GATE 2015 Examination-31st After Noon

EC: Electronics & Communications Engineering

***Duration*: 180 minutes** ***Maximum Marks*: 100**

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen
3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory. The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each. The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.
4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.
5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.
9. 9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (◯) placed before the choice.
10. 10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**. For these questions, the answer should be entered** by using the virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of 1/3 marks for a 1-mark question and 2/3 marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**
13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

Declaration by the candidate:

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition".

GATE-2015 SET-A(31st After Noon) GENERAL ABILITY

Q.1-Q.5 Carries 1 Marks each

1. What is the adverb for the given word below ? Misogynous:

(A) Misogynousness (B) Misogynity (C) Misogynously (D) Misogynous

Sol: (C) Misogyny is a noun and its adjective is misogynous and adverb should be misogynously.

2. An electric bus has onboard instruments that report the total electricity consumed since the start of the trip as well as the total distance covered. During a single day of operation, the bus travels on stretches M, N, O, and P, in that order. The cumulative distances traveled and the corresponding electricity consumption are shown in the Table below :

Stretch	Comulative distance (km)	Electricity used (kWh)
M	20	12
N	45	25
O	75	45
P	100	57

The stretch where the electricity consumption per km is minimum is

(A) M (B) N (C) O (D) P

Sol: (D)

3. Choose the word most similar in meaning to the given word :

Awkward

(A) Inept (B) Graceful (C) Suitable (D) Dreadful

Sol: (A) Word AWK word means “Hard to deal with” or person who causes inconvenience

4. Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram’s selection is 1/6 and that of Ramesh is 1/8. What is the probability that only one of them will be selected ?

(A) 47/48 (B) 1/4 (C) 13/48 (D) 35/48

Sol: (B)

5. Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence :Dhoni, as well as the other team members of Indian team, __________ present on the occasion.

(A) were (B) was (C) has (D) have

Sol: (B)

Q.6-Q.10 Carries 2 Marks each

6. In the following sentence certain parts are underlined and marked P, Q, and r. One of the parts may contain certain error or may not be acceptable in standard written communication. Select the part containing an error. Choose D as your answer if there is no error.
The student corrected <u>all the errors</u> (P) that <u>the instructor marked</u> (Q) on the <u>answer book</u> (R).
(A) P (B) Q (C) R (D) No Error

Sol: (B)

7. A tiger is 50 leaps of its own behind a deer. The tiger takes 5 leaps per minute to the deer's 4. If the tiger and the deer cover 8 metre and 5 metre per leap respectively, what distance in metres will the tiger have to run before it catches the deer ?

Sol: (800)

8. Lamenting the gradual sidelining of the arts in school curricula, a group of prominent artists wrote to the Chief Minister last year, asking him to allocate more funds to support arts education in schools. However, no such increase has been announced in this year's Budget. The artists expressed their deep anguish at their request not being approved, but many of them remain optimistic about funding in the future.
Which of the statement(s) below is/are logically valid and can be inferred from the above statements?
(i) The artists expected funding for the arts to increase this year.
(ii) The Chief Minister was receptive to the idea of increasing funding for the arts.
(iii) The Chief Minister is a prominent artist.
(iv) Schools are giving less importance to arts education nowadays.
(A) (iii) and (iv) (B) (i) and (iv) (C) (i), (ii) and (iv) (D) (i) and (iii)

Sol: (B)

9. If $a^2+b^2+c^2=1$, then $ab+bc+ac$ lies in the interval
(A) $[1,2/3]$ (B) $[-1/2,1]$ (C) $[-1,1/2]$ (D) $[2,-4]$

Sol: (B)

$$(a+b+c)^2=a^2+b^2+c^2+2(ab+bc+ac)$$

$$\Rightarrow \quad (a+b+c)^2=1+2(ab+bc+ca)$$

$$\because \quad (a+b+c)^2>0$$

So $\quad (ab+bc+ca)>-1/2$

using AM – GM in equality

$$\frac{a^2+b^2}{2} \geq \sqrt{a^2b^2}$$

$\Rightarrow \quad a^2+b^2 \geq 2ab$

Similarly $\quad b^2+c^2 \geq 2bc$

$\quad c^2+a^2 \geq 2ac$

$\Rightarrow \quad 2\left(a^2+b^2+c^2\right) \geq 2\left(ab+bc+ca\right)$

$\therefore \quad \left(ab+bc+ca\right) \leq 1$

Here it will lie in range $\left[-1/2, 1\right]$

10. Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.

Statements :

I. All film stars are playback singers.

II. All film directors are film stars.

Conclusions :

I. All film directors are playback singers.

II. Some film stars are film directors.

(A) Only conclusion I follows. (B) Only conclusion II follows.

(C) Neither Conclusion follows (D) Both Conclusion-I and II follows

Sol: (D)

GATE-2015 SET-A(31st After Noon) ELECTRONICS AND COMMUNICATION ENGINEERING-EC

Q.1-Q.25 Carries 1 Marks each

1. The value of x for which all the Eigen-values of the matrix given below are real is

$$\begin{bmatrix} 10 & 5+j & 4 \\ x & 20 & 2 \\ 4 & 2 & -10 \end{bmatrix}$$

(A) 5 + j (B) 5 – j (C) 1 – 5j (D) 1 + 5j

Sol: (B) Matrix should be Hermetian Matrix $A = \left(A^*\right)^T$

Ref: Mathematics Class Notes

Transpose conjugate of a Matrix $[A^\theta]$

$A^\theta = (\overline{A'}) = (\bar{A})'$

If $A = [a_{ij}]_{m \times n}$, then $A^\theta = [\overline{a_{ji}}]_{n \times m}$

A^θ for above $= \begin{bmatrix} -i & -2i \\ 3+2i & 5-2i \end{bmatrix}$

1. Hermition Matrix : Any matrix A is said to be Hermitian, if and only if $[A^\theta = A]$ not necessarily be square.

2. In an 8085 microprocessor, which one of the following instructions changes the content of the accumulator ?

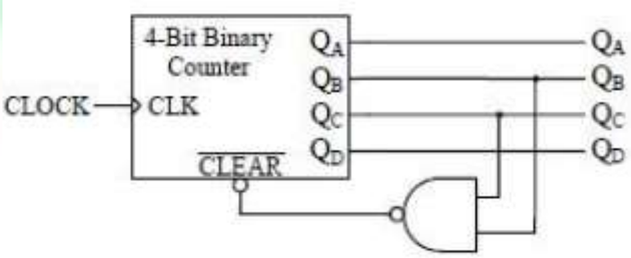
(A) MOV B,M (B) PCHL (C) RNZ (D) SBI BEH

Sol: (D)

3. Let $f(z) = \dfrac{az+b}{cz+d}$. If $f(z_1) = f(z_2)$ for all $z_1 \neq z_2$, $a = 2, b = 4$ and $c = 5$, then d should be equal to _______.

Sol: (10)

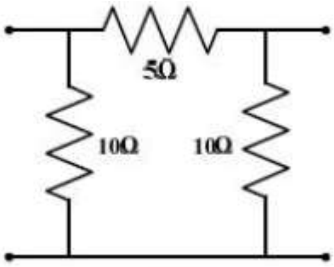
4. A mod-n counter using a synchronous binary up-counter with synchronous clear input is shown in the figure. The value of n is _______.



Sol: (6)

Here $Q_DQ_CQ_BQ_A$ should be 0110 so it should be MOD-6 Counter

5. The 2-port admittance matrix of the circuit shown is given by

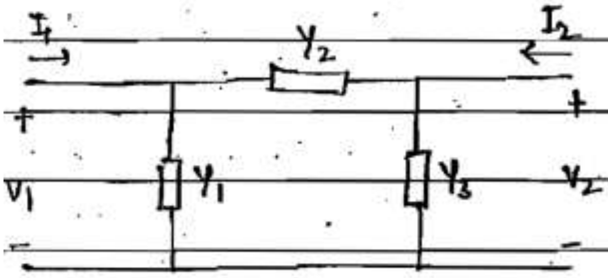


(A) $\begin{bmatrix} 0.3 & 0.2 \\ 0.2 & 0.3 \end{bmatrix}$ (B) $\begin{bmatrix} 15 & 5 \\ 5 & 15 \end{bmatrix}$ (C) $\begin{bmatrix} 3.33 & 5 \\ 5 & 3.33 \end{bmatrix}$ (D) $\begin{bmatrix} 0.3 & 0.4 \\ 0.4 & 0.3 \end{bmatrix}$

Sol: (A)

Ref: PANACEA Network Class Notes Page No.111

Basic N/w for Y-parameters [calculation for n/w without dependent sources]

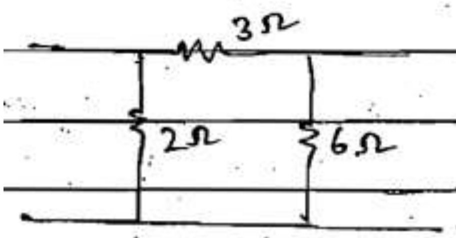


$Y_{11} = Y_1 + Y_2$

$Y_{12} = Y_{21} = -Y_2$

$Y_{22} = Y_2 + Y_3$

alculate Y-parameters:



$Y_1 = 1/2\,℧$ $\quad Y_2 = 1/3\,℧$ $\quad Y_3 = 1/6\,℧$

$$Y = \begin{bmatrix} 5/6 & -1/3 \\ -1/3 & 1/2 \end{bmatrix} ℧$$

6. Let the signal $f(t) = 0$ outside the interval $[T_1, T_2]$, where T_1 and T_2 are finite. Furthermore, $|f(t)| < \infty$. The region of convergence (ROC) of the signal's bilateral Laplace transform F(s) is

(A) a parallel strip containing the jΩ axis
(B) a parallel strip not containing the jΩ axis
(C) the entire s-plane
(D) a half plane containing the jΩ axis

Sol: (C)

Ref: PANACEA Signal System Class Notes Page No.230

Rules for calculation of ROC

ROC of X(s) depends upon nature of x(t). Here, it is assum
that X(s) is the rational function of s.

