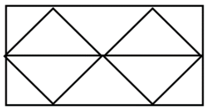
REAL TEST

ECE

Q1 In the figure shown below, various horizontal and vertical segments divide the outer shape into multiple regions. How many rectangles and triangles are there in the figure?



(A) Two rectangles & Twelve triangles
(B) Five rectangles & Ten triangles
(C) Six rectangles & Twelve triangles
(D) Eight rectangles & Eleven triangles

Q2 Train P leaves station A at 08:00 hours and reaches station B at 12:00 noon. Train Q leaves station B at 09:00 hours and reaches station A at 15:00 hours. Assuming both trains travel at constant speeds, at what exact time do the two trains cross each other?
(A) 10:15 hours
(B) 10:36 hours
(C) 10:48 hours
(D) 11:30 hours

Q3 Two fair dice are thrown simultaneously. In how many possible outcomes is the number shown on the top face of the first die greater than the number on the bottom face of the second die?
(A) 18 (B) 36
(C) 6 (D) 15

Q4 Select the most appropriate meaning of the underlined idiom.
The actor decided to live life **in the fast lane**.
(A) Racing away to the moon
(B) A life of extreme speed
(C) A life filled with excitement
(D) Dropping charges of crime

Q5 Select the most appropriate synonym of the given word.
LUCID
(A) Lucky (B) Timely
(C) Clear (D) Happy

Q6 Which of the following powers of 6 is the largest factor of : 1 × 2 × 3 × 4 × 5.........× 89 × 90.
(A) 6^{24} (B) 6^{44}
(C) 6^{34} (D) 6^{18}

Q7 In a bakery, Rohan can bake half as many cakes as Meera in one-sixth of the time it takes Meera. If they decide to work together, they can bake all the cakes in 10 days. How many days would Meera need to bake all the cakes by herself?
(A) 40 days (B) 25 days
(C) 30 days (D) 35 days

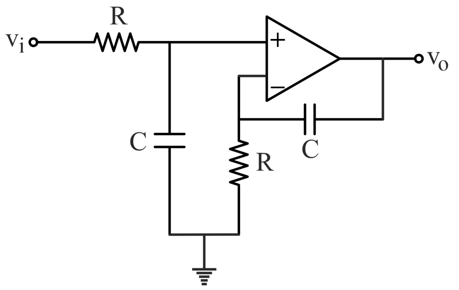
Q8 The given sentence contains a grammatical error. Identify the segment that contains the error.
Smitha was offered the job although having no qualifications.
(A) although having
(B) Smitha was offered
(C) the job
(D) no qualifications

Q9 A rectangular sheet of cardboard has its sides in the ratio 1:4. Riya keeps cutting it in half along the longer side. After several cuts, she wonders: after how many cuts will the rectangle again have the same 1:4 ratio of sides?
(A) 4 cuts (B) 6 cuts
(C) 3 cuts (D) Never

Q10 A chef intends to fill a display case with 20 cupcakes, reaching its full capacity. Every 30 seconds, he adds 2 cupcakes, but a mischievous helper takes 1 cupcake out. How much time will it take for all 20 cupcakes to be in the display case for the first time?
(A) 600 seconds (B) 328 seconds
(C) 570 seconds (D) 300 seconds

Q11 An isotropic antenna is radiating power 100 W. The strength of electric and magnetic field strength at a distance 5 m from the antenna, are ________ and ________ respectively.
(A) 21.9 V/m, 58.1 mA/m
(B) 15.5 V/m, 41.1 mA/m
(C) 10.95 V/m, 29.06 mA/m
(D) None

Q12 If the op-amp shown in figure below is ideal, then the circuit acts as



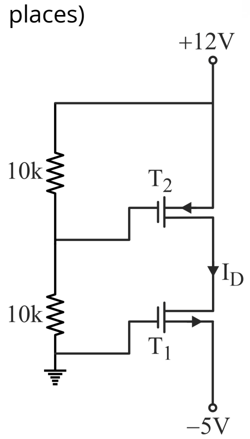
(A) Low pass filter
(B) Bandpass filter
(C) All pass filter
(D) High pass filter

Q13 To implement 3-input XOR operation using 2-input NAND gate, number of NAND gate required will be ______.

Q14 In a p-type MOSFET, inversion channel is created at certain gate to source voltage. Inversion channel is dominated by

(A) Electrons (B) Holes
(C) Acceptor ions (D) Donor ions

Q15 For the given MOSFET arrangement, threshold voltage $|V_T|$ = 2V and $k_n'\left(\frac{W}{L}\right)$ = 0.1 mA/V^2. The maximum value of drain current is ______mA. (Rounded off to two decimal places)



Q16 For x(n) = cos $\left(\frac{\pi n}{2}\right)$, the DTFS coefficients are represented as c_k, then choose the correct option(s):

(A) C_1 is non zero (B) C_1 is zero
(C) C_3 is non zero (D) C_7 is non zero

Q17 In a pure – SC, trivalent impurity is added with concentration $N_A = \frac{3\ n_i}{2}$, where n_i is intrinsic carrier conc^n then?

