

# GATE 2023


## Instrumentation Engineering

### Questions & Solutions

 11<sup>th</sup> Feb Forenoon Session

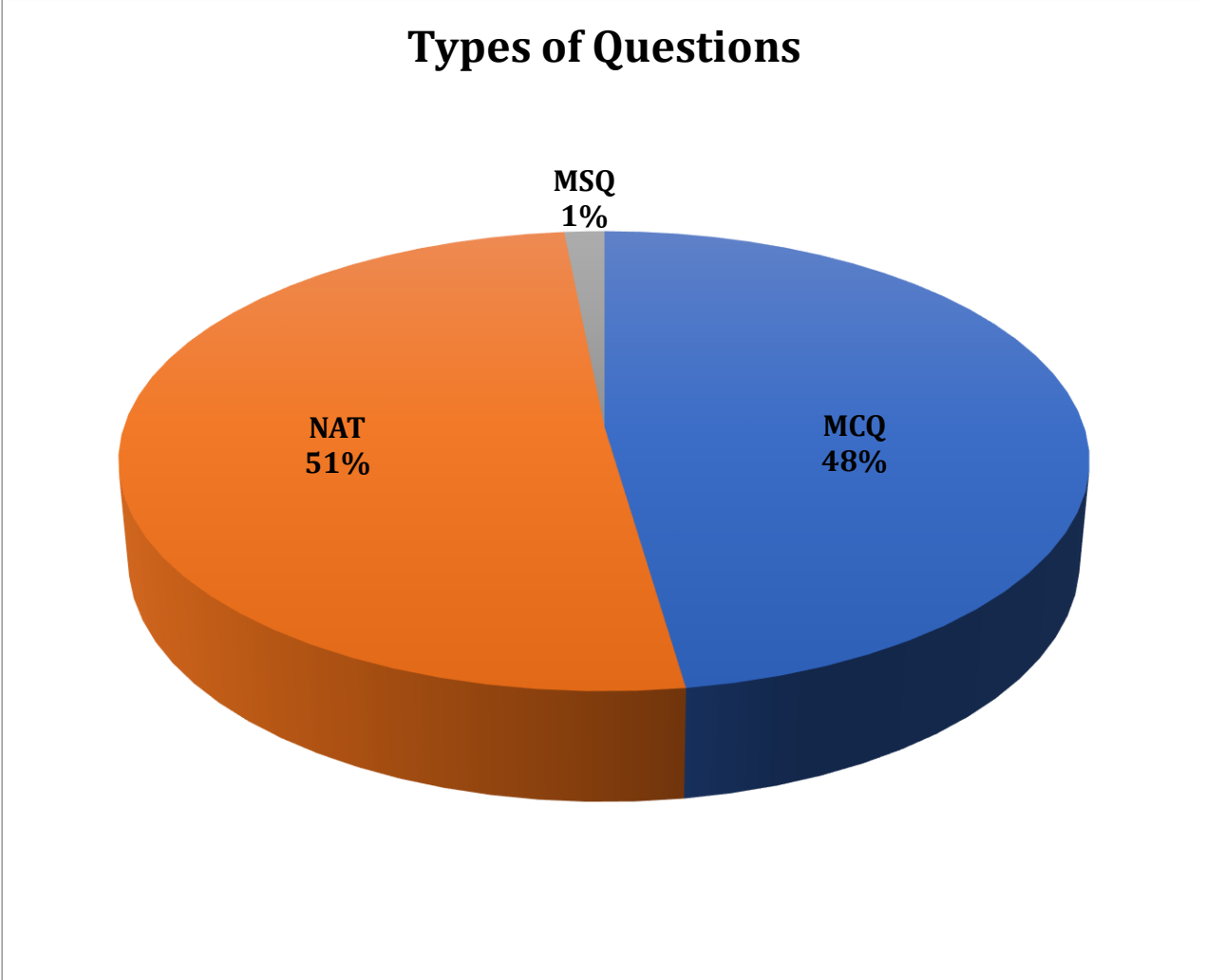


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IN

## GATE 2023 Paper Analysis Memory Based



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### SECTION - A

### GENERAL APTITUDE

1. Residency is a famous housing complex with many well-established individuals among its residents. A recent survey conducted among the residents of the complex revealed that all of those residents who are well established in their respective fields happen to be academicians. The survey also revealed that most of these academicians are authors of some best-selling books. Based only on the information provided above, which one of the following statements can be logically inferred with certainty?
- (A) Some authors of best-selling books are residents of the complex who are well-established in their fields.
- (B) All academicians residing in the complex are well established in their fields.
- (C) Some residents of the complex who are well established in their fields are also authors of some best-selling books .
- (D) Some academicians residing in the complex are well established in their fields.

