BSNL Junior Telecom Officers-JTO 2009 SOLUTIONS

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Technical Section - I

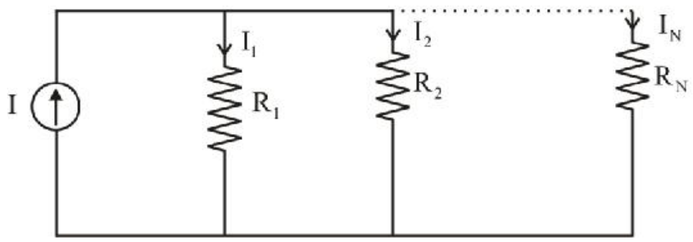
4. Pinch off voltage is define as the minimum drain to source voltage where I_D enters into saturation.
7. GaAs is the direct bandgap material in which most of the energy will be released in the form of light during recombination.
9. Schottky diode contains a metal-semiconductor junction.
10. In n type semiconductor, concentration of holes is equal to $P_n = \frac{n_i^2}{n_n}$
12. Given: $V_1 = AV_2 - BI_2$, $I_1 = CV_2 - DI_2$

Now the admittance looking into the port-1 is, $Y = \frac{I_1}{V_1} = \frac{CV_2 - DI_2}{AV_2 - BI_2}$

Now $V_2 = -I_2R_L$

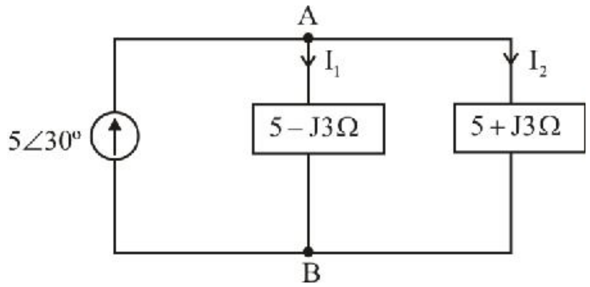
$$\Rightarrow \quad Y = \frac{-CI_2R_L - DI_2}{-AI_2R_L - BI_2} = \frac{CR_L + D}{AR_L + B}$$

13. LED is device which converts electrical energy into optical energy, this process is called elector-luminescence.
14.



$$I_k = \left(\frac{\frac{1}{R_K}}{\frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots \frac{1}{R_N}} \right) I$$

15.



$$I_1 = \frac{5\angle 30^\circ \times (5 + J3)}{5 - J3 + 5 + J3}$$

$$I_1 = \frac{14\angle 30^o \times (5 + J3)}{2}$$

$$V_{AB} = (5 - J3) I_1 = \frac{1\angle 30^o}{2}(25 + 9) = 17\angle 30^o$$

16. Given: $l = \frac{a}{2}$, we know that, for $\frac{a}{2}$ lossless transmission line $Z_{in} = Z_L$

18. We know that, for a rectangular waveguide cut off frequency is given by;

$$f_c = \left(\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}\right)\frac{C}{2}$$

For m = 1, n = 0 or n = 1, m = 0 i..e, TE_{10} and TE_{01} mode have the least f_c.
If a > b, then TE_{10} is dominant mode, having least f_c.

