

# GATE 2023



Electronics & Communication Engineering

Questions & Solutions

 5<sup>th</sup> Feb Afternoon Session

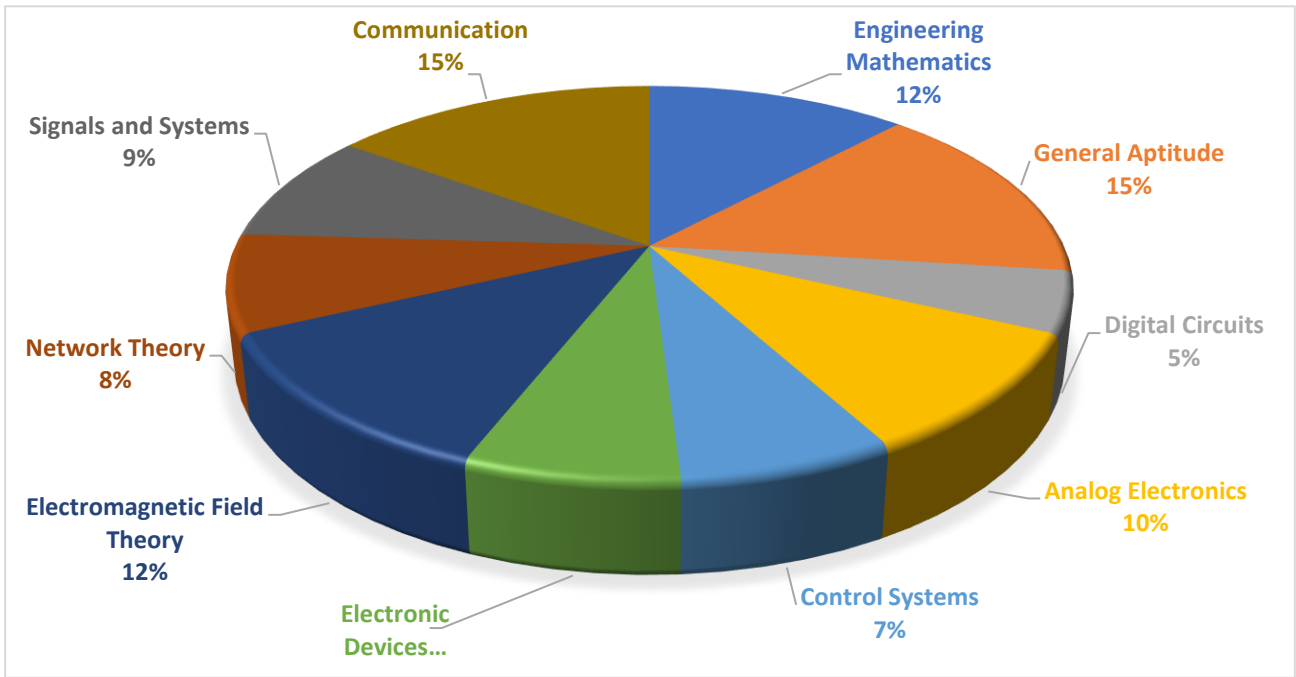


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## GATE 2023 Paper Analysis Memory Based