MCQ

Correct Option: D

2 Mark



2. The village was nested in a green spot, \_\_\_\_\_ the ocean and the hills.

- (A) at (B) in  
(C) between (D) through

MCQ

Correct Option: C

1 Mark

3. Disagree : Protest :: Agree : \_\_\_\_\_ .

- (A) Pretext (B) Refuse  
(C) Refute (D) Recommend

MCQ

Correct Option: D

1 Mark

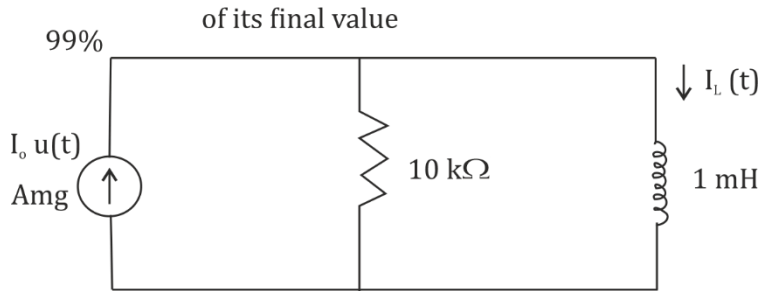


### SECTION - B

### TECHNICAL

1. The time required for the inductor current to reach 99% of its final value will be \_\_\_\_\_  $\mu\text{sec}$ .

Assume initial current through the inductor is  $\frac{I_0}{5}$ .

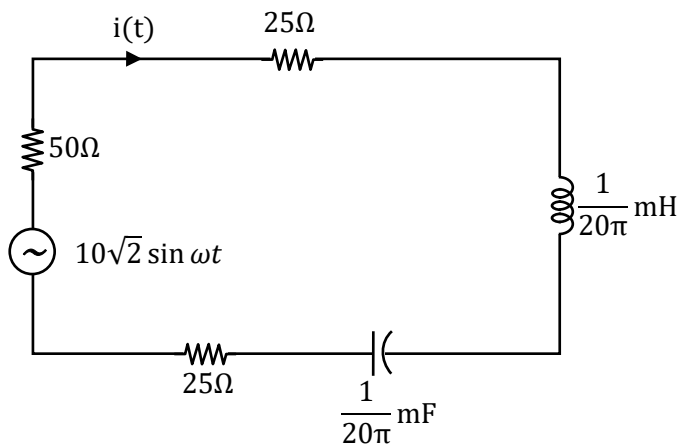


**NAT**

**Answer: 0.438**

**2 Mark**

2. If  $\omega = 2000\pi$ , then the rms value of the current  $i(t)$  will be \_\_\_\_\_ Amp.



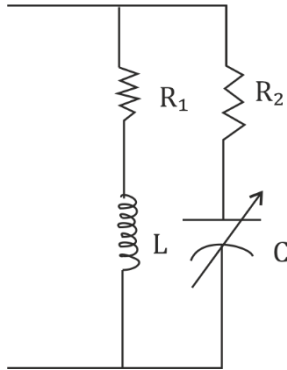
**NAT**

**Answer: 0.1**

**2 Mark**



3. If  $\omega = 100\pi$  rad/sec.,  $R_1 = R_2 = 2.2\Omega$ ,  $L = 7\text{mH}$ , then the value of capacitance,  $C$  will be \_\_\_\_\_ F, if the admittance is purely real.