19. Radiation resistance of a quarter wave monopole is $R_r = 36.5\Omega$

21. We know, shunt resistance $R_{sh} = \frac{R_m}{m-1}$

Here, $R_m = 10\Omega$

$$m = \frac{I}{I_m} = \frac{1}{0.1} = 10$$

$$\Rightarrow \quad R_{sh} = \frac{10}{10-9} = 1.111\Omega$$

22. We know, Diode current $I_D = I_0 e^{V/¦V_T}$

$$\Rightarrow \quad 200 = I_0 e^{\left(1/(2\times 25.7\times 10^{-3}\right)}$$

$$\Rightarrow \quad I_0 = 7.108 \times 10^{-7} \text{ Amp}$$

30. Given: $D_2 = 2D_1$ and $l_2 = 4l_1$
We know that,
Resistance of wire is given by,

$$R = \frac{°l}{A} \qquad \{° \rightarrow \text{resistivity}\}$$

$$R = \frac{°l}{®D^2/4}$$

$$\Rightarrow \quad R_1 = \frac{°l_1}{®D_1^2/4}$$

$$\Rightarrow \quad R_2 = \frac{°l_2}{®D_2^2/4} = \frac{°4l_1}{®4D_1^2/4}$$

$$\Rightarrow \quad R_2 = \frac{4l_1°}{®D_1^2} = R_1$$

31. Given: $L = 4\pi \times 10^{-7}$ H , A = 1 mm^2 , D = 1m

Now voltage , $V = L\frac{dI}{dt}$

34. Given: $R_H = 3.6 \times 10^{-4}\ m^3/c$ $\rho = 9 \times 10^{-3}\ \Omega m$

We know that,

Mobility $\mu = \sigma R_H$

$$= \frac{1}{9\times10^{-3}}\times3.6\times10^{-4} = 0.04\,m^2\,V^{-1}\,S^{-1}$$

and carrier density = $\frac{1}{qR_H}$

$$= \frac{1}{1.6\times10^{-19}\times3.6\times10^{-4}} = 1.73\times10^{22}/m^3$$

35. The conductivity of a semiconductor is

$\sigma = nq\mu_n + pq\mu_p$ …(1)

By mass action law,

$$P = \frac{n_i^2}{n} \quad ...(2)$$

From (1) and (2),

$$\pm = nq«_n + \frac{n_i^2}{n}q«_p$$

$$\text{Now } \frac{d\pm}{dn} = q«_n - \frac{1}{n^2}n_1^2q«_p$$

Now $\frac{d\pm}{dn} = 0$ for minimum conductivity,

$$\Rightarrow \quad n = ni\sqrt{\frac{«_p}{«_n}}$$

36. We know that, $\text{a}_{(«m)} = \frac{1.24}{E_g}$

$$\text{a} = \frac{1.24}{1.42}«m = 0.875«m$$

37. We know that,

For $\frac{\text{a}}{8}$ lossless transmission line with $Z_L = 0$, the equivalent impedance, $Z_{in} = \left(\frac{Z_L + JZ_0}{Z_0 + JZ_L}\right)Z_0$

$$Z_{in} = JZ_0$$

$$Z_{in} = 50J$$

$$\Rightarrow \quad j\times2®\times10^9\times L = 50J$$

$$\Rightarrow \quad L = \frac{25}{®}nH$$

38. Given: $V_{BE} = 0.7V$, $= 99$ *and* $V_c = 7.5V$

Apply KVL in base emitter loop,

$-9 + R_BI_B + 0.7 = 0$

$R_BI_B = 8.3$ …(1)

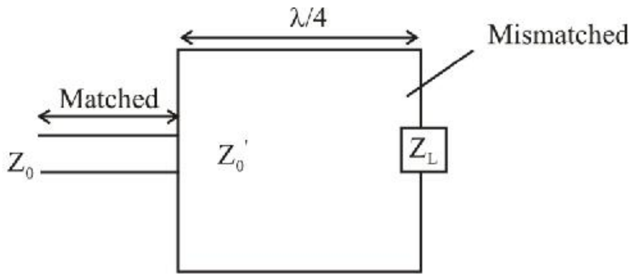
Apply KVL in collector emitter loop,

$-100 + I_c\, 10 + 7.5 = 0$

$\Rightarrow$ $I_c = 9.25$ mA

From (1), $R_B = 88.83\ k\Omega$

39.



Here, $Z_0' = \sqrt{Z_0 Z_L}$

$Z_0' = \sqrt{120 \times 30} = 60\Omega$

41. For maximum power transfer, R = 1Ω and

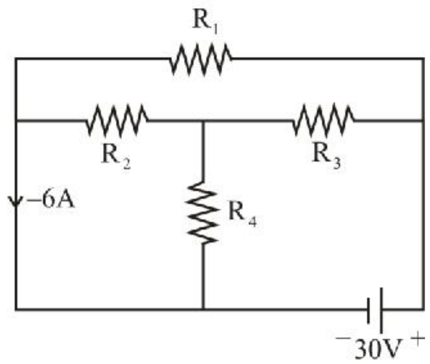
$P_{\max} = \frac{1^2}{4 \times 1} = 0.25\,\text{watt}$

50% of P_{max} = 0.125 watt

$\Rightarrow \quad 0.125 = \left(\frac{1}{1+R}\right)^2 \times R$

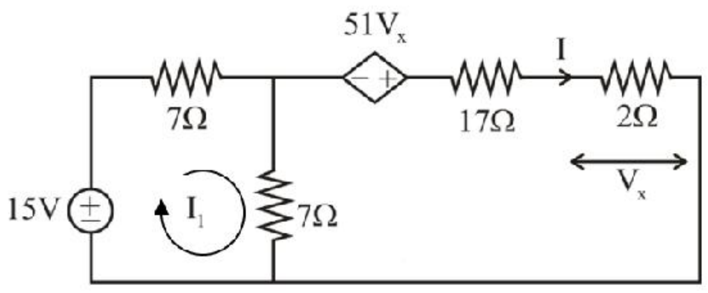
$\Rightarrow \quad R = \left(3 - \sqrt{8}\right)\Omega$

