1. Ans. A.
Dissent is to disagree

2. Ans. B.
Revert means set back

3. Ans. B.
Vindicate has 2 meanings
1) Clear of blain
2) Substantiate, justify

4. Ans. A.

$$(2x)^n \times \left(\frac{y}{2}\right)^m = 2^{n-m} \times x^n y^m$$

5. Ans. D. 495
Let consecutive odd numbers be a-10, a-8, a-6, a-4, a-2, a, ……a+12
Sum of 1st 5 number =5a-30=425 $\Rightarrow$ a=91
Last 5 numbers=(a+4)+(a+6)+…….+(a+12)
=(95+97+99+101+103)= 495

6. Ans. C.

13	M
$17(13+4)$	$Q(M+4)$
$19(17+2)$	S(Q+2)
23(19+4)	W=(s+4)

$\Rightarrow$ 23W

7. Ans. B.
KCLFTSB SHSWDG
Reverse order: Reverse order:
BCS TOF LUCK GO OD W I S HES
Ace the exam
Reverse order should be
MAXE EHT ECA
Looking at the options we have M X H T C

8. Ans. B.

$$A + P\left(1+\frac{r}{100}\right)^n$$

$$A = 2P$$

$$2 = \left(1+\frac{r}{100}\right)^n$$

$$\therefore \quad r = 7.2$$

9. Ans. C.
Let total cost in 2012 is 100
Raw material increases in 2013 to 1.3 x 20=26
Other Expenses increased in 2013 to 1.2 x 80=96
Total Cost in 2013 =96+26=122
Total Cost increased by 22%
Hint: Labour cost (i.e, 4,50,000) in 2012 is redundant data.

10. Ans. B.
1 appears in units place in 4! Ways
Similarly all other positions in 4! Ways Same for other digits.
Sum of all the numbers = (11111) X 4! (1+3+5+7+9) = 6666600

11. Ans. D.

$$\sum_{n=0}^{\infty} \frac{1}{n!} = 1 + \frac{1}{1!} + \frac{1}{2!} + \ldots\ldots$$

$$= e \; as \; e^x = 1 + \frac{x}{1!} + \frac{x}{2!} + \ldots\ldots \forall x \; in \; R$$

12. Ans. A.

$$(\nabla f)_{P(1,1,1)} = \left(\bar{i}(2x) + \bar{j}(6y) + \bar{k}(3z^2)\right)_{P(1,1,1)}$$

$$= 2\bar{i} + 6\bar{j} + 3\bar{k}$$

$$\left|(\nabla f)_P\right| = \sqrt{4+36+9} = 7$$

13. Ans. A.

$$X \sim N(0,1) \Rightarrow f(X) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2}, -\infty < X < \infty$$

$$\therefore E\{|X|\} = \int_{-\infty}^{\infty} |X| . f(X) dx$$

$$= \frac{1}{\sqrt{2\pi}} X^2 \int_0^{\infty} X e^{-x^2/2} dx$$

$$= \frac{2}{\sqrt{2\pi}} \int_0^{\infty} e^{-u} du = \sqrt{\frac{2}{\pi}} = 0.797 \simeq 0.8$$

14. Ans. B.

$$A.E: -m^2 + 2m + 1 = 0 \Rightarrow m = -1, -1$$

$\therefore$ general solution is $x = (a+bt)e^{-t}$

15. Ans. A.

$$f = \frac{1}{\sqrt{2}}\left(x^2 y + xy^2\right)$$

$$\Rightarrow \nabla f = \bar{i}\left[\frac{2xy + y^2}{\sqrt{2}}\right] + \bar{j}\left[\frac{x^2 + 2xy}{\sqrt{2}}\right]$$

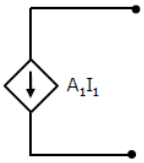
$$at(1,1), \nabla f = \frac{3}{\sqrt{2}}\bar{i} + \frac{3}{\sqrt{2}}\bar{i}$$

$\hat{e} =$ unit vector in the direction i.e., making an angle of $\frac{\pi}{4}$ with y-axis

$$= \left(\sin\frac{\pi}{4}\right)\bar{i} + \left(\cos\frac{\pi}{4}\right)\bar{j}$$

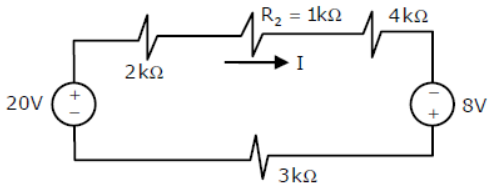
$$\therefore directional\ derivative = \hat{e}.\nabla f = 2\left(\frac{3}{\sqrt{2}}\right)\left(1/\sqrt{2}\right) = 3$$