(A) It is n-type SC with $n = \frac{3\ n_i}{2}$
(B) It is p-type SC with $p = \frac{3\ n_i}{2}$
(C) It is p-type SC with p = $2n_i$
(D) It is p-type SC with $n = \frac{2}{3}\ n_i$

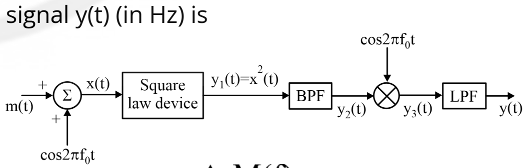
Q18 A survey was conducted among 800 College students. The results for their preference for three
subjects: Mathematics(M), Physics(P) and Chemistry(C) are as follows:

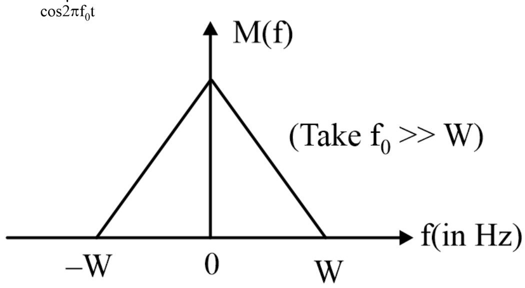
- 350 students like M, 300 students like P, 250 students like C.
- 150 students like both M and P, 100 students like both P and C.
- 120 students like both M and C.
- 70 students like all three subjects (M, P and C)

How many students do not like any of the three subjects?

(A) 600 (B) 370
(C) 450 (D) 200

Q19 A message signal m(t) whose spectrum M(f) is passed through a system as shown below. The BPF (Band Pass Filter) has a bandwidth of 2W Hz centered at fo and the LPF (Low pass filter) has a bandwidth of WHz. The bandwidth of the signal y(t) (in Hz) is





(A) W (B) 2W
(C) 3W (D) 4W

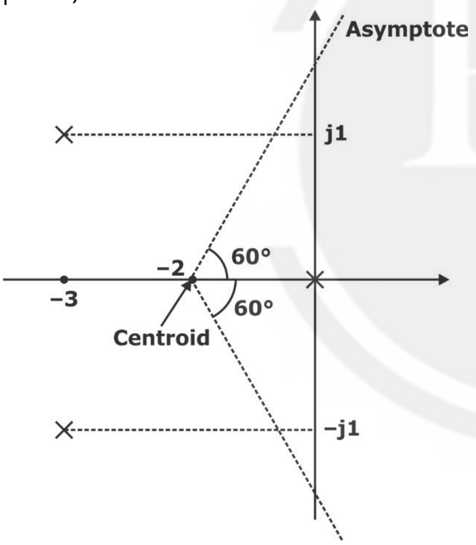
Q20 It is desired to construct uniform transmission lines using polyethylene (ε_r = 2.25) as the dielectric medium. The distance of separation for 300 Ω two-wire transmission line, where radius of the conducting wires is 0.6 mm, is ________ (mm).

(A) 25.51 (B) 7.31
(C) 14.62 (D) 12.76

Q21 A Boolean function is given as: f(A, B, C) = $\overline{A}B + \overline{A}C$+BC it will further simplify to

(A) $\overline{A}B + \overline{A}C$
(B) $\overline{A}B + BC$
(C) $\overline{A}C + BC$
(D) No simplification is possible

Q22 The figure shown the asymptote root locus in real axis and location of poles and centred, then the ratio $\left(\frac{break\ in}{break\ away}\right)$ point of the root locus is ______. (Rounded off to two decimal places).



Q23 If X(t) and Y(t) are two orthogonal stationary random processes and two other processes U(t) and V(t) are formed as follows:

U(t) = X(t) + Y(t)
V(t) = 2X(t) + 3Y(t)

The which of the following is true ?

(A) $R_U(\tau) = R_X(\tau) - R_Y(\tau)$
(B) $R_V(\tau) = R_X(\tau) + 3R_Y(\tau)$
(C) $R_{UV}(\tau) = 4R_X(\tau) + 9R_Y(\tau)$
(D) $R_{UV}(\tau) = 2R_X(\tau) + 3R_Y(\tau)$

Q24 A logic circuit implements the Boolean function $F = \overline{x}y + x\overline{y}\,\overline{z} + xy\,\overline{z}$. It is found that the input combination x = z = 1 can never occur. Taking this into account, a simplified expression for F is given by

(A) x + z (B) y + z
(C) x + y (D) x + y + z

Q25 Let $m_1(t)$ and $m_2(t)$, be two message signal and let $y_1(t)$ and $y_2(t)$ be the corresponding modulated version.

