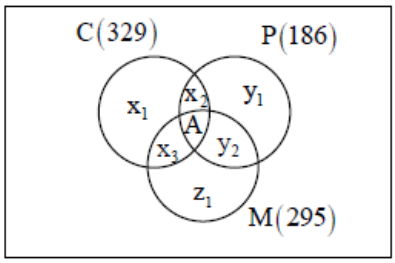
Solutions

General Aptitude

1. Ans. C.
The ninth and the tenth of this month are Monday and Tuesday respectively.

2. Ans. D.



Given

$A + x_2 = 83$ -------(1)

$A + y_2 = 63$ --------(2)

$A + x_3 = 217$ --------(3)

And

$x_1 + x_2 + A + x_3 = 329$ --------(4)

$x_2 + A + y_1 + y_2 = 186$ --------(5)

$x_3 + A + y_2 + z_1 = 295$ --------(6)

$x_1 + x_2 + x_3 + y_1 + y_2 + z_1 + A = 500$ -------(7)

$(1)+(2)+(3) \Rightarrow x_1 + y_2 + x_3 = 363 - 3A$ ---(8)

$(4)+(5)+(6) \Rightarrow 3A + 2(363 - 3A) +$

$(x_1 + y_1 + z_1) = 810$

$\Rightarrow 3A + 2(363 - 3A)Z + (x_1 + y_1 + z_1) = 810$ --

$\Rightarrow -3A + 726 + (500 - x_2 - x_3 - y_1 - A) = 810$

$\Rightarrow -3A + 726 + 500(363 - 3A) - A) = 810$

$\Rightarrow 863 - A = 810 \Rightarrow A = 53$

Alternate method

$n(C) = 329.n(P) = 186,$

$n(M) = 295, n(C \cap P) = 83;$

$n(C \cap M) = 217.(P \cap M) = 63$

$n(P \cup C \cup M) = n(C) + n(P) + n(M)$

$- n(C \cap P) - n(P \cap M)$

$+ n(P \cap C \cap M)$

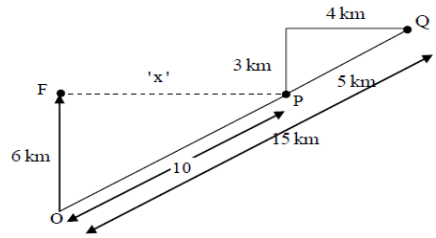
$\Rightarrow 500 = 329 + 186 +$

$295 - 83 - 217 + n(P \cap C \cap m)$

$\Rightarrow n(P \cap C \cap m) = 500 - 447 = 53$

3. Ans. A.
It is easier to read this year's textbook than the last year's.

4. Ans. A.



The required distance

$FP = x = \sqrt{100 - 36} = \sqrt{64}$

$x = 8, East$

5. Ans. B.
For rules to be followed, we need to check P's drink and S's age.

6. Ans. D.
Correct answer is D

7. Ans. C.
Total no. of 3 digit no's = $\underline{9}1010 = 900$

The no. of 3-digit numbers in which '1' is to the immediate right of 2 = 19

8. Ans. B.
Closer lines represents steepest path

Alternate method

The steepest path will be the path which is deepest from sea level. So, P to R is the steepest path.

9. Ans. C.
Given 1200 Men + 500 Women can build a bridge in 2 weeks. And
900 Men + 250 Women will take 3 weeks to build the same bridge
∴ To complete in a week; there are 2400 Men + 1000W required in the first equation and 2700 Men + 750 Women required in the second equation.

∴2400 M + 1000W = 2700M + 750W $\Rightarrow 1W = \frac{6M}{5}$

∴The no. of men required to build the bridge in one week

$= 2400M + 1000(\frac{6M}{5}) = 3600Men$

Alternate method
Let a man can build the bridge in x weeks and a woman can build the bridge in y weeks.

So, $\frac{120}{x} + \frac{500}{y} = 1/2 \qquad \frac{900}{x} + \frac{250}{y} = 1/3$

Byequations i and ii ;weget
x 3600;y 3000
$\Rightarrow$ A man builds the bridge in 3600 weeks
$\Rightarrow$Required men 3600 to build in a week.

10. Ans. A.
Correct answer would be A

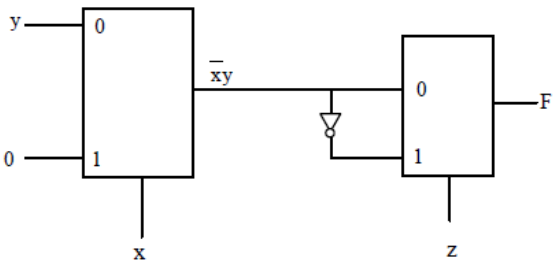
Electronics & Communications

1. Ans. B.

$Exp:\ F = \bar{x}y\bar{z} + z\left(\overline{\bar{x}y}\right)$

$F = \bar{x}y\bar{z} + (x + \bar{y})z$

$F = \bar{x}y\bar{z} + xz + \bar{y}z$



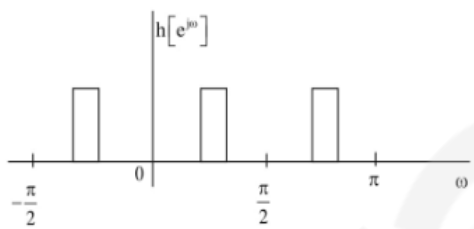
2. Ans. C.