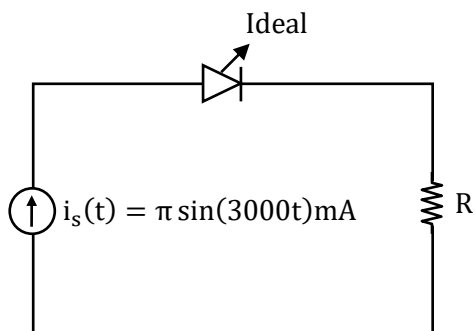


NAT

Answer: \*

2 Mark

4. Find the Average Current?



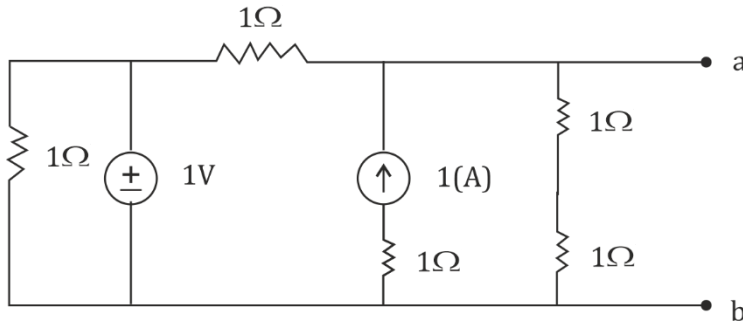
NAT

Answer: 1

1 Mark



5. Thevenin's equivalent resistance across terminals a & b will be \_\_\_\_\_  $\Omega$ .



NAT

Answer: 2/3

1 Mark

6. Find phase margin of the system whose open loop Transfer Function is given by

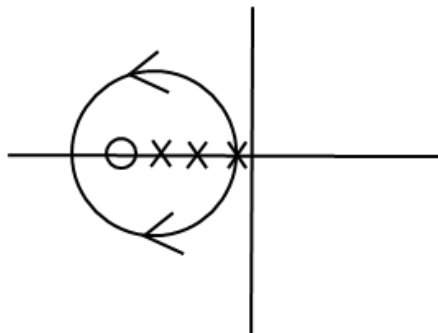
$$G(s)H(s) = \frac{s - 1}{(s + 1)^2}$$

NAT

Answer: 0

1 Mark

7. Some question given  $K_p + sK_D + \frac{K_i}{s}$  T.f  $\frac{1}{s(s-a)(s-b)}$  find the value of  $K_D$



NAT

Answer: \*

2 Mark



8. Number of zeros of  $s^3 + 2s^2 + 5s + 80$  in R. H. S plane is \_\_\_\_\_

**NAT**

**Answer: 2**

**1 Mark**

9. Number of times Nyquist plot of  $G(s)H(s) = \frac{(s-1)(s-2)}{2(s+1)(s+2)}$ , encircles the origin is \_\_\_\_\_

**NAT**

**Answer: -2**

**1 Mark**

10.  $\lim_{x \rightarrow 0} \left[ x \sin \left( \frac{1}{x} \right) \right]$

(A) does not exist

(B) 1

(C) 0

(D)  $\infty$

**MCQ**

**Correct Option: C**

**1 Mark**

11.  $\ddot{x} = -kx$ ,  $x(0) = 1$ ,  $\dot{x}(0) = 0$ , then the value of  $x(t)$  will be \_\_\_\_\_.

(A)  $x(t) = 2e^{-kt} - kt - 1$

(B)  $x(t) = 1$

(C)  $x(t) = 2e^{-kt} + 2kt - 1$

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

**MCQ**

**Correct Option: B**

**2 Mark**





12. If  $A = \begin{bmatrix} 1 & 4 \\ -3 & \alpha \\ \beta & 6 \end{bmatrix}_{3 \times 2}$  & Rank (A) = 1 then the value of  $\left(\frac{\alpha}{\beta}\right) = \underline{\hspace{2cm}}$

NAT

Answer: -8

2 Mark

13.  $F(z) = \frac{1}{1-z}$  expanded as power series around  $(z = 2)$  would result in  $F(z) =$

$\sum_{k=0}^{\infty} a_k (z - 2)^k$  with ROC  $|z - 2| < 1$  then  $a_k = \underline{\hspace{2cm}}$

