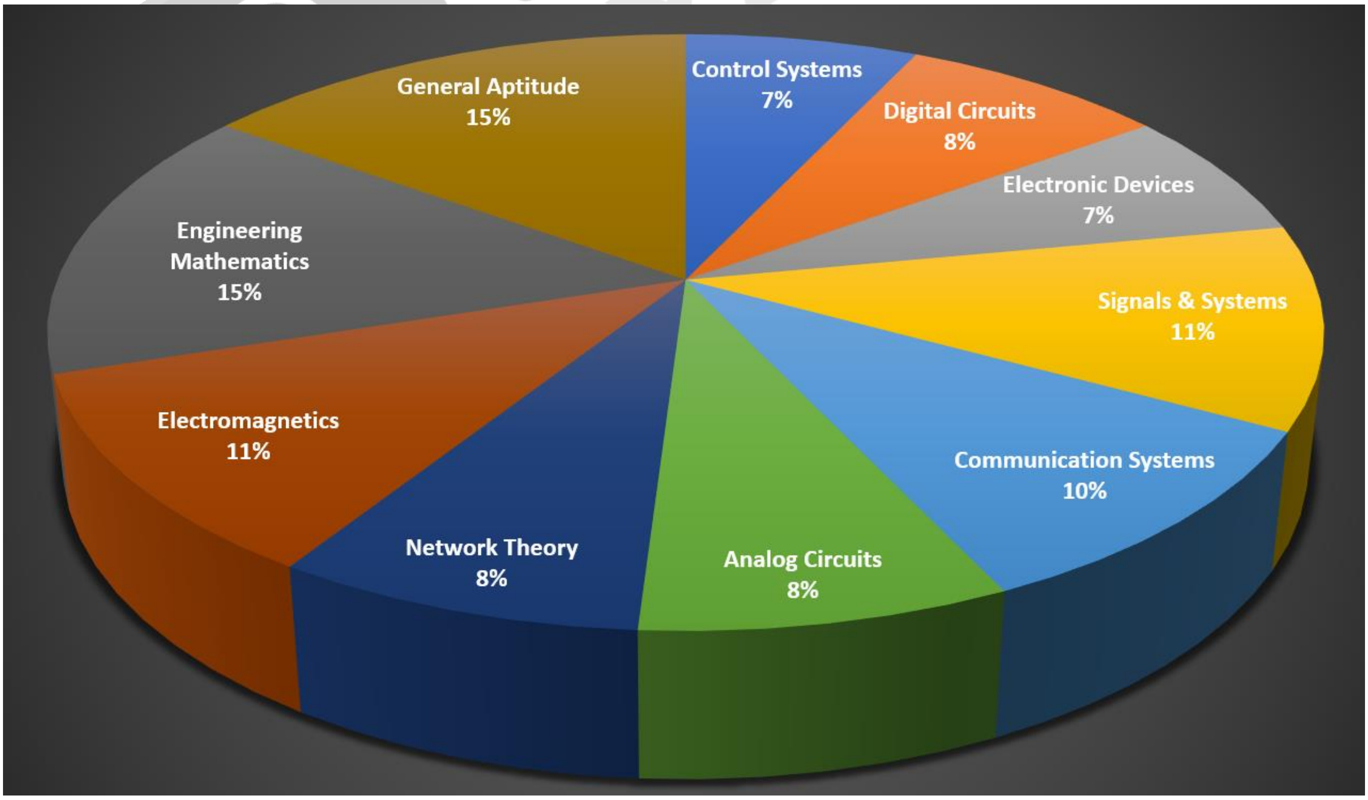
- **Overall Difficulty Level:** Easy to Moderate
- Electronic Devices & Signals and Systems Questions were easy but tricky.
- **MSQ weightage:** 4
- **NAT weightage:** 16
- **MCQ weightage:** 45
- Questions from General Aptitude were easy but lengthy.

GATE 2023 Electronics & Communication Engineering Comparison with last 3 Years' Data

S.No.	Subject Name	2023	2022	2021	2020
1	Control Systems	**7**	7	8	12
2	Digital Circuits	**8**	11	9	7
3	Electronic Devices	**7**	8	6	10
4	Signals & Systems	**11**	6	8	8
5	Communication Systems	**10**	13	16	12
6	Analog Circuits	**8**	10	9	13
7	Network Theory	**8**	8	8	7
8	Electromagnetics	**11**	6	8	6
9	Engineering Mathematics	**15**	16	13	10
10	General Aptitude	**15**	15	15	15
	Total	**100**	**100**	**100**	**100**

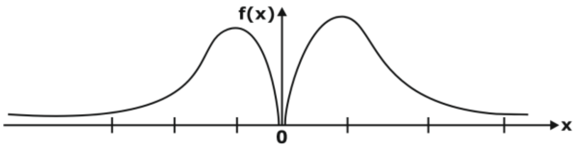
GATE 2023 Electronics & Communication Engineering: Subject-Wise Marks Distribution

Subjects	Questions		Total Marks
	1 Mark	2 Marks	
Control Systems	1	3	7
Digital Circuits	4	2	8
Electronic Devices	3	2	7
Signals & Systems	3	4	11
Communication Systems	2	4	10
Analog Circuits	2	3	8
Network Theory	4	2	8
Electromagnetics	1	5	11
Engineering Mathematics	5	5	15
General Aptitude	5	5	15
Total	30	35	100



Section-A: General Aptitude

1. Which of the following options represent the given graph?



A. $f(x) = x^2e^{2-|x|}$

B. $f(x) = x^2e^{-|x|}$

C. $f(x) = x^2e^{2-|x|}$

D. $f(x) = x^2e^{-2|x|}$

[MCQ, 2 Marks]

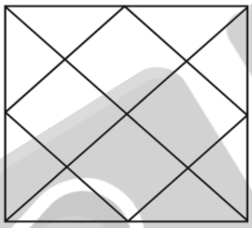
Ans. D

Sol. Check for even symmetry.

$f(t) = f(-t)$

So, correct answer is $x^2e^{-2|x|}$

2. How many rectangles are present in the given figure?



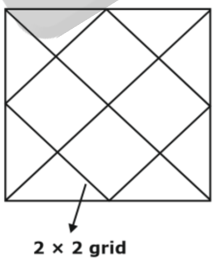
A. 10 B. 8

C. 9 D. 12

[MCQ, 2 Marks]

Ans. A

Sol.



$(1 + 2)(1 + 2) = 9$

Total $\Rightarrow 9 + 1 = 10$

3. In a class of 100 students

(i) There are 30 students who neither like romantic movie nor comedy movies.

(ii) Number of students who like romantic movies is twice the number of students who like comedy moves and

(iii) The number of students who like both romantic movies and comedy moves is 20

How many students in the class like romantic movies

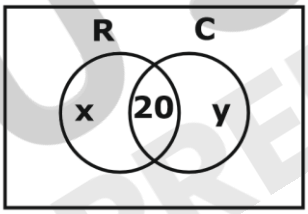
A. 60 B. 30

C. 40 D. 20

[MCQ, 1 Mark]

Ans. A

Sol.



$x + 20 + y + 30 = 100$

$x + y = 50$

$R = 2C$

$(x + 20) = 2(Y + 20)$

$x + 20 = 2Y + 40$

$x + 2(50 - x) + 20$

$x = 40$

So that $x + 20 = 60$

4. What is the smallest number with distinct digits whose digits add upto 45.

A. 99999 B. 123456789

C. 123555789 D. 123457869

[MCQ, 2 Marks]

Ans. B

Sol. Distinct digits mean all the digits should be different.

$\therefore$ 1 2 3 4 5 6 7 8 9 & 1 2 3 4 5 7 8 6 9

So, 1 2 3 4 5 6 7 8 9 < 1 2 3 4 5 7 8 6 9

Correct answer is 1 2 3 4 5 6 7 8 9

5. A 100 cm × 32 cm rectangular sheet is folded 5 times. Each time the sheet is folded, the long Edge aligns with its opposite side. Eventually, the folded sheet is a rectangle of dimension 100 cm × 1 cm. The total no. of creases visible when the sheet is unfolded is.

A. 32 B. 63

C. 31 D. 5

[MCQ, 1 Mark]

Ans. C

Sol. $\Rightarrow 1 + 2^1 + 2^2 + 2^3 + 2^4$

$\Rightarrow 1 + 2 + 4 + 8 + 16$

$\Rightarrow 31$

6. Courts : __________ : : Parliament : Legislature

A. Executive B. Governmental

C. Judiciary D. Legal

[MCQ, 2 Marks]

Ans. C

Sol. As Legislature functions in Parliament Judiciary functions in courts.

7. When I was a kid, I was partial to stories about other worlds and interplanetary travel. I used to imagine that I could just gaze off into space and be whisked to another planet.

A. It is an adult's memory of what he or she liked as a child.

B. The child in the passage read stories about interplanetary travels only in parts.

C. It is a child's description of what he or she likes.

D. It teaches us that stories are good for children.

[MCQ, 2 Marks]

Ans. A

Sol. It is an adult's memory of what he or she liked as a child.

8. I cannot support this proposal.

My _______ will not permit it.

A. Conscious B. Constant

C. Consensus D. Conscience

Ans. D

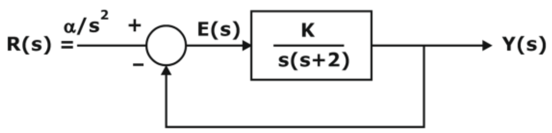
Sol. Option D is correct.

[MCQ, 1 Mark]

Section-B: Technical

11. A closed loop system is shown with k > 0 α > 0.

Find the steady state error due to ramp input.