$h[n] = 5\delta[n] - 7\delta[n-1] + 7\delta[n-3] - 5\delta[n-4]$ Obtain

$h[e^{j\omega}] = 5 - 7e^{-j\omega} + 7e^{-3j\omega} - 5^{-4j\omega}$

$At\omega = 0 and \frac{\pi}{2};\quad h[e^{j\omega}] = 0$

For $0 < \omega < \frac{\pi}{2}$ at a frequency ω_o maximum value of $h[e^{j\omega}]$ is obtained



3. Ans. A.

If I & V are in phase then the circuit is in resonance.

At resonance

$$\left|\frac{V_C}{V_R}\right| = Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{5}\sqrt{\frac{5}{5}} = 0.2$$

4. Ans. B.

In a DRAM information is stored in a capacitor.

5. Ans. A.

Here, $V_{DS} < V_{GS} - V_{PH}$, so n-channel MOSFET is working in linear region.

$$I_D = \mu_n C_{ox}\frac{W}{L}\left[(V_{GS} - V_{TH}).V_{DS} - \frac{V_{DS}^2}{2}\right]$$

So, transconductance g_{in} is in linear region and is given by

$$g_m = \left.\frac{\partial I_D}{\partial V_{GS}}\right|_{V_{DS}=const}$$

$$= (\mu_n C_{ox})\frac{W}{L}.V_{DS} = 100\times10^{-6}\times50\times0.1$$

$$= 5\times10^{-4} = 0.5mA/V$$

6. Ans. C.

$\Rightarrow$ two spheres are joined with a conducting wire, the voltage on two spheres is same.

$\Rightarrow V_a = V_b \Rightarrow$ The capacitance of sphere $\propto$ radius

$$\frac{C_a}{C_b} = \frac{a}{b}$$

We know Q = CV

$$\frac{Q_a}{Q_b} = \frac{C_a}{C_b} = \frac{a}{b}$$

$$\frac{E_a}{E_b} = \frac{\frac{1}{4\pi\varepsilon_0}\frac{a}{a^2}}{\frac{1}{4\pi\varepsilon_0}\frac{b}{b^2}} = \frac{a}{b} > 1$$

$$E_a > E_b$$

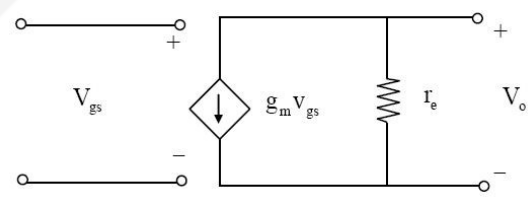
7. Ans. B.

logic implemented by the circuit is XOR.

8. Ans. C.

If channel length modulation is considered and significant it means $\lambda \neq 0$

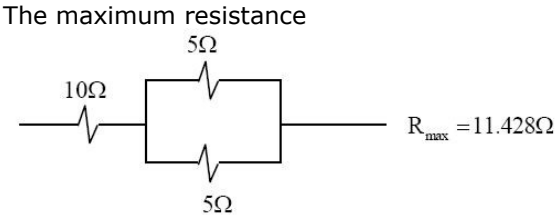
V_A (early voltage) $= \frac{1}{\lambda}$ and $r_e = \frac{V_A}{I_D}$



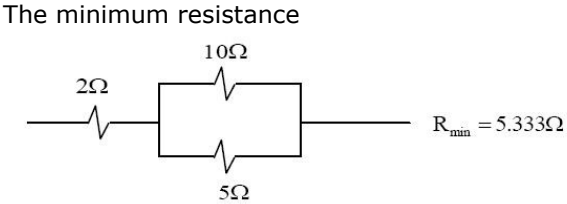
If $V_{AS} > V_{TH}$ and $V_{DS} > (V_{DS} - V_{TH})$ then it indicates that MOSFET is working in saturation region and it can be used as an amplifier. So it can act as current source with finite output impedance.

9. Ans. A.

The maximum resistance



The minimum resistance



$$\frac{R_{max}}{R_{min}} = 2.14$$

10. Ans. C.
If the reverse bias voltage across the base collector junction is increased, then their effective base width will decrease and collector current will increase, therefore their common-emitter current gain increases.

11. Ans. A.
$\because$ ----(1)
$\because$ $x_2(t)+45u(t)$ .....(2)
Apply L.T to above equation
$x_1(t)=0$ [Because initial conditions are zero]

$$Sx_2(s)-x_2(0)=-9X_2(s)+\frac{45}{S}$$

$$X_2(s)[s+9]=\frac{45}{3}$$

$$X_2(s)=\frac{45}{s(s+9)}$$

$$X_2(s)=\frac{S}{5}-\frac{5}{s+9}$$

$$X_2(t)=5u(t)-5e^{-9t}u(t)$$

$$\underset{t\to\infty}{It}\,|\sqrt{x_1^2(t)+x_2^2}(t)|=\underset{t\to\infty}{It}\,|x_2(t)|=5$$