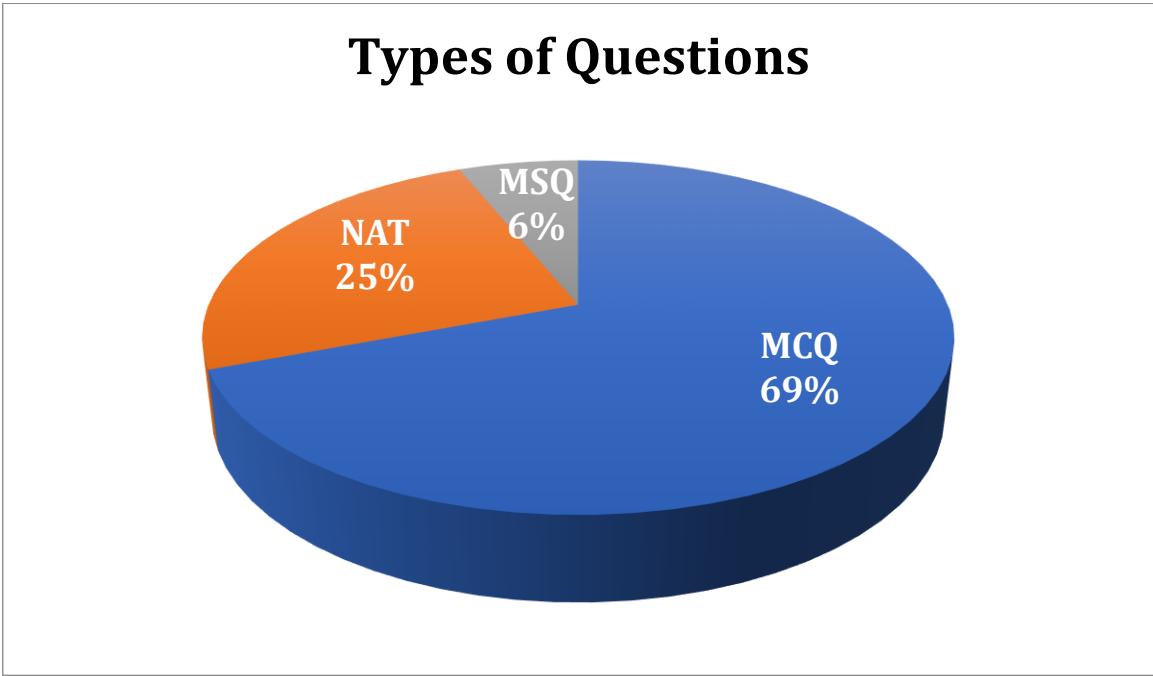


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**GATE 2023 Paper Analysis**  
Memory Based



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## SECTION - A

## GENERAL APTITUDE

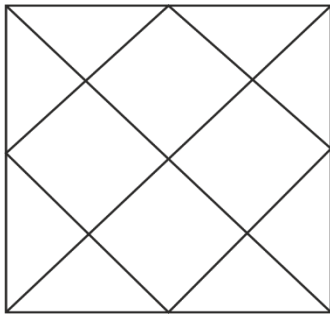
1. I cannot support this proposal; my \_\_\_\_\_ will not permit it?
- (A) Consensus (B) Consent  
(C) Conscious (D) Conscience

MCQ

Correct Option: A

1 Mark

2. Count the number of rectangles?



- (A) 10 (B) 8  
(C) 9 (D) 12

MCQ

Correct Option: A

1 Mark



EC

3. Courts: \_\_\_\_\_ :: Parliament: Legislature
- (A) Judiciary (B) Governmental  
(C) Executive (D) Legal

MCQ

Correct Option: A

1 Mark

4. 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 moves?
- (A) 60 (B) 30  
(C) 40 (D) 20

MCQ

Correct Option: A

2 Mark

5. What is the smallest number with distinct digits whose digits add upto 45?
- (A) 99999 (B) 123456789  
(C) 23555789 (D) 123457869

MCQ

Correct Option: B

2 Mark



EC

6. A  $100 \text{ cm} \times 32 \text{ cm}$  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  $100 \text{ cm} \times 1 \text{ cm}$ . The total number of creases visible when the sheet is unfolded is \_\_\_\_\_

(A) 32

(B) 63

(C) 31

(D) 5

MCQ

Correct Option: C

2 Mark



EC

### SECTION - B

### TECHNICAL

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

(A)  $\frac{1}{\sqrt{T_1 T_2}}$

(B)  $\frac{1}{T_1 T_2}$

(C)  $\frac{1}{T_2 \sqrt{T_1}}$

(D)  $\frac{1}{T_1 \sqrt{T_2}}$

MCQ

Correct Option: A

1 Mark

2.  $\vec{E} = \hat{a}_x G_x \cos(\omega t - Bz) + \hat{a}_y G_y \cos(\omega t - Bz + \theta)$  V/m

Which of the following will give rise to LHEP?