ROC doesnot contains any pole.

If x(t) is a finite duration signal, then ROC will be
entire s-plane except possibility s = 0 and ∞.

7. The general solution of the differential equation $\frac{dy}{dx}=\frac{1+\cos 2y}{1-\cos 2x}$ is

(A) $\tan y-\cot x=c$ (c is a constant) (B) $\tan x-\cot y=c$ (c is a constant)

(C) $\tan y+\cot x=c$ (c is a constant) (D) $\tan x+\cot y=c$ (c is a constant)

Sol: (C)

$$\frac{dy}{dx}=\frac{1+\cos 2y}{1-\cos 2x}=\frac{\cos^2 y}{\sin^2 x}$$

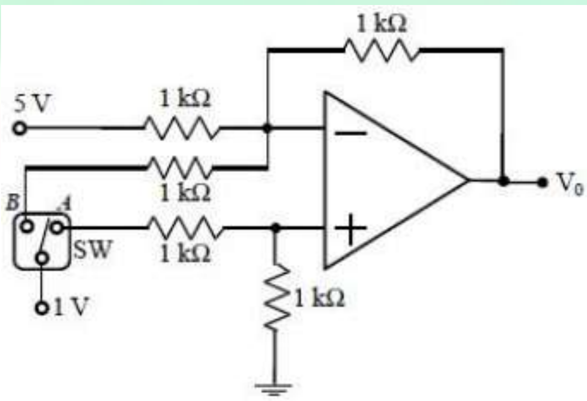
$$\int \sec^2 y\, dy=\int \text{cosec}^2 x\, dx$$

$$\tan y=-\cot x+c$$

$$\Rightarrow\ \tan y+\cot x=c$$

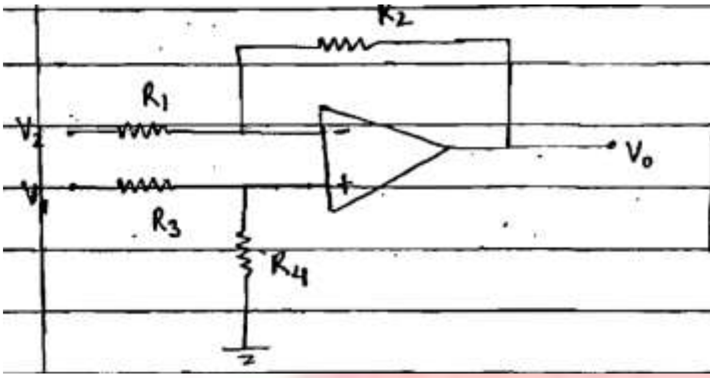
Ref: Basic Question

8. In the circuit shown, $V_0=V_{0A}$ for switch SW in position A and $V_0=V_{0B}$ for SW in position B. Assume that the opamp is ideal. The value of $\frac{V_{0B}}{V_{0A}}$ is __________.



Sol: (1.5)

Ref: Exactly same type of Qs were discussed on Page No. 217 in Analog class notes



if $\frac{R_2}{R_1} = \frac{R_4}{R_3}$

$$\boxed{V_o = -\frac{R_2}{R_1}(V_2 - V_1)}$$

9. An n-type silicon sample is uniformly illuminated with light which generates 10^{20} electron-hole pairs per cm^3 per second. The minority carrier lifetime in the sample is 1 µs. In the steady state, the hole concentration in the sample is approximately 10^x, where x is an integer. The value of x is _______.

Sol: (14) $\frac{dp}{dt} = \frac{p - p_0}{\tau_p} \Rightarrow 10^{20} = \frac{10^x}{10^{-6}}$ so here x=14

Ref: On Page No. 41 in EDC class notes of PANACEA Notes

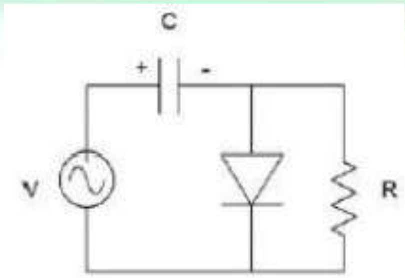
at t=0; No temp. is increased.

$\frac{dp}{dt} = 0 = g - \frac{p_0}{\tau_p}$

$\therefore \boxed{g = \frac{p_0}{\tau_p}}$ p_0 = conc of holes in n-type before increasing the temp.

$\therefore \frac{dp}{dt} = \frac{p_0 - p}{\tau_p}$

10. If the circuit shown has to function as a clamping circuit, then which one of the following conditions should be satisfied for the sinusoidal signal of period T ?

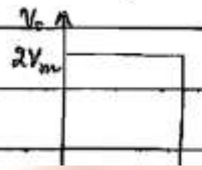


(A) RC << T (B) RC = 0.35 T (C) RC ≈ T (D) RC >> T

Sol: (D) For a Clamper circuit RC values are designed in such a manner that it will not discharge for 5 time cycles.

Ref: On Page No. 163 in EDC class notes of PANACEA Notes

Concept: R value is selected in such a manner such that capacitor C will not discharge atleast for 5 time constants.



11. In a source free region in vacuum, if the electrostatic potential $\varphi = 2x^2 + y^2 + cz^2$, the value of constant c must be _______.

Sol: (-3) $\phi = 2x^2 + y^2 + cz^2$

$$E = -\nabla\phi = -4x\vec{a}_x - 2y\vec{a}_y - 2cz\vec{a}_z$$

$$\nabla \cdot \vec{E} = 0 \Rightarrow \quad -4-2-2c=0 \Rightarrow -2c=6 \;\therefore\; (c=-3)$$

Ref: Exact same concept Question on Page-17 of Electrometric Theory Class Notes

1) Electrostatic field in charge-free region

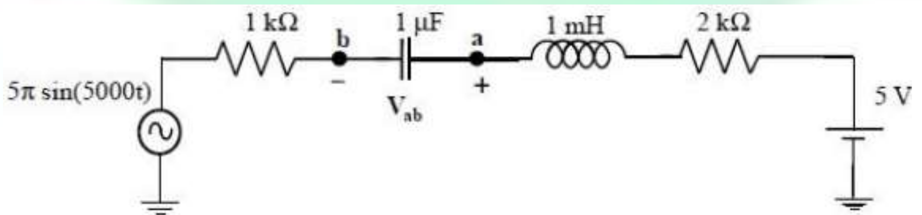
$\nabla \cdot \vec{E} = 0$, $\nabla \times \vec{E} = 0$

2) $\nabla \cdot \vec{E} \neq 0$, $\nabla \times \vec{E} = 0$ → Electrostatic field in region with charge

3) $\nabla \cdot \vec{B} = 0$, $\nabla \times \vec{B} \neq 0$ → Magnetostatic field in current carrying conductor.

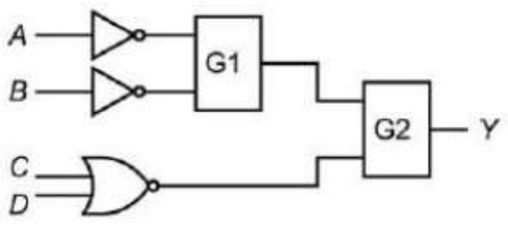
for time-varying fields also, $\nabla \cdot \vec{B} = 0$
$(\nabla \times \vec{B}) = 0$ when there is a no current source.

12. In the circuit shown, the average value of the voltage V_{ab} (in Volts) in steady state condition is _____.



Sol: (5) In steady state 5 Volt DC will appear across capacitor and its average value will be 5 V only
While in case of Average value across capacitor due to AC source will be zero hence it shd be 5 V only.