16. Ans. C.



The dependent source represents a current controlled current source

17. Ans. A.
By source transformation



$By\ KVL,$

$20-10k.I+8=0$

$\Rightarrow I=\dfrac{28}{10k}$

$\Rightarrow \boxed{I=2.8mA}$

18. Ans. A.

$$E=\frac{hC}{\lambda}\Rightarrow \lambda=\frac{6.62\times10^{-34}\times3\times10^{8}}{1.42\times1.6\times10^{-19}}=0.87\,\mu m$$

19. Ans. A.

$n_i\ \alpha\ T^{3/2}e^{-Eg/kT}\quad and$

$\rho_t\ \alpha\ \dfrac{1}{\eta_i}$

∴ From the graph, Energy graph of S_i can be estimated

20. Ans. B.

21. Ans. B.
When a CE amplifier's emitter resistance is not by passed, due to the negative feedback the voltage gain decreases and input impedance increases

22. Ans. D.

$When\ V_i<-1.7V: D_1-ON\ and\ D_2-OFF$

$\therefore V_0=-1.7V$

$When\ V_i>-2.7V: D_1-OFF\ and\ D_2-ON$

$\therefore V_0=2.7V$

$When -1.7<V_i<2.7V: Both\ D_1\ and\ D_2-OFF$

$\therefore V_0=V_i$

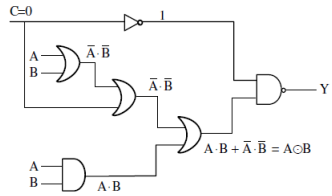
23. Ans. D.

24. Ans. B.

Capacitor drop rate $=\dfrac{dv}{dt}$ For a capacitor, $\dfrac{dv}{dt}\propto\dfrac{1}{c}$

∴ Drop rate decreases as capacitor value is increased
For a capacitor, $Q=cv=i\times t\Rightarrow t\propto c$
∴ Acquisition time increases as capacitor value increased

25. Ans. A.

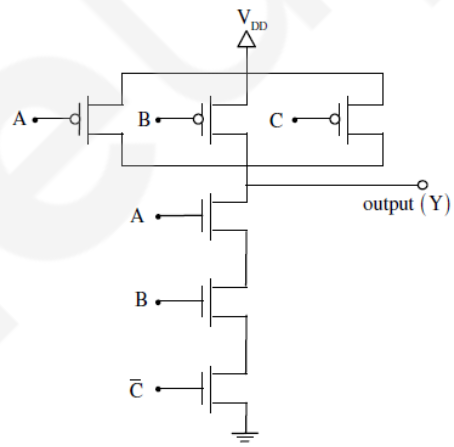


$Y=\overline{1.A}\odot$

$=\overline{A}\odot$

$=A\oplus B=\overline{A}B+A\overline{B}+\overline{A}B$

26. Ans. A.



This circuit is CMOS implementation
If the NMOS is connected in series, then the output expression is product of each input with complement to the final product.

$So, Y=\overline{A.B.\overline{C}}$

$=\overline{A}+\overline{B}+C$

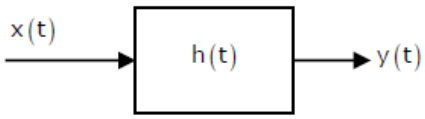
27. Ans. D.

$$x[n]=\left(\frac{2}{3}\right)^{n}u[n+3]$$

$$X\left(e^{j\Omega}\right)=\sum_{n=-3}^{\infty}\left(\frac{2}{3}\right)^{n}.e^{-j\Omega n}=\frac{\left(\frac{2}{3}\right)^{-3}.e^{j3\Omega}}{1-\frac{2}{3}e^{-j\Omega}}$$

$$\Rightarrow A=\left(\frac{3}{2}\right)^{3}=\frac{27}{8}=3.375$$

28. Ans. D.
Let x(t) Fourier transform be x(t)



$y(t) = x(t) * h(t)[convolution]$

$\Rightarrow Y(f) = X(f).H(f)$

$\Rightarrow Y(f) = e^{-j4\pi f}(f)$

$\Rightarrow y(t) = x(t-2)$

29. Ans. A.

$y[n] = x[n] * x[n]$

$Let\, Y(e^{j\Omega}) is\, F.T.\, pair\, with\, y[n]$

$\Rightarrow Y\left(e^{j\Omega}\right) = X\left(e^{j\Omega}\right).X\left(e^{j\Omega}\right)$