A. 2α/k B. α/2k

C. α/k D. α/4k

[MCQ, 2 Marks]

Ans. A

Sol. $G(s)=\dfrac{k}{s(s+2)} \rightarrow$ Type '1'

$$K_V = \lim_{s\to 0} sG(s) = \frac{k}{2}$$

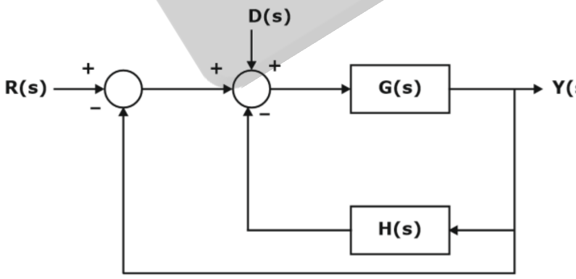
So, e_{ss} for input α[t u (t)]

$$= \alpha\left(\frac{1}{K_V}\right) = \alpha\left(\frac{2}{k}\right)$$

$$e_{ss} = \frac{2\alpha}{k}$$

12. In the following block diagram, R(s) and P(s) are two inputs.

The output Y(s) is expressed as Y(s) = G_1(s) R(s) + G_2(s) D(s). Then G_1(s) and G_2(s) are given by



A. $G_1(s)=\dfrac{G(s)}{1+G(s)-H(s)}$ and
$G_2(s)=\dfrac{G(s)}{2+G(s)-G(s)H(s)}$

B. $G_1(s)=\dfrac{G(s)}{1+G(s)+G(s)H(s)}$ and
$G_2(s)=\dfrac{G(s)}{1+G(s)+G(s)H(s)}$

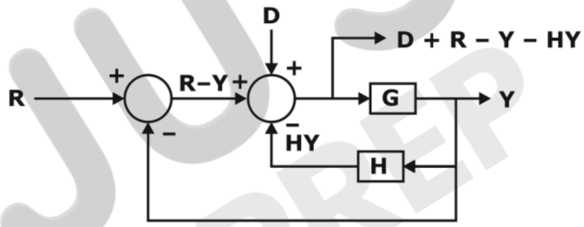
C. $G_1(s)=\dfrac{G(s)}{2+G(s)+H(s)}$ and
$G_2(s)=\dfrac{G(s)}{2+G(s)+G(s)H(s)}$

D. $G_1(s)=\dfrac{G(s)}{1-G(s)+H(s)}$ and
$G_2(s)=\dfrac{G(s)}{1-G(s)+G(s)H(s)}$

[MCQ, 2 Marks]

Ans. B

Sol.



So, Y = G(D + R – y – Hy)

Y(1 + G + GH) = GR + GD

$$Y=\frac{G}{1+G+GH}R+\frac{G}{1+G+GH}$$

13. The open loop transfer function of a unity negative feedback system is

$$G(s)=\frac{K}{s(1+sT_1)(1+sT_2)}$$

Where K, T_1 and T_2 are positive constants. The phase crossover frequency, in rad/s is.

A. $\dfrac{1}{T_2\sqrt{T_1}}$ B. $\dfrac{1}{T_1\,T_2}$

C. $\dfrac{1}{T_1\sqrt{T_2}}$ D. $\dfrac{1}{\sqrt{T_1\,T_2}}$

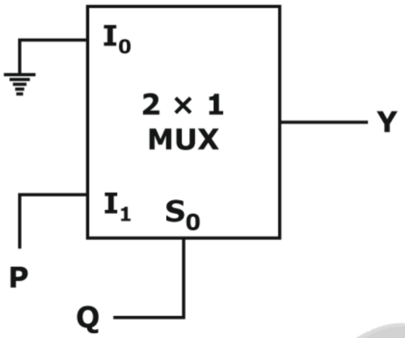
[MCQ, 1 Mark]

Ans. D

Sol. $G(j\omega)=\dfrac{K}{j\omega(1+j\omega\,\pi)(1+j\omega\,T_2)}$

$$\angle G(j\omega) = -90^\circ - \tan^{-1}(\omega\pi) - \tan^{-1}(\omega T_2)$$
$$= -180^\circ$$
$$\tan^{-1}(\omega T_1) + \tan^{-1}(\omega T_2) = 90^\circ$$
$$\tan^{-1}\left(\frac{\omega T_1 + \omega T_2}{1 - \omega^2 T_1 T_2}\right) = 90^\circ$$
$$\Rightarrow 1 - \omega^2 T_1 T_2 = 0 \Rightarrow \omega_p = \frac{1}{\sqrt{T_1 T_2}}$$

14. In the circuit shown below; P and Q are the inputs. The logical function realized by the circuit.



A. $\overline{P+Q}$ B. PQ

C. P + Q D. $\overline{PQ}$

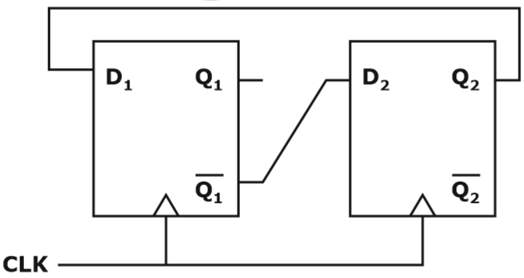
[MCQ, 2 Marks]

Ans. B

Sol. $Y = \bar{S}I_0 + SI_1$

$Y = \bar{Q}\cdot O + Q\cdot P = PQ$

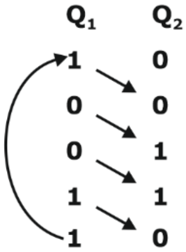
15. In the given sequence circuit initial states are $Q_1 = 1$, $Q_2 = 0$. For clock frequency of 1 MHz; frequency of Q_2(in kHz).



[NAT, 2 Marks]

Ans. 250

Sol.



$Q_2^+ = \bar{Q}_1$

$Q_1^+ = Q_2$

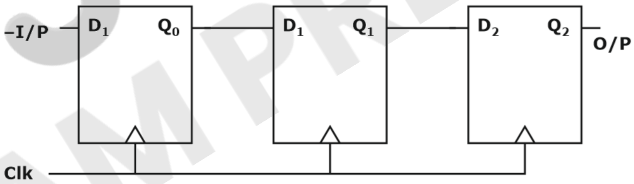
MOD – 4

$f_{Q_2} = \frac{f_{clk}}{4} = \frac{1\text{ MHz}}{4} = 250\text{ kHz}$

16. The synchronous sequential circuit shown below works at a clock frequency of 1 GHz. The throughput in M bits/s and latency in ns respectively

A. 333.3, 1 B. 33.3, 3

C. 2000, 3 D. 1000, 3



[MCQ - 2 Marks]

Ans. D

Sol. f_{clk} = 1 GHz

T_{clk} = 1 ns

So, t_{pd} for each flip flop to satisfy.

$t_{pd} \leq 1$ ns

warts case t_{pd} = 1 ns

So, to transmit 1^{st} bit serially

delay = 3 ns

but for 2^{nd} bit ⇒ 4 ns

3^{rd} bits ⇒ 5 ns

⋮

n bits = (n + 2)ns

$(n + 2) \times 10^{-9}$s → n bits

let $(n + 2) \times 10^{-9} = 1$

$n = 10^9 - 2 \approx 10^9$

So, 1sec $\rightarrow 10^9$ bits = 1000 Mbits

throughput = 1000 Mbits

17. The SNR of an ADC with a full scale sinusoidal input is 61.96 dB. % Resolution of ADC _________

[NAT, 1 Mark]

Ans. 0.097

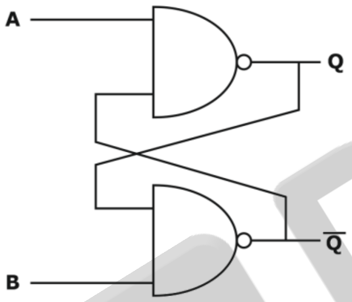
Sol. SNR = 1.763 + 6.02n = 61.96

$n \approx 10$

$$\% \text{ resolution} = \frac{1}{2^{n-1}} \times 100$$

$\approx 0.097\%$

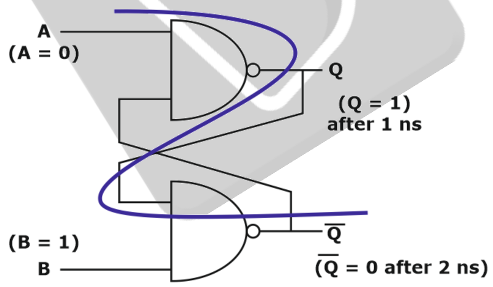
18. For a circuit shown below, the propagation delay of each NAND gate is 1ns. The critical path delay ______ ns.



[NAT, 1 Mark]

Ans. 2

Sol.



Critical path delay = 2 ns

19. In an external semiconductor, the hole concentration given by $1.5n_i$, where n_i is intrinsic carrier concentration of 1×10^{10} cm^{-3}. The ratio of electron to hole mobility for equal hole and electron drift current is given as _______

[NAT, 2 Marks]

Ans. 2.25

Sol. Electron drift current.

$I_n = AJ_n = A\,\sigma\,E = A\,nq\mu_n E$ ... (1)

Hole drift current $I_D = Apq\mu_p E$ ... (2)

$$\frac{I_n}{I_p} = \frac{n}{p} \cdot \frac{\mu_n}{\mu_p} = 1 \quad \text{... (3)}$$

$\because I_n = I_p$

$$\frac{\mu_n}{\mu_p} = \frac{p}{n} \quad \text{... (4)}$$

$p = 1.5\,n_i \qquad n = \frac{n_i^2}{p} = \frac{n_i}{1.5}$

$$\therefore \frac{\mu_n}{\mu_p} = \frac{1.5n_i}{n_i/1.5} = 1.5^2 = 2.25$$

20. In a semiconductor, if fermi energy level lies in conduction band, then the semiconductor is known as.

A. Degenerative n-type

B. Non-degenerative n-type

C. Degenerative p-type

D. Non-degenerative n-type

[MCQ, 2 Marks]

Ans. A

Sol. Option A is correct.