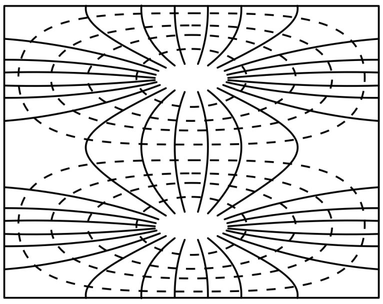
Which of the following statement is/are correct?

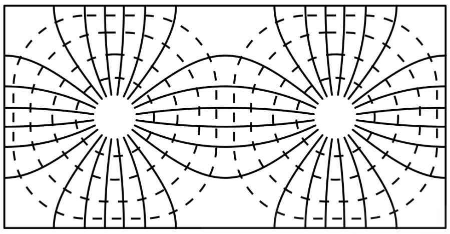
(A) When the combined message signal $m_1(t)$ and $m_2(t)$ DSB modulate a carrier $A_c\cos2\pi f_c t$, the result is the sum of the DSB amplitude-modulated signals $y_1(t)$ and $y_2(t)$.
(B) If $m_1(t)$ and $m_2(t)$ frequency modulates a Carrier, the modulated signal is equal to the sum of $y_1(t)$ and $y_2(t)$
(C) When the combined message signal $m_1(t)$ and $m_2(t)$ DSB modulate a carrier $A_c\cos2\pi f_c t$, the result is not equal to the sum of the DSB amplitude-modulated signals $y_1(t)$ and $y_2(t)$.
(D) If $m_1(t)$ and $m_2(t)$ frequency modulates a Carrier, the modulated signal is not equal to the sum of $y_1(t)$ and $y_2(t)$

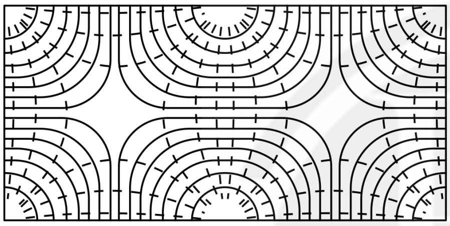
Q26 An air filled rectangular waveguide with dimensions 'a' and 'b' that will operates in the dominant TE_{10} mode at f = 10 GHz. The minimum value of 'a' of the waveguide which should be chosen so that at f = 10 GHz the waveguide not only operated on the single TE_{10} mode but also that f = 10 GHz is simultaneously 25% above the cut-off frequency of the dominant TE_{10} mode, is __________ cm.

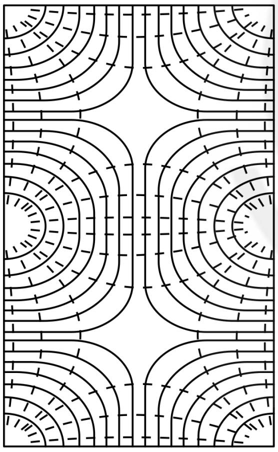
(A) 0.9375 (B) 1.875
(C) 3.75 (D) 1.2

Q27 Which of the following will represent field pattern of TM_{21} in rectangular wave guide ?

(A) 

(B) 

(C) 

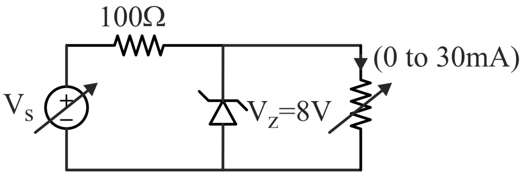
(D) 

Q28 $L = \lim_{x \to 0} \left(\frac{1}{x}\right)^{\tan x}$

(A) L = 0 (B) $L = \frac{1}{e}$

(C) L = e (D) L = 1

Q29 An 8 V Zener diode voltage regulator as shown in figure below operates from a source that varies from 12 V to 18 V. The series resistance is 100 Ω and the load draws current that varies from 0 mA to 30 mA. Then which of the following is/are correct under worst-case conditions?



(A) $P_{Z(max)}$ = 80 mW

(B) $P_{Z(max)}$ = 800 mW

(C) $I_{Z(max)}$ =10 mA

(D) $I_{Z(max)}$ = 100 mA

Q30 Q. Which of the following statements is/are correct?

(A) A demultiplexer cannot be used as a decoder.

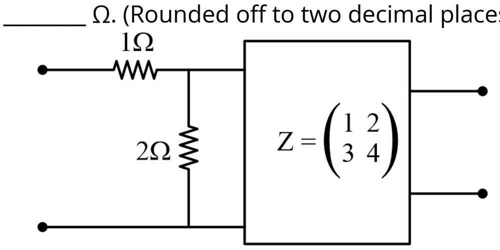
(B) A demultiplexer selects one of many outputs.

(C) The input to output pin ratio of a multiplexer with n control inputs is $2^n : 1$.

(D) The dual of an expression $(\overline{A}B + BC + \overline{C}D)$ is $(\overline{A} + B)(B + C)(\overline{C} + D)$.