12. Ans. B.

$$\begin{bmatrix}1&-1&0&0&0\\0&0&1&-1&0\\0&1&-1&0&0\\-1&0&0&0&1\\0&0&0&1&-1\end{bmatrix}$$

$$R_4\to R_4+R_1\sim\begin{bmatrix}1&-1&0&0&0\\0&0&1&-1&0\\&&-1&0&0\\0&-1&0&0&1\\0&0&0&1&-1\end{bmatrix}$$

$$R_4\to R_4+R_3\sim\begin{bmatrix}1&-1&0&0&0\\0&0&1&-1&0\\&&-1&0&0\\0&-1&0&0&1\\0&0&0&1&-1\end{bmatrix}$$

$$R_2\leftrightarrow R_3\sim\begin{bmatrix}1&-1&0&0&0\\0&0&1&-1&0\\&&-1&0&0\\0&-1&0&0&1\\0&0&0&1&-1\end{bmatrix}$$

$$R_4\to R_4+R_3\sim\begin{bmatrix}1&-1&0&0&0\\0&1&-1&0&0\\&&1&-1&0\\0&0&0&-1&1\\0&0&0&1&-1\end{bmatrix}$$

$$R_5\to R_5+R_4\sim\begin{bmatrix}1&-1&0&0&0\\0&1&-1&0&0\\&&1&-1&0\\0&0&0&-1&1\\0&0&0&0&0\end{bmatrix}$$

Which is in Echelon form $\Rightarrow$ Rank = No. of non-zero rows= 4

13. Ans. B.
Percentage of power reflected is $=|\Gamma|^2\times100$

$$|\Gamma|=\frac{VSWR-1}{VSWR+1}=\frac{5.8-1}{5.8+1}=\frac{4.8}{6.8}=0.7058$$

% Power reflected $=|\Gamma|^2\times100=49.82\%$

14. Ans. B.
Given Input-output relationship describes integration over a fundamental period T. The integration over one period is linear and time-invariant.

15. Ans. D.
The phase-lead controller adds zero and a pole, with the zero to the right of the pole, to the forward-path transfer function. The general effect is to add more damping to the closed-loop system. The rise time and settling time are reduced in general.
$\to$ Reduces the steady state error
$\to$ Reduces the speed of response (i.e. ζ decreases)
$\to$ Increases the gain of original network without affecting stability
$\to$ Permits the increases of gain if phase margin is acceptable
$\to$ System becomes lesser stable
$\to$ Reduces the effect of noise
$\to$ Decrease the bandwidth

16. Ans. B.
Z=4 is a pole of order '1' (or) simple pole
Residue of f(z) at z=4= Res f(z)=

$$\lim_{z\to4}[(z-4).\frac{1}{(z-4)(z+1)^3}]=\frac{1}{5^3}=\frac{1}{125}\,and$$

Z=-1 is a pole of order '3'.

$$\underset{z=-1}{\text{Res}}\,f(z)=\frac{1}{(3-1)!}$$

$$\lim_{z\to-1}\left\{\frac{d^2}{dz^2}\left[(z+1)^3.\frac{1}{(z-4)(z+1)^3}\right]\right\}$$

$$=\frac{1}{2}\lim_{z\to-1}\left[\frac{d^2}{dz^2}\left(\frac{1}{z-4}\right)\right]=-\frac{1}{125}$$

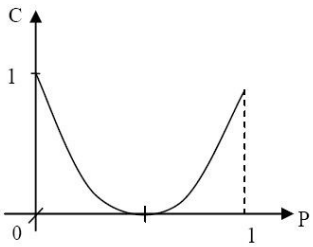
17. Ans. D.
For sinusoidal signal
$(SNR)_Q$ in dB = 6.0n+1.75

Given required $(SNR)_Q$ =40dB

$\Rightarrow$ 6.0n+1.75≥40dB
$\Rightarrow$6.0n≥40-11.75
$\Rightarrow$n≥ $\frac{40-11.75}{6.02}$
$\Rightarrow$n=7(Since 'n' must be an integer)

18. Ans. A.
$D^2+2D-5=0$
$\Rightarrow D=-1\pm\sqrt{6}$ (roots are real and distinct)
$\Rightarrow y=k_1.e^{(-1+\sqrt{6})x}+k_2e^{(-1-\sqrt{6})x}$
Where k1, k2 are arbitrary constants.

19. Ans. C.



For memory less binary Symmetric channel
Channel capacity
C=1-H(p)

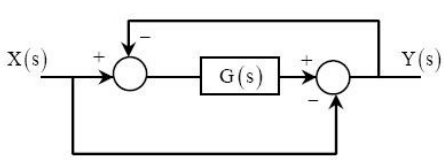
H(p)= $p\log_2\frac{1}{p}+(1-p)\log_2\left(\frac{1}{1+p}\right)$

p$\rightarrow$ Cross over probability
$\Rightarrow C=1+p\log_2 p+(1-p)\log_2(1-p)$
At p=0; C=1
At p=1; C=1
At p= $\frac{1}{2}$ C=0