42. By applying reciprocity theorem, we get,



$I_2 = -6A$

43. By source transformation



By KVL

$-15 + 14I_1 - 7I = 0$ ...(1)

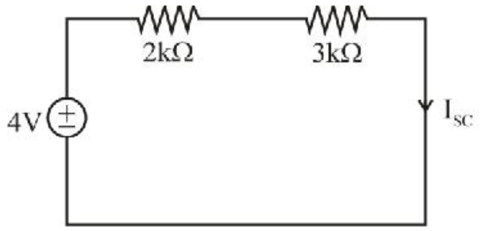
$26I - 7I_1 - 51V_x = 0$

$\Rightarrow$ $26I - 7I_1 - 51 \times 2I = 0$

$\Rightarrow$ $-76I - 7I_1 = 0$ ...(2)

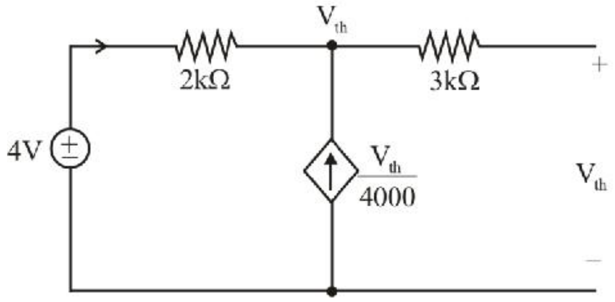
From (1) and (2) **I** = –94.34 mA

44. Calculation of I_{SC}:



$$I_{SC} = \frac{4}{5} = 0.8\,mA$$

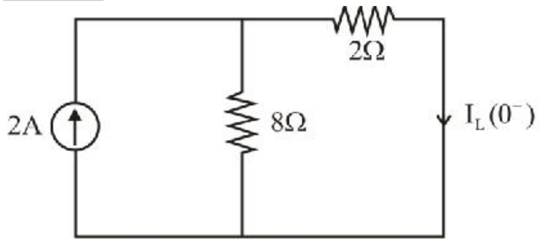
Calculation of V_{th}:



By Nodal analysis $\frac{4 - V_{th}}{2000} + \frac{V_{th}}{4000} = 0$ $\therefore$ V_{th} = 8V

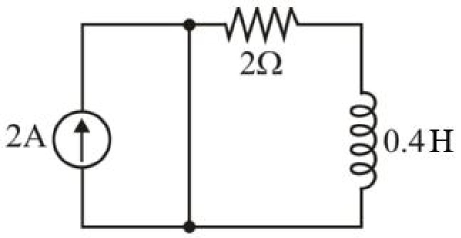
$$\Rightarrow \quad R_{th} = \frac{V_{th}}{I_{SC}} = \frac{8}{0.8 \times 10^{-3}} = 10\,k\Omega$$

45. **At t = 0^-**



$\Rightarrow$ $I_L(0^-)$ = 1.6 Amp

At t > 0

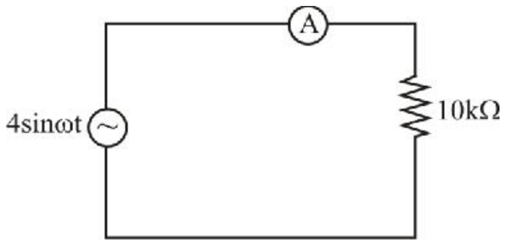


Now $\quad 2 = \frac{L}{R} = \frac{0.4}{2} = 0.2$

$$i(t) = i_L(0^-)e^{-t/2} = 1.6e^{-5t}$$

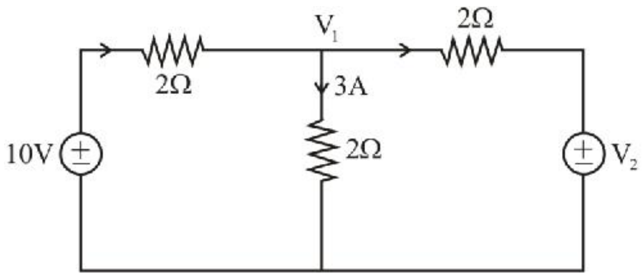
$$i(0.15) = 0.755\,\text{Amp}$$

47. Here D_1 will be short-circuited and D_2 will be open circuited.



$$\Rightarrow \quad I = \frac{4\sin\mu t}{10\times10^3} = \frac{4}{\sqrt{2}\times10}\text{mA} = \frac{0.4}{\sqrt{2}}\text{mA}$$

50.