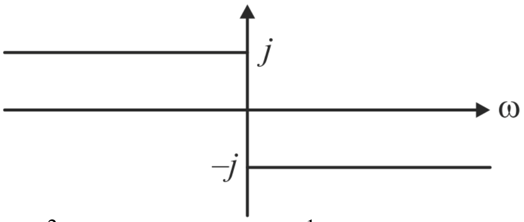
Q31 For log(1– 5z) with |z| < $\frac{1}{5}$, the Inverse Z-transform is given by $\frac{\alpha^n u(-\beta n - 1)}{n}$; then the value of αβ is _____. (Rounded off to two decimal places)

Q32 Consider below given circuit, then the value of Z_{12} of the complete 2-port network will be _______ Ω. (Rounded off to two decimal places)



Q33 Reverse saturation current of a pn junction diode is $I_0 = 10^{-8}$A. Diode is at equilibrium at no applied bias, then the value of diffusion current flowing through diode (from p to n direction) _________ nA.

Q34 Fourier transform of signal h(t) is H(ω). H(ω) is shown in the figure below. Then h(t) is



(A) $\frac{2}{\pi t}$ (B) $\frac{1}{\pi t}$

(C) $\frac{j}{\pi t}$ (D) $\frac{-j}{\pi t}$

Q35 Let X and Y be two independent random variables. Var (X) = 4 and Var(Y) = 9. Choose the correct option(s) given below.

(A) Var(2X) = 8

(B) Var(X - Y) = 13

(C) Var(2X - 3Y) = 97

(D) Var(Y/3) = 1

Q36 The value of the following series

$\frac{1}{2}-\frac{1}{6}+\frac{1}{24}-\frac{1}{120}+$ .... is ______

(Round off to two decimal places).

Q37 Consider the system of linear equations

x + y + 5z = 3

x + 2y + 2z = 5

2x + 4y + 4z = k

For the system to have infinitely many solutions, the value of k is ____ (Enter in integer)

Q38 For a CE amplifier shown below upper 3-dB cut-off frequency is _____ kHz, provided below:

(i) Unity gain frequency = 800 MHz

(ii) C_μ = 1 pF

(iii) C_π = 7 pF

(iv) r_π = 2.5 kΩ

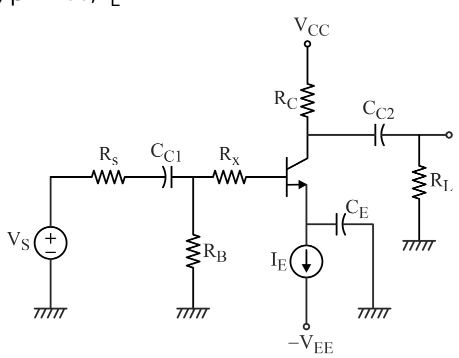
(v) r_0 = 100 kΩ

(vi) V_{CC} = 10 V = $-V_{EE}$

(vii) R_S = R_L = 5 kΩ

(viii) R_c = 8 kΩ R_x = 50 Ω, R_B = 100 kΩ

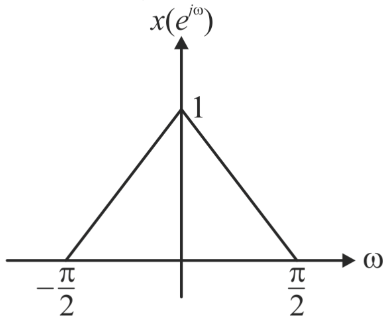
(ix) β = 100, I_E = 1 mA



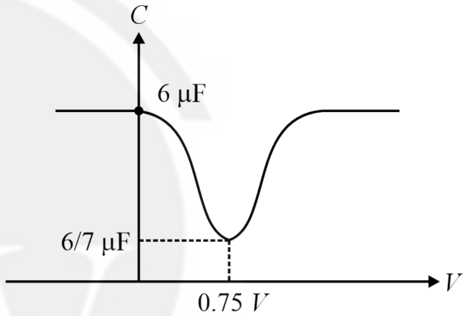
(A) 560 (B) 630

(C) 762 (D) 875

Q39 For a signal x(n), its DTFT is shown below such that a constant A is given by $\frac{\sum_{n=-\infty}^{\infty} nX(n)}{\sum_{n=-\infty}^{\infty} X(n)}$. Then the value of A is ______. (Rounded off to nearest integer)

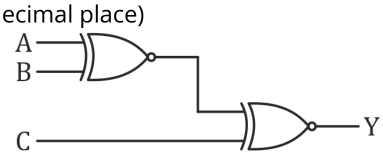


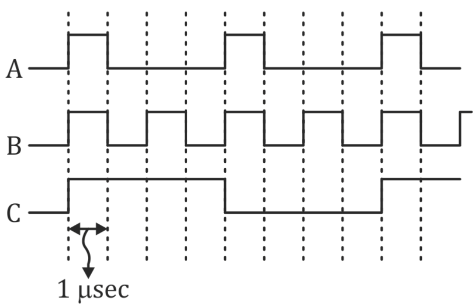
Q40 C-V characteristic of a MOS capacitor is given below:



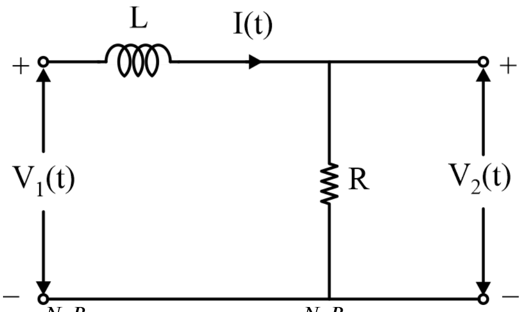
If area of crossection A = 1 cm^2 and substrate doping is N_S = 2 × $10^{16}/cm^3$ then value of maximum electric field inside substrates in depletion mode of operation is ______ kV/cm.

Q41 The waveform of three periodic signals A, B and C are shown in the figure below. If they are applied to the two EX-NOR gate combination circuits, then the frequency of output 'Y' will be _________kHz. (Rounded off to one decimal place)





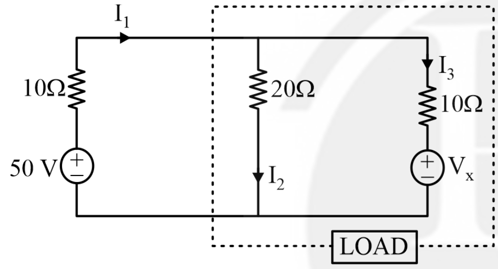
Q42 Consider the circuit shown below. If the two sided power spectral density of $V_1(t)$ is given as, $S_{V_1}(f) = \frac{N_0}{2} W/Hz$. Then the average power of $V_2(t)$ will be



(A) $\frac{N_0 R}{4L} Watts$ (B) $\frac{N_0 R}{2L} Watts$

(C) $\frac{N_0 4L}{R} Watts$ (D) $\frac{2N_0 L}{R} Watts$

Q43 For the circuit shown below, which of the following is/are correct so that maximum power is transferred to load?



(A) V_x = 10V (B) I_1 = 2.5 A

(C) I_2 = 1.25 A (D) I_3 = 1A

Q44 For a system, CLTF = $\frac{10(s+3)}{s^3+6s^2+11s+6}$. If the state space representation of the system is x(t) =

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x(t) + \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} u(t)$$

, y(t) = [C_1 C_2 C_3] x(t) .

then $\frac{b_1+C_1}{b_2+C_2}$ is _______. (Rounded off to one decimal place).

(A) 2 (B) 3

(C) 4 (D) 5

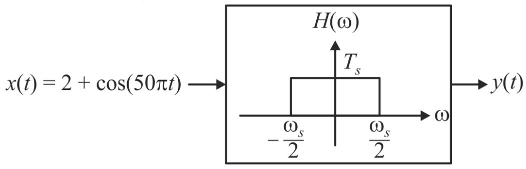
Q45 If the Fourier transform of $x_1(t) = te^{-|t|}$ is $X_1(\omega)$ and of $x_2(t) = \frac{4}{(1+t^2)^2}$ is $X_2(\omega)$ then $\frac{X_1(\omega)}{X_2(\omega)}$ at ω = π rad/sec is _____. (Rounded off to two decimal places).

Q46 The inverse Laplace transform is given as

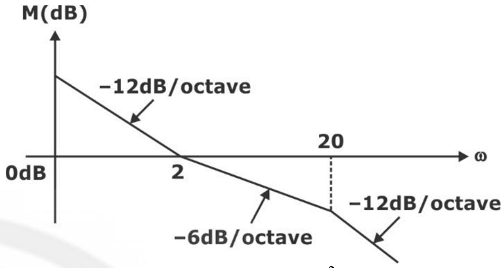
$$L^{-1}\left\{\frac{s+3}{s^2-4s+13}\right\} = e^{2t}\left\{\cos 3t + \alpha \cdot \sin 3t\right\}$$

The value of 'α' is _______ (Round off to three decimal places)

Q47 A signal x(t) is sampled at 0.01 sec, such that its output y(t) is A + cos(ωt) as shown below. The value of A is ______. (Rounded off to nearest integer)

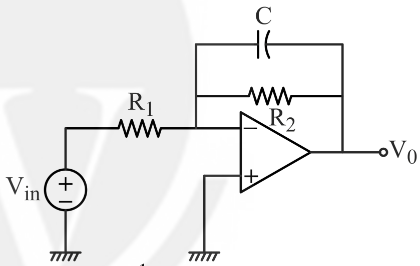


Q48 The magnitude plot for a minimum phase system is shown



The steady state error for $\frac{5t^2}{2}$ input is ______. (Rounded off to two decimal places).