21. For an intrinsic semiconductor at T = 0 K, which of the following statement is true.

A. All energy states in the conduction band is filled with electrons and valence is empty

B. All energy states in conduction and valence bands are filled with electrons

C. All energy states in the conduction and valence band are filled with holes

D. All energy states in the valence band are filled with electrons and conduction band is empty

[MCQ, 2 Marks]

Ans. B

Sol. At = 0 K, semiconductor is insulator

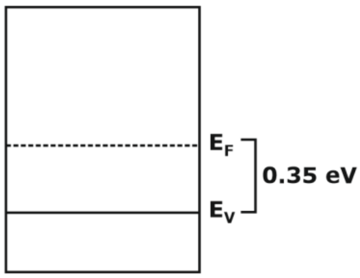
$\therefore$ There will be no intrinsic excitation.

22. In a semiconductor device, the fermi-energy level is 0.35 eV above the valence band energy, the effective density state in valence band at T = 300 K is 1 × 10^{19} cm^{-3}. The thermal equilibrium hole concentration in Si at 400 K is ______ × 10^{13} cm^{-3}.

[NAT, 2 Marks]

Ans. 60.4

Sol. N_V = 1 × 10^{19} cm^{-3} at 300 K



$$E_F - E_V = kT\ln\frac{N_V}{P}$$

From this,

$$p = N_V e^{-[E_F - E_V]/kT}$$

$$N_{V_2} = N_{V_1} \times \left(\frac{T_2}{T_1}\right)^{3/2}$$

$$= 1\times10^{19} \times \left(\frac{400}{300}\right)^{3/2} = 1.539\times10^{19}/cm^3$$

kT at T = 300 K is 0.0259 eV

kT at T = 400 K is

$$= 0.0259 \times \frac{400}{300} = 0.0345 \text{ eV}$$

p = 1.539 × 10^{19} $e^{-0.35/0.0345}$

p = 6.04 × $10^{14}/cm^3$

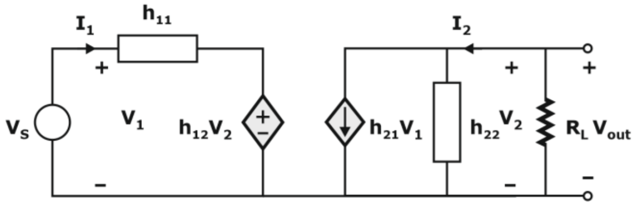
23. The h-parameters of a two-port network are shown below. The condition for the maximum small signal voltage gain V_{out}/V_S is.

A. h_{11} = 0, h_{12} = very high, h_{21} = very high and h_{22} = 0

B. h_{11} = 0, h_{12} = 0 h_{21} = very high,h_{22} = 0

C. h_{11} = very high, h_{12} = 0, h_{21} = very high h_{22} = 0

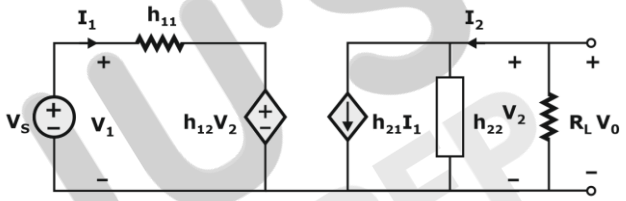
D. h_{11} = 0, h_{12} = 0, h_{21} = very high, h_{22} = very high



[MCQ, 2 Marks]

Ans. B

Sol.



$V_1 = h_{11}I_1 + h_{12}V_2$ ... (1)

$I_2 = h_{21}I_1 + h_{22}V_2$ ... (2)

$V_2 = -I_2R_L$ ... (3)

$V_1 = h_{11}I_1 - h_{12}I_2R_L$ ... (4)

$I_2 = h_{21}I_1 - h_{22}I_2R_L$ .... (5)

$I_2[1 + h_{22}R_L] = h_{21}I_1$

$$\frac{I_2}{I_1} = \frac{h_{21}}{1+h_{22}R_L} \quad .... (6)$$

Put (6) in (4)

$$V_1 = h_{11}I_1 - \frac{h_{12}R_2h_{21}}{1+h_{22}R_L}I_1$$

$V_S = V_1 = [h_{11}\ (1 + h_{22}R_L)) - h_{12}h_{21}R_L]I_1$ ... (7)

$$A_{VS} = \frac{V_0}{V_S} = \frac{-I_2R_L}{I_1(h_{11}(1+h_{22}+R_L)-h_{12}h_{21}R_L)} \quad ...(8)$$

From (6) and (8)

$$A_{VS} = \frac{V_0}{V_s} = \frac{h_{21}}{1+h_{22}R_L}\cdot\frac{R_L}{[h_{11}(1+h_{22}R_L)-h_{12}h_{21}R_L]}$$

From this,

if $h_{11} = 0$ $h_{22} = 0$

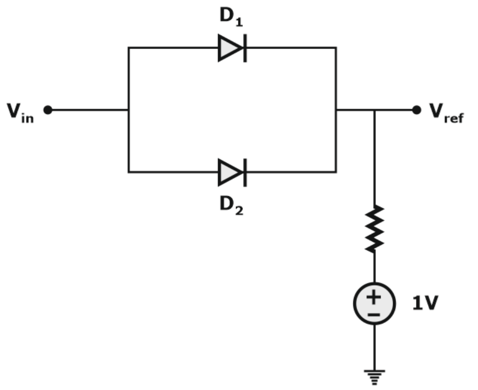
the $A_{VS} \cong -\frac{1}{h_{12}}$

$h_{12} = 0$

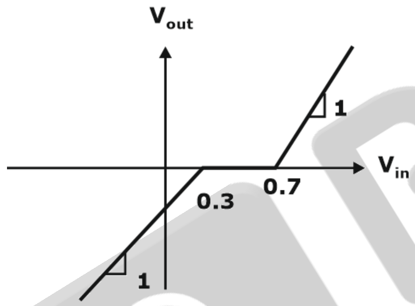
$A_{VS} \cong \infty$ very high

B. $h_{11} = 0$ $h_{12} = 0$ $h_{22} = V$. Low h_{21} = very high

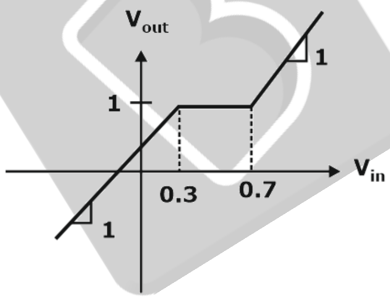
24. If D_1 & D_2 are silicon diodes and cut off voltage is given as 0.7V. Then the transfer characteristics is.



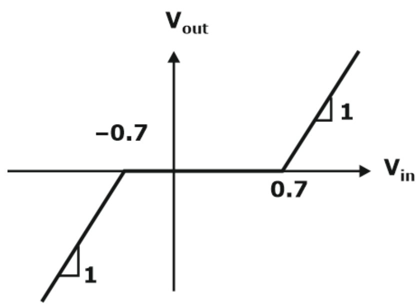
A.



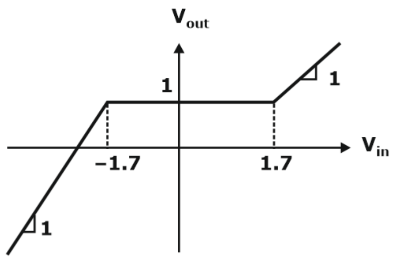
B.



C.



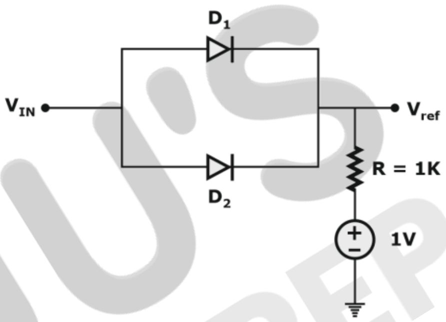
D.



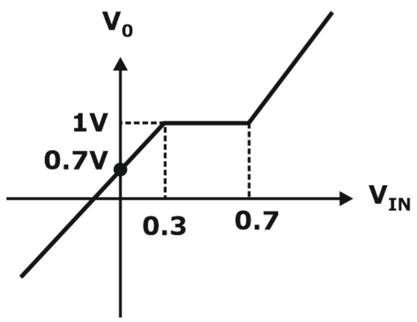
[MCQ, 2 Marks]

Ans. B

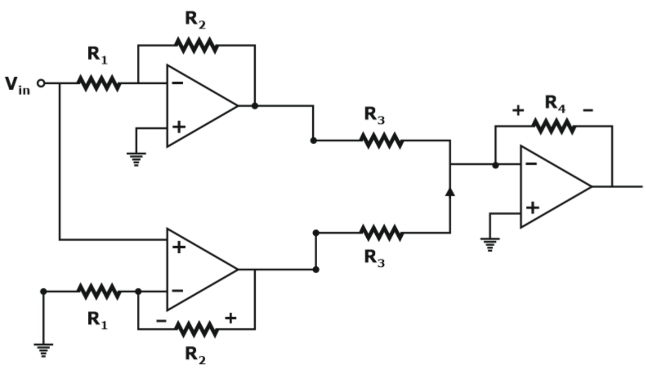
Sol.



V_{in}	D_1	D_2	V_0
$V_{IN} > 1.7$	ON	OFF	$V_{IN} - 0.7$
$0.3 < V_{IN} < 1.7$	OFF	OFF	1V
$V_{IN} \leq 0.3$	OFF	ON	$V_{IN} + 0.7$



25. Find $\frac{V_{out}}{V_{in}} = ?$



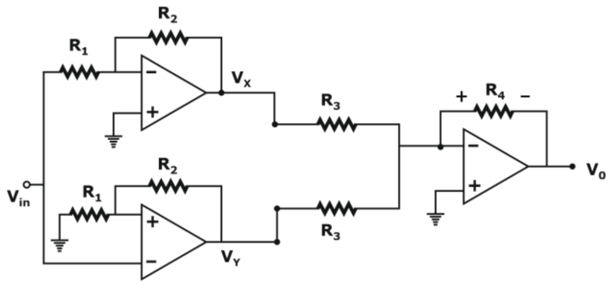
A. I- R_4/R_3 B. R_4/R_3

C. $-R_4/R_3$ D. 1+ R_4/R_3

[MCQ, 2 Marks]

Ans. C

Sol.