By nodal analysis,

$$\frac{10-V_1}{2} - 3 - \left(\frac{V_1-V_2}{2}\right) = 0$$

$$10 - V_1 - 6 - V_1 + V_2 = 0$$

$$4 - 2V_1 + V_2 = 0 \qquad \text{...(1)}$$

Now $V_1 = 3 \times 2 = 6V$

From (1)

$4 - 12 + V_2 = 0$

$\Rightarrow \quad V_2 = 8V$

Technical Section - II

1. TWT is a specialized vacuum tube in which the radio waves interact with the electron beam while traveling down a wire helix which surrounds the beam. These have wide bandwidth, but output is limited to a few hundred watts.

2. Given:- F(A, B, C) = πM (0, 2, 3)

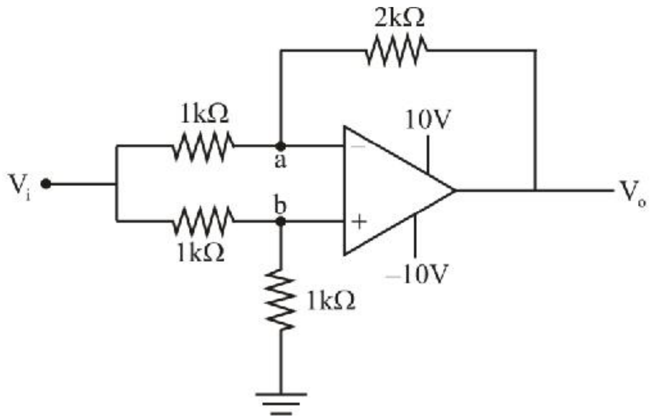
$$= \Sigma m(1, 4, 5, 6, 7)$$
$$= \bar{A}\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$$
$$= \bar{B}C(A + \bar{A}) + A\bar{B}\bar{C} + AB(C + \bar{C})$$
$$= \bar{B}C + A\bar{B}\bar{C} + AB$$
$$= \bar{B}C + A(B + \bar{B}\bar{C})$$
$$= \bar{B}C + A[(B + \bar{B})(B + \bar{C})]$$
$$= \bar{B}C + AB + A\bar{C}$$
$$= A + \bar{B}C$$

3. Number of address lines required to address 8K bytes of memory is 13.
As, 2^{13} = 8192 = 8K bytes

4. ASCII is a character encoding scheme. ASCII code represent text in computer, communication equipment and other devices that use text.

5. Binary number = 1101100
1's complement = 0010011
2's complement = 0010011+1
= 0010100
= 14 in BCD

6.



$$V_a = \frac{V_i \times 2 + V_0 \times 1}{2 + 1} = \frac{2V_i + V_0}{3}$$

$$V_b = \frac{V_i \times 1}{1+1} = \frac{V_i}{2}$$

Due to virtual short circuit.

$$V_a = V_b$$

$$\frac{2V_i + V_0}{3} = \frac{V_i}{2}$$

$$4V_i + 2V_0 = 3V_i$$

$$2V_0 = -V_i$$

$$\frac{V_0}{V_i} = -0.5$$

7. If V_0 = +10V, then D_2 ON and D_1 OFF.

$$V_{UT} = \frac{10 \times 2}{2+0.5} = 8V$$

If V_0 = –10V, then D_1 ON and D_2 OFF.

$$V_{LT} = \frac{-10 \times 2}{2+2} = -5V$$

8. (i) $\overline{x+y} = \bar{x}\,\bar{y}$ (Demorgan's theorem)

(ii) $\overline{\bar{\bar{x}}+y} = \overline{x+y} = \bar{x}\,\bar{y}$

(iii) $\overline{\bar{\bar{x}}\,\bar{\bar{y}}} = \overline{xy} = \bar{x}+\bar{y}$

(iv) $\overline{\bar{x}+\bar{y}} = \bar{\bar{x}}.\bar{\bar{y}} = xy \neq \bar{x}\,\bar{y}$

9. A Boolean function can be expressed as sum of products (SOP) i.e., sum of minterms and product of sums i.e., product of maxterm.

10. CMOS logic family having the lowest power dissipation 0.01 mW and highest noise margin as $(V_{OH})_{min}$ is closer to the power supply voltage and $(V_{OH})_{max}$ is closer to zero.