Q49 For the circuit shown below, if



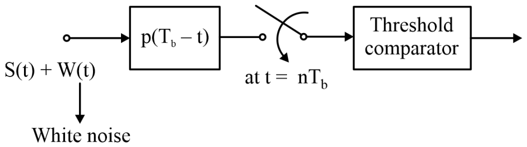
(A) $\omega >> \frac{1}{R_2 C}$, circuit will because like integrator

(B) $\omega << \frac{1}{R_2 C}$, circuit will behave like amplifier

(C) $\omega >> \frac{1}{R_2 C}$, circuit will behave like amplifier

(D) $\omega << \frac{1}{R_2 C}$, circuit will behave like integrator

Q50 Binary data is transmitted through an AWGN channel with power spectral density of h/2 W/Hz using a pulse p(t) for logic-0 and a pulse 3p(t) for logic-1. The signal is received by using a matched filter receiver as shown below

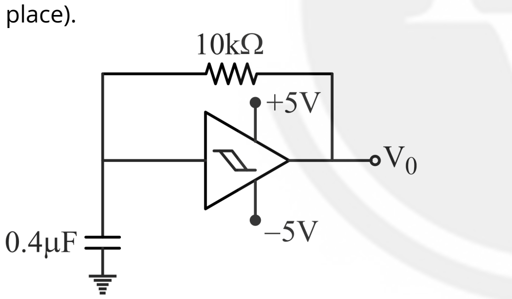


The duration of the pulse p(t) is T_b and the energy association with the pulse p(t) is E_p. If logic-0 and logic-1 are equiprobable and optimum threshold used by the threshold comparator, then the bit error rate (BER) will be [Q(x) indicates Q-function and E_b is the average bit energy]

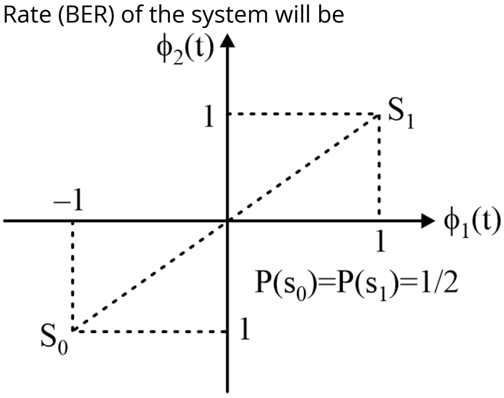
(A) $Q\left(\sqrt{\frac{2E_b}{\eta}}\right)$ (B) $Q\left(\sqrt{\frac{E_b}{\eta}}\right)$

(C) $Q\left(\sqrt{\frac{0.8E_b}{\eta}}\right)$ (D) $Q\left(\sqrt{\frac{0.4E_b}{\eta}}\right)$

Q51 A hysteresis type TTL inverter is used to realize an oscillator in the circuit. V_{LT} = 0.9V, L_{UT} = 1.8V, the period for which output is 'high is _____ msec. (Rounded off to three decimal place).



Q52 The constellation diagram of a binary modulation scheme is shown below. The two equiprobable symbols shown in the diagram are transmitted through an AWGN channel with noise $PSD = \frac{1}{2}W/Hz$. If a correlator receiver with optimum threshold detection is used at the receiver end, then the Bit Error Rate (BER) of the system will be



(A) Q(1) (B) Q(2)

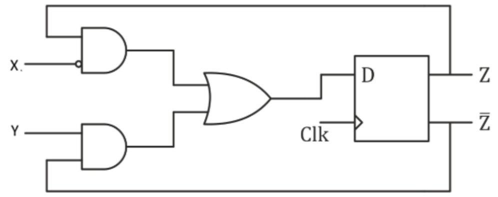
(C) Q(3) (D) Q(4)

Q53 Consider the following D.E:

y" + y = sin(t)

with initial conditions as y(0) = 0 and y' (0) = 0. The value of y (π) is____(Round off to two decimal places)

Q54 A sequential circuit using D flip-flops and logic gates is shown below. When X and Y are the inputs and Z is the output. Then the circuit is



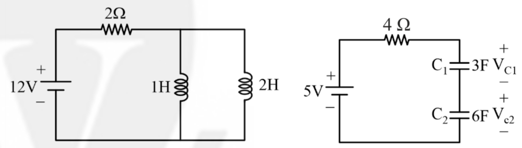
(A) S-R FF with inputs X = R and Y = S

(B) S-R FF with inputs X = S and Y = R

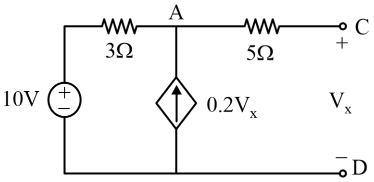
(C) J-K FF with inputs X = J and Y = K

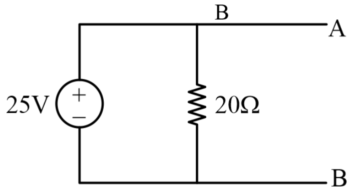
(D) J-K FF with inputs X = K and Y = J

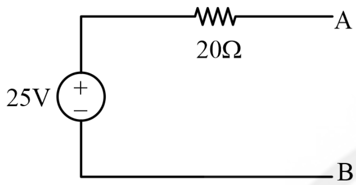
Q55 If the steady state voltage across the capacitor 6 F is $V_{c2}(\infty)$ and current in the inductor 1H is $i_1(\infty)$, then $\frac{V_{c_2}(\infty)}{i_1(\infty)}$ is _____ mΩ. (Rounded off to two decimal places).