(A)  $C_{1x} = 2, C_{1y} = 1, \theta = \frac{3\pi}{4}$

(B)  $C_{1x} = 2, C_{1y} = 1, \theta = \frac{\pi}{2}$

(C)  $C_{1x} = 1, C_{1y} = 2, \theta = \frac{3\pi}{2}$

(D)  $C_{1x} = 1, C_{1y} = 1, \theta = \frac{\pi}{4}$

MCQ

Correct Option: B

1 Mark

EC

3. In a semiconductor if the fermi level less to conduction band then the semiconductor is known as

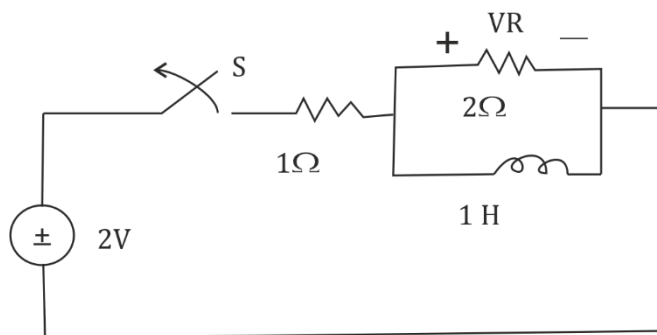
- (A) non-degenerated P-type      (B) Degenerated P-type  
(C) Degenerated N-type      (D) Non-Degenerated P-type

MCQ

Correct Option: C

1 Mark

4. The maximum magnitude of  $V_R$  in \_\_\_\_\_ volts.



NAT

Answer: 4

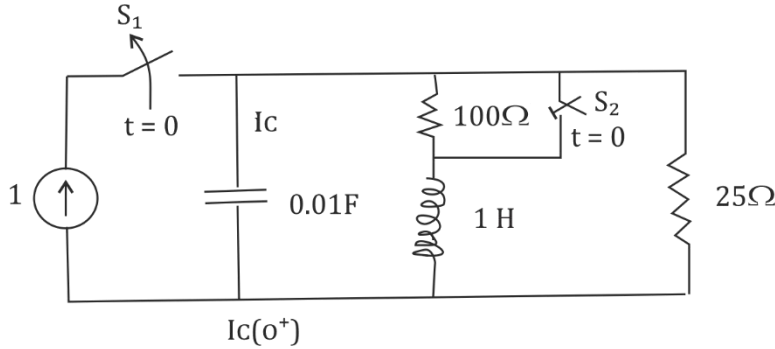
1 Mark





EC

5. For the given circuit, find the value of  $i_c$  at  $t = 0^+$



- (A) 0.8 (B) 1  
(C) -1 (D) 0.2

MCQ

Correct Option: C

2 Mark

6. The value of line integral  $\int_P^Q z^2 dx + 3y^2 dy + 2xz dz$  along straight line joining  $P(1, 2, 3)$  &  $Q(2, 3, 1)$  is \_\_\_\_\_

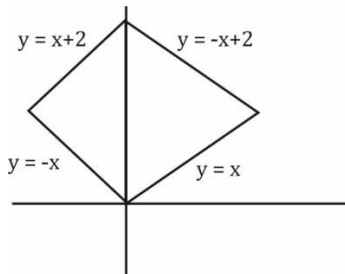
- (A) 24 (B) 29  
(C) 20 (D) 12

MCQ

Correct Option: A

2 Mark

7. Find  $\iint_R xy \, dx \, dy$  over region  $R$  shown.



NAT

Answer: 0

2 Mark

EC

8.  $x \Rightarrow n \times 1$  real column vector with length  $\ell = \sqrt{x^T x}$  Trace of matrix  $P = ?$

(A)  $\ell^2/2$

(B)  $\ell^2$

(C)  $\ell^2/4$

(D)  $\ell$

MCQ

Correct Option: B

1 Mark

9. The rate of increment of scalar field  $f(x, y, z) = xyz$ , in the direction of  $V(2, 1, 2)$  at point  $(0, 2, 1)$  is

(A) 1

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

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

(D) 4

MCQ

Correct Option: C

1 Mark

10. Counter integral  $\oint_C \frac{z+2}{z^2+2z+2} dz$  where the contour  $C$  is  $\{C : |z + 1 - \frac{3}{2}j| = 1\}$  taken in the Contour clockwise direction is \_\_\_\_\_.