11. **T Flip flop:**

Characteristic table:

T	Q	Q(n+1)
0	0	0
0	1	1
1	0	1
1	1	0

$$Q(n+1) = \bar{T}\,Q + T\,\bar{Q}$$

12. The nyquist plot of G(Jω)H(Jω) of a closed loop control system encloses the point (–1, J0)

⇒ Gain Margin < 1

$\Rightarrow$ Gain Margin = –ive (dB)

13. Given:-

$$\frac{2d^2y(t)}{dt^2}+\frac{3dy(t)}{dt}+4y(t)=r(t)+2r(t-1)$$

$$\Rightarrow \; 2s^2Y(s)+3sY(s)+4Y(s)=R(s)+2R(s)e^{-s}$$

$$\Rightarrow \; \frac{Y(s)}{R(s)}=\frac{1+2e^{-s}}{2s^2+3s+4}$$

14. We know that, DSB-SC signal is given by:-

$s(t)=A_c m(t)\cos 2® f_c t$. Where, $A_c \cos 2® f_c t$ is carrier signal.

Here, $s(t)=\left(1+a_m\cos 2® f_a t\right)\cos 2® f_m t \cos 2® f_c t$

$$\Rightarrow \; m(t)=\left(1+a_m\cos 2® f_a t\right)\cos 2® f_m t$$

15. FM signal is given by,

$s(t)=A_c\cos(\bar{}_i(t))$

Where, $\bar{}_i(t)=\int_0^t µ_i\,dt=\int_0^t\left(f_c+k_f m(t)\right)2®\,dt \;=2® f_c t+2® k_f\int_0^t m(t)\,dt$

$$\Rightarrow \; s(t)=A_c\cos\left[2® f_c t+2® k_f\int_0^t m(t)\,dt\right]$$

16. Given:- $P(t)\xleftrightarrow{F.T}P(f)$

Condition for zero inter symbol interference in the absence of noise is

$$\sum_{n=-\infty}^{\infty}P(f-nR_b)=1$$

$$\sum_{n=-\infty}^{\infty}P\left(f-\frac{n}{T_b}\right)=1$$

17. The magnitude response of an ideal equalizer for rectifying a distortion characterized by $T\sin c(fT)e^{-J® fT}$ is

$$\left|\frac{1}{T\sin c(fT)e^{-J® fT}}\right|=\left|\frac{1}{\frac{T\sin(® fT)}{® fT}e^{-J® fT}}\right| \Rightarrow \frac{® f}{\sin(® fT)}$$

18. We know that, Minimum sampling frequency $f_s = 2f_m$ is also known as Nyquist rate.

$\Rightarrow$ 8kHz = $2f_m$

$\Rightarrow$ f_m = 4 kHz

19. A klystron is a linear beam vacuum tube, in which bunching of electrons is caused by velocity modulation.

20. Program counter points to the address location from where the next byte i.e., next instruction is to be fetched.

21. Given: f = 1GHz

d = 30 km

P_t = 1 Watt

P_r = –30 dBm

We know that,

$$P_r = \frac{P_t G_t G_r}{\left(\frac{4® d}{a}\right)^2} = \frac{P_t G^2}{\left(\frac{4® d}{a}\right)^2} \qquad \{G_t = G_r\}$$

$$10^{-6} = P_r = \frac{1 G^2}{\left(\frac{4® \times 30 \times 10^3}{0.3}\right)^2} \Rightarrow G = 400®$$

22. In memory mapped I/o, the processor can manipulate I/o data residing in interface register with the same instructions that are used to manipulate memory location.

23. When i = 1.0

$\Rightarrow$ dx = 0.0

$\Rightarrow$ sum = 0.0

$\Rightarrow$ x = 4.0 {sum < x}

when i = 2

$\Rightarrow$ dx = 4.0

$\Rightarrow$ sum = 4.0

$\Rightarrow$ x = 8.0 {sum < x}

when i = 3

$\Rightarrow$ dx = 16.0

$\Rightarrow$ sum = 20.0

$\Rightarrow$ x = 16.0 {sum > x}

$\Rightarrow$ sum = 20.0

24. Total number of comparison of 200 element is section sort is $0(n^2) = (200)^2$ = 40000 comparison

40,000 comparisons takes 3ms.