$Y\left(e^{j\Omega}\right) = \frac{1}{1-0.5e^{-j\Omega}}.\frac{1}{1-0.5e^{-j\Omega}}$

$also\, Y(e^{j\Omega}) = \sum_{h\infty-\infty}^{\infty} y[n]e^{-j\Omega n}$

$\Rightarrow \sum_{h\infty-\infty}^{\infty} y[n] = Y\left(e^{j0}\right) = \frac{1}{0.5}.\frac{1}{0.5} = 4$

30. Ans. A.

$\rightarrow$ In a BODE diagram, in plotting the magnitude with respect to frequency, a pole introduce a line 4 slope $-20dB$ / dc

$\rightarrow$ If 4th order all-pole system means gives a slope of $(-20) * dB / dec\, i.e. -80dB / dec$

31. Ans. C.

$Transfer\ function \frac{Y(s)}{U(s)} = \frac{4}{S^2 + 4s + 4}$

If we compare with standard 2nd order system transfer function

$i.e., \frac{w_n{}^2}{s^2 + 2\xi w_n s + w_n{}^2}$

$w_n{}^2 = 4 \Rightarrow w_n = 2\, rad / \sec$

32. Ans. A.

Poisson distribution: It is the property of Poisson distribution.

33. Ans. B.

$\frac{\text{Ratio of total side band power}}{\text{Carrier power}} \alpha \mu^2$

If it in doubled, this ratio will be come 4 times

34. Ans. D.

Electric field of an antenna is

$$E_\theta = \frac{\eta I_0 d1}{4\pi}\sin\theta \left[\begin{array}{ccc} \frac{J\beta}{r} + & \frac{1}{r^2} - & \frac{J}{\beta r^3} \\ \downarrow & \downarrow & \downarrow \\ \text{Radiation Field} & \text{Inductive Field} & \text{Electrostatic Field} \end{array}\right]$$

$\therefore\ E\ \alpha \frac{1}{r}$

$\frac{E_1}{E_2} = \frac{r_2}{r_1} \Rightarrow E_2 = 6\,|\,mv/m$

$P = \frac{1}{2}\frac{E^2}{\eta} = \frac{1}{2}\frac{36\times10^{-8}}{120\pi} = 47 - 7\, nw/m^2$

35. Ans. B.

1) Point electromagnetic source, can radiate fields in all directions equally, so isotropic.

2) Dish antenna $\rightarrow$ highly directional

3) Yagi – uda antenna $\rightarrow$ End fire

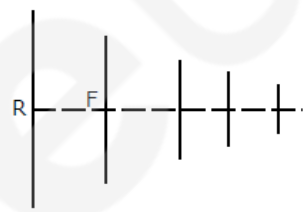


Figure: Yagi-uda antenna

36. Ans. C.

$A.E: m^2 + 4m + 4 = 0 \Rightarrow m = -2, -2$

$\therefore solution\, is\, y = (a + bx)e^{-2x}$ .....(1)

$y = (a + bx)\left(-2e^{-2x}\right) + e^{-2x}(b)$.....(2)

using $y(0) = 1; y(0) = 1, (1)\, and\, (2)\, gives$

$a = 1\, and\, b = 3$

$\therefore y = (1 + 3x)e^{-2x}$

$at\, x = 1, y = e^{-2} = 0.541 \simeq$

37. Ans. C.

Parcel will be lost if

a. it is lost by the first post office

b. it is passed by first post office but lost by the second post office

Prob (parcel is lost) $= \frac{1}{5} + \frac{4}{5}\times\frac{1}{5} = \frac{9}{25}$

P (Parcel lost by second post if it passes first post office) = P (Parcel passed by first post office) x P(Parcel lost by second post office) $= \frac{4}{5}\times\frac{1}{5} = \frac{4}{25}$

Prob(parcel lost by 2nd post office | parcel lost)= $\frac{4/25}{9/25} = \frac{4}{9} = 0.44$

38. Ans. D.

$If\ f(t) \leftrightarrow F(s)$

$Then\ if\ (t) \leftrightarrow \frac{-d}{ds}F(s)$

$= \frac{-d}{ds}\left(\frac{1}{s^2+s+1}\right)$

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

Alternative Way:

$F(s) = \frac{1}{s^2+s+1}$

$L[g(t) = t.f(t)] = -\frac{d}{ds}[F(s)]$

(using multiplication by t)

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

39. Ans. C.

Let x (opposite side), y (adjacent side) and z (hypotenuse) of a right angled triangle.