13. In the figure shown, the output Y is required to be $Y = AB + \overline{C}\,\overline{D}$. The gates G1 and G2 must be, respectively,



(A) NOR, OR (B) OR, NAND (C) NAND, OR (D) AND, NAND

Sol: (A)

14. The signal $\cos\left(10\pi t + \frac{\pi}{4}\right)$ is ideally sampled at a sampling frequency of 15 Hz. The sampled signal is passed through a filter with impulse response $\left(\frac{\sin(\pi t)}{\pi t}\right)\cos\left(40\pi t - \frac{\pi}{2}\right)$. The filter output is

(A) $\frac{15}{2}\cos\left(40\pi t - \frac{\pi}{4}\right)$ (B) $\frac{15}{2}\left(\frac{\sin(\pi t)}{\pi t}\right)\cos\left(10\pi t + \frac{\pi}{4}\right)$

(C) $\frac{15}{2}\cos\left(10\pi t - \frac{\pi}{4}\right)$ (D) $\frac{15}{2}\left(\frac{\sin(\pi t)}{\pi t}\right)\cos\left(40\pi t - \frac{\pi}{2}\right)$

Sol: (A)

Ref: Exact same concept Question on Page-165 of Communication Theory Class Notes

$s(t) = c(t) . m(t)$

$m(t) \rightarrow$ [ ] $\rightarrow s(t) = m(t)\, c(t)$

$c(t) \rightarrow$

$$s(t) = \frac{dt}{T_s} m(t) + \frac{2dt}{T_s} m(t)\left[C_1 \cos\left(\frac{2\pi t}{T_s}\right) + C_2 \cos\left(\frac{4\pi t}{T_s}\right) + \ldots\right]$$

$$s(t) = \underbrace{\frac{dt}{T_s} m(t)}_{f_m} + \underbrace{\frac{2dt}{T_s} m(t)\, C_1 \cos\left(\frac{2\pi t}{T_s}\right)}_{f_s \pm f_m} + \underbrace{\frac{2dt}{T_s} m(t)\, C_2 \cos\left(\frac{4\pi t}{T_s}\right)}_{2f_s \pm f_m}$$

15. A unity negative feedback system has an open-loop transfer function $G(s)=\frac{k}{s(s+10)}$. The gain k for the system to have a damping ratio of 0.25 is __________

Sol: (400)

$$G(s)=\frac{k}{s(s+10)}$$

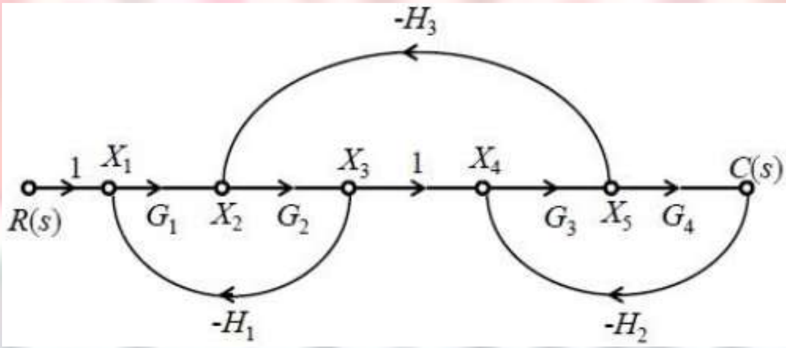
$$1+G(s)=0 \quad \Rightarrow \quad s^2+10s+k=0$$

$$2\{\omega_n=10 \quad \Rightarrow \quad \omega_n=200$$

$$k=\omega_n{}^2=400$$

Ref: Exact many same concept questions discussed. Very easy question

16. For the signal flow graph shown in the figure, the value of $\frac{C(s)}{R(s)}$ is



(A) $\frac{G_1G_2G_3G_4}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

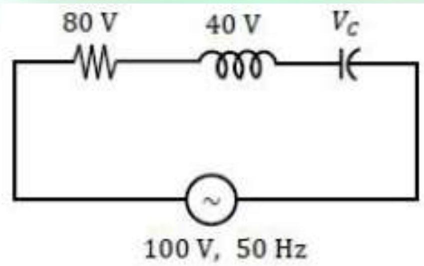
(B) $\frac{G_1G_2G_3G_4}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(C) $\frac{1}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(D) $\frac{1}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

Sol: (B)

17. The voltage (V_C) across the capacitor (in Volts) in the network shown is _______.



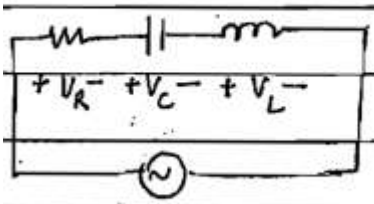
Sol: (-20) $(100)^2=(80)^2+(V_c-40)^2$

$\Rightarrow \quad V_c = +100 \text{ or } -20$

But Capacitor will have opposite polarity voltage.

Ref: Exact same concept Question on Page-58 class notes of Network Theory

Calculation of voltage in RLC



$V = V_R + V_L + V_C$

$V_R = I \cdot R \Rightarrow |V_R| = V_R$

$V_L = j\omega L \cdot I \Rightarrow |V_L| = \omega L \cdot I = j|V_L|$

$V_c = \frac{-j}{\omega C} \cdot I = -j|V_c|$

$|V| = \sqrt{(V_R)^2 + (|V_L| - |V_c|)^2}$

18. By performing cascading and/or summing/differencing operations using transfer function blocks $G_1(s)$ and $G_2(s)$, one CANNOT realize a transfer function of the form

(A) $G_1(s)G_2(s)$ (B) $\frac{G_1(s)}{G_2(s)}$

(C) $G_1(s)\left(\frac{1}{G_1(s)} + G_2(s)\right)$ (D) $G_1(s)\left(\frac{1}{G_1(s)} - G_2(s)\right)$

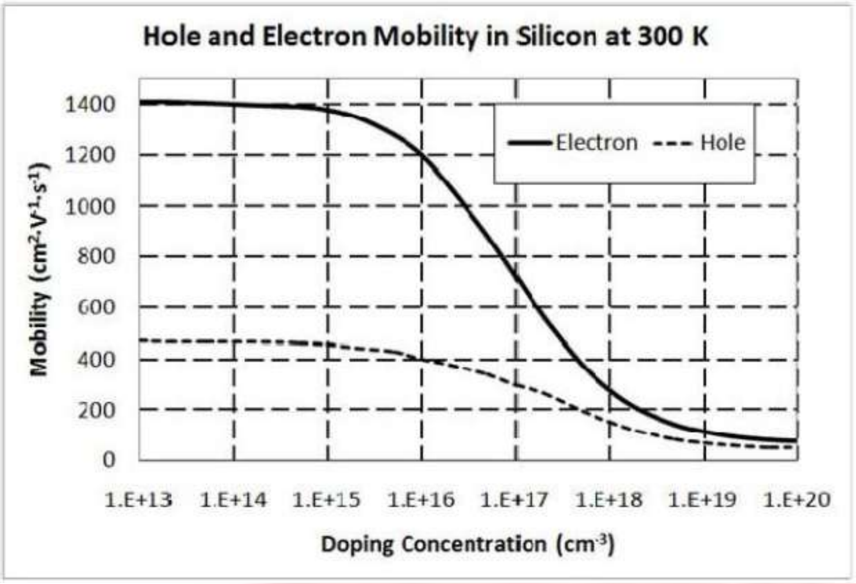
Sol: (B)

19. The bilateral Laplace transform of a function $f(t) = \begin{cases} 1 & \text{if } a \le t \le b \\ 0 & \text{otherwise} \end{cases}$ is

(A) $\frac{a-b}{s}$ (B) $\frac{e^s(a-b)}{s}$ (C) $\frac{e^{-as} - e^{-bs}}{s}$ (D) $\frac{e^{s(a-b)}}{s}$

Sol: (C)

20. A piece of silicon is doped uniformly with phosphorous with a doping concentration of $10^{16}/\text{cm}^3$. The expected value of mobility versus doping concentration for silicon assuming full dopant ionization is shown below. The charge of an electron is $1.6\times10^{-19}\,\text{C}$. The conductivity (in S cm^{-1}) of the silicon sample at 300K is __________.



Sol: (1.92)

21. The electric field of a uniform plane electromagnetic wave is

$$\vec{E} = \left(\vec{a}_x + j4\vec{a}_y\right)\exp\left[j\left(2\pi\times10^7 t - 0.2z\right)\right].$$

The polarization of the wave is

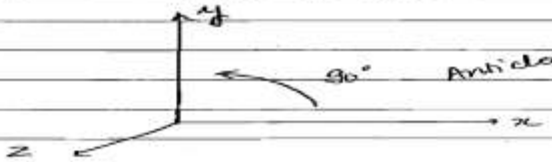
(A) right handed circular
(B) right handed elliptical
(C) left handed circular
(D) left handed elliptical

Sol: (D) Ref: Exactly same type of Question were discussed on Page No. 90&91 in EMT class notes

$\vec{E} = E_0 e^{j(\omega t - \beta z)}(\vec{a}_x + j\vec{a}_y)$ circular polarization

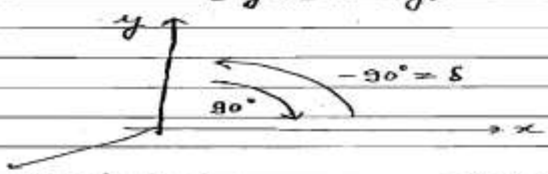
$= E_0 e^{j(\omega t - \beta z)}\vec{a}_x + jE_0 e^{j(\omega t - \beta z)}\vec{a}_y$

$= E_0 e^{j(\omega t - \beta z)}\vec{a}_x + E_0 e^{j(\omega t - \beta z + \pi/2)}\vec{a}_y$



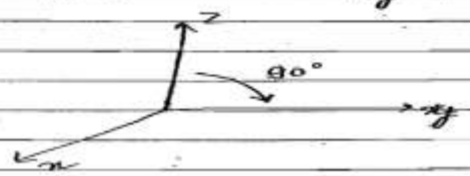
Anticlockwise convention ⟷ left circular polarization

$\vec{E} = E_0 e^{j(\omega t - \beta z)}(j\vec{a}_x + \vec{a}_y)$



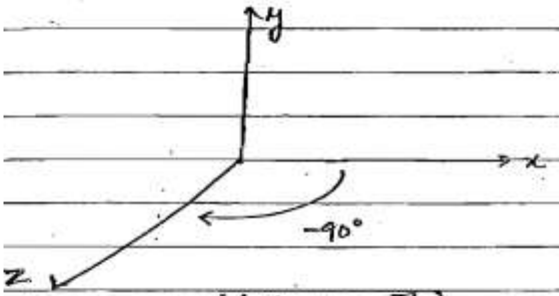
Right circular Polarization

$\vec{E} = E_0 e^{j(\omega t - \beta x)}\vec{a}_y + E_0 e^{j(\omega t - \beta x - 90°)}\vec{a}_z$



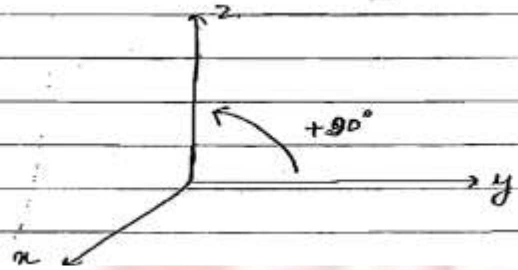
Right circular Polarization

$\vec{E} = E_0 e^{j(\omega t-\beta y)} \vec{a_x} + E_0 e^{(j(\omega t-\beta y) - \pi/2)} \vec{a_z}$



Right Hand Circular Polarization

$\vec{E} = E_0 e^{j(\omega t-\beta x - \pi/2)} \vec{a_y} + E_0 e^{j(\omega t-\beta x)} \vec{a_z}$



Left Hand Circular Polarization

22. Two causal discrete-time signals x[n] and y[n] are related as $y[n]=\sum_{m=0}^{n} x[m]$.

If the z-transform of y[n] is $\dfrac{2}{z(z-1)^2}$, the value of x[2] is __________.