20. Ans. A.
$V_0=\frac{V_m}{\pi}=\frac{10}{\pi}=3.1847V$

21. Ans. A.
Given x(t) =U+Vt
X(2)=U+2V
E [x (2)] =E[U+2V] = E[U]+2E[V]=0+2×1=2

22. Ans. A.

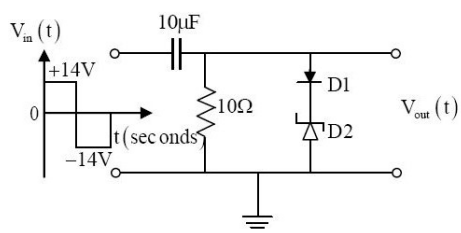


$\frac{Y(s)}{X(s)}=\frac{2+1}{1+2}=1$

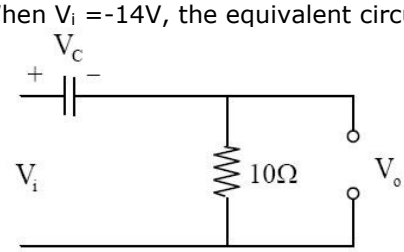
23. Ans. A.
x+y+2=1
2x-y+2z=0
We have angle between two planes
$a_1x+\ b_1y+c_1y+d_1=0$
$a_xx+\ b_2y+c_2y+d_2=0$
Is
$\cos\theta=\frac{|a_1a_2+b_1b_2+c_1c_2|}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}$
$\Rightarrow\cos\theta=\frac{|2-1+2|}{\sqrt{1+1+1}\sqrt{4+1+4}}=\frac{3}{\sqrt{3\sqrt{9}}}=\frac{1}{\sqrt{3}}$
$\Rightarrow\theta\cong 54.73$

24. Ans. A.
Given V_{BE}=0.8V; α=1
As α=1; β is very large
So, $I_E\simeq I_C$
$V_B=\frac{18\times16}{60}=4.8V$
$I_C=\frac{4.8-08}{2\times10^3}=2mA$
$V_{CE}=18-6\times10^3\times2\times10^{-3}$
=18-12=6V

25. Ans. A.
When V_i=14V, the equivalent circuit is



$V_i=V_c+V_0$
$V_C=V_i-V_0$
$V_C=14-(6.8+0.7)=14-7.5=6.5V$
Maximum V_0=7.5V
When V_i =-14V, the equivalent circuit is



$V_0=V_i-V_c=-14V-6.5=-20.5V$
Minimum V_0 =-20.5V

26. Ans. B.

curl $\vec{F} = 0$

$$\Rightarrow \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ 3y - k_1 z & k_2 x - 2z & -k_3 y - z \end{vmatrix} = 0$$

$$\Rightarrow \bar{i}(-k_3+2) - \bar{j}(0+k_1) + \bar{k}(k_2-3) = 0$$

$$\Rightarrow k_1 = 0, k_2 = 3, k_3 = 2$$

27. Ans. A.

Total power when μ =50% is

$$P_T = P_c\left[1+\frac{\mu^2}{2}\right]$$

$$P_T = 5\left[1+\frac{(0.5)^2}{2}\right] = 5[1+0.125] = 5[1.125]$$

$$P_T = 5.625$$

When $\mu = 40\%$

Total power remains 5.625 $\Rightarrow 5.625 = P_c\left[1+\frac{(0.4)^2}{2}\right]$

$$\Rightarrow 5.625 = P_C[1+0.08]$$

$$P_C = 5.22$$

28. Ans. A.

Consider an LTI system with magnitude response

$$|H(f)| = \begin{cases} 1-\frac{|f|}{20} & |f| \le 20 \\ 0 & |f| > 20 \end{cases}$$

And phase response $Arg\{H(f)\} = -2f$.

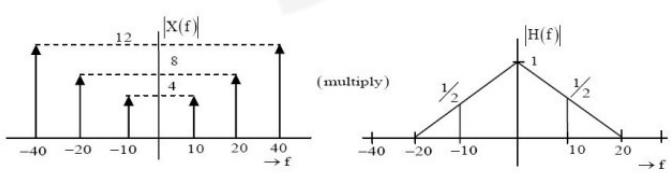
If the input to the system is

$$x(t) = 8\cos\left(20\pi t + \frac{\pi}{4}\right) + 16\sin\left(40\pi t + \frac{\pi}{8}\right) + 24\cos\left(80\pi t + \frac{\pi}{16}\right)$$

Then the average power of the output signal y (t) is _____.

Obtain X(f) for the given x(t)

$$|X(f)| = 4[\delta(f-10)+\delta(f+10)]$$
$$+8[\delta(f-20)-\delta(f+20)]$$
$$12[\delta(f-40)+\delta(f+40)]$$



$$\therefore ||Y(f)| = \frac{4}{2}[\delta(f-10)+\delta(f+10)]$$

$$= \left[\frac{1}{2}(\delta(f-10)+\delta(f+10))\right]$$

$$y(t) = 4\cos 2\pi t$$

Thus, max power is $= \frac{16}{2} = 8$

29. Ans. A.

$$V_{FB} = \phi_{MS} = \frac{Q_F}{C_{ox}}$$

$$q\phi_{MS} = q\phi_M - q\phi_s$$

$$= q\phi_M - q_{xo}(E_c - E_f) = 4.1 - 4.0 - 0.9 = -0.8eV$$

$$\phi_{MS} = \frac{-0.8\times q\times 1V}{q} = -0.8V$$

$$C_{ox} = \frac{E_{ox}}{t_{ox}} = 34.5\times 10^{-9} F/cm^2$$

$$-1 = -0.8 - \frac{Q_F}{34.5\times 10^{-9}} F/cm^2$$

$$-1 = 0.8 - \frac{Q_F}{34.5\times 10^{-9}}$$

$$-0.2 = -\frac{Q_F}{34.5\times 10^{-9}}$$

$$Q_F = 6.9nc/cm^2$$

30. Ans. A.

Work done due to field and external agent must be zero

qV= $\frac{1}{2}MV^2 \Rightarrow -16\times 10^{-19} \times \frac{1.6\times 10^{-19}}{4\pi\varepsilon_0\gamma} = \frac{1}{2}m\times(10^5)^2$