(A)  $\pi(1 - j)$

(B)  $-\pi(1 - j)$

(C)  $-\pi(1 + j)$

(D)  $\pi(1 + j)$

MCQ

Correct Option: D

2 Mark

11.  $V_1 = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}, V_2 = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}$  be a 2 vectors  $V_1 = \alpha V_2 + e$ , value of  $\alpha$  for which mm length of error  $e$ .

(A)  $\frac{-2}{7}$

(B)  $\frac{7}{2}$

(C)  $\frac{-7}{2}$

(D)  $\frac{2}{7}$

MCQ

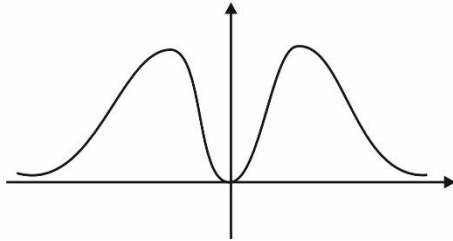
Correct Option: D

2 Mark



EC

12. Which of the following represents the given plot?



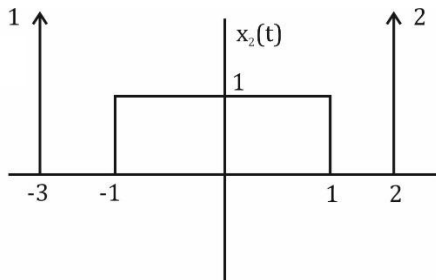
- (A)  $x \cdot 2^{-x}$                       (B)  $x^2 2^{-|x|}$   
(C)  $|x| \cdot 2^{-x}$                       (D)  $x \cdot 2^{-|x|}$

MCQ

Correct Option: B

1 Mark

13.  $x_1(t) = u(t+1.5) - u(t-1.5)$



$$y(t) = x_1(t) * x_2(t)$$

Find the value of  $\int_{-\infty}^{\infty} y(t) dt = \underline{\hspace{2cm}}$

NAT

Answer: 15

2 Mark

14. The Fourier Transform of signal  $x(t) = e^{-t^2}$  is \_\_\_\_\_.

- (A)  $\sqrt{\pi} e^{-\frac{\omega^2}{4}}$                       (B)  $\sqrt{\pi} e^{-\frac{\omega^2}{2}}$   
(C)  $\sqrt{\pi} e^{-\frac{\omega^2}{8}}$                       (D)  $\sqrt{\pi} e^{+\frac{\omega^2}{4}}$

MCQ

Correct Option: A

1 Mark

EC

15. Consider a narrow band signal propagating in lossless dielectric medium ( $\epsilon_r = 4, \mu_r = 1$ ) with phase velocity  $V_p$  and group  $V_g$  which of the \_\_\_\_\_.
- (A)  $V_p < c, V_g > c$  (B)  $V_p > c, V_g < c$   
(C)  $V_p < c, V_g < c$  (D)  $V_p > c, V_g > c$

MCQ

Correct Option: A

2 Mark

16. 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  $H(e^{j\Omega}) = 1 - 1/2e^{-2j\Omega}$   
The output  $y(n)$  of the system.
- (A)  $\delta(n) - \delta(n-1) - 0.5\delta(n-2) + 2.5\delta(n-3) - \delta(n-5)$   
(B)  $\delta(n) + \delta(n-1) - 0.5\delta(n-2) - 2.5\delta(n-3) + \delta(n-5)$   
(C)  $\delta(n) - \delta(n-1) - 0.5\delta(n-2) - 2.5\delta(n-3) + \delta(n-5)$   
(D)  $\delta(n) + \delta(n-1) - 0.5\delta(n-2) + 2.5\delta(n-3) + \delta(n-5)$