$V_X = -\ R_2/R_1\ V_{in}$ ... (1)

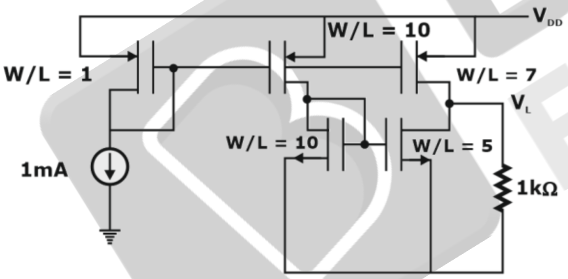
$V_y = (1 + R_2/R_1)\ V_{in}$ .... (2)

$$V_0 = -\frac{R_4}{R_3}V_x - \frac{R_4}{R_3}V_y$$

$$V_0 = -\frac{R_4}{R_3}[V_X + V_y] \quad \text{.... (3)}$$

$$V_0 = -\frac{R_4}{R_3} \quad \text{[from (1) (2) (3)]}$$

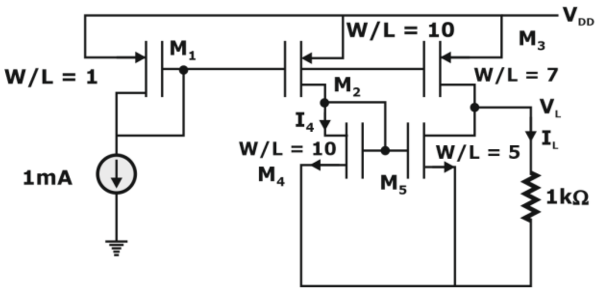
26. In the circuit below, the voltage V_L is?



[NAT, 2 Marks]

Ans. 2

Sol.



M_2 & M_4 are in series

$$I_2 = I_4 = \frac{(W/L)}{(W/L)} \times I_{ref.}$$

$$= \frac{10}{1} \times 1 = 10 \text{ mA}$$

$$I_3 = \frac{(W/L)_3}{(W/L)_1} \times I_{ref} = \frac{7}{1} \times 1 = 7 \text{ mA}$$

$$I_5 = \frac{(W/L)_5}{(W/L)_4} I_4$$

$$I_5 = \frac{5}{10} \times 10 = 5 \text{ mA}$$

$I_3 = I_5 + I_L$

$7 = 5 + I_L$

$I_L = 7 - 5 = 2$ mA

$V_L = I_L R_L = 2 \times 1 = 2$ Volt

27. Consider the signal x(t) and $y(t) = x(e^t)$ output. The system is____.

A. Causal and TIV

B. Non-Causal and TV

C. Causal and TV

D. Non-Causal and TIV

[MCQ, 2 Marks]

Ans. B

Sol. $y(t) = x(e^t)$

(i) Causality test:

Put, t = 0

$y(0) = x(e^0) = x(1)$

present output depends on future input samples.

∴ System is non-causal.

(ii) Test for time invariance:

∵ $y(t) = x(e^t)$

Argument has time function e^t which represents time variant system.

∴ System is non-causal and time variant.

Correct answer (B)

28. FT of $x(t) = e^{-t^2}$ is _____

A. $\sqrt{\pi}e^{\frac{-\omega^2}{4}}$ B. $\sqrt{\pi}e^{\frac{\omega^2}{2}}$

C. $\dfrac{e^{\frac{-\omega^2}{4}}}{2\sqrt{\pi}}$ D. $\sqrt{\pi}e^{\frac{-\omega^2}{2}}$

[MCQ, 2 Marks]

Ans. A

Sol. $x(t) \xleftrightarrow{\text{CTFT}} X(\omega)$

$\because\ e^{-at^2} \xleftrightarrow{\text{CTFT}} \sqrt{\dfrac{\pi}{a}}e^{-\frac{\omega^2}{4a}}$

Put, a = 1

$e^{-t^2} \xleftrightarrow{\text{CTFT}} \sqrt{\pi}\,e^{-\frac{\omega^2}{4}}$

Correct option (A)

29. Match the following

Signal types		Spectral characteristics	
1.	Continuous and aperiodic	a.	Continuous and aperiodic
2.	Continuous and Periodic	b.	Continuous and Periodic
3.	Discrete and aperiodic	c.	Discrete and aperiodic
4.	Discrete and Periodic	d.	Discrete and Periodic

A. 1-a, 2-b, 3-c, 4-d
B. 1-a, 2-c, 3-d, 4-b
C. 1-a, 2-c, 3-b, 4-d
D. 1-d, 2-b, 3-c, 4-a

[MCQ - 2 Marks]

Ans. C

Sol. Duality table

Time domain		Frequency domain
Continuous	→	Aperiodic
Aperiodic	→	Continuous
Discrete	→	Periodic
Periodic	→	Discrete

30. If input x(n) having DTFT $X(e^{j\Omega}) = 1 - e^{-j\Omega} + 2e^{-3j\Omega}$ be passed through as LTI system of frequency response $H(e^{j\Omega}) = 1 - \frac{1}{2}e^{-2j\Omega}$

The output y(n) of the system

A. δ(n) – δ(n – 1) – 0.5δ(n – 2) + 2.5δ(n –3) – δ(n – 5)

B. δ(n) + δ(n – 1) – 0.5δ(n – 2) – 2.5δ(n –3) + δ(n – 5)

C. δ(n) – δ(n – 1) – 0.5δ(n – 2) – 2.5δ(n –3) + δ(n – 5)

D. δ(n) + δ(n – 1) + 0.5δ(n – 2) + 2.3δ(n –3) + δ(n – 5)

[MCQ - 2 Marks]

Ans. A

Sol. $x[n] \xleftrightarrow{\text{DTFT}} X(e^{+j\Omega})$

$X(e^{j\Omega}) = 1 - e^{-j\Omega} + 2e^{-j3\Omega}$

$X(z) = 1 - z^{-1} + 2z^{-3}$ ……… (i)

& $H(e^{j\Omega}) = 1 - \frac{1}{2}e^{-j2\Omega}$

$H(z) = 1 - \frac{1}{2}z^{-2}$ ……… (ii)

Now, Y(z) = X(z).H(z)

$Y(z) = (1 - z^{-1} + 2z^{-3}).\left(1 - \frac{1}{2}z^{-2}\right)$

$Y(z) = 1 - z^{-1} + 2z^{-3} - \frac{1}{2}z^{-2} + z^{-3} - z^{-5}$

$Y(z) = 1 - z^{-1} - \frac{1}{2}z^{-2} + \frac{5}{2}z^{-3} - z^{-5}$

Taking I.Z.T.

y[n] = δ(n) – δ(n – 1) – 0.5δ(n – 2) + 2.5δ(n –3) – δ(n – 5)

Correct answer (A)

31. Let m(t) be a bandlimited signal with bandwidth B and energy E. Let ω_0 = 10B, the energy of signal $m(t)\cos\omega_0 t$

A. $\frac{E}{4}$ B. E

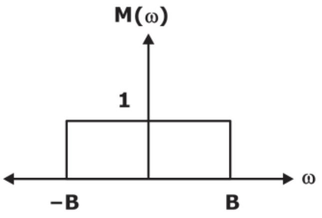
C. 2E D. $\frac{E}{2}$

[MCQ, 2 Marks]

Ans. D

Sol. $m(t) \xleftrightarrow{CTFT} M(\omega)$

Let $M(\omega)$ be as follows



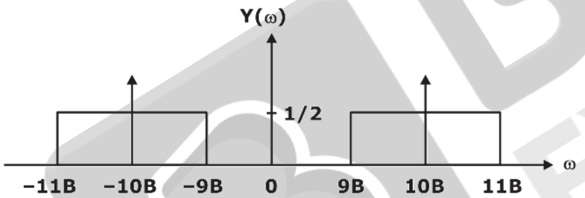
$$E = \frac{1}{2\pi}\int_{-B}^{B} |M(\omega)|^2 \cdot d\omega$$

$$E = \frac{1}{2\pi}\int_{-B}^{B} 1 \cdot d\omega$$

$$E = \frac{1}{2\pi} 2B$$

$$\Rightarrow E = \frac{B}{\pi}$$

Now, $y(t) = m(t) \,.\, \cos(\omega_0 t) \leftrightarrow y(\omega)$



$$E_y = \frac{1}{2\pi}\int_{-\infty}^{\infty} |Y(\omega)|^2 \cdot d\omega$$

$$= 2 \cdot \frac{1}{2\pi}\int_{9B}^{11B} \left(\frac{1}{2}\right)^2 \cdot d\omega$$

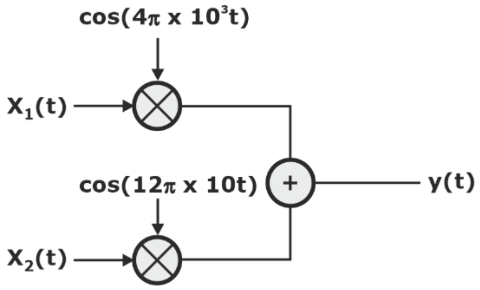
$$= \frac{1}{4\pi}(11B - 9B) = \frac{2B}{4\pi} = \frac{B}{2\pi}$$

$$E_y = \frac{E}{2}$$

32. Let $x_1(t)$ and $x_2(t)$ be two band limited signals having bandwidth.

$B = 4\pi \times 10^3$ rad/s each. In the figure below, the Nyquist sampling frequency in rad/s, required to sample y(t) is?