Sol: (0) $X(z)=\dfrac{2}{z(z^2-1)^2}$

$$X(z)=\frac{2}{z\cdot(z+1)^2(z-1)^2}=\frac{2}{z\cdot z^4(1-z^{-2})^2}=\frac{2}{z^5}\left[1-z^{-2}\right]^{-2}$$

$$=\frac{2}{z^5}\left[1+2z^{-2}+\frac{(-2)(-3)}{2}(-z^{-2})^2+\frac{-2x-3x-4}{3}(-z^2)^3+\frac{-2x-3x-4x-5}{4}(-z^2)^4----\right]$$

As no coefficient of z^{-2} exists so $x[2]=0$.

Ref: Same concept Qs were discussed on Page-264 in Signal&System class notes

23. A sinusoidal signal of amplitude A is quantized by a uniform Quantizer. Assume that the signal utilizes all the representation levels of the Quantizer. If the signal to quantization noise ratio is 31.8 dB, the number of levels in the Quantizer is _________.

Sol: (32) L = 32 → It is not mentioned what type of message signal so assume that it is sinusoidal signal

$SNR(\text{in dB})=1.76+6n$

$\therefore\quad n=5 \rightarrow L=2^5=32$

Ref: Exact same concept Question on Page-196 class notes of Communication system.

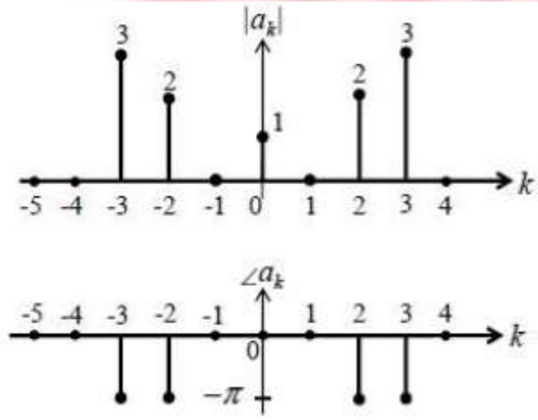
SNR in case of PCM

$$\boxed{SNR = 3L^2\left(\frac{\overline{m^2(t)}}{m_p^2}\right)}$$

where $\overline{m^2(t)}$ = Mean square value of msg signal $m(t)$

m_p = Peak value of message signal.

24. The magnitude and phase of the complex Fourier series coefficients a_k of a periodic signal x(t) are shown in the figure. Choose the correct statement from the four choices given. Notation: C is the set of complex numbers, R is the set of purely real numbers, and P is the set of purely imaginary numbers.

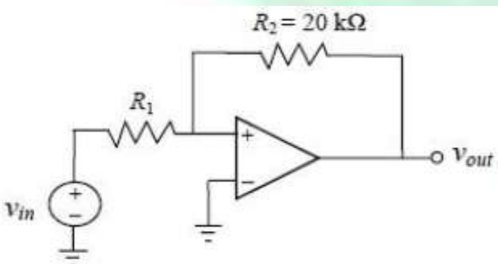


(A) $x(t)\in R$ (B) $x(t)\in P$

(C) $x(t)\in(C-R)$ (D) the information given is not sufficient to draw any conclusion about x(t)

Sol: (A) $x(t)=2\left(3e^{-j\pi}+2e^{-j\pi}\right)=2$ which is real

25. In the bitable circuit shown, the ideal opamp has saturation levels of $\pm 5V$. The value of R_1 (in kΩ) that gives a hysteresis width of 500 mV is _________.



Sol: (1)

$$V_H=\frac{2R_2V_{sat}}{R_2+R_1}\Rightarrow 0.5=\frac{2R_1\times 5}{20+R_1}\Rightarrow R_1=1K$$

Ref: Exact same concept Question on Page-264 class notes of Analog electronics

Schmitt trigger eliminates effect of noise because noise voltage less than hysteresis width cannot cause triggering.

$V_H = UTP - LTP$

$= \frac{2R_2}{(R_1+R_2)} \cdot V_{sat}$

Q.26-Q.55 Carries 2 Marks each

26. Consider the differential equation $\frac{dx}{dt} = 10 - 0.2x$ with initial condition $x(0) = 1$. The response $x(t)$ for $t > 0$ is

(A) $2 - e^{-0.2t}$ (B) $2 - e^{0.2t}$ (C) $50 - 49e^{-0.2t}$ (D) $50 - 49e^{0.2t}$

Sol: (C) Basic Q

27. An air-filled rectangular waveguide of internal dimensions $a\,cm \times b\,cm\,(a > b)$ has a cutoff frequency of 6 GHz for the dominant TE_{10} mode. For the same waveguide, if the cutoff frequency of the TM_{11} mode is 15 GHz, the cutoff frequency of the TE_{01} mode in GHz is _______.

Sol: (13.75) Directly Formula based Q

28. Consider two real sequences with time-origin marked by the bold value,

$$x_1[n] = \{1, 2, 3, 0\}, \quad x_2[n] = \{1, 3, 2, 1\}$$

Let $x_1(k)$ and $x_2(k)$ be 4-point DFTs of $x_1[n]$ and $x_2[n]$, respectively.

Another sequence $x_3[n]$ is derived by taking 4-point inverse DFT of $X_3(k) = X_1(k)X_2(k)$.

The value of $x_3[2]$ is __________.

Sol: (11) Ref: Exact same concept Question on Page-202 class notes of Signal system

CIRCULAR CONVOLUTION

$x[n] = \{1, 3, 2, -4, 6\}$
$h[n] = \{5, 4, 3, 2, 1\}$

$= x[n] \circledast h[n] \longrightarrow \sum_{m=0}^{N-1} x[m]\, h[n-m]_{\text{mod } N}$

$x[m] = \{1, 3, 2, -4, 6\}$
$h[-m] = \{1, 2, 3, 4, 5\}$

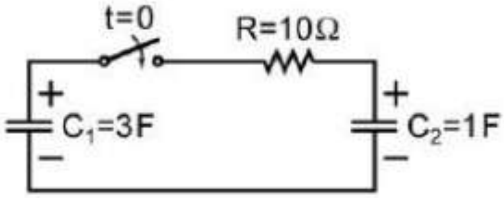
If there are N points in DFT, then there will be N values in the output.

$y[0] = \sum_{m=0}^{N-1} x[m]\, h[0-m]_{\text{mod } 5}$

$h[0-m]_{\text{mod } 5} = \{5, 1, 2, 3, 4\}$
$h[1-m]_{\text{mod } 5} = \{4, 5, 1, 2, 3\}$
$h[2-m]_{\text{mod } 5} = \{3, 4, 5, 1, 2\}$
$h[3-m]_{\text{mod } 5} = \{2, 3, 4, 5, 1\}$
$h[4-m]_{\text{mod } 5} = \{1, 2, 3, 4, 5\}$

$y[0] = 24$ $y[1] = 31$ $y[2] = 33$
$y[3] = 5$ $y[4] = \cancel{33}\ 27$

29. In the circuit shown, the initial voltages across the capacitors C_1 and C_2 are 1 V and 3 V, respectively. The switch is closed at time t = 0. The total energy dissipated (in Joules) in the resistor R until steady state is reached, is ________.



Sol: (1.5)

$$U_i = \frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2 = \frac{1}{2}\times 3\times 1 + \frac{1}{2}\times 1\times 9 = 6\,J \qquad U_f - U_i = 1.5$$

$$\text{In steady both Cap will Have } V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{6}{4} = 1.5$$

$$U_f = \frac{1}{2}C_1V^2 + \frac{1}{2}C_2V^2 = \frac{2.25}{2}(1+3) = 4.5$$

30. In a MOS capacitor with an oxide layer thickness of 10 nm, the maximum depletion layer thickness is 100 nm. The permittivities of the semiconductor and the oxide layer are ε_s and ε_{ox} respectively. Assuming $\varepsilon_s / \varepsilon_{ox} = 3$, the ratio of the maximum capacitance to the minimum capacitance of this MOS capacitor is _________.