$$\Rightarrow \gamma = 5.058\times 10^{-8} m$$

31. Ans. C.

To find $\int_0^1\left(\int_0^1 \frac{x-y}{(x+y)^3}dy\right)dx$

Consider $\int_0^1 \frac{x-y}{(x+y)^3}dy = x\int_0^1 \frac{1}{(x+y)^3}dy - \int_0^1 \frac{y}{(x+y)^3}dy$

$$= \frac{x.(x+y)^{-3+1}}{-3+1}\Big|_0^1 - \int_0^1 \frac{(x+y)-x}{(x+y)^3}dy$$

$$= \frac{-x}{2}\left[\frac{1}{(x+1)^2} - \frac{1}{x^2}\right] - \int_0^1 \frac{1}{(x+y)^2}dy$$

$$+x\int_0^1 \frac{1}{(x+y)^3}dy$$

$$= -\frac{-x}{2}\left[\frac{1}{(x+1)^2} - \frac{1}{x^2}\right] - \frac{(x+y)^{-2+1}}{-2+1}\Big|_0^1$$

$$-\frac{x}{2}\left[\frac{1}{(x+1)^2} - \frac{1}{x^2}\right]$$

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

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

$$\therefore \int_0^1\left(\int_0^1 \frac{x-y}{(x+y)^3}dy\right)dx = \int_0^1\left(\frac{1}{(x+1)^2}\right)dx = \frac{-1}{x+1}\Big|_0^1$$

$$= \frac{1}{2}$$

Similarly, $\int_0^1\left(\int_0^1 \frac{x-y}{(x+y)^3}dx\right)dy = -\frac{1}{2}$

32. Ans. A.

Let 'X' is a random variable which takes number of attempts

Given probability of any attempts to be successful,

$$p = 40\% = \frac{40}{100} = \frac{2}{5}, q = 1 - \frac{2}{5} = \frac{3}{5}$$

X	1	2	3	4	
P(X)	$\frac{2}{5}$	$\left(\frac{3}{5}\right)\times\left(\frac{2}{5}\right)$	$\left(\frac{3}{5}\times\frac{3}{5}\right)\times\left(\frac{2}{5}\right)$	$\left(\frac{3}{5}\times\frac{3}{5}\times\frac{3}{5}\right)\times\left(\frac{2}{5}\right)$	

$$\sum(X) = \sum X_p(X) = \left(1\times\frac{2}{5}\right) + 2\left(\frac{3}{5}\times\frac{2}{5}\right) +$$

$$3\left(\frac{3}{5}\right)^2\left(\frac{2}{5}\right) + 4\left(\frac{3}{5}\right)^3\left(\frac{2}{5}\right) +$$

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

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

$$= \frac{2}{5}\times\frac{25}{4} = 2.5$$

∴ Average number of attempts that passengers need to make to get seat reserved is '2.5'

33. Ans. B.

The output of the ripple carry adder will be stable at t is 70ns

34. Ans. A.

$$\theta_c = \sin^{-1}\left(\sqrt{\frac{\varepsilon_{\gamma^2}}{\varepsilon_{\gamma 1}}}\right) = \sin^{-1}\left(\frac{1}{\sqrt{1.75}}\right) = 49.106$$

$$\Rightarrow \tan\ \theta_c = \frac{5}{d} \Rightarrow d = \frac{5}{\tan\theta_c} = 4.33m$$

35. Ans. C.

N=0, Because 0 < L < 1

There are no encircles around (Y, 0)

And

$$G(S) = \frac{10K(S+2)}{S^3 + 3S^2 + 10}$$

$$= \frac{10K(S+2)}{(S+3.72)[S-(0.31\pm 1.598i)]}$$

So, P=2

N=P-Z

Z=2

OR $C.E = S^3 + 3S^2 + 10KS + 20K + 10$

If stable 30 K > 20K+10

K>1

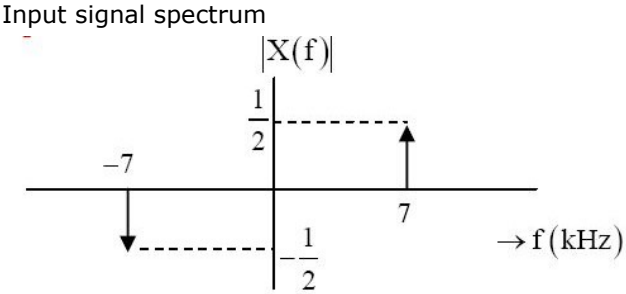
Here, in the question asking 0 < K < 1

So, System is unstable

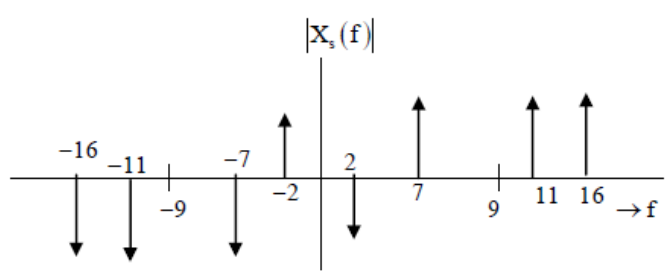
36. Ans. B.