MCQ

Correct Option: A

2 Mark

17. Let  $m(t)$  be a bandlimited signal with bandwidth  $B$  and energy  $E$ . Let  $\omega^o = 10B$ , the energy of Signal  $m(t)\cos\omega^o t$ .
- (A)  $E/4$  (B)  $E$   
(C)  $2E$  (D)  $E/2$

MCQ

Correct Option: A

2 Mark



EC

18. Match the follow:

### Signal Types

1. Continuous and aperiodic
2. Continuous and Periodic
3. Discrete and aperiodic
4. Discrete and Periodic

### Spectral characteristics

- a. Continuous and aperiodic
- b. Continuous and Periodic
- c. Discrete and aperiodic
- 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

Correct Option: C

2 Mark

19.  $Y(t) = x(e^t)$

(A) Causal & TV

(B) NC & TV

(C) NC & TIV

(D) C & TIV

MCQ

Correct Option: B

1 Mark

20. In external semiconductor the hole concentration given by  $1.5 n_i$ , where  $n$  is intrinsic carrier concentration of  $1 \times 10^{10} \text{cm}^{-3}$ . The ratio of electron to hole mobility for equal hole and electron drift current density is given as \_\_\_\_\_.

NAT

Answer: 2.25

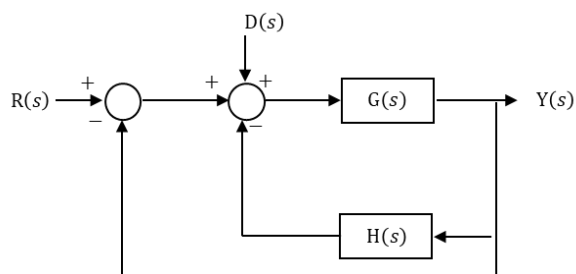
2 Mark



EC

21.  $R(s)$  and  $P(s)$  are two inputs

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



NAT

Correct Option: \*

1 Mark

22. OLTF  $a(s) H(s) = \frac{k}{s(1+sT_1)(1+sT_2)}$   $K, T_1 T_2 > 0$  phase crossover frequency?