Now, 4000 elements takes $(4000)^2$ comparisons

So, 40000 comparisons required 3 ms

$\therefore$ 1 ,, ,, $\frac{3 \times 10^3 s}{40,000}$

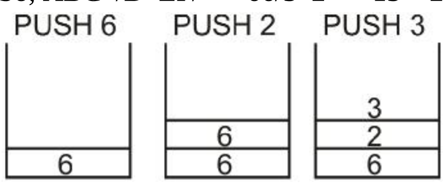
$\therefore \quad (4000)^2 \quad ,, \quad ,, \quad \frac{3\times10^3 s}{40,000}\times 4000\times 4000$

$=1200\times10^{-3} s = 1.2\sec$

25. Post fix expression is ABC*/D–EF/+

Given: A = 6, B = 2, C = 3, D = 3, E = 4 and F = 2

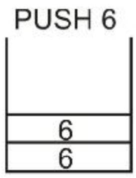
So, ABC*/D–EF/+ = 66/3–2+ = 13 – 2+ = –22+ = 0



*operator encounter

Pop top 2 element 3 and 2

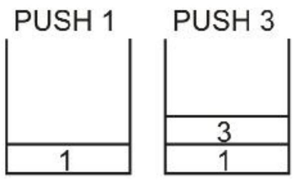
2*3 = 6



Again encounter '/' operator

pop top two element and find the value

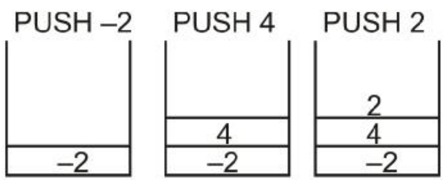
$\frac{6}{6}=1$



'–' operator encounter

pop top two element and find the value

1 – 3 = –2

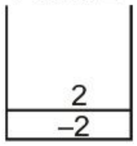


'/' operator encounter

pop top two element and find the value

$\frac{4}{2}=2$

PUSH 2



'+' operator encounter
pop top two element and find the value
–2 + 2 = 0
Value printed 0

26. Address range : CC00 to CFFF
So, first 4 bits are 1100
So, address lines are $A_{15}, A_{14}, \overline{A_{13}}, \overline{A_{12}}$. Next byte is changing from C to F. i.e., 1100 to 1111.
So next two address lines are A_{11}, A_{10}.

27. ALE → Address Latch Enable
PSW → Program Status Word
CMA → Complement Accumulator
RLC → Rotate Accumulator Left

28. LXIB 2070 H
⇒ B = 20H , C = 70H
MVI A, 8FH MVI C, 68H
⇒ A = 8FH ⇒ C = 68 H
SUB C
⇒ A = A – C = 27H
ANI 0F H
⇒ A AND 0F = 07 H
STAX B
⇒ Content of memory location 2070H is 07H.

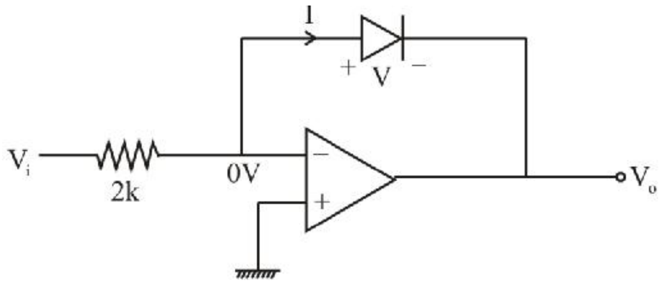
29. There are total 9 jump instruction.

1.	JC, Jump if carry flag is set	→ 3 bytes
2.	JNC, Jump if carry flag is reset	→ 3 bytes
3.	JZ, Jump if zero flag is set	→ 3 bytes
4.	JNZ, Jump if zero flag is reset	→ 3 bytes
5.	JP, Jump if positive	→ 3 bytes
6.	JM, Jump if minus	→ 3 bytes
7.	JPE, Jump if parity even	→ 3 bytes
8.	JPO, Jump if parity odd	→ 3 bytes
9.	JMP, Unconditional Jump	→ 3 bytes
		27 bytes

30. $\mu = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10\times10^{-3}\times0.01\times10^{-6}}} = 10^5$ rad/sec

31. Minimum size of ROM = $2^n \times n = 4 \times 2$

32.



$$\Rightarrow V_0 = -V$$

$$I = I_s e^{V/V_T}$$

$$I = I_s e^{-V_0/V_T}$$

$$\ln\left(\frac{I}{I_s}\right) = \frac{-V_0}{V_T} \Rightarrow V_0 = -V_T \ln\left(\frac{I}{I_s}\right)$$

Now from the figure,

$$V_i = 2I \Rightarrow V_0 = -V_T \ln\left(\frac{V_i}{2I_s}\right)$$

Case 1: $V_i = 2V \Rightarrow V_{01} = -V_T \ln\left(\frac{1}{2I_s}\right)$ ...(1)