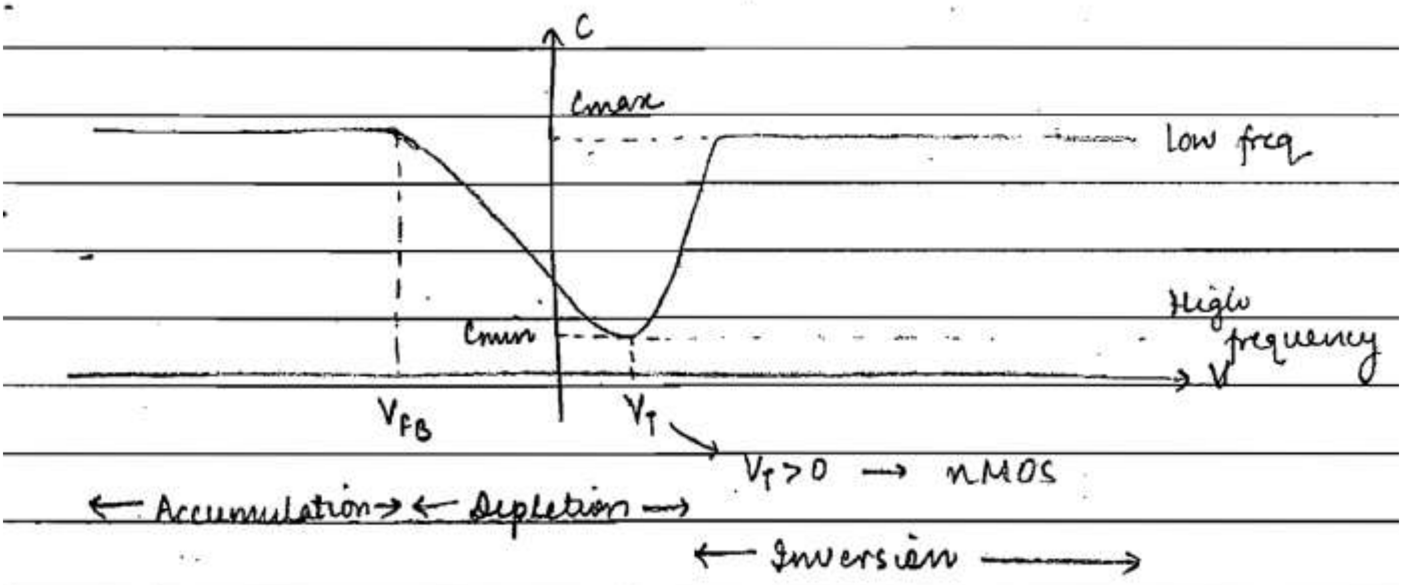
Sol: (4.33) $\quad C_{ox}(\max) = \dfrac{\varepsilon_{si02}}{t_{ox}}$

$$C_{min} = C_{ox} \text{ series } C_D = \frac{\frac{\varepsilon_{si02}}{t_{ox}} \cdot \frac{\varepsilon_{si}}{d}}{\frac{\varepsilon_{si02}}{t_{ox}} + \frac{\varepsilon_{si}}{d}} \qquad C_{min} = \frac{\varepsilon_{sio2} \cdot \varepsilon_{si}}{d\ \varepsilon_{si02} + t_{ox} \cdot \varepsilon_{si}}$$

$$\frac{C_{max}}{C_{min}} = \frac{d\ \varepsilon_{si02} + t_{ox} \cdot \varepsilon_{si}}{\varepsilon_{si} \cdot t_{ox}} = \frac{d}{t_{ox}} \cdot \frac{\varepsilon_{si02}}{\varepsilon_{si}} + 1$$

$$= 1 + \frac{100}{10} \times \frac{1}{3} = \frac{13\cancel{0}}{3\cancel{0}} = \frac{13}{3} = (4.33)$$

Ref: Exactly same concept was discussed on Page No. 318 in EDC class notes



Accumulation Mode: In this mode, only capacitance will be oxide capacitance. that is equal to gate capacitance in this case.

$$C_g = C_{ox} = \frac{\epsilon_{SiO_2}}{t_{ox}}$$

Depletion Mode: There is a formation of Depletion layer, so, there will be oxide capacitance and depletion capacitance and overall value of Cox and Cd will be.

$$C_g = \frac{C_{ox}\,C_d}{C_{ox} + C_d}$$

C_{ox} C_d

31. Input x(t) and output y(t) of an LTI system are related by the differential equation $y''(t) - y'(t) - 6y(t) = x(t)$. If the system is neither causal nor stable, the impulse response h(t) of the system is

(A) $\frac{1}{5}e^{3t}u(-t) + \frac{1}{5}e^{-2t}u(-t)$
(B) $-\frac{1}{5}e^{3t}u(-t) + \frac{1}{5}e^{-2t}u(-t)$
(C) $\frac{1}{5}e^{3t}u(-t) - \frac{1}{5}e^{-2t}u(t)$
(D) $-\frac{1}{5}e^{3t}u(-t) - \frac{1}{5}e^{-2t}u(t)$

Sol: (B) $H(s) = \frac{1}{(s-3)(s+2)} = \frac{1}{5(s-3)} - \frac{1}{5(s+2)}$

Since it is neither causal nor stable so ROC can't be right of the right most pole and also does not include jw axis so only possible ROC is $\mathrm{Re}\{s\} < -2$

so $h(t) = -\frac{1}{5}e^{3t}u(-t) + \frac{1}{5}e^{-2t}u(-t)$

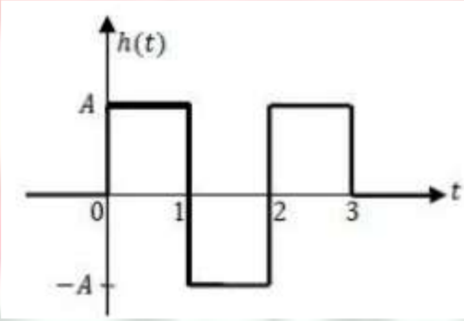
32. If C denotes the counterclockwise unit circle, the value of the contour integral

$$\frac{1}{2\pi j}\oint_C \mathrm{Re}\{z\}\,dz$$

is ______________.

Sol: (0) $\mathbf{Re}\{z\} = \frac{Z+\bar{Z}}{2}$ which is not analytic function hence this value should be zero

33. A zero mean white Gaussian noise having power spectral density $\frac{N_0}{2}$ is passed through an LTI filter whose impulse response h(t) is shown in the figure. The variance of the filtered noise at t = 4 is



(A) $\frac{3}{2}A^2N_0$ (B) $\frac{3}{4}A^2N_0$ (C) A^2N_0 (D) $\frac{1}{2}A^2N_0$

Sol: (A) $\delta_{xx} = \frac{N_0}{2}$ & $E[y] = E[x].\int_{-\infty}^{\infty} h(t)dt = 0$

$R_{yy}(\tau) = R_{xx}(\tau) \otimes h(t) \otimes h(-t)$

Here $R_{xx}(\tau) = \frac{N_0}{2}\delta(t)$

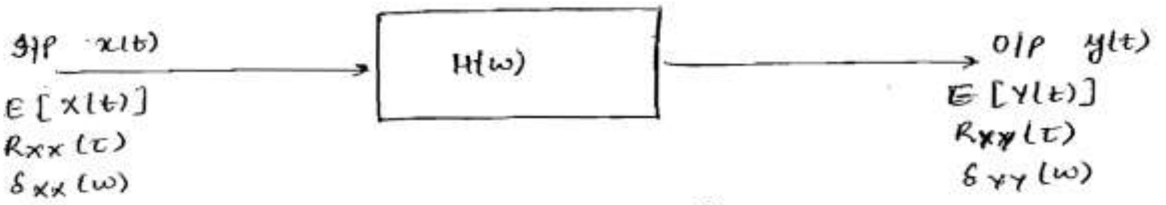
z(t)= $h(t) \otimes h(-t) = \int_{-\infty}^{\infty} h(\tau)h(-(t-\tau))d\tau$

Then $R_{yy}(\tau) = R_{xx}(\tau) \otimes h(t) \otimes h(-t)$

$z(0) = \int_{-\infty}^{\infty} (h(\tau))d\tau = \int_0^3 A^2 d\tau \quad z(0) = A^2 \times 3$

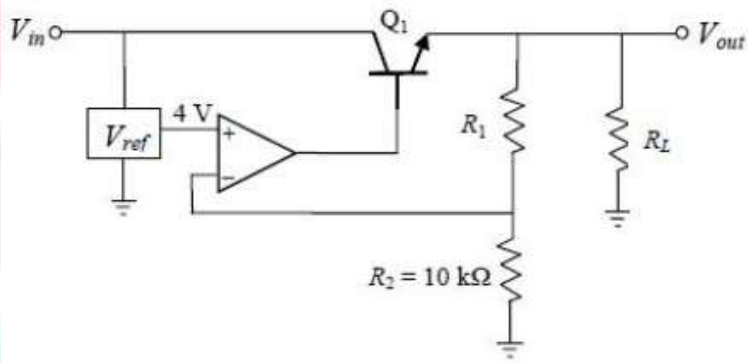
$R_{yy}(0) = \frac{3}{2}A^2N_0 = E[Y^2] \qquad \sigma_{Y^2} = E[Y^2] - [\bar{Y}]^2 = E[Y^2] = \frac{3}{2}A^2N_0$

Ref: Exactly same concept Many Qs were discussed in Random Variable 35-40 class notes



- $E[y(t)] = E[x(t)] \cdot \int_{-\infty}^{\infty} h(\tau)\, d\tau$
- $R_{xy}(\tau) = R_{xx}(\tau) \otimes h(\tau)$
- $R_{yx}(\tau) = R_{xx}(\tau) \otimes h(-\tau)$
- $R_{yy}(\tau) = R_{xx}(\tau) \otimes h(\tau) \otimes h(-\tau)$

34. For the voltage regulator circuit shown, the input voltage (V_{in}) is $20\,V \pm 20\%$ and the regulated output voltage (V_{out}) is 10 V. Assume the opamp to be ideal. For a load R_L drawing 200 mA, the maximum power dissipation in Q_1 (in Watts) is _______.