(A)  $\frac{1}{T_2\sqrt{T_1}}$

(B)  $\frac{1}{T_1 T_2}$

MCQ

(C)  $\frac{1}{T_1\sqrt{T_2}}$

(D)  $\frac{1}{\sqrt{T_1 T_2}}$

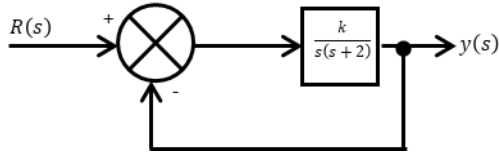
Correct Option: D

1 Mark



EC

23. The steady state error due to ramp Input  $R(s) = \frac{\alpha}{s^2}$  is



(A)  $\frac{\alpha}{4k}$

(B)  $\frac{\alpha}{k}$

(C)  $\frac{\alpha}{2k}$

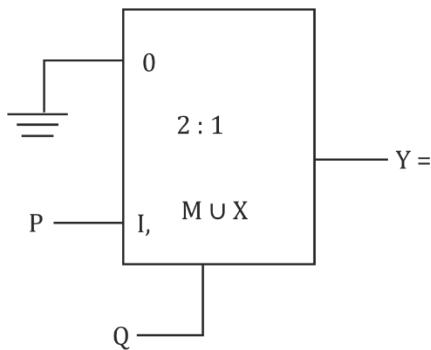
(D)  $\frac{2\alpha}{k}$

MCQ

Correct Option: D

2 Mark

24. Find the output of the following MUX?



(A)  $y = P + Q$

(B)  $y = \bar{P}Q$

(C)  $\bar{P} + Q$

(D)  $PQ$

MCQ

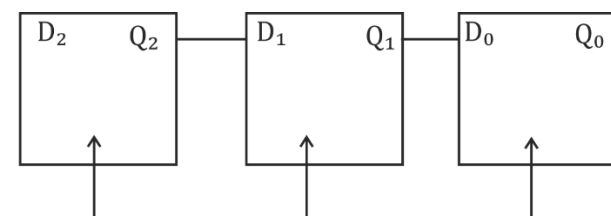
Correct Option: D

1 Mark



EC

25. Find the throughput and latency (nano sec) of the following circuit?



$f_{clk} = 1\text{GHz}$

(A) 333.3, 1

(B) 33.3, 3

(C) 2000, 3

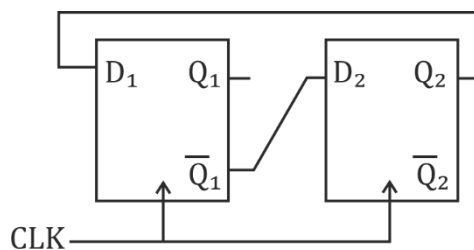
(D) 1000, 3

MCQ

Correct Option: D

2 Mark

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



NAT

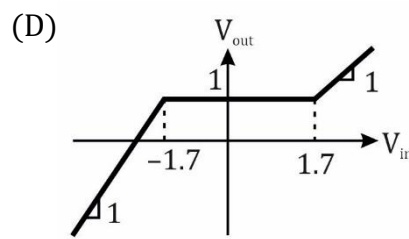
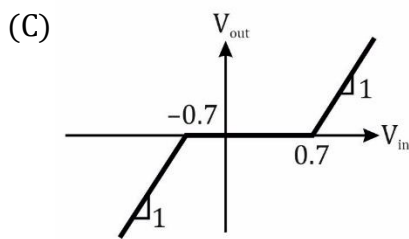
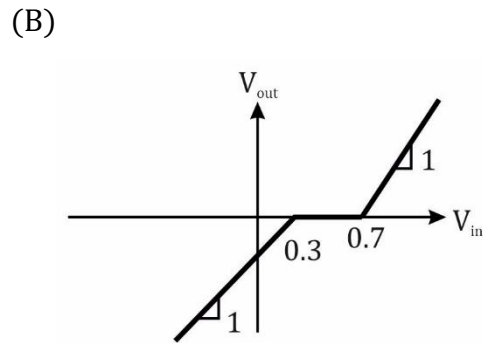
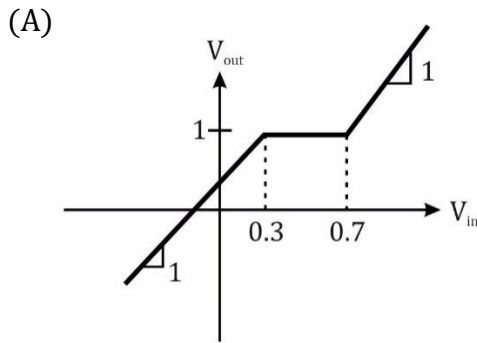
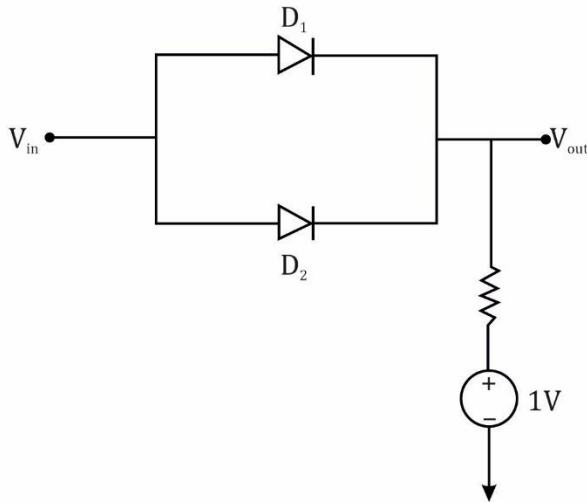
Answer: 250

2 Mark



EC

27.  $D_1$  and  $D_2$  – Silicon diode condition voltage = 0.7V transfer characteristics is