Given Z + y = K(constant) .....(1) and angle between them say 'θ' then Area,

$A = \frac{1}{2}xy = \frac{1}{2}(z\sin\theta)(z\cos\theta) = \frac{z^2}{4}\sin 2\theta$

$Now(1) \Rightarrow z + z\sin\theta = k \Rightarrow z = \frac{k}{1+\sin\theta}$

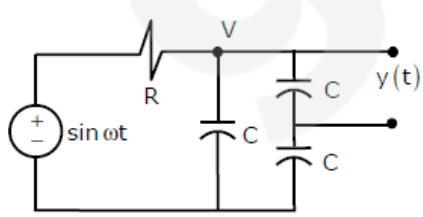
$\therefore\ A = \frac{k^2}{4}\left[\frac{\sin 2\theta}{(1+\sin\theta)^2}\right]$

In order to have maximum area, $\frac{dA}{d\theta} = 0$

$\Rightarrow \frac{k^2}{4}\left[\frac{(1+\sin\theta)^2(2\cos\theta) - \sin 2\theta(\cos\theta).2(1+\sin\theta)}{(1+\sin\theta)^4}\right] = 0$

$\Rightarrow \theta = \frac{\pi}{6} = 30°$

40. Ans. B.



$By\ nodal\ method,$

$\frac{V - 1\angle 0°}{R} + \frac{V}{\left(1/j\omega c\right)} + \frac{V}{\left(2/j\omega c\right)} = 0$

$V\left[\frac{1}{R} + j\omega c + \frac{j\omega c}{2}\right] = \frac{1\angle 0°}{R}$

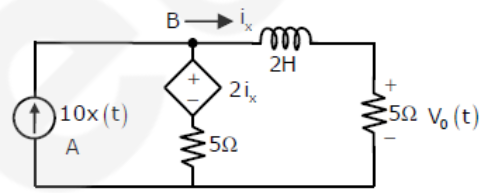
$V = \frac{2}{2+3j\omega RC}$

$Y = \frac{V}{2} \Rightarrow \frac{2}{2+3j\omega 3RC}$

$given\,|A(\omega)| = \frac{1}{4} \Rightarrow \frac{1}{\sqrt{4+9R^2c^2.\omega}}$

$\Rightarrow \boxed{\omega = \frac{2}{\sqrt{3}RC}}$

41. Ans. C.

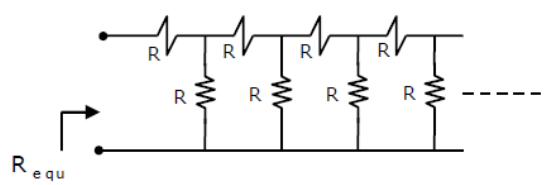


For $t \to \infty$, i.e., at steady state, inductor will behave as a shot circuit and hence $V_B = 5.i_x$

By KCL at node $B, -10 + V_B - 2i_x + i_x = 0 \Rightarrow i_x = \frac{50}{8}$

$V_0(t) = 5i_x(t) \Rightarrow V_0(t) = \frac{250}{8} = \boxed{31.25\,volts}$

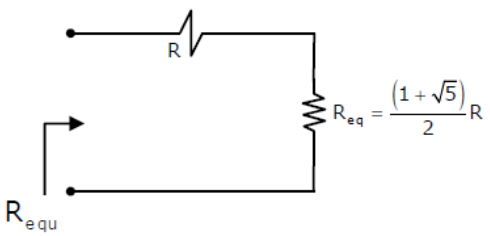
42. Ans. B.