[MCQ, 2 Marks]

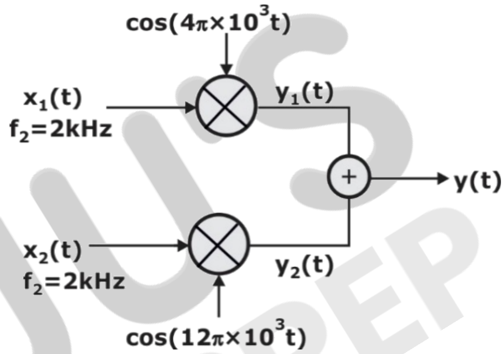


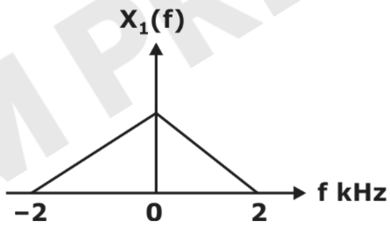
A. $8\pi \times 10^3$ B. $20\pi \times 10^3$

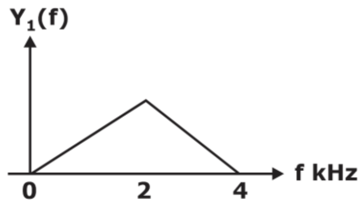
C. $40\pi \times 10^3$ D. $32\pi \times 10^3$

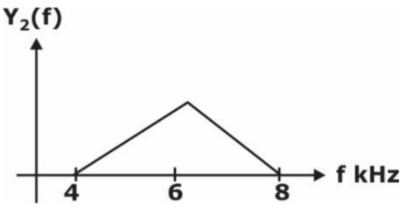
Ans. D

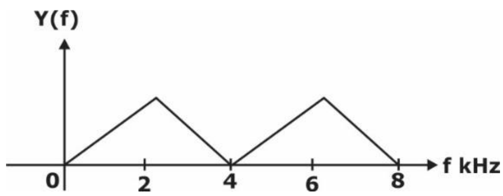
Sol.











Signal y(t) is bandlimited to 8 kHz.

Nyquist rate, $f_s = 2f_m = 2 \times 8 \times 10^3 = 16$ kHz

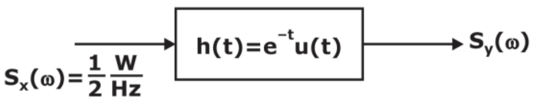
$\omega_s = 2\pi f_s = 32\pi \times 10^3$ rad/sec

33. Let X(t) be a white gaussian noise with power spectral density ½ W/H2. If X(t) is input to an LTI system with impulses response $e^{-t}u(t)$. The average power of the system output is W. (Upto two decimal places)

[NAT, 2 Mark]

Ans. 0.25

Sol.



$S_y(\omega) = S_x(\omega)|H(\omega)|^2$

$= \frac{1}{2}\left|\frac{1}{1+j\omega}\right|^2$

$= \frac{1}{2}\left(\frac{1}{1+\omega^2}\right)$

Output average power $= \frac{1}{2\pi}\int_{-\infty}^{\infty} S_y(\omega)\, d\omega$

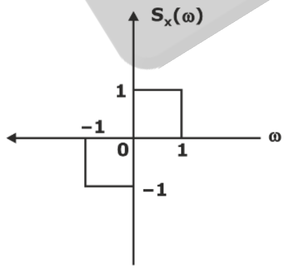
$= \frac{1}{2\pi} \times 2\int_{-\infty}^{\infty} \frac{1}{2}\frac{1}{\left(1+\omega^2\right)} d\omega$

$= \frac{1}{2\pi} \times \left[\tan^{-1}\omega\right]_0^{\infty} = \frac{1}{2\pi} \times \frac{\pi}{2}$

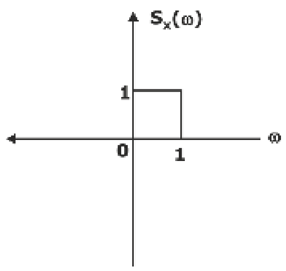
$= 0.25$

34. For a real signal, which of the following is /are valid power spectral density/densities?

A.



B.



C. $S_x(\omega) = e^{-\omega^2}\cos^2\omega$

D. $S_x(\omega) = \frac{2}{9+\omega^2}$

Ans. C, D

Sol. Properties of power spectral density:

(1) $S_x(\omega)$ should be real and positive

(2) $S_x(\omega) = S_x(-\omega)$

$S_x(\omega) = e^{-\omega^2}\cos^2\omega$

$S_x(-\omega) = e^{-(-\omega)^2}\cos^2(-\omega) = e^{-\omega^2}\cos^2\omega$

(Hence even symmetry)

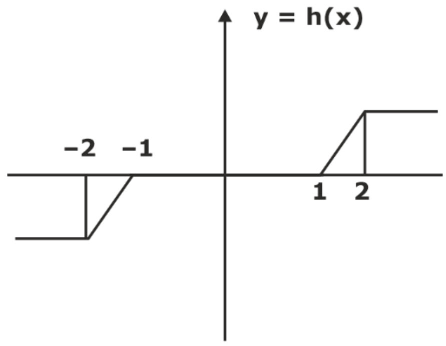
$S_x(\omega) = \frac{2}{9+\omega^2}$

$S_x(\omega) = \frac{2}{9+(-\omega^2)^2} = \frac{2}{9+\omega^2} = S_x(\omega)$

(even symmetry)

Option (C) and (D) are correct.

35. A random variable X, distributed normally as N(G1) undergoes the transformation y = n(x), given in the figure. The form of probability density function of y is (a, b, c are non zero) constants and g(y) is piece-wise continuous function)



A. aδ (y + 2) + bδ (y) +cδ (y−2) + g(y)

B. aδ (y − 1) + bδ (y + 1) +g (y)

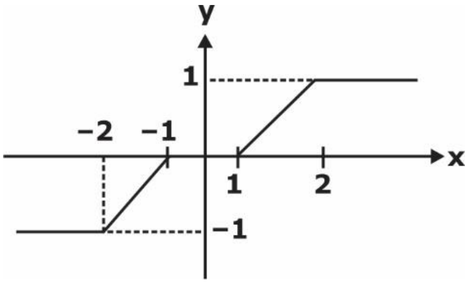
C. aδ (y + 2) + bδ (y − 2) + g(y)

D. aδ (y + 1)+ bδg(y) + cδ (y − 1) + g(y)

[MCQ - 1 Mark]

Ans. D

Sol.



For −1 < x < 1, y = 0

For x > 2, y = +1

For 1 < x < 2 and −2 < x < −1, y = variable

The PDF of Y will have form,

$$f_y(y) = \sum_{i=0}^{n} p(y_i)\,\delta(y - y_i) + g(y)$$

Where, g(y) = piece-wise continuous function because for 1 < x < 2 and −2 < x < −1 it is nootropics increasing hence it is following continuous function which will have form $\frac{f_x(x)}{\left(\frac{dy}{dx}\right)}$.

$f_y(y) = a\boldsymbol{\delta}(y + 1) + b\boldsymbol{\delta}g(y) + c\boldsymbol{\delta}(y - 1) + g(y)$

option (D).

36. Let a frequency modulated (FM) signal $x(t) = A\cos(\omega_{ct} + k_f$ where m(t) is a message signal of band width W. It is passed through a non-linear system with output $y(t) = 2x(t) + 5(x(t))^2$, Let B_T denote the FM bandwidth. The minimum value of ω_C required to recover x(t) from y(t) is _____.

[MCQ - 2 Mark]

A. $B_T + \omega$

B. $\frac{3}{2}B_T$

C. $\frac{5}{2}B_T$

D. $2B_T + \omega$

Ans. B

Sol. $y(t) = 2x(t) + 5x^2(t)$

$$= 2A\cos(\omega_c t + k_f\int_{-\infty}^{t} m(d)d\lambda + 5A^2\cos^2$$

$$\left[\omega_c t + k_f\int_{-\infty}^{t} m(\lambda)\,d\lambda\right]$$

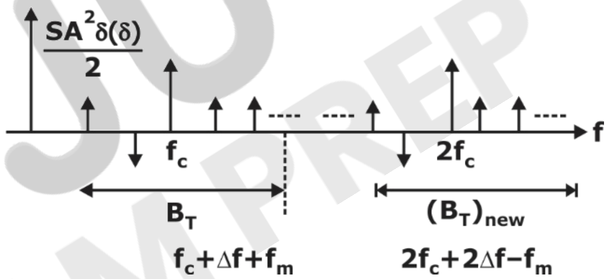
$$= \underbrace{2a\cos[\omega_c t + k_f\int_{-\omega}^{t} m(\lambda)d\lambda]}_{FM}$$

$$+\underbrace{\frac{5A^2}{2}}_{DC}\underbrace{[1+\cos(2\omega_c t + 2k_f\int_{-\omega}^{t} m(\lambda)d\lambda]}_{FM}$$

Bandwidth of FM is gives by, $B_T = 2(\Delta f + f_m)$

After squaring f_c and Δf will get doubled and f_m unchanged.

i.e., $(B_T)_{new} = 2[2\Delta f + f_m]$



To recover original signal x(t) the following condition should be satisfied.

$f_c + \Delta f + f_m < 2f_c - 2\pi f - f_m$

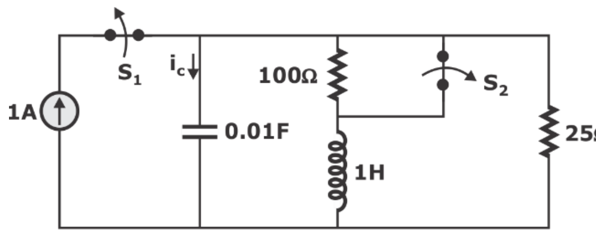
$f_c > 3\Delta f + 2f_m$

$\Rightarrow f_c > \frac{3}{2}[2(\Delta f + f_m)] - f_m$

$f_c > \frac{3}{2}B_T - f_m$

Option (B)

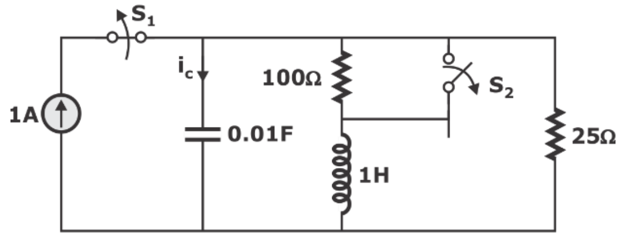
37. The switch S_1 was closed and S_2 was open for a long time. At t = 0, switch S_1 is opened and S_2 closed. The value of $i_c(0^+)$ (in A).