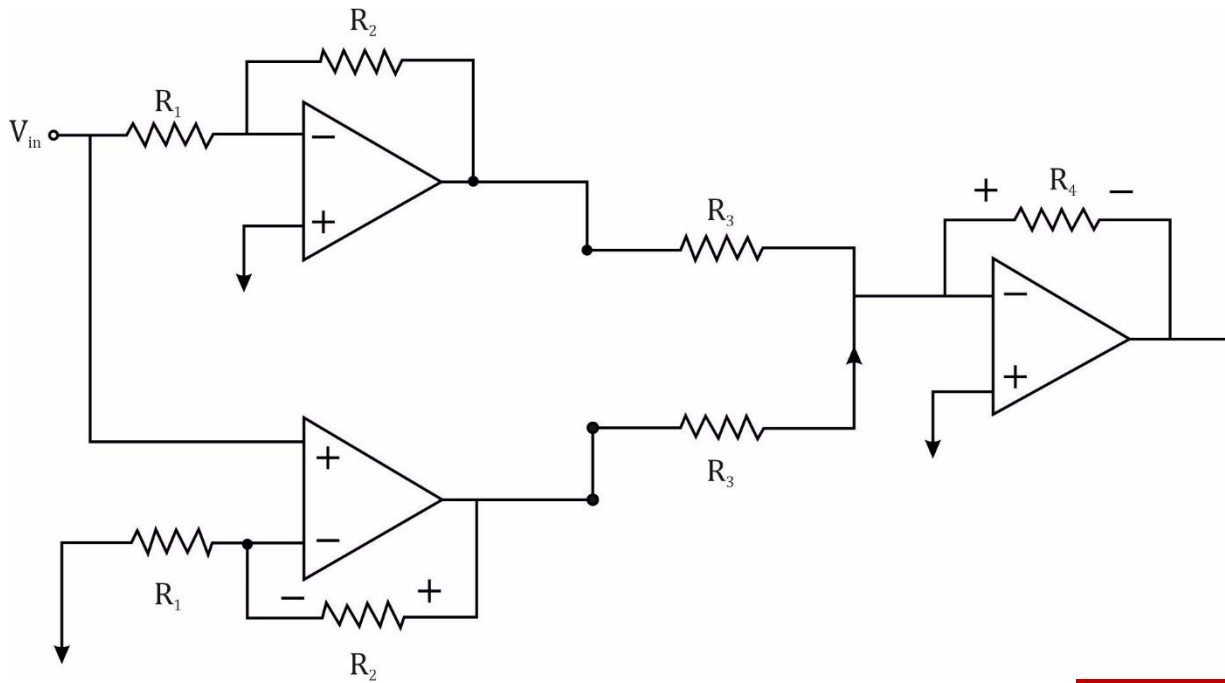
MCQ

Correct Option: A

2 Mark

EC

28. For the given circuit, calculate  $\frac{V_{out}}{V_{in}}$



- (A)  $1 - R_4/R_3$   
(C)  $-R_4/R_3$

- (B)  $R_4/R_3$   
(D)  $1 + R_4/R_3$

MCQ

Correct Option: C

2 Mark

EC

29. Let  $m(t) \rightarrow BW = B$

Energy =  $E$

Assuming  $\omega_0 = 10B$

The energy in the signal  $m(t) \cdot \cos \omega_0 t$  is

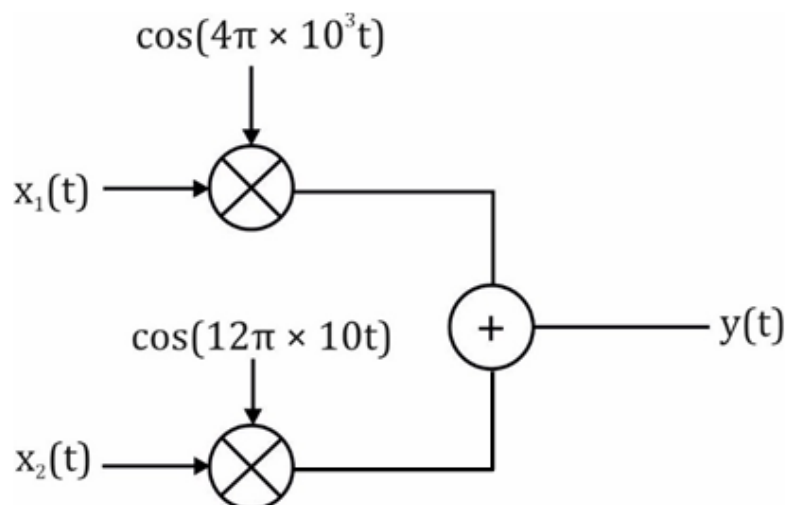
- (A)  $E$  (B)  $\frac{E}{3}$   
(C)  $2E$  (D)  $\frac{E}{2}$