Given input signal $x(t) = \sin(1400\pi t)$

Input signal spectrum



Sampled signal spectrum is the spectrum of X(f) which repeats with integer multiples of 9 kHz.



The sampled signal spectrum is passed through a LPF of cutoff frequency 12 KHz. Thus, the filtered-out sinusoids are of 2 KHz, 7 KHz and 11 KHz frequency.

37. Ans. A.

$$G(s)=\frac{2(s+1)}{s^3+ks^2+2s+1}$$

$$\omega=2rad/\sec$$

K=??

$$1+G(s)H(s)=0$$

$$1+\frac{2(k+1)}{s^3+ks^2+2s+1}\Rightarrow s^3+ks^2+4s+3=0$$

s^3	1	4
s^2	k	3
s^1	$\frac{4k-3}{k}$	0
s^0	3	

For marginal stable

$$\frac{4k-3}{k}=0\Rightarrow k=\frac{3}{4}=0.75$$

Cross check

Take auxiliary equation

$$ks^2+3=0$$

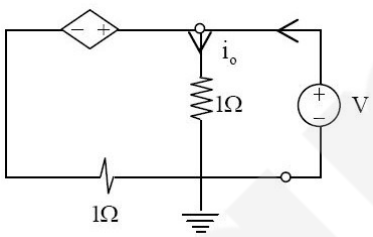
$$\frac{3}{4}s^2+3=0$$

$$s\pm j2$$

$$\omega=2rad/\sec$$

$$k=\frac{3}{4}$$

38. Ans. A.



To find

$$R_{th}=\frac{V}{I}$$

Here

$$i_0=\frac{V}{1\Omega}=V$$

Nodal at V

$$\frac{V-3i_0}{I}+\frac{V}{I}-I=0$$

$$V-3V+V-I=0$$

$$R_{th}=-1\Omega$$

39. Ans. A.

Given $x(t)=\frac{\sin u(t)}{\pi t}$

By using frequency integration property,

$$\frac{x(t)}{t}\overset{L}{\leftrightarrow}\int_{-\infty}^{\infty}X_1(u)du$$

Consider

$$x_1(t)=\sin tu(t)\overset{L}{\leftrightarrow}\frac{1}{s^2+1}=X_1(s)$$

$$\therefore\int_{-\infty}^{s}\left(\frac{1}{u^2+1}\right)du=\frac{\pi}{2}\tan^{-1}(s)$$

$$\therefore L[x(t)]=\frac{1}{\pi}\left[\frac{\pi}{2}-\tan^{-1}(s)\right]=X(s)$$

$$\therefore Y(s)=X(s)H(j)=\frac{1}{2s}-\frac{1}{\pi s}\tan^{-1}s$$

By using final value theorem,

$$\lim_{t\to\infty}=\lim_{s\to 0}sY(s)=\lim_{s\to 0}\left[\frac{1}{2}-\frac{1}{2}\tan^{-1}(s)\right]=\frac{1}{2}$$

40. Ans. D.

$$I=\bigcirc$$

Consider

$$f(z)=e^z\left(\frac{z^2-1}{z^2+1}\right)=e^z\left(\frac{z^2-1}{(z+i)(z-i)}\right)$$

$\Rightarrow z=\pm i$ are simple poles of f(z) which lie inside |z|=3

Residue of f(z) at

$$z=i=\lim_{z\to i}(z-i)\left(e\ \frac{(z^2-1)}{(z+i)(z-i)}\right)=ie^i$$

& Residue of f(z) at

$$z=i=\lim_{z\to i}(z+i)\left(e^z\frac{(z^2-1)}{(z+i)(z-i)}\right)=-ie^{-i}$$

$\therefore$ By residue theorem,

$$I=\bigcirc\qquad=2\pi i(ie^i-ie^{-i})$$

$$=2\pi(e^i-e^{-i})$$

$$=-4\pi i\left(\frac{e^i-e^{-i}}{2i}\right)=4\pi i\sin(1)$$

41. Ans. C.

It is a useless channel as MAP criteria cannot decide anything on receiving "0" we cannot decide what is transmitted.

42. Ans. A.

If left side is p-region and right side is n-region then electric field triangle will be down warded and if the left side is n-region and right side is p-region, then electric field triangle will be upward.

43. Ans. D.

$x_1(t) = x_2(t)$

$sX_1(s) = X_2(s) \rightarrow (1)$

$x_2(t) + 2x_1(t) + 3x_2(t) = r(t)$

$sX_2(s) + 2X_1(s) + 3X_2(s) = R(s)$

$\left[s^2 + 2 + 3s\right] X_1(s) = R(s)$

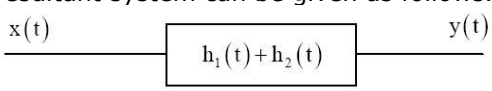
$$C(s) = X_1(s) = \frac{R(s)}{s^2 + 3s + 2}$$

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

system is over damped

44. Ans. A.

Since $h_1(t) and h_2(t)$ and are connected in parallel the resultant system can be given as follows.