Case 2: $V_i = 4V \Rightarrow V_{02} = -V_T \ln\left(\frac{2}{I_s}\right)$ ...(2)

Now (2) – (1)

$$V_{02} - V_{01} = -V_T \ln\left(\frac{2}{I_s}\right) + V_T \ln\left(\frac{1}{I_s}\right) = V_T \ln\left[\frac{1}{I_s} \times \frac{I_s}{2}\right]$$

$$V_{02} - V_{01} = V_T \ln\left(\frac{1}{2}\right)$$

$$V_{02} = V_{01} - V_T \ln(2)$$

33. $g_{mo} = \frac{i_o}{V_i} = \frac{i_o}{I_1}.\frac{I_1}{V_i} \Rightarrow \frac{i_o}{I}.g_{m1} \cong g_{m1}$

34. $G(s)H(s) = \frac{k(s+4)}{s(s+1)}$

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

$$s^2 + s + ks + 4k = 0$$

$$\Rightarrow \quad k = \frac{-s^2 - s}{s+4}$$

Now, $\frac{dk}{ds} = 0$

$$\Rightarrow \quad (2s+1)(s+4) - (s^2 + s) = 0$$

$$\Rightarrow \quad 2s^2 + 8s + s + 4 - s^2 - s = 0$$

$$\Rightarrow \quad s^2 + 8s + 4 = 0$$

$$\Rightarrow \quad s = -0.53\,,\ -7.46$$

36. $P = \bar{x}\,\bar{y}\,\bar{z} + \bar{x}\,y\,z + x\,\bar{y}\,z + x\,y\,\bar{z}$

$$P = \bar{z}(x \odot y) + z(x \oplus y)$$

$$P = z(x \oplus y) + \bar{z}\,(\overline{x \oplus y})$$

$$P = \overline{x \oplus y \oplus z}$$

37. Given: $q(s) = s^4 + s^3 + 2s^2 + 2s + 3 = 0$

RH Table:

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

When, a = 0, then $\frac{2a-3}{a} = -\infty$. So, there are 2 sign changes in the first column. So, there are 2 roots in the right half of the s plane.

38. There are 3 variables, out of which 2 are required for select lines and 1 will be used for input. Let A be the input variable.

Let A be the input variable.

	I_0	I_1	I_2	I_3
$\bar{A}$	0	①	2	③
A	4	⑤	⑥	7
	0	1	A	$\bar{A}$

39.

Clk	$\overline{CLR}$	L	C		
↑	1	1	X	→	Load inputs
↑	1	0	1	→	Count next binary state
X	0	X	X	→	Clear outputs
X	1	0	0	→	No change

40. D flip flop is set initially

So,

$$\begin{array}{r} \oplus\, 11011 \\ 11011 \\ \oplus\quad\;\; 1 \\ \hline 110111 \\ \hline \end{array}$$

Sum = 10111, carry = 1

41. Here, $P_1 = \dfrac{3}{(s+1)(s+4)}$

$$L_1 = \frac{-1}{s+1},\; L_2 = \frac{-3}{(s+1)(s+4)}$$

From the Mason's gain formula,

$$\frac{Y(s)}{R(s)} = \frac{P_k \Delta_k}{\Delta}$$

$$= \frac{\dfrac{3}{(s+1)(s+4)} \times 1}{1 + \dfrac{1}{s+1} + \dfrac{3}{(s+1)(s+4)}}$$

$$= \frac{3}{s^2 + 5s + 4 + s + 4 + 3} \Rightarrow \frac{3}{s^2 + 6s + 11}$$

42. $G(s)H(s) = \dfrac{(k + 0.366s)}{s(s+1)}$

$$G(J\mu)H(J\mu) = \frac{k + 0.366\,J\mu}{J\mu\,(J\mu + 1)} = \left|G(J\mu_{gc})H(J\mu_{gc})\right| = 1$$

$$\Rightarrow \frac{\sqrt{k^2 + (0.366)^2 \mu_{gc}^2}}{\mu_{gc}\sqrt{\mu_{gc}^2 + 1}} = 1$$

$$\Rightarrow \frac{k^2 + (0.366)^2}{1(1+1)} = 1$$

$$\Rightarrow k = 1.366$$

43. Given:- k = 96, f_s = 8kHz, n = 8, s = 1

We know that, for TDM, data rate = $(nk+s)f_s$ = 6152 kbps ⇒ 6.152 Mbps

44. Given: d = 36000 km , f_d = 10 GHz

We know that, Downlink loss = $\left(\frac{4® d}{a}\right)^2$

$$= \frac{4® \times 36000 \times 10^3}{3 \times 10^8 / (10 \times 10^9)} = 2.27 \times 10^{20} \Rightarrow 203.56\,\text{dB}$$