MCQ

Correct Option: D

1 Mark

30. 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



- (A)  $8\pi \times 10^3$  (B)  $20\pi \times 10^3$   
(C)  $40\pi \times 10^3$  (D)  $32\pi \times 10^3$

MCQ

Correct Option: D

2 Mark



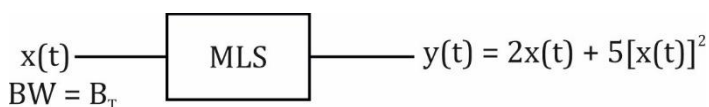
EC

31. Fm signal

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

$m(t)$  = msy signal of BW =  $W$  = Fm

It is passed through a Nm linear system  $y(t) = 2x(t) + 5[x(t)]^2$  BW of Fm =  $B_T$



The minimum value  $\omega_c$  required to recover  $x(t)$  from  $y(t)$

(A)  $\frac{5}{2}B_T$

(B)  $\frac{3}{2}B_T$

MCQ

(C)  $2B_T + W$

(D)  $B_T + W$

Correct Option: \*

2 Mark

32. The electric field of a plane electromagnetic wave is

$$E = a_x C_{1x} \cos(\omega t - \beta z) + a_y C_{1y} \cos(\omega t - \beta z + \theta) \text{ v/m. which of the following}$$

combinations (s) will give rise to a left handed elliptically polarized (LHEP) wave?

(A)  $C_{1x} = 1, C_{1y} = 2, \theta = \frac{3\pi}{2}$

(B)  $C_{1x} = 2, C_{1y} = 1, \theta = \frac{\pi}{2}$

MCQ

(C)  $C_{1x} = 2, C_{1y} = 1, \theta = \frac{3\pi}{4}$

(D)  $C_{1x} = 1, C_{1y} = 1, \theta = \frac{\pi}{4}$

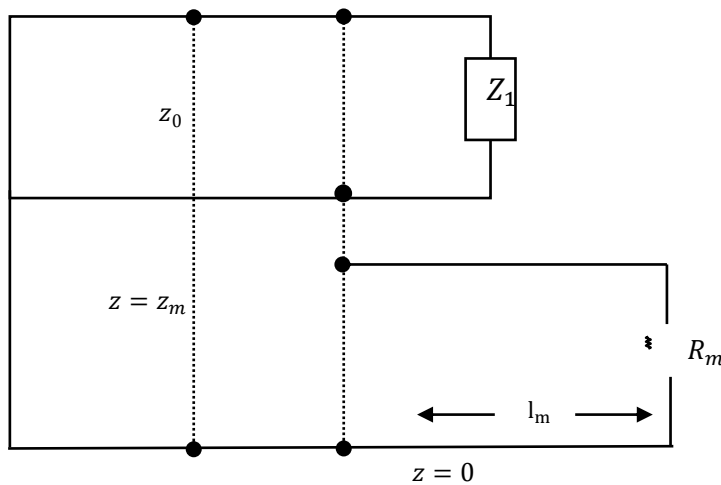
Correct Option: \*

2 Mark



EC

33. The standing wave ratio on a  $50\Omega$  lossless transmission line transmitted in an unknown ad impedance is found to be 2.0. The distance between successive voltage minima is 30 cm and the first minimum is located at 10 cm from the load.  $Z$  can be replaced by an equivalent, length  $l_m$  and terminating resistance  $R_m$  of the same line. The value of  $R_m$  and  $l_m$  respectively are



NAT

Correct Option: \*

2 Mark