[NAT, 2 Marks]

Ans. −1

Sol.



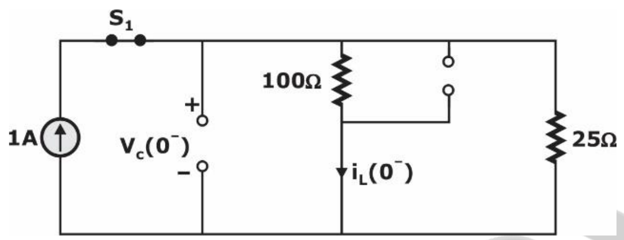
$S_1 \rightarrow$ closed and $S_2 \rightarrow$ open for long time.

i.e., $S_1 \rightarrow$ closed from $t = -\infty$ to $t = 0^-$

and $S_2 \rightarrow$ opened from $t = -\infty$ to $t = 0^-$

At $t = 0^-$, the network is in steady state and $i_c(0^-)$ will be zero.

∴ capacitor is O.C. and inductor is S.C.

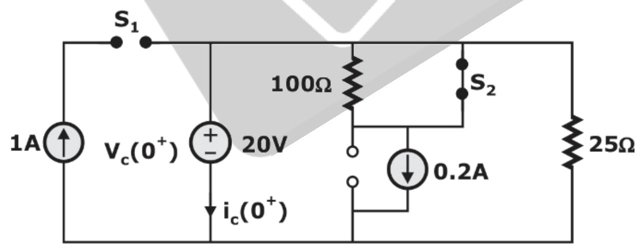


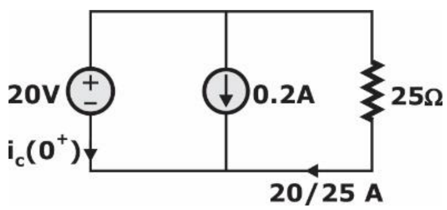
$i_1(0^-) = \frac{1}{100}\begin{bmatrix} 2 & -1 \\ -1 & 4/3 \end{bmatrix}$S. = 0.2 Amp's

$i_c(0^-) = i_L(0^-) \times 100 = 0.2 \times 100 = 20$ volts

At $t = 0^+$, The network is in transient state,

∴ capacitor acts as S.C and inductor acts as O.C.

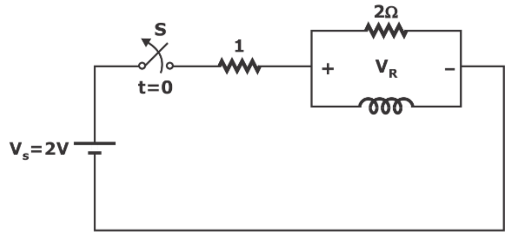




$-i_c(0^+) = 0.2 + 0.8$

$I_c(0^+) = -1$ A

38. The maximum magnitude of V_R in _____ Volts.

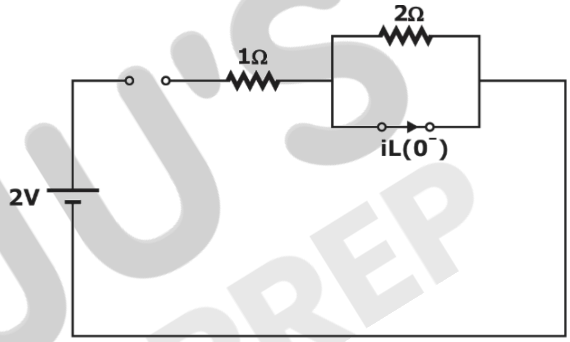


[NAT, 1 Mark]

Ans. +4

Sol. At $t = 0^-$, the network is in steady state

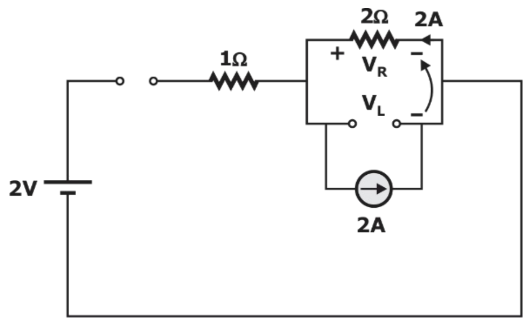
∴ A inductor acts S.C.



$i_L(0^-) = \frac{2}{1} = 2$ Amps

At $t = 0^+$; the network is in transient state

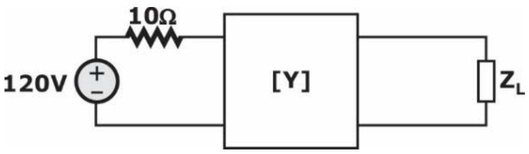
∴ inductor acts as O.C



By KVL; $-V^L(0^+) = V_R = 0$

$|V_L(0^+)| = V_R = 2 \times 2 = 4$ Volts

39. For a two-port network shown below, the [λ] parameters is given as $[y] = \frac{1}{100}\begin{bmatrix} 2 & -1 \\ -1 & 4/3 \end{bmatrix}$S. The value of load impedance Z_L in Ω, for maximum power transfer will be______



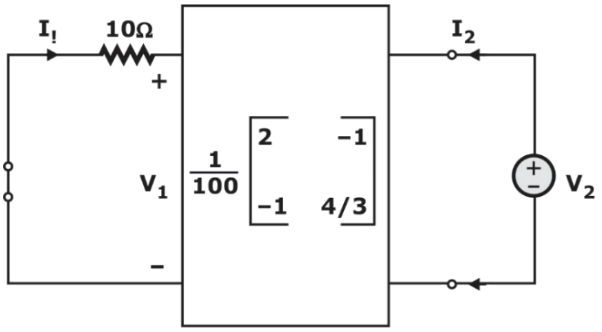
[NAT – 2 Marks]

Ans. 82.19

Sol. For maximum power transfer to load Z_L

$= Z_{Th}$

Z_{th} calculation:



$$Y = \begin{bmatrix} 0.02 & -0.01 \\ -0.01 & 0.013a \end{bmatrix}$$

We know, $I_1 = Y_{11} V_1 + Y_{12} V_2$ ...(i)

$I_2 = Y_{21} V_1 + Y_{12} V_2$ ...(ii)

$I_1 = 0.02\,[-10I_1] + (-0.01)V_2$

$1.2\, I_1 = -0.01\, V_2$ ...(iii)

$I_2 = -0.01[-10I_1] + 0.013\, V_2$

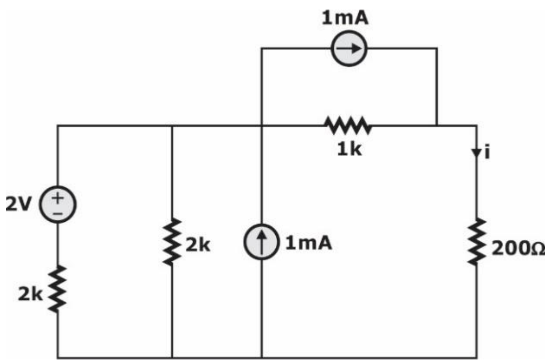
$I_2 = 0.1I_I + 0.013\, V_2$ ....(iv)

Sub (3) in (4), we get

$$I_2 = 0.1\left[\frac{-0.01\, V_2}{1.2}\right] + 0.013\, V_2$$

$$\frac{V_2}{I_2} = Z_{22} = Z_{th} = 82.19\ \Omega$$

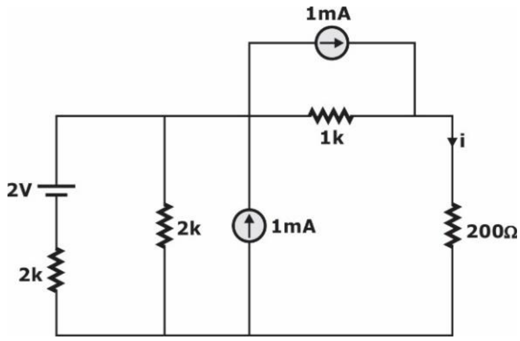
40. Find current I flowing through 200 Ω resistor in mA.



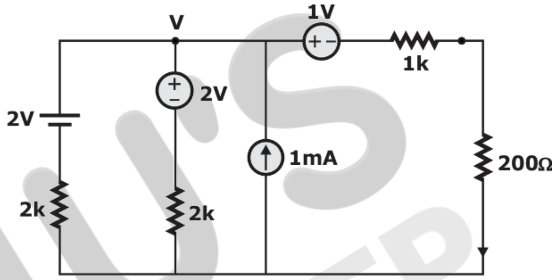
[MCQ - 2 Marks]

Ans. 1.67

Sol. By source transformation.