(A)  $\left(\frac{1}{z}\right)^k$

(B)  $(-1)^k$

(C)  $(-1)^{k+1}$

(D)  $\left(\frac{-1}{z}\right)^{k+1}$

MCQ

Correct Option: C

2 Mark

14. Choose solution 'S' for set of equations,

$x - 2y + z = 0$  &  $x - z = 0$

(A)  $S = \left\{ \alpha \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} + \beta \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \mid \alpha, \beta \in \mathbb{R} \right\}$

(B)  $S = \left\{ \alpha \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \mid \alpha \in \mathbb{R} \right\}$

(C)  $S = \left\{ \alpha \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} + \beta \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix} \mid \alpha, \beta \in \mathbb{R} \right\}$

(D)  $S = \left\{ \alpha \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \mid \alpha \in \mathbb{R} \right\}$

MCQ

Correct Option: B

2 Mark



15. For the given function,

$g(x) = \max \{(x - 2)^2, -2x + 7\}; x \in (-\infty, \infty)$  then the minimum value of  $g(x) =$  \_\_\_\_\_

**NAT**

**Answer: 1**

**1 Mark**

16.  $f(z) = j \frac{1-2}{1+2} f^{-1}(2)$  maps real axis to

- (A) Unit circle with center not at origin
- (B) Real Axis
- (C) Imaginary Axis
- (D) Unit circle with center at origin

**MCQ**

**Correct Option: D**

**1 Mark**

17.  $h(t) = \delta(t) + 0.5 \delta(t - 4)$

$x(t) = \cos\left(\frac{7\pi}{4}t\right)$  find  $y(t)$  \_\_\_\_\_

- (A)  $0.5 \sin\left(\frac{7\pi}{4}t\right)$
- (B)  $1.5 \sin\left(\frac{7\pi}{4}t\right)$
- (C)  $0.5 \cos\left(\frac{7\pi}{4}t\right)$
- (D)  $1.5 \cos\left(\frac{7\pi}{4}t\right)$

**MCQ**

**Correct Option: C**

**2 Mark**



18. If time period of  $x(t)$  is 100 sec, then Time period of  $y(t) = x(4t)$  will be \_\_\_\_\_ sec.

NAT

Answer: 25

1 Mark

19.  $\frac{y(s)}{x(s)} = \frac{s - \pi}{s + \pi}$  steady state output  $y(t) = \sin \pi t$  input  $x(t) = ?$