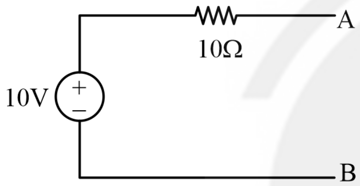


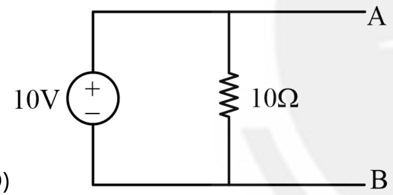
Q56 The circuit shown in figure, contains a dependent current source between A and B terminals. The Thevenin's equivalent circuit across terminals C and D.



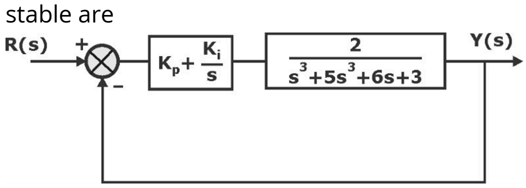
(A)


(B)


(C)


(D)


Q57 A unity feedback control system that uses proportional integral controller is shown in figure below. The stability of closed loop system is controlled by proportional integral controller. The maximum value of K_i and corresponding value of K_P for the system to be stable are



(A) $K_i = 4.5$ (B) $K_P = 6$

(C) $K_P = 13.5$ (D) $K_i = 5$

Q58 If a, b and c are the roots of $x^3 - 5x + 3 = 0$, then the value of the determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is equal to______.

Q59 Which of the following is NOT correct?

(A) Indirect bandgap SCs are not used for designing of LED.

(B) MOSFET is used as voltage variable resistance in triode region at low V_{DS}.

(C) Due to early effect, current gain of BJT decreases

(D) In reverse bias diode maximum electric field is at junction

Q60 Which of the following statement(s) is/are correct regarding a vector field $\vec{A}$.

(A) $\vec{\nabla}.\vec{A} = 0$, $\vec{A}$ is solenoidal

(B) $\vec{\nabla}^2\vec{A} = 0$, $\vec{A}$ is solenoidal

(C) $\vec{\nabla}\times\left(\vec{\nabla}\times\vec{A}\right) = \vec{\nabla}\left(\vec{\nabla}.\vec{A}\right) - \nabla^2\vec{A}$

(D) $\vec{\nabla}.\left(\vec{\nabla}\times\vec{A}\right) = 0$

Q61 In a n-type MOSFET operating in depletion mode, following information is given:

Surface potential $_s$= 0.45 V

Depletion region width inside substrate W = 10μm

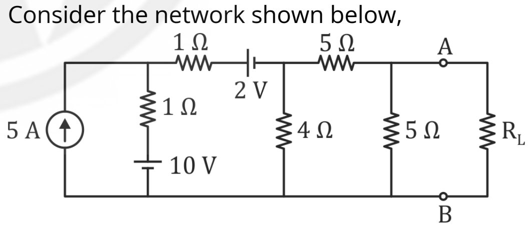
Maximum electric field inside oxide layer will be

Given: $\frac{\epsilon_{Si}}{\epsilon_{SiO_2}} = 2.5$

(A) 0.9 kV/cm (B) 2.25 kV/cm

(C) 0.36 kV/cm (D) None of these

Q62 Consider the network shown below,



The value of norton's current and norton's resistance are

(A) $I_N = 2.53A, R_N = 1.87\Omega$

(B) $I_N = 1.37A, R_N = 2.79\Omega$

(C) $I_N = 2.53A, R_N = 2.79\Omega$

(D) $I_N = 1.37A, R_N = 1.87\Omega$

Q63 A 50 Ω lossless transmission line is terminated in a load impedance $Z_L = R_L + jX_L$. The relation between 'R_L' and 'X_L' in order that the standing wave ratio on the line is 2, is a circle of radius 'R'. The value of 'R' is ________(Ω)

Q64 For a (7, 4) linear block code, the parity check matrix is given by

$$\bar{H} = \begin{bmatrix} 1 & 0 & 0 & \vdots & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & \vdots & 1 & 1 & b & 0 \\ 0 & 0 & 1 & \vdots & 0 & 1 & 1 & a \end{bmatrix}$$

If it is known that "0100011" is a valid codeword for the given code, then the value of 'a' and 'b' are respectively.