→ For an infinite ladder network, if all resistance are having same value of R

Then equivalent resistance is $\left(\frac{1+\sqrt{5}}{2}\right).R$

→ For the given network, we can split in to R is in series with $R_{equivalent}$



$$\Rightarrow R_{equ} = R + 1.618R \Rightarrow \boxed{\frac{R_{equ}}{R} = 2.618}$$

43. Ans. C.
For the two-part network

$$Y = matrix = \begin{bmatrix} \frac{1}{30}+\frac{1}{10} & \frac{-1}{30} \\ \frac{-1}{30} & \frac{1}{60}+\frac{1}{30} \end{bmatrix}$$

$$Z_{matrix} = [Y]^{-1}$$

$$Z = \begin{bmatrix} 0.1333 & -0.0333 \\ -0.0333 & 0.05 \end{bmatrix}^{-1}$$

$$Z = \begin{bmatrix} 9 & 6 \\ 6 & 24 \end{bmatrix}$$

44. Ans. A.

$$P = N_A - N_D = 1\times10^{18} - 1\times10^{15} = 9.99\times10^{17}$$

$$\eta = \frac{\eta_i^2}{P} = \frac{(1.5\times10^{10})^2}{9.99\times10^{17}} = 225.2/cm^3$$

45. Ans. B.

$$I_{C_1} = I_{C_2}\ (given)$$

$$I_{S_1} e^{\frac{V_{BE_1}}{V_T}} = I_{S_2} e^{V_{BE_2}/V_T}$$

$$e^{(V_{BE_1}-V_{BE_2})/V_T} = \frac{I_{S_1}}{I_{S_2}}$$

$$V_{BE_1} - V_{BE_2} = V_T 1n \frac{I_{S_1}}{I_{S_2}}$$

$$= 26\times10^{-3} 1n\left[\frac{300\times300}{0.2\times0.2}\right] \because$$

$$\left(V_{BE_1} - V_{BE_2}\right) = 381mV$$

46. Ans. D.

47. Ans. B.

$$A_V = \frac{R_E}{r_e + R_E} = \frac{R_E}{\frac{V_T}{I_E} + R_E} = \frac{I_E R_E}{V_T + I_3 R_E}$$

$$\therefore \quad A_V = \frac{I_C R_E}{V_T + I_C R_E} (\because \quad \simeq$$

$$\therefore I_C R_E >> U_T \Rightarrow A_V \text{ in almost constant}$$

48. Ans. C.

Input impedance of CB amplifier, $z_i = r_e = \frac{V_1}{I_E}$

$$\Rightarrow 50 = \frac{25mV}{I_E}$$

$(\because$ s received from 50Ω antenna and $V_T = 25mV)$

$$\Rightarrow I_E = \frac{25mV}{50\Omega} = 0.5mA$$

49. Ans. D.

$\because \quad h, I_B$ *is neglected*

$$\therefore V_B = 12\times\frac{10k}{10k+5k} = 8V$$

$$V_E = V_B - 0.7 = 7.3V$$

$$\therefore V_{CE} = 12 - 7.3 = 4.7V$$

$$\therefore \text{maximum undistorted } V_0(p-p) = 2\times4.7V = 9.4V$$

50. Ans. C.

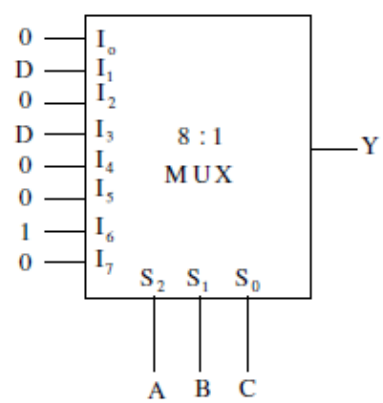
$$Y = \overline{A}\overline{B}CD + \overline{A}BCD + AB\overline{C}$$

Remaining combinations of the select lines will produce output 0.

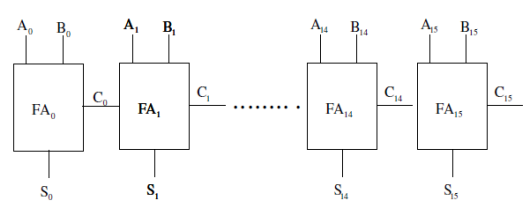
$$So,\ Y = \overline{A}CD(\overline{B}+B) + AB\overline{C}$$

$$= \overline{A}CD + AB\overline{C}$$

$$= AB\overline{C} + \overline{A}CD$$



51. Ans. D.



This is 16-bit ripple carry adder circuit, in their operation carry signal is propagating from 1st stage FA0 to last

state FA15, so their propagation delay is added together but sum result is not propagating. We can say that next stage sum result depends upon previous carry.

So, last stage carry (C_{15}) will be produced after 16×12ns = 192ns

Second last stage carry (C_{14}) will be produced after 180 ns.

For last stage sum result (S_{15}) total delay = 180ns + 15ns = 195ns

So, worst case delay = 195 ns

52. Ans. A.

Let the opcode of STA is XXH and content of accumulator is YYH.