(A)  $\cos\left(\pi t + \frac{\pi}{4}\right)$

(B)  $\sin\left(\pi t + \frac{\pi}{2}\right)$

MCQ

(C)  $\sin\left(\pi t - \frac{\pi}{2}\right)$

(D)  $\sin(\pi t)$

Correct Option: C

2 Mark

20. If  $x(n) = u(-n + 5) - u(n + 3)$  then the smallest value of 'n' for which  $x(n) = 0$  is \_\_\_\_\_.

NAT

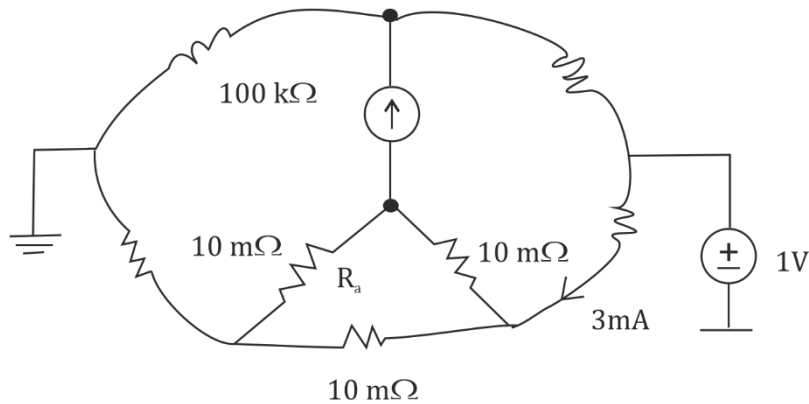
Answer: -3

2 Mark



IN

21. If the bridge is balanced then the current flows through resistor  $R_a$  will be \_\_\_\_\_ Amp.



NAT

Answer: 1

2 Mark

22. The following excitation table is corresponding to which Flip-Flop?

Q(t)	Q(t + 1)	X
0	0	0
0	1	1
1	0	1
1	1	0

MCQ

- (A) T-Flip Flop
- (B) JK-Flip Flop
- (C) D-Flip Flop
- (D) SR-Flip Flop

Correct Option: A

1 Mark

23. Match the following.

1)  $x \oplus xP)1$

2)  $x \oplus \bar{x}Q) 0$

3)  $x \oplus 0R) \bar{x}$

4)  $x \oplus 1S) x$

(A) 1-Q, 2-P, 3-S, 4-R

(B) 1-Q, 2-S, 3-P, 4-R

(C) 1-R, 2-S, 3-P, 4-Q

(D) 1-Q, 2-S, 3-R, 4-P

MCQ

Correct Option: A

1 Mark

24. The Boolean function,  $F(w, x, y, z) = \sum m(4, 5, 10, 11, 12, 13, 14, 15)$  can be simplified to

(A)  $x\bar{y} + wy$

(B)  $wx + \bar{w}x\bar{y} + w\bar{x}y$

(C)  $wx + wy + x\bar{y}$

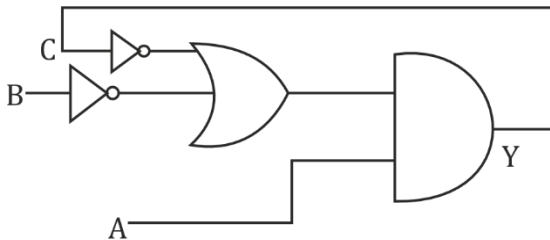
(D)  $\bar{x}y + \bar{w}y$

MCQ

Correct Option: A

1 Mark

25. Initially  $A = B = C = 1$ , when the circuit is turned-ON. If the delays of AND, OR & NOT gates are 10ns, 10ns & 5ns respectively. If the frequency of steady state oscillations of the output  $y$  is \_\_\_\_\_ MHz.



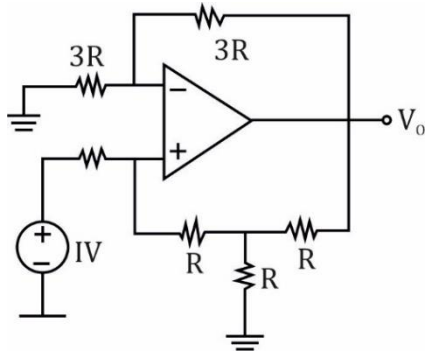
NAT

Answer: 20

2 Mark

IN

26. The value of  $V_o$  is \_\_\_\_\_.

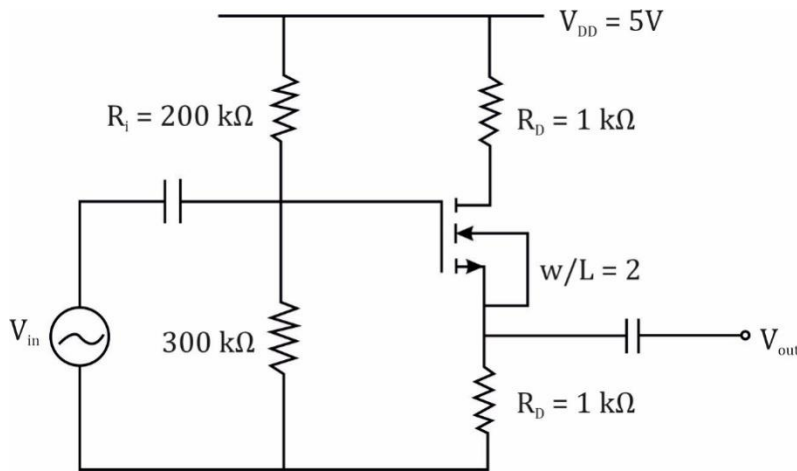


NAT

Answer: 2

2 Mark

27. Figure below shows a feedback amplifier constructed using an nMOS transistor. Assume that  $\mu_n C_{ox} = 1 \text{ mA/V}^2$ , thus hold voltage  $V_T = 1 \text{ V}$  and  $w/L = 2$ . The bias voltage at the drain terminal is  $4\text{V}$ . The capacitors  $C_\infty$  offer zero impedance once at signal frequency. The ratio  $V_{out}/V_{in}$  is \_\_\_\_\_.