So, uplink loss = 203.56 + 1.583 = 205.15 dB

45. In uniform quantizer, the quantization noise is given by;

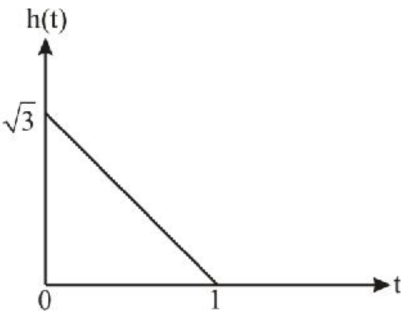
$$N_q = \frac{\Delta^2}{12}$$

Where, Δ is step size and it is given by $\Delta = \frac{V_{(\text{Peak to peak})}}{2^n}$

$$\Rightarrow \; N_q = \frac{V^2_{(\text{Peak to peak})}}{2^{2n} \times 12}$$

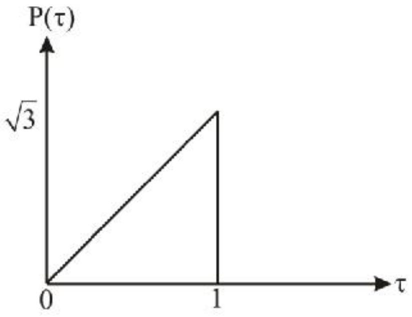
46. For Matched filter, impulse response $h(t) = P(T - t) = P(1 - t)$

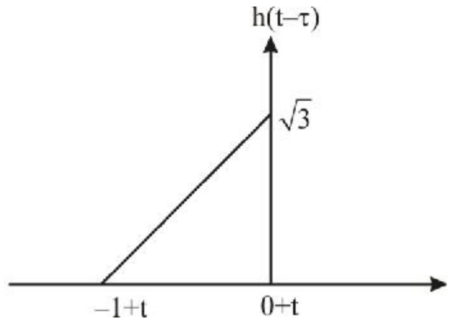
⇒



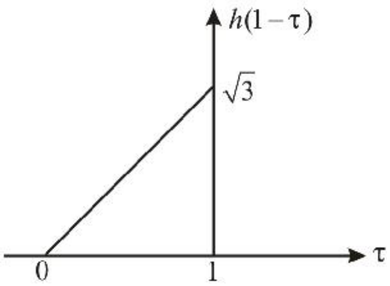
Now output $y(t) = P(t) * h(t) = \int_{-\infty}^{\infty} p(²)h(t - ²)\, d²$ ...(1)

Now,





Put t = 1



$$\Rightarrow \quad y(1) = \int_0^1 \sqrt{3}^2 . \sqrt{3}^2 \ d^2 \quad \Rightarrow \quad 3\left[\frac{2^3}{3}\right]_0^1 = 1$$

47. Given: Responsivity R = 0.5 A/W

$$\Rightarrow \quad \frac{I_p}{p} = 0.5 \quad \Rightarrow \quad \frac{25\times10^{-6}}{p} = 0.5 \quad \Rightarrow \quad p = 5\times10^{-5} \text{ Watt}$$

Power loss = αL = 1 × 3 = 3dB = 2

So, the required transmitted power is = 2× 5 × 10^{-5} = 10^{-4} watt = –10 dBm

48. Given: Coupling C = 20 dB and directivity D = 30 dB

$$\Rightarrow \quad C = -10\log_{10}\left(\frac{P_3}{P_1}\right) dB$$

$$20 = C = -10\log_{10}\left(\frac{P_3}{10}\right) dB$$

$$\Rightarrow \quad D = -10\log_{10}\left(\frac{P_4}{P_3}\right) dB$$

$$30 = D = 10\log_{10}\left(\frac{P_3}{P_4}\right) dB$$

$$\Rightarrow \quad P_3 = 0.1\text{watt}$$

$$\Rightarrow \quad 1000 = \frac{0.1}{P_4}$$

$$\Rightarrow \quad P_4 = 0.1\text{mwatt}$$

50. Given: D = 2 , f = 300 MHz

We know that,

$$\text{Directivity } D = \frac{4®}{a^2} A_e$$

$$\Rightarrow \quad 2 = \frac{4®}{[3\times10^8/(300\times10^6)]} A_e$$

$$\Rightarrow \quad A_e = \frac{1}{2®} m^2$$