By Nodal analysis



$$\frac{V-2}{2k} + \frac{V-2}{2k} + \frac{V+1}{1200} = 0$$

$$V\left[\frac{1}{2k} + \frac{1}{2k} + \frac{1}{1200}\right] = \frac{k}{2k} + \frac{2}{2k} + \frac{1}{1200}$$

$V[1.833 \times 10^{-3}] = 1.83 \times 10^{-3}$

$V = 1$ volts

$$\therefore i = \frac{1+1}{1k+200} = \frac{2}{1200} = 1.67 \text{ mA}$$

41. A series RLC circuit has θ = 1000 at a centre frequency 10^6 rad/sec. Possible values of R, L and C.

A. L = 1μH, C = 1μF, R = 0.01Ω

B. L = 1μH, C = 1μF, R = 0.001Ω

C. L = 1μH, C = 1μF, R = 0.1Ω

D. L = 1μH, C = 1μF, R = 1Ω

[MCQ, 1 Mark]

Ans. B

Sol. Series RLC circuit

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$1000 = \frac{1}{R}\sqrt{\frac{1}{1}}$$

R =0.001 Ω

$\omega = 10^6$ rad/sec

42. A transparent dielectric coating is applied to glass (ε_r = 4, μ_r = 1) to eliminate the reflection of red light (λ_0 = 0.75 μm). The minimum thickness of the dielectric coating in μm that can be used Is (round off to 2 decimal place)

Sol. $\eta_2 = \sqrt{\eta_1\eta_3} = \sqrt{\varepsilon_{r1}\varepsilon_{r_3}} = 2$

$$\lambda_2 = \frac{0.75}{\sqrt{\varepsilon_{r_2}}} = 0.530\ \mu m$$

$$d = \frac{\lambda_2}{4} = 0.133\ \mu m$$

43. The electric field of a plane electromagnetic wave is E = $a_x C_{1x} \cos(\omega t - \beta z) + a_y C_{1y} \cos(\omega t - \beta z + \theta)$ V/m. Which of the following combination(s) will give rise to a left-handed elliptically polarized (LHEP) wave?

A. C_{1x} = 1, C_{1y} = 2, θ = 3π/2

B. C_{1x} = 2, C_{1y} = 1, θ = π/2

C. C_{1x} = 2, C_{1y} = 1, θ = 3π/4

D. C_{1x} = 1, C_{1y} = 1, θ = π/4

Ans. B, C, D

Sol. $E = C_{ix} \cos|\omega t - \beta z)\hat{i} + C_{iy} \cos|\omega t - \beta z + 0]\hat{j}$

$E_x = C_{ix} \cos|\omega t - \beta z]$

$E_y = C_{iy} \cos|\omega t - \beta z + \theta]$

At z = 0 and t = 0,

$E_x = C_{ix}$

$E_y = C_{iy} \cos\theta$

At z = 0 and t = t_1,

$E_x = C_{ix} \cos\omega t_1$

$E_y = C_{iy} \cos[\omega t_1 + \theta]$

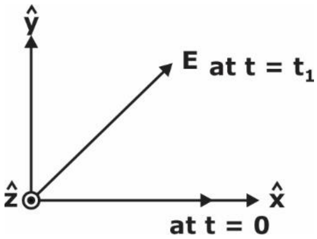
Option A,

$E_x(0, 0) = 1$

$E_y = (0, 0) = 2\cos\frac{\pi}{2} = 0$

$E_x(0, t_1) = 1\cos\omega t_1$

$E_y(0, t) = 2\cos[\omega t_1 + \frac{3\pi}{2}]$ = positive and less than 2



This is right elliptical.

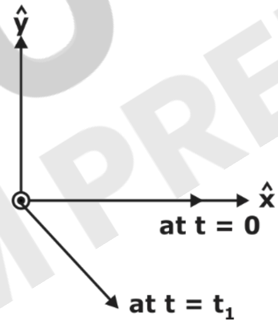
Option (B)

At t = 0,

Option B:

$E_x(0, 0) = 1$ $\quad$ $E_x(0, t_1) = 2\cos\omega t_1$

$E_y(0, 0) = 0$ $\quad$ $E_y(0, t_1) = \cos[\omega t_1 + \frac{\pi}{2}]$



This is left elliptical.

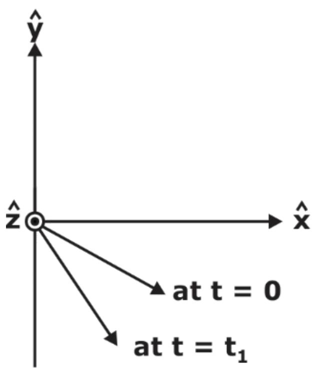
Option (C)

$E_x = (0, 0) = 2$

$E_y(0, 0) = 1\cos\frac{3\pi}{4} = -\frac{1}{\sqrt{2}}$

$E_x = (0, t_1) = 2\cos\omega t_1$

$E_y(0, t_1) = 1\cos\left[\omega t_1 + \frac{3\pi}{4}\right]$



It is left elliptical.

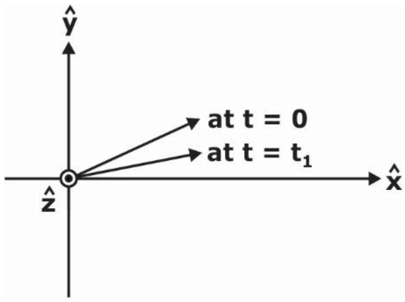
Option (D)

$E_x(0, 0) = 1$

$E_y(0, 0) = 1\cos\frac{\pi}{4} = \frac{1}{\sqrt{2}}$

$E_x(0, t_1) = 1\cos\omega t_1$

$E_y(0, t_1) = \cos\left(\frac{\pi}{4} + \omega t_1\right)$



This is left elliptical.

So, option B,C, D are correct.

44. Consider a narrow band signal, propagating in a lossless dielectric material ($\epsilon_r = 4$, $\mu_r = 1$), with phase velocity v_p and group velocity v_g, which of the following statements are true (c is velocity of light in vacuum)

A. $v_p > c$, $v_g > c$ B. $v_p > c$, $v_g > c$

C. $v_p < c$, $v_g > c$ D. $v_p < c$, $v_g < c$

Ans. *

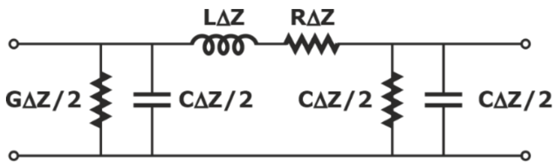
Sol. $V_p = \frac{c}{\sqrt{\varepsilon_r\mu_r}} = \frac{3\times10^8}{\sqrt{4\times1}} = 1.5\times10^8 < c$

$V_P V_g = c^2$

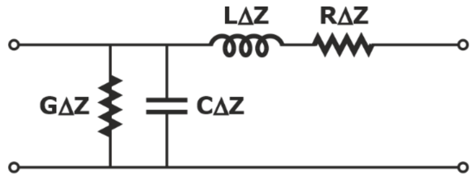
$V_g = \frac{V}{V_p} = \frac{9\times10^{16}}{1.5\times10^8} = 6\times10^8 > c$

45. The following circuits representing an lumped element equivalent of an infinitesimal section of a transmission line is/are.

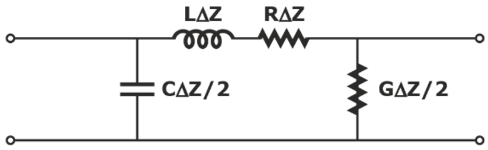
A.



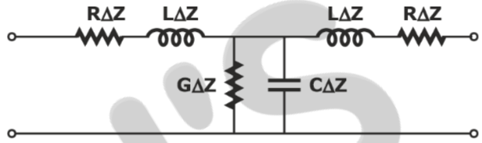
B.



C.



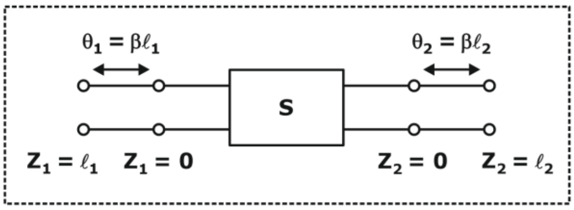
D.



Ans. A, C, D

Sol. From a reciprocity and symmetry property of transmission lines, options A, C, D are correct.

46. Given S parameter, $S = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}$ with reference to Z_0. Two lossless transmission line section of length $\theta_1 = \beta I_1$, θI_2, are added to input and output port as shown. The resultant S parameter S' is.



A. $\begin{bmatrix} S_{11}e^{-j(\theta_1+\theta_2)} & S_{12}e^{-j(\theta_1+\theta_2)} \\ S_{21}e^{-j(\theta_1+\theta_2)} & S_{21}e^{-j2(\theta_2)} \end{bmatrix}$

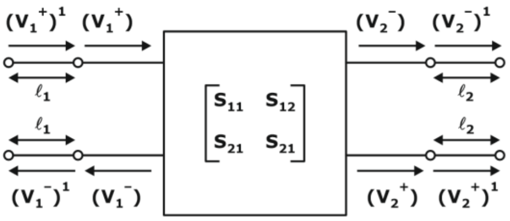
B. $\begin{bmatrix} S_{11}e^{-j(\theta_1+\theta_2)} & S_{12}e^{-j(\theta_1+\theta_2)} \\ S_{21}e^{-j(\theta_1+\theta_2)} & S_{21}e^{j2(\theta_2)} \end{bmatrix}$

C. $\begin{bmatrix} S_{11}e^{-j(\theta_1)} & S_{12}e^{-j(\theta_1+\theta_2)} \\ S_{21}e^{-j(\theta_1)} & S_{21}e^{j2(\theta_2)} \end{bmatrix}$

D. $\begin{bmatrix} S_{11}e^{-j(\theta_1+\theta_2)} & S_{12}e^{-j(\theta_2)} \\ S_{21}e^{j(\theta_1+\theta_2)} & S_{21}e^{j2(\theta_2)} \end{bmatrix}$

Ans. None of the above

Sol.



$$\left(V_1^+\right) = \left(V_1^+\right)' e^{-j\theta_1}$$

$$\left(V_1^-\right)' = \left(V_1^-\right)e^{-j\theta_1} \Rightarrow \left(V_1^-\right) = \left(V_1^-\right)'e + j\theta_1$$

$$\left(V_2^-\right)' = \left(V_2^-\right)e^{-j\theta_2} \Rightarrow \left(V_2^-\right) = \left(V_2^-\right)'e + j\theta_2$$

$$\left(V_2^+\right) = \left(V_2^+\right)' e^{-j\theta_2}$$

$$V_1^- = S_{11}V_1^+ + S_{12}V_2^+ \qquad \text{... (i)}$$

$$V_2^- = S_2V_1^+ + S_{22}V_2^+ \qquad \text{... (ii)}$$

From Equation (i)

$$\left(V_1^-\right)' e^{j\theta 1} = s_{11}\left(V_1^+\right)'e^{-j\theta_1} + S_{12}\left(V_2^+\right)'e^{-j\theta_2}$$

$$\left(V_1^-\right)' = S_{11}e^{-j2\theta_1}\left(V_1^+\right)' + S_{12}e^{-j(\theta_1+\theta_2)}\left(V_2^+\right)'$$