$\therefore y(t) = x(t) * [h_1(t) + h_2(t)]$

From the given $h_1(t) \& h_2(t)$

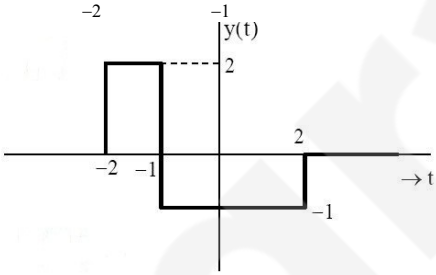
$h_1(t) + h_2(t) = [2\delta(t+2) - 3\delta(t+1) + \delta(t-2)]$

$\because \quad (t)$

$y(t) = 2u(t+2) - 3u(t+1) + u(t-2)$

$\therefore$ Energy of

$$y(t) = \int_{-2}^{-1} (2)^2 dt + \int_{-1}^{2} (-1)^2 \ dt = 4[1] + 1[3] = 7$$



45. Ans. C.

If $V_D \geq V_G - V_{TH},$ then transistor is working in saturation region.

So, For transistor M_2

$V_{D_2} > V_{G_2} - V_{TH}$

$3V > (2.5 - 1)V$

Assume that M1 is working in saturation, so that

$I_{D1} = I_{D2}$

$V_{GS1} - V_{TH} = V_{GS2} - V_{TH}$

$2V = V_{G2} - V_{S2}$

$= 2.5V - V_{S2}$

$\therefore V_{s2} = V_{D1} = 0.5V.$

Now, for M1, transistor to work in saturation $V_{D1} \geq V_{G1} - V_{TH}$ but it is not satisfied by M1 transistor and $V_{D1} \geq V_{G1}$ so, transistor M1 is ON but working in linear region.

46. Ans. C.

$\bar{P}\bar{Q}R + \bar{P}QR + P\bar{Q}R$

47. Ans. B.

$x(t) = 5\sin(4\pi \times 10^3 t - 10\pi \cos(2\pi \times 10^2 t))$

Transform theorem frequency

$$f_1(t) = f_c + \frac{1}{2\pi} k_p . \frac{d}{dt} m(t)$$

$$\frac{d}{dt} m(t) = 5\cos(4\pi \times 10^3 t - 10\pi \cos(2\pi \times 10^3 t))$$

$(4\pi \times 10^3 + 10\sin(2\pi \times 10^3 t).2\pi \times 10^3)$

$$\frac{d}{dt} m(t)|_{t=0.5} = 5\cos(2\pi + 10\pi) \times (4\pi \times 10^3 + 0)$$

$= 20\pi \times 10^3$

$$f_1\ (t) = 20 + \frac{1}{2\pi} \times 5 \times 20\pi = 70kHz$$

48. Ans. B.

$$f(x) = \frac{1}{3} x(x^2 - 3) = \frac{x^3}{3} - x$$

$$f'(x) = \frac{3x^2}{3} - 1 = x^2 - 1$$

$\Rightarrow x^2 - 1 = 0$

$\Rightarrow x^2 - 1 = 0$

$\Rightarrow x = \pm 1$

$f''(x) = 2x$

$f''(1) = 2 > 0 \Rightarrow$

at x =1, f(x) has local minimum.

$f''(-1) = -2 < 0 \Rightarrow at x = -1, f(x)$ has local maximum

For x = 1, local minimum value

$$= f(1) = \frac{1}{3} - 1 = \frac{-2}{3}$$

Finding f(- 100) = -333433.33

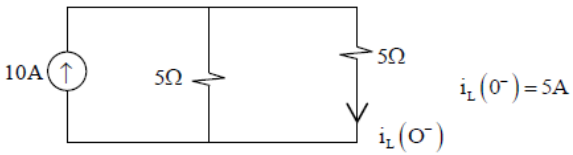
f (100) = 333233.33

($\because$ x =100, -100 are end points of interval)

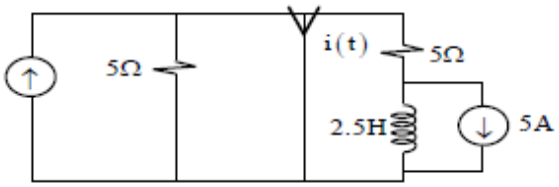
$\therefore$ Minimum occurs at x= - 100

49. Ans. A.

At t = 0



AT t ≥ 0



$$\tau = \frac{L}{R} = \frac{2.5}{5} = \frac{1}{2} \Rightarrow i_L(\infty) = 0$$

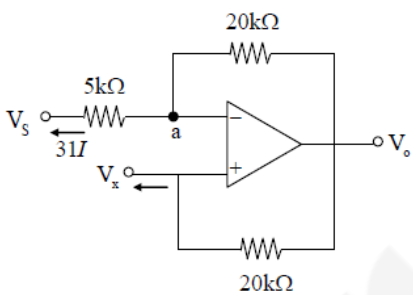
$$i_L = 5e^{-2t}$$

$$i(t) = 10 - 5e^{-2t}$$

$$At..t = 0.5s$$

$$i(0.5) = 10 - \frac{5}{e} = 8.16A$$

50. Ans. A.



KCL at node 'a'