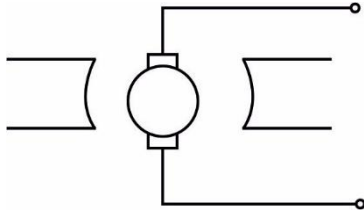


NAT

Answer: \*

2 Mark

28. DC shunt generator rotor is rotating in clockwise AV no load voltage in 200 V. If the rotation of rotor is reversed then what will be the terminal voltage.



NAT

Answer: 0

1 Mark

29. The short circuit test is performed on secondary on a 1- $\phi$  T/R and following results were obtained.

Watt meter reading = 8 watts

Am meter reading = 2A,  $f = 1\text{kHz}$

Volt meter reading = 6V

Assuming linear magnetization curve and negligible no load losses. If primary is connected with a source of 2V(rms) and a series capacitor of  $\frac{1}{2\pi\sqrt{5}}$  mf by keeping the secondary shorted then current flowing at primary will be \_\_\_\_\_ A.

NAT

Answer: 1

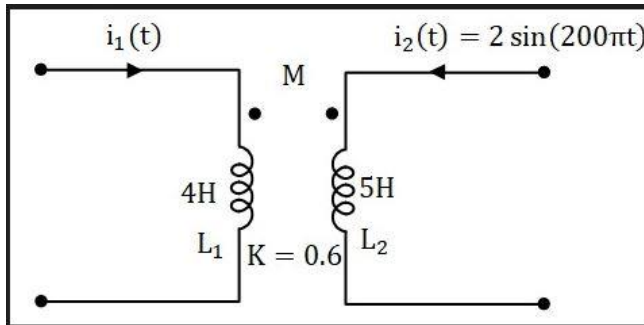
2 Mark





32. If  $i_1(t) = \sin[200\pi t]$  mA then the peak energy stored in the circuit is

\_\_\_\_\_  $\mu\text{J}$



**NAT**

**Answer: 17.37**

**2 Mark**

33. A continuous real valued signal  $x(t)$  has finite positive energy and  $x(t) = 0, t < 0$ . From the list given below select all the signal whose continuous time Fourier transform is purely imaginary.

(A)  $x(t) + x(-t)$

(B)  $J(x(t) + x(-t))$

(C)  $x(t) - x(-t)$

(D)  $J(x(t) - x(-t))$

**MSQ**

**Correct Option: B, C**

**2 Mark**

34. The Laplace transform of the continuous time signal  $x(t)e^{-3t}u(t-5)$  is \_\_\_\_\_  
 $u(t)$  denotes the continuous time unit step signal.

(A)  $\frac{e^{-5s}}{s+3}, \text{Real}\{s\} > -3$

(B)  $\frac{e^{-5(s+3)}}{s+3}, \text{Real}\{s\} > -3$

(C)  $\frac{e^{-5(s-3)}}{s+3}, \text{Real}\{s\} > -3$

(D)  $\frac{e^{-5(s-3)}}{s-3}, \text{Real}\{s\} > -3$

**MCQ**

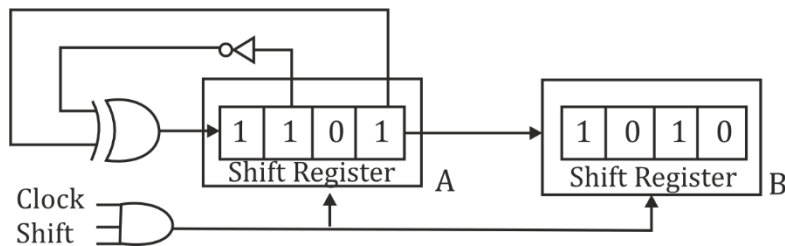
**Correct Option: B**

**2 Mark**



IN

35. In the circuit shown below, the initial binary content of shift register A is 1101 and that of shift register B is 1010. The shift register are +ve edge triggered, and gates have no delay.
- When the shift control is high, what will be the binary content of the shift registers A and B after 4 clock pulses?



- (A) A = 1101, B = 1101                      (B) A = 0101, B = 1101  
(C) A = 1010, B = 1111                      (D) A = 1110, B = 1001

MCQ

Correct Option: B

2 Mark