Sol: (2.66) $V_{max} = 24 \,\&\, V_0 = 10 \Rightarrow V_{CE} = 14$ here if you will take

$P_D = V_{CE} \times I_L = 14 \times 0.2 = 2.8w(\text{Wrong answer})$

$P_D = V_{CB} \times I_C = (14 - 0.7)V \times (200 + 0.4)mA = 2.6652W$

Ref: Exactly same concept Qs Asked in GATE paper and discussed in class.

35. Let $X \in \{0,1\}$ and $Y \in \{0,1\}$ be two independent binary random variables. If $P(X=0) = p$ and $P(Y=0) = q$, then $P(X+Y \geq 1)$ is equal to

(A) $pq + (1-p)(1-q)$ (B) pq (C) $p(1-q)$ (D) $1-pq$

Sol: (D) $P\{X+Y \geq 1\} = 1 - P\{X+Y < 1\}$

only one case is left

$X = 0$ & $Y = 0$

So $P\{X+Y\} < 1 = pq$

$P\{X+Y\} \geq 1 = 1 - pq$

Ref: Exactly same concept Qs Asked in Previous GATE paper and discussed in class.

36. The transfer function of a mass-spring-damper system is given by

$$G(s) = \frac{1}{Ms^2 + Bs + K}$$

The frequency response data for the system are given in the following table.

ω in rad/s	$\lvert G(j\omega)\rvert$ in dB	$\arg(G(j\omega))$ in deg
0.01	-18.5	-0.2
0.1	-18.5	-1.3
0.2	-18.4	-2.6
1	-16	-16.9
2	-11.4	-89.4
3	-21.5	-151
5	-32.8	-167
10	-45.3	-174.5

The unit step response of the system approaches a steady state value of ________.

Sol: (0.398) $e_{ss} = \frac{1}{K}$ where $G(s) = \frac{1}{Ms^2 + Bs + K}$

Value of K can be solved by using concept of Bode Plot :

37. Let the random variable X represent the number of times a fair coin needs to be tossed till two consecutive heads appear for the first time. The expectation of x is _________.

Sol: (1.5) $E[X] = \sum_{i=1}^{N} x_i p(x_i) = 1\times 0.5 + 2\times 0.5 = 1.5$

38. The state variable representation of a system is given as

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 0 & -1 \end{bmatrix} x; \quad x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$y = \begin{bmatrix} 0 & 1 \end{bmatrix} x$$

The response y(t) is

(A) sin(t) (B) $1 - e^t$ (C) $1 - \cos(t)$ (D) 0

Sol: (D)

39. An LC tank circuit consists of an ideal capacitor C connected in parallel with a coil of inductance L having an internal resistance R. The resonant frequency of the tank circuit is

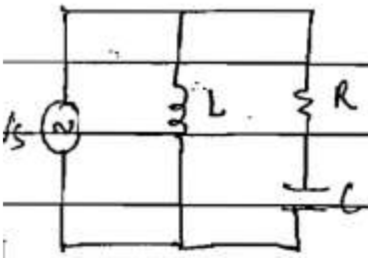
(A) $\frac{1}{2\pi\sqrt{LC}}$ (B) $\frac{1}{2\pi\sqrt{LC}}\sqrt{1 - R^2\frac{C}{L}}$

(C) $\frac{1}{2\pi\sqrt{LC}}\sqrt{1 - \frac{L}{R^2C}}$ (D) $\frac{1}{2\pi\sqrt{LC}}\left(1 - R^2\frac{C}{L}\right)$

Sol: (B)

This Q can be solved by use of short trick method very easily.

Ref: Exactly same Qs was discussed in class notes of Network Page No. 149



$$I_1 = \frac{V_s}{j\omega L} \qquad I_2 = \frac{V_s}{R - j/\omega C}$$

$$Y = \frac{1}{j\omega L} + \frac{R + j/\omega C}{R^2 + 1/\omega^2 C^2}$$

Img part = 0 $\Rightarrow \dfrac{1}{\omega L} = \dfrac{1}{\omega C\left(R^2 + 1/\omega^2 C^2\right)}$

$$\Rightarrow \frac{L}{C} = R^2 + \frac{1}{\omega^2 C^2}$$

$$\Rightarrow \frac{L}{C} - R^2 = \frac{1}{\omega^2 C^2}$$

$$\Rightarrow \omega^2 = \frac{1}{C^2}\left[\frac{1}{L/C - R^2}\right]$$

$$\boxed{\omega = \sqrt{\frac{1}{LC - R^2C^2}}}$$

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40. The electric field of a plane wave propagating in a lossless non-magnetic medium is given by the following expression

$$E(z,t) = a_x 5\cos\left(2\pi\times10^9 t + \beta z\right) + a_y 3\cos\left(2\pi\times10^9 t + \beta z - \frac{\pi}{2}\right)$$

The type of the polarization is

(A) Right Hand Circular.
(B) Left Hand Elliptical.
(C) Right Hand Elliptical.
(D) Linear.

Sol : (B)

41. The output of a standard second-order system for a unit step input is given as

$y(t) = 1 - \dfrac{2}{\sqrt{3}} e^{-t}\cos\left(\sqrt{3}t - \dfrac{\pi}{6}\right)$. The transfer function of the system is

(A) $\dfrac{2}{(s+2)(s+\sqrt{3})}$ (B) $\dfrac{1}{s^2+2s+1}$ (C) $\dfrac{3}{s^2+2s+3}$ (D) $\dfrac{4}{s^2+2s+4}$

Sol: (D)

Compare with equation

$$C(t)=1-\frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}}\sin(\omega dt+\phi)=1-\frac{2}{\sqrt{3}}e^{-t}\sin\left(\sqrt{3}t+\frac{\pi}{3}\right)$$

$$w_d=\sqrt{3} \qquad \phi=60^{\circ}$$

$$\cos\phi=\xi \quad \Rightarrow \quad (\xi=0.5) \qquad \text{here } (\omega_n=2)$$

Second order transfer function is $\frac{\omega_n^{\ 2}}{s^2+2\xi\omega_n s+\omega_n^{\ 2}}=\frac{4}{s^2+2s+4}$

Ref: Based upon very basic equation of control system

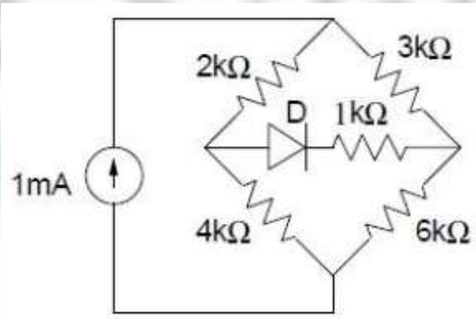
42. Let $x(t)=a\,s(t)+s(-t)$ with $s(t)=\beta e^{-4t}u(t)$, where u(t) is unit step function. If the bilateral Laplace transform of x(t) is

$$X(s)=\frac{16}{s^2-16}\ -4<\text{Re}\{s\}<4;$$

then the value of β is ________.

Sol: (-2)

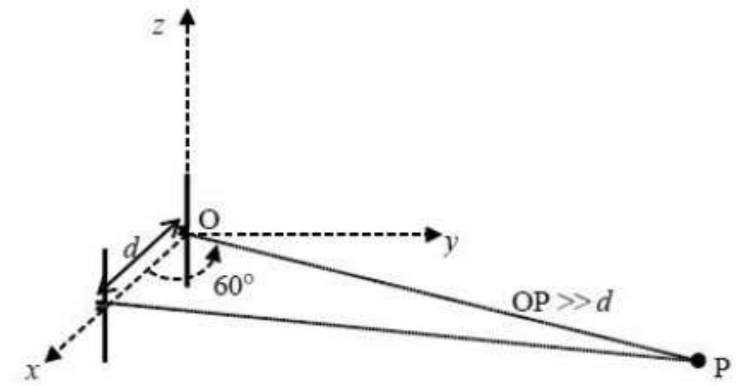
43. The diode in the circuit given below has $V_{ON}=0.7\,V$ but is ideal otherwise. The current (in mA) in the 4 kΩ resistor is ________.



Sol: (0.6) Since it is Wheat stone bridge

$$I=\frac{1\times 9}{9+6}=\frac{9}{15}=0.6\,\text{mA}$$

44. Two half-wave dipole antennas placed as shown in the figure are excited with sinusoidally varying currents of frequency 3 MHz and phase shift of $\pi/2$ between them (the element at the origin leads in phase). If the maximum radiated E-field at the point P in the x-y plane occurs at an azimuthal angle of 60°, the distance d (in meters) between the antennas is _________.