$$\frac{V_0 - V_i}{20} = \frac{V_x - 0.7}{5}$$

$$V_c - V_i = 4V_x - 2.8$$

$$V_0 = 5V_x - 2.8$$

Now,

$$I_s e^{V_X/V_T} = 31 I_s e^{V_S/V_T}$$

$$\frac{V_x}{V_T} = \ln 31 + \frac{V_s}{V_T}$$

$$\frac{V_x - V_s}{V_T} = \ln 31$$

$$\Rightarrow V_x = 0.789V$$

From equation (i)

$$V_0 = 5 \times 0.789 - 2.8 = 1.145V$$

51. Ans. A.

From the state diagram, let us obtain the transition of states and out when IN channel.

Initial state is

So, the input sea is 10101101001101

When

IN=1 Then $S_0 \to S_1, with$ out =0

IN=0 Then $S_1 \to S_z, with$ out =0

IN=1 Then $S_1 \to S_n, with$ out =1

IN=0 Then $S_3 \to S_2, with$ out =0

IN=1 Then $S_2 \to S_3, with$ out =1

IN=1 Then $S_3 \to S_1, with$ out =0

IN=0 Then $S_1 \to S_2, with$ out =0

IN=1 Then $S_2 \to S_3, with$ out =1

IN=0 Then $S_3 \to S_2, with$ out =0

IN=0 Then $S_2 \to S_u, with$ out =0

IN=1 Then $S_0 \to S_1, with$ out =0

IN=1 Then $S_1 \to S_1, with$ out =0

IN=0 Then $S_1 \to S_2, with$ out =0

IN=1 Then $S_2 \to S_3, with$ out =1

→ The ticketed mark now corresponding to output = 1.

So output will be 1 '4' times.

52. Ans. B.

Cut off frequency of TE_{10} is

$$f_c = \frac{c}{2}\frac{1}{a} = \frac{3\times10^8}{2} \times \frac{1}{2.29\times10^{-2}} = 65.5\times10^8 Hz$$

Since $b < \frac{a}{2} \Rightarrow next$ higher mode is TE_{20}

$$f|_{TE_{20}} = \frac{c}{2} \times \frac{2}{a} = 13.1GHz$$

$$f \le 0.95 \times 13.1 = 12.45GHz$$

53. Ans. A.

$$J_s = \frac{J_L}{\left[e^{\left(\frac{V_{OC}}{V_T}\right)} - 1\right]} = \frac{2.5\times10^{-3}}{\left[e^{\frac{(0.451)}{0.025}} - 1\right]} = 3.6\times10^{-11} A/cm^2$$

If incident light is increased by 20 times ⇒ J_L is also increased by 20 times

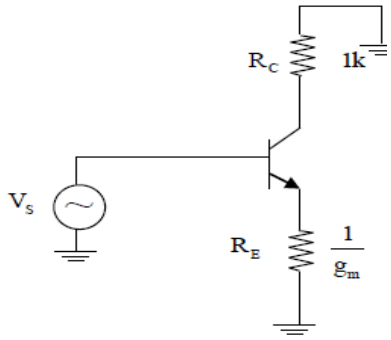
$J^1_L = 20 \times J_L = 50$ mA/cm²

$$V_{oc}^1 = \eta V_T \ell n\left(\frac{J_L^1}{J_o} + 1\right)$$

$$= 2 \times 25mV \ell n\left(\frac{50\times10^{-3}}{3.0245\times10^{-7}} + 1\right)$$

$$= 0.6 \text{ V}$$

54. Ans. A.
a.c equivalent circuit for the given figure



$$g_m = \frac{I_C}{V_T} = \frac{2.6\times10^{-3}}{26\times10^{-3}} = 100m\Omega$$

$$R_c = 1k;\quad R_E = \frac{1}{g_m};$$

$$A_V = \frac{-g_m R_E}{1+g_m R_E} = -\frac{100\times1}{1+1} = -50$$

$$|A_V| = 50$$

55. Ans. B.
Drain current in saturation is

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}[V_{GS}-V_{TH}]^2$$

For transistor T_1

$I_D = I_{D1}$ and

$$g_m = g_{m1} = \frac{\partial I_{D1}}{\partial V_{GS}} = \mu_n C_{ox}\frac{\omega}{L}(V_{GS}-V_{TH})$$

For transistor T2

$$W_2 = 2W_1 = 2W$$

$$(V_{GS}-V_{Th})_2 = 2(V_{GS}-V_{Th})_1 = 2(V_{GS}-V_{Th})$$

$$I_{D_2} = \frac{1}{2}\mu_n C_{ox}\frac{2W}{L}\left[2(V_{GS}-V_{TH})\right]^2 = 8I_{D_1}$$

$$g_{m_2} = \frac{\partial I_{D_2}}{\partial V_{GS_2}} = \mu_n C_{ox}\frac{2W}{L}\times2(V_{GS}-V_{TH}) = 4gm_1$$

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