From Equation (ii)

$$\left(V_2^-\right)'e^{+j\theta_2} = S_{21}\left(V_1^+\right)e^{-j\theta_1} + S_{22}\left(V_2^+\right)e^{-j\theta_2}$$

$$\left(V_2^-\right)' = S_{21}e^{+j(\theta_1+\theta_2)}\left(V_1^+\right)' + S_{22}e^{-j(\theta_1+\theta_2)}\left(V_2^+\right)'$$

$$\begin{bmatrix}\left(V_1^-\right)' \\ \left(V_2^-\right)'\end{bmatrix} = \begin{bmatrix}S_{11}e^{-j(2\theta_1)} & S_{12}e^{-j(\theta_1+\theta_2)} \\ S_{21}e^{-j(\theta_1+\theta_2)} & S_{21}e^{-j2(\theta_2)}\end{bmatrix}\begin{bmatrix}\left(V_1^+\right)' \\ \left(V_2^+\right)'\end{bmatrix}$$

47. Contour integral $\oint_c \left(\frac{z+2}{z^2+2z+2}\right)dz$ where the contour C is $\left\{c : \left|z+1-\frac{3}{2}j\right| = 1\right\}$ taken in the contour clockwise direction is –

A. $\pi(1 + j)$ B. $-\pi(1 + j)$

C. $-\pi(1 - j)$ D. $\pi(1 - j)$

[MCQ - 2 Marks]

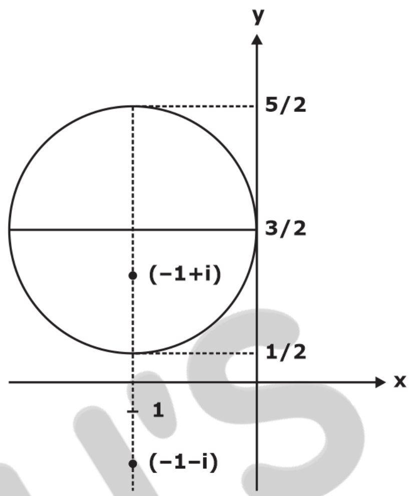
Ans. A

Sol. C: $\left|z+1-\frac{3}{2}i\right| = 1$

$$\left|(x+1)+i\left(y-\frac{3}{2}\right)\right| = 1$$

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

Centre $\left(-1, \frac{3}{2}\right)$, radians = 1



Poles: $z^2 + 2z + z = 0$

$z = -1 \pm i$

$$R = \lim_{z\to -1+i}\left[z-(-1+i)\right]\frac{(z+2)}{\left[z-(-1+i)\right]\left[z-(-1-i)\right]}$$

$$R = \frac{1+i}{2i}$$

Integral (I) = $2\pi i(R)$

$= 2\pi i \times \left(\frac{1+i}{2i}\right)$

$= \pi(1 + i)$

48. $V_1 = \begin{bmatrix}1\\2\\0\end{bmatrix}$, $V_2 = \begin{bmatrix}2\\1\\3\end{bmatrix}$ are two vectors. The value of coefficient α in the expression $V_1 = \alpha V_2 + e$, which minimized the length of error vectors C is.

[MCQ, 1 Mark]

A. $\frac{7}{2}$ B. $-\frac{2}{7}$

C. $\frac{2}{7}$ D. $-\frac{7}{2}$

Ans. C

Sol. $V_1 = \begin{bmatrix}1\\2\\0\end{bmatrix}$, $V_2 = \begin{bmatrix}2\\1\\3\end{bmatrix}$

$\because V_1 = \alpha V_2 + e$

$e = V_1 - \alpha . V_2$

$$e = \begin{bmatrix}1\\2\\0\end{bmatrix} - \begin{bmatrix}2\alpha\\\alpha\\3\alpha\end{bmatrix}$$

$$e = \begin{bmatrix}1-2\alpha\\2-\alpha\\-3\alpha\end{bmatrix}$$

Length of e = |e| =

$$\sqrt{(1-2\alpha)^2 + (2-\alpha)^2 + (-3\alpha)^2}$$

$e^2 = (1-2\alpha)^2 + (2-\alpha)^2 + (-3\alpha)^2$

$= 4\alpha^2 + \alpha^2 + 9\alpha^2 - 4\alpha - 4\alpha + 5$

$e^2 = 14\alpha^2 - 8\alpha + 5$

let, $f(x) = 14\alpha^2 - 8\alpha + 5$

(i) $f'(x) = 28\alpha - 8$

(ii) From max/min

$f'(\alpha) = 0$

$28\alpha - 8 = 0$

$\alpha = \frac{2}{7}$

(iii) $f''(\alpha) = 28$

$\because f''\left(\frac{2}{7}\right) = 28 > 0$

$\because f(\alpha)$ will minimum for $\left(\alpha = \frac{2}{7}\right)$

49. Let $\omega^4 = 16j$. Which of the following cannot be value of ω.

A. $2e^{j\pi/8}$
B. $2e^{j5\pi/8}$
C. $2e^{j2\pi/8}$
D. $2e^{j9\pi/8}$

[MCQ, 2 Marks]

Ans. C

Sol. $\omega^4 = 16j$

$\omega = (16j)^{1/4}$

$\omega = 2(j)^{1/4}$

$\omega = 2\left(e^{j\frac{\pi}{2}}\right)^{1/4}$

$\omega = 2.e^{j\frac{\pi}{8}}$

(i) Option A: $\omega = 2e^{j\frac{\pi}{8}}$

(ii) Option B: $2e^{j\frac{5\pi}{8}} = 2e^{j\frac{\pi}{8}}$

(iii) Option C: $2e^{j\frac{2\pi}{8}} \neq 2e^{j\frac{\pi}{8}}$

(iv) Option D: $2e^{j\frac{9\pi}{8}} = 2e^{j\frac{\pi}{8}}$

Correct option (C)

50. The value of line integral $\int_P^Q \left[(z^2dx + 3y^2dy + 2x^3dz)\right]$ along the straight line joint the point P(1, 1, 2) and Q(2, 3, 1) is

A. – 5
B. 24
C. 20
D. 29

[MCQ, 2 Marks]

Ans. B

Sol. $\int_P^Q \left[(z^2dx + 2xzdz) + 3y^2dy\right]$

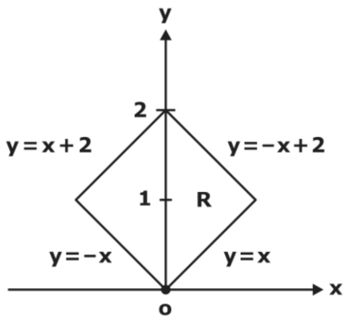
$\int d(z^2x) + d(y^3) = \int d(xz^2 + y^3)$

$= \left[xz^2 + y^3\right]_{P(1,\,1,\,2)}^{Q(2,\,3,\,1)}$

= (2 × 1 + 27) – (1 × 4 + 1)

= 24

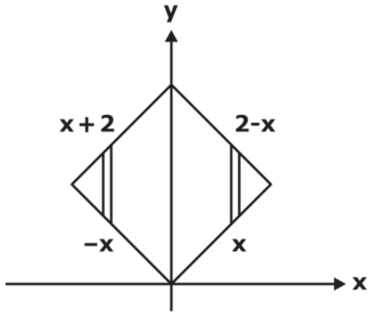
51. The value of integral $\iint xydxdy$ over the region R given in the figure is



[NAT, 2 Marks]

Ans. 0

Sol.



$$I = \int_{x=-1}^{0}\int_{y=-x}^{x+2} xydydx + \int_{x=0}^{1}\int_{y=x}^{2-x} xydydx$$

$$= \int x\left[\frac{y^2}{2}\right]_{-x}^{x+2} dx + \int x\left[\frac{y^2}{2}\right]_{x}^{2-x} dx$$

$$= \int_{x=-1}^{0} (2x+2x^2)\,dx + \int_{x=0}^{1} (2x-2x^2)\,dx$$

$$= \int_{-1}^{0} 2x + \int_{-1}^{0} 2x^2dx - \int_{0}^{1} 2x^2dx$$

= 0 + I + I

= 0

52. Let x be an n × 1 real column vector with length $\ell = \sqrt{x^Tx}$. The trace of the matrix $P = xx^T$ is

A. $\frac{\ell^2}{2}$

B. ℓ^2

C. $\frac{\ell^2}{4}$

D. ℓ

[MCQ, 2 Marks]

Ans. B

Sol.

$$P = xx^T = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}\begin{bmatrix} x_1 & x_2 & \cdots x_n \end{bmatrix}$$

$$= \begin{bmatrix} x_1 & x_1x_2 & x_1x_3 \cdots x_1x_n \\ x_2 & x_2^2 & x_2x_1 \cdots x_2x_n \\ \vdots & & \\ x_n & \cdots\cdots\cdots & \cdots\cdots x_nx_1 \end{bmatrix}$$

So, Trace $= x_1^2 + x_2^2 + \cdots\cdots\cdots x_n^2 = \ell^2$

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GATE 2023 Electronics Engineering: Expected Topper's Marks

- **80+/100 Marks Expected for AIR under 10**
- **70+/100 Marks Expected for AIR under 100**

GATE 2023 Electronics Engineering: Expected Cut-Off

Category	2021	2022	Expected 2023
General	25	25	26 Marks
OBC	25.5	22.5	23.5 Marks
SC/ST	16.6	16.6	17.5 Marks


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