Sol: (50) $\psi = \beta d\cos\phi + \delta$ Here $0 = \frac{2\pi}{\lambda} d\cos 60 - \frac{\pi}{2} \Rightarrow d = \frac{\lambda}{2} = 50$ meter

Ref: Exact formula and concept was discussed on Page No. 166 in EMT class notes

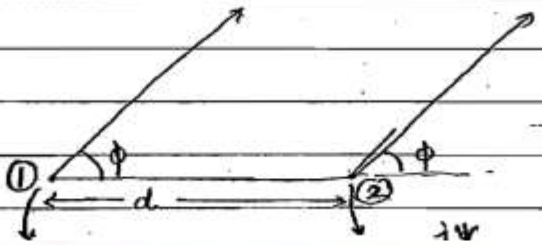
Antenna array is used to increase directivity in a desired direction. It is a set of 2 or more antenna which are combined to improve performance over single antenna.

$\psi = \beta d\cos\phi + \delta$

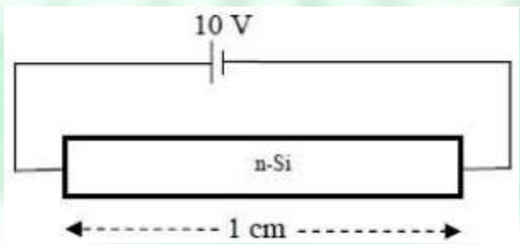
ψ is the angle b/w Electric field produced by antenna ① and ②.

ϕ = Angle from array axis

δ = Progressive phase shift in



45. A dc voltages of 10 V is applied across an n-type silicon bar having a rectangular cross-section and a length of 1 cm as shown in figure. The donor doping concentration N_D and the mobility of electrons μ_n are $10^{16} cm^{-3}$ and $1000 cm^2V^{-1}s^{-1}$, respectively. The average time (in μs) taken by the electrons to move from one end of the bar to other end is ________.



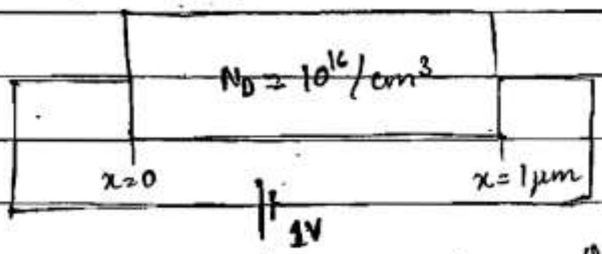
Sol: (100) $E = \frac{10}{10^{-2}} = 10^3 \left(v/m\right)$

So $v = \mu E = \frac{1000\,cm^2}{\cancel{V}\,sec} \times \frac{10^3\,\cancel{V}}{meter}$ $v = 10^4\,cm/sec$

$d = v \cdot \tau \Rightarrow 1cm = \frac{10^4\,cm}{sec} \times \tau$ $\tau = 10^{-4}\,sec = 100\,\mu sec$

Ref: Exactly same type of Q was discussed on Page No. 34 in EDC class notes

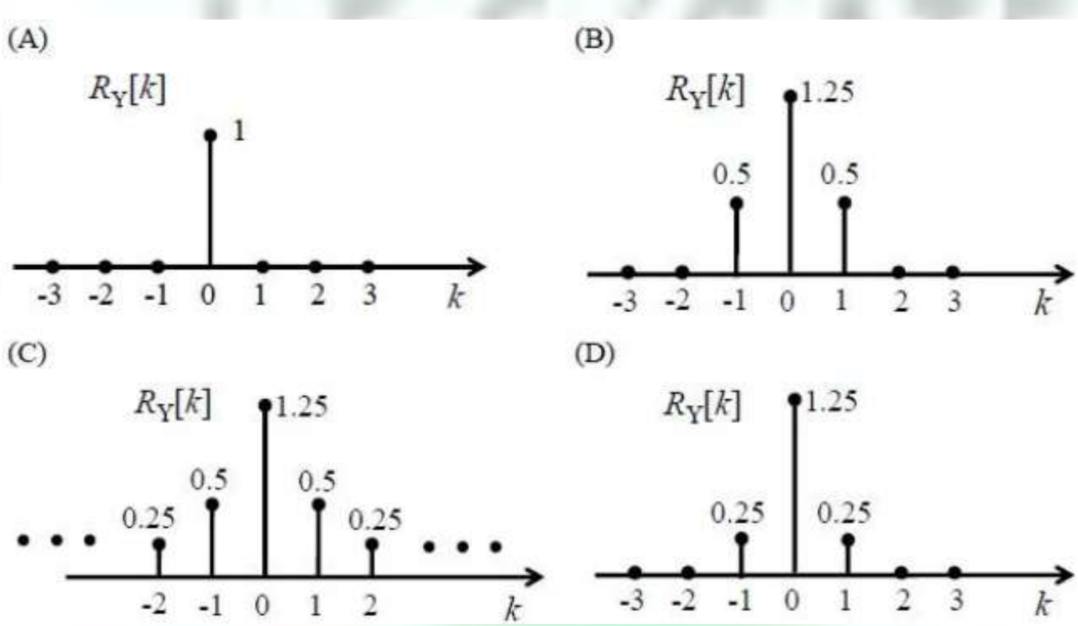
Statement: A Si sample with unit-cross-sectional area shown below is in thermal equilibrium, $T = 300K$, $e = 1.6 \times 10^{-19}$ C, $V_T = 26mV$ and $\mu_n = 1350\ cm^2/V\text{-}s$.



Q. What is the magnitude of Electric field? at $x = 0.5\ \mu m$.

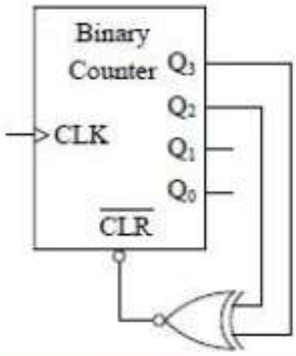
Q: What is value of e^- drift current density at $x = 0.5\ \mu m$.

46. $\{X_n\}_{n=-\infty}^{n=\infty}$ is an independent and identically distributed (i.i.d.) random process with X_n equally likely to be +1 or -1. $\{Y_n\}_{n=-\infty}^{n=\infty}$ is another random process obtained as $Y_n = X_n + 0.5X_{n-1}$. The autocorrelation function of $\{Y_n\}_{n=-\infty}^{n=\infty}$, denoted by $R_Y[k]$ is



Sol: (C) Just calculate the value of Cross correlation by using concept of Convolution.

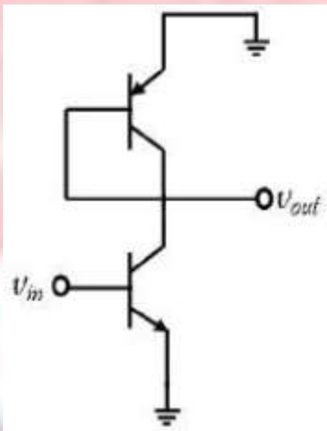
47. The figure shows a binary counter with synchronous clear input. With the decoding logic shown, the counter works as a



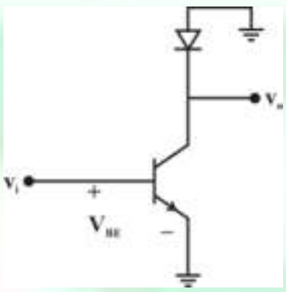
(A) mod-2 counter (B) mod-4 counter (C) mod-5 counter (D) mod-6 counter

Sol: (B) Output of EX-NOR should be Zero and so $Q_3Q_2Q_1Q_0$ should be 0100 which is nothing but zero

48. In the ac equivalent circuit shown, the two BJTs are biased in active region and have identical parameters with $\beta >> 1$. The open circuit small signal voltage gain is approximately ______.



Sol: (-1) Base and collector are connected so that it work like on diode.



$$v_o - 0 = -0.7 \quad \Rightarrow \quad v_o = -0.7$$

$$v_i - 0 = 0.7 \quad \Rightarrow \quad v_i = 0.7$$

So $\left(\dfrac{v_o}{v_i} = -1\right)$

Ref: Questions on similar concept were given in test series.

49. A function of Boolean variables X, Y and Z is expressed in terms of the min-terms as

$$F(X, Y, Z) = \Sigma(1, 2, 5, 6, 7)$$

Which one of the product of sums given below is equal to the function F(X, Y, Z) ?

(A) $(\bar{X} + \bar{Y} + \bar{Z}) \cdot (\bar{X} + Y + Z) \cdot (X + \bar{Y} + \bar{Z})$

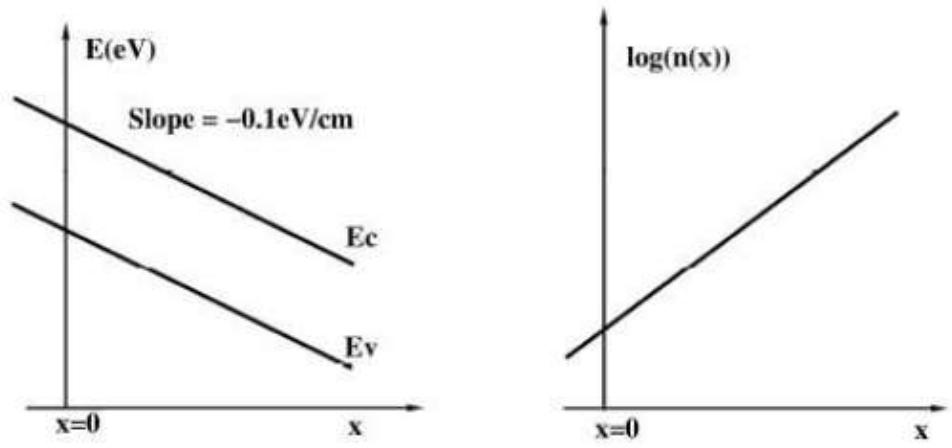
(B) $(X+Y+Z)\cdot(X+\bar{Y}+\bar{Z})\cdot(\bar{X}+Y+Z)$