Instruction: STA 1234 H

Starting address given = 1FFEH

So, the sequence of data and addresses is given below:

Address (in hex) : Data (in hex)

$A_{15} - A_8$	$A_7 - A_0$		
1F	FE H	→	XXH
1F	FF H	→	34H
20	00 H	→	12 H
12	34 H	→	YYH

53. Ans. B.

$$Given, H(s) = \frac{1}{s^2+s-6} = \frac{1}{(s+3)(s-2)}$$

It is given that system is stable thus its ROC includes $j\omega$ axis. This implies it cannot be causal, because for causal system ROC is right side of the rightmost pole.

⇒ Poles at s = 2 must be removes so that it can be become causal and stable simultaneously.

$$\Rightarrow \frac{1}{(s+3)(s-2)}(s-2) = \frac{1}{s+3}$$

$$Thus, H_1(s) = s-2$$

54. Ans. B.

Given differential equation

$$s^2 y(s) + \alpha s y(s) + \alpha^2 y(s) = x(s)$$

$$\Rightarrow \frac{y(s)}{x(s)} = \frac{1}{s^2+\alpha s+\alpha^2} = H(s)$$

$$g(t) = \alpha^2 \int_0^t h(z)dz + \frac{d}{dt}h(t) + \alpha h(t)$$

$$= \alpha^2 \frac{H(s)}{s} + SH(s) + \alpha H(s)$$

$$= \alpha^2 \frac{1}{s(s^2+\alpha s+\alpha^2)} + s\frac{1}{(s^2+2s+\alpha^2)} + \frac{\alpha}{s^2+\alpha s+\alpha^2}$$

$$= \frac{\alpha^2+\alpha s+s^2}{s^2+\alpha s+\alpha^2} = \frac{1}{s}$$

$$No.of\ poles = 1$$

55. Ans. B.

This can be solve by directly using option and satisfying the condition given in question

$$X = DFT(x)$$

$$D_{FT}(D_{FT}(x)) = DFT(X) = \frac{1}{N}\sum_{n=0}^{N-1} X[n]e^{-j\frac{2\pi}{N}nk}$$

$$DFT\ y[1\ 2\ 3\ 4]$$

$$X = \frac{1}{\sqrt{4}}\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & -j & -1 & j\\ 1 & -1 & 1 & -1\\ 1 & +j & -1 & -j\end{bmatrix}\begin{bmatrix}1\\2\\3\\4\end{bmatrix} = \frac{1}{\sqrt{4}}\begin{bmatrix}10\\2+2j\\2\\-2-j2\end{bmatrix}$$

DFT of (x) will not result in [1 2 3 4]

Try with DFT of Y 1 2 3 2]

$$X = \frac{1}{\sqrt{4}}\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & -j & -1 & j\\ 1 & -1 & 1 & -1\\ 1 & +j & -1 & -j\end{bmatrix}\begin{bmatrix}1\\2\\3\\4\end{bmatrix} = \frac{1}{\sqrt{4}}\begin{bmatrix}8\\-2\\0\\-2\end{bmatrix} = \begin{bmatrix}4\\-1\\0\\-1\end{bmatrix}$$

$$DTF\ of \begin{bmatrix}4\\-\\0\\-1\end{bmatrix} = \frac{1}{\sqrt{4}}\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & -j & -1 & j\\ 1 & -1 & 1 & -1\\ 1 & +j & -1 & -j\end{bmatrix}\begin{bmatrix}4\\-1\\0\\-1\end{bmatrix}$$

$$= \frac{1}{2}\begin{bmatrix}2\\4\\6\\4\end{bmatrix} = \begin{bmatrix}1\\2\\3\\2\end{bmatrix}$$

Same as x

Then 'B' is right option

56. Ans. D.

Given state model,

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

$$A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$$

$\phi(t) \Rightarrow$ state transistion matrix

$$\phi(t) = L^{-1}\left[(SI - A)^{-1}\right]$$

$$[SI - A]^{-1} = \begin{bmatrix} s & -1 \\ 0 & s \end{bmatrix}^{-1} \Rightarrow \frac{1}{s^2}\begin{bmatrix} s & 1 \\ 0 & s \end{bmatrix}$$