(C) $(\bar{X}+\bar{Y}+Z)\cdot(\bar{X}+Y+\bar{Z})\cdot(X+\bar{Y}+Z)\cdot(X+Y+\bar{Z})\cdot(X+Y+Z)$

(D) $(X+Y+\bar{Z})\cdot(\bar{X}+Y+Z)\cdot(\bar{X}+Y+\bar{Z}).(\bar{X}+\bar{Y}+Z)\cdot(\bar{X}+\bar{Y}+\bar{Z})$

Sol: (B)

50. The energy band diagram and the electron density profile n(x) in a semiconductor are shown in the figures. Assume that $n(x)=10^{15}e^{\left(\frac{qax}{kT}\right)}cm^{-3}$, with $a=0.1V/cm$ and x expressed in cm. Given $\frac{kT}{q}=0.026V$, $D_n=36\,cm^2s^{-1}$, and $\frac{D}{\mu}=\frac{kT}{q}$. The electron current density (in A/cm^2) at x = 0 is



(A) -4.4×10^{-2} (B) -2.2×10^{-2} (C) 0 (D) 2.2×10^{-2}

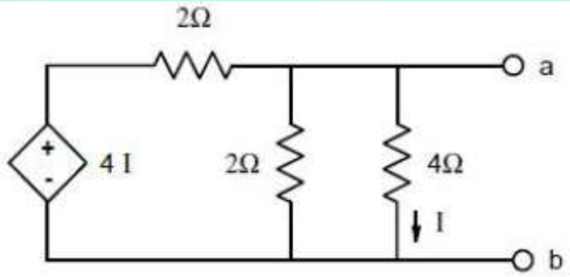
Sol: (B)

$$J_n(x)=qD_n\frac{dn}{dx}=10^{15}\times qD_n\times\frac{qa}{kT}e^{\frac{qax}{kT}}$$

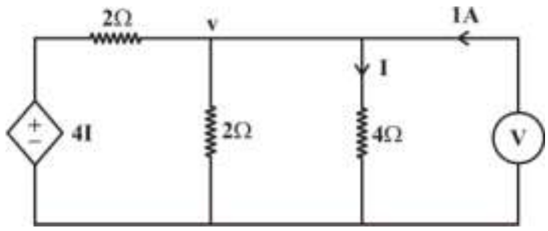
$$J_n(x=0)=-eD_n\frac{dn}{dx}=10^{15}\times\frac{-eaD_n}{V_T}=2.21\times10^{-2}$$

Here electron conc is increasing with distance so negative conc gradient

51. In the circuit shown, the Norton equivalent resistance (in Ω) across terminals a-b is _______.



Sol: (1.33)



$$\frac{v-4I}{2}+\frac{v}{2}+\frac{v}{4}-1=0$$

$$2(v-4I)+2v+v-4=0$$

$$5v-8I-4=0 \qquad \text{and} \qquad I=v/4$$

$$5v-8\left(\frac{v}{4}\right)=4 \qquad 3v=4$$

$$\boxed{v=4/3} \qquad \boxed{R_{Th}=\frac{4}{3}\Omega}$$

Ref: Many Qs on same concept were discussed on Page-87 in Network theory class notes

52. The value of the integral $\int_{-\infty}^{\infty} 12\cos(2\pi t)\frac{\sin(4\pi t)}{4\pi t}dt$ is ______.

Sol: (3) $\qquad I=\int_{-\infty}^{\infty} 12\cos 2\pi t\cdot\frac{\sin 4\pi t}{4\pi t}dt$

$$I=\int_{-\infty}^{\infty}\frac{6}{4\pi t}\cdot(\sin 6\pi t+\sin 2\pi t)dt=6\int_{-\infty}^{\infty}\frac{\sin 6\pi t}{4\pi t}dt+6\int_{-\infty}^{\infty}\frac{\sin 2\pi t}{4\pi t}dt$$

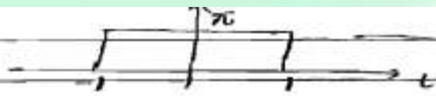
$$=1.5\int_{-\infty}^{\infty}\frac{\sin 6\pi t}{\pi t}dt+1.5\int_{-\infty}^{\infty}\frac{\sin 2\pi t}{\pi t}dt$$

But $\quad \int_{-\infty}^{\infty}\frac{\sin x}{x}dx=\pi$

$$6\pi t=x \quad dt=\frac{dx}{6\pi}$$

So $\quad \int_{-\infty}^{\infty}\frac{\sin x}{x}\times\cancel{6}\times\frac{dx}{\cancel{6}\pi} \qquad$ So $\quad I=3$

Ref: Many Qs on same concept were discussed on Page-162 in Signal&System class notes

$Sa(t) \xrightarrow{F.T.}$  $\longrightarrow G(\omega)$

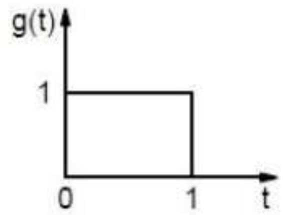
what is the value of integral $I=\int_{-\infty}^{\infty}\frac{\sin t}{t}dt=\int_{-\infty}^{\infty}Sa(t)$

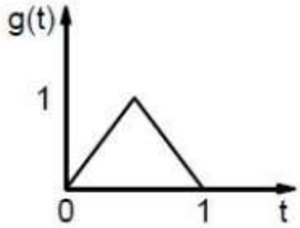
$F[Sa(t)] \longrightarrow \int_{-\infty}^{\infty}Sa(t)e^{-j\omega t}dt = G(\omega)$

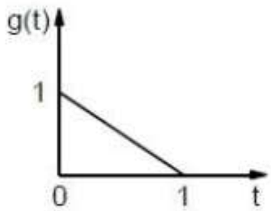
$G(0)=\pi=\int_{-\infty}^{\infty}\frac{\sin t}{t}dt$

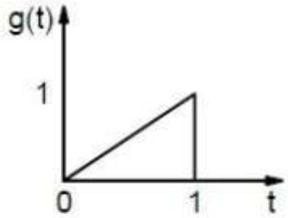
53. Consider a binary, digital communication system which uses pulses g(t) and –g(t) for transmitting bits over an AWGN channel. If the receiver uses a matched filter, which one of the following pulses will give the minimum probability of bit error ?

28A/11 Ground Floor Jia Sarai (Near IIT)- Hauz Khas Metro Station New Delhi-110016
Helpline No.: 09811382221, 011-32662945
Website: www.panaceainstitute.org.in, E-mail: panacea.institute@gmail.com

(A)


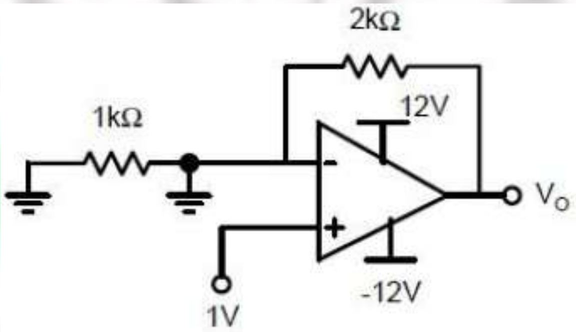
(B)


(C)


(D)


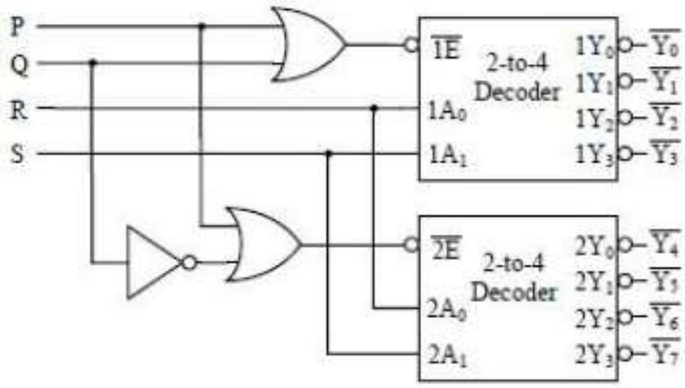
Sol: (A) It will have maximum Signal To ratio at the output and that's why Probability of error will be minimum.

54. Assuming that the opamp in the circuit shown below is ideal, the output voltage V_o (in volts) is _________.



Sol: (12)
Since virtual ground concept is not valid here so there may be two cases either OP-AMP is Finite loop gain OP-AMP or there is no negative feed back. Here OPAMP is Ideal and hence there will be no effective negative feedback and hence $V_0 = +V_{sat} = 12$ V

55. A 1-to-8 demultiplexer with data input D_{in}, address inputs S_0, S_1, S_2 (with S_0 as the LSB) and $\overline{Y}_0$ to $\overline{Y}_7$ as the eight demultiplexed outputs, is to be designed using two 2-to-4 decoders (with enable input $\overline{E}$ and address inputs A_0 and A_1) as shown in the figure. D_{in}, S_0, S_1 and S_2 are to be connected to P, Q, R and S, but not necessarily in this order. The respective input connections to P, Q, R, and s terminals should be



(A) S_2, D_{in}, S_0, S_1 (B) S_1, D_{in}, S_0, S_2 (C) D_{in}, S_0, S_1, S_2 (D) D_{in}, S_2, S_0, S_1

Sol: (D)