$$\phi(t) = L^{-1}\begin{bmatrix} 1/s & 1/s^2 \\ 0 & 1/s \end{bmatrix}$$

$$\phi(t) = \begin{bmatrix} 1 & t \\ 0 & 1 \end{bmatrix}$$

57. Ans. A.

$$G_P(s) = \frac{ps^2 + 3ps - 2}{s^2 + (3+p)s + (2-p)}$$

By R H criteria

The characteristic equation is $s^2 + (3+p)s + (2-p) = 0$

$i.e.\ s^2 + (3+p)s + (2-p) = 0$

s^2	1	$(2-p)$
s^1	$(3+\phi)$	0
s^0	$(2-p)$	

For stability, first column elements must be positive and non-zero

$i.e. (1)(3+p) > 0 \Rightarrow \boxed{p > -3}$

$and\ (2)(2-p) > 0 \Rightarrow \boxed{p < 2}$

$i.e. \boxed{-3 < p < 2}$

The maximum value of p unit which G_P remains stable is 2

58. Ans. C.

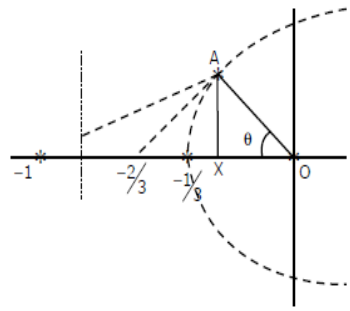
We know that the co-ordinate of point A of the given root locus i.e., magnitude condition

$$|G(s)H(s)| = 1$$

Here, the damping factor $\xi = 0.5$ and the length of OA = 5

$\xi = 0.5$

Then in the right angle triangle



$$\cos\theta = \frac{OX}{OA} \Rightarrow \cos 60 = \frac{OX}{0.5} \Rightarrow OX = \frac{1}{4}$$

$$\Rightarrow \sin\theta = \frac{AX}{OA} \Rightarrow \sin 60 = \frac{AX}{0.5} \Rightarrow AX = \frac{\sqrt{3}}{4}$$

So, the co-ordinate of point A is $-1/4 + j\sqrt{3}/4$

Substituting the above value of A in the transfer function and equating to 1 i.e. by magnitude condition,

$$\left|\frac{k}{s(s+1)^2}\right|_{s=-1/4+j\sqrt{3}/4} = 1$$

$$k = \sqrt{\frac{1}{16} + \frac{3}{16}} \cdot \left(\sqrt{\frac{9}{16} + \frac{3}{16}}\right)^2$$

$$\boxed{k = 0.375}$$

59. Ans. C.

$H_1 : x = +1; H_0 : x = -1$

$P(H_1) = 0.75; P(H_0) = 0.25$

Received signal γ=X+Z

Where $Z - N(0,-2); f_Z(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{-Z^2/2\sigma^2}$

$$\text{Received signal } \gamma = \begin{cases} 1+Z & if\ X = 1 \\ -1+Z & if\ X = -1 \end{cases}$$

$$f_\gamma(y/H_1) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{1}{2\sigma^2}(\gamma-1)^2}$$

$$f_\gamma(y/H_0) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{1}{2\sigma^2}(\gamma+1)^2}$$

At optimum threshold y_{opt} : for minimum probability of error

$$\left.\frac{f_\gamma(y/H_1)}{f_\gamma(y/H_0)}\right|_{y=opt} = \frac{P(H_0)}{P(H_1)}$$

$$\left.e^{\frac{1}{2\alpha^2}\left[(\gamma-1)^2-(\gamma-+)^2\right]}\right|_{y_{opt}} = \frac{P(H_0)}{P(H_1)}$$

$$e^{+2y_{opt}/\sigma^2} = \frac{P(H_0)}{P(H_1)}$$

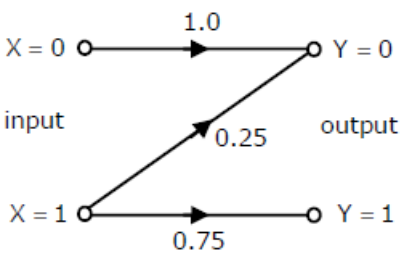
$$y_{opt} = \frac{\sigma^2}{2}1_n\left(\frac{P(H_0)}{P(H_1)}\right) = \frac{-1.1\sigma^2}{2} = -0.55\sigma^2$$

$y_{opt} = \text{Optimum threshold}$

$y_{opt} < 0 \therefore \text{Threshold is negative.}$

60. Ans. D.

Given channel $z \geq 0, then \int_s \nabla$



We have to determine, $P\{x=0/y=0\}$

$$P\{x=0/y=0\} = \frac{P\{y=0/x=0\}P\{x=0\}}{P\{y=0\}}$$

$$= \frac{1.\frac{1}{2}}{1.\frac{1}{2}+0.25\times\frac{1}{2}} = \frac{4}{5} = 0.8$$

61. Ans. C.

Bandwidth requirement for m-level PSK $= \frac{1}{T}(1+\alpha)$

[Where T is symbol duration. α is roll of factor]

$$\Rightarrow \frac{1}{T}(1+\alpha) = 100\times10^3$$

$\alpha = 1$ [100% excess bandwidth]

$$\Rightarrow \frac{1}{T}(2) = 100\times10^3$$

$$\Rightarrow T = \frac{2}{100\times10^3} = 20\mu\sec$$

Bit duration

$$= \frac{1}{200\times10^3} = 0.5\times10^{-5} = 5\times10^{-6}\sec$$

$$\text{Bit duration} = \frac{Symbol\ duration}{\log_2 m}$$

$$\Rightarrow \log_2 m = \frac{20\times10^{-6}\sec}{5\times10^{-6}} = 4 \Rightarrow M = 16$$

62. Ans. C.

$X \in [-a,a] and\ P(x=-a) = P(x=a) = ½$

$\gamma = X + Z \rightarrow$ Received signal

$$Z \sim N(\beta X, 1)$$

$$f_Z(z) = \frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}(Z-\beta X)^2}$$

$$\gamma = \begin{cases} -a+z & \text{if } x=-a \\ a+z & \text{if } x=+a \end{cases}$$

$$Q(a) = 1\times10^{-8}$$

$$Q(a) \approx e^{-\vartheta^2/2}$$

$H_1 : x = +a$

$H_0 : x = -a$

and Threshold $= 0$

$$f_\gamma(y/H_1) = \frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}(y-a(1+\beta))^2}$$

$$f_\gamma(y/H_0) = \frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}(y+a(1+\beta))^2}$$

$BER:$

$$P_e = P(H_1)P(e/H_1) + P(H_0)P(e/H_0)$$

$$= \frac{1}{2}\int_{-\infty}^{0}\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}(y-a(1+\beta))^2}dy + \frac{1}{2}\int_{-0}^{\infty}\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}(y+a(1+\beta))^2}$$

$$dy = Q(a(1+\beta))$$

$\beta = 0$

$$P_e = Q(a) = 1\times10^{-8} = e^{-a^2/2} \Rightarrow a = 6.07$$

$$\beta = -0.3$$

$$P_e = Q(6.07(1-0.3)) = Q(4.249)$$

$$P_e = e^{-(4.249)^2/2} = 1.2\times10^{-4}$$

$$P_e \simeq 10^{-4}.$$

63. Ans. D.

A $\qquad$ B

$(0kV/cm, 20kV/cm)$ $\qquad$ $(5\times10^{-4}kV/cm, 40kV/cm)$

$$E - 20 = \frac{40-20}{5\times10^{-4}}(x-0) \Rightarrow E = 4\times10^4 x + 20$$

$$V_{AB} = -\int_A^B E.d1 = -\int_A^{5\times10^{-4}/cm}(4\times10^4 x + 20)dx$$

$$= -\left(4\times10^4\frac{x^2}{2} + 20x\right)\Bigg|_0^{5\times10^{-4}} = -(2\times10^4\times25\times10^{-8} + 20\times5\times10^{-4})$$

$$= -(50\times10^{-4} + 100\times10^{-4}) = -150\times10^{-4}kV$$

$$\Rightarrow V_{AB} = -15V$$

64. Ans. C.

$$\int_s \nabla \times \vec{F}.d\vec{s} = \oint_C \vec{F}.d\vec{r}$$

(using stoke's theorem and C is closed curve i.e.,

$x^2 + y^2 = 1, z = 0$

$\Rightarrow x = \cos\theta, y = \sin\theta \; and \; \theta : 0 to 2\pi$

$= \oint_C zdx + xdy + ydz$

$= \oint_C xdy = \int_0^{2\pi} \cos\theta(\cos\theta d\theta)$

$= \frac{1}{2}\left(\theta + \frac{\sin 2\theta}{2}\right)_0^{2\pi} = \pi \simeq 3.14$

65. Ans. D.

$Given \; E = -\left(2y^3 - 3yz^2\right)a_x \left(6xy^2 - 3xz^2\right)a_y + 6xyz.a_z$ By verification option (D) satisfy

$E = -\nabla\nabla$

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