(A) 0 and 0
(B) 0 and 1
(C) 1 and 0
(D) 1 and 1

Q65 If the current density given by $\vec{J} = r\hat{a}_r - \sin\theta\,\hat{a}_\theta + 3\hat{a}_\phi$ A/m^2, the magnitude of the current crossing the surface defined by r = 2m, $0 \le \theta \le 90°$, $30° \le \phi \le 60°$ is ____.

Answer Key

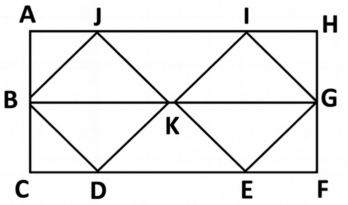
Q1	B
Q2	C
Q3	D
Q4	C
Q5	C
Q6	B
Q7	A
Q8	A
Q9	D
Q10	C
Q11	C
Q12	A
Q13	8~8
Q14	B
Q15	0.44~0.46
Q16	A, C
Q17	C
Q18	D
Q19	A
Q20	A
Q21	D
Q22	2.35~2.4
Q23	D
Q24	C
Q25	A, D
Q26	B
Q27	B
Q28	D
Q29	B, D
Q30	B, C, D
Q31	0.2~0.2
Q32	1.31~1.35
Q33	10~10
Q34	B
Q35	B, C, D
Q36	0.35~0.38
Q37	10~10
Q38	C
Q39	0~0
Q40	3.2~3.2
Q41	125~125
Q42	A
Q43	B, C
Q44	B
Q45	0.45~0.55
Q46	1.6~1.67
Q47	2~2
Q48	1.2~1.3
Q49	A, B
Q50	D
Q51	0.98~1
Q52	B
Q53	1.5~1.6
Q54	D
Q55	410~420
Q56	B
Q57	A, B
Q58	0~0
Q59	C
Q60	A, C, D
Q61	B
Q62	B
Q63	37.3~37.8
Q64	D
Q65	1~1.1

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

Pointing the figure as



The Rectangles are :

ABGH, BCFG, ACFH, BDKJ & KEGI. Total 5.

The Triangles are:

ABJ, BJK, JKI, IKG, IHG, BCD, BDK, KDE, KEG & GEF. Total 10.

Q2 Text Solution:

If the distance between Stations A and B is D km

Train P speed = D/4 (covers in 4 hours i.e. 0800 to 1200)

Train Q speed = D/6 (covers in 6 hours i.e. 0900 to 1500)

To reach the meeting point, Distance covered by Train P + Distance covered by Train Q = Total Distance (D).

Let's say they meet after 'x' hours from 0800.

Thus, x(D/4) + (x-1) (D/6) = D

Or (x/4) + (x-1 / 6) = 1

Or 3x + 2x – 2 = 12

Or 5x = 14

Thus x =14/5 = 2 and 4/5 hours = 2 hours 48 minutes

From 0800, 2 hours 48 minutes = 10:48 hours

Q3 Text Solution:

If top face of 1^{st} die is 2, then second die is 1 (Only 1 case)

If top face of 1^{st} die is 3, then second die is 1 or 2 (2 cases)

If top face of 1^{st} die is 4, then second die is 1 or 2 or 3 (3 cases)

Similarly, If top face of 1^{st} die is 5, then 4 cases

If top face of 1^{st} die is , then 5 cases.

Total 1 + 2 + 3 + 4 + 5 = 15

Q4 Text Solution:

The idiom "live life in the fast lane" means a life filled with excitement   Option C.

Q5 Text Solution:

Lucid means easy to understand, clear, transparent in meaning or thought.

Q6 Text Solution:

As 6 is formed by the product of 3 and 2. Also number of 3's is less as compared to 2's. So, as many 3's those many 6's are formed.

To find in 90!

$\frac{90}{3}$ gives 30

$\frac{30}{3}$ gives 10

$\frac{10}{3}$ gives 3 (whole number)

$\frac{3}{3}$ gives 1

And $\frac{1}{3}$ gives 0 (whole number).

Thus total 30 + 10 + 3 + 1 = 44. Thus 90! has largest factor 6^{44}.

Q7 Text Solution:

If Meera bakes 1 cake in 1 unit time, Rohan bakes ½ cake in $\frac{1}{6}$ unit time.

Or Rohan bakes 1 cake $\frac{2}{6}$ unit time.

Comparing Time taken to do the work

Meera : Rohan = 1 : $\frac{1}{3}$ = 3 : 1

If Rohan takes x days, Meera takes 3x days.

Given that they do together the work in 10 days, i.e. $\left(\frac{1}{x}\right)+\left(\frac{1}{3x}\right)=\frac{1}{10}$

Or $\left(\frac{4}{3x}\right)=\frac{1}{10}$ Or $\frac{3x}{4}$= 10 Or x = $\frac{40}{3}$.

Thus Meera takes $3\left(\frac{40}{3}\right)$ = 40 days.

Q8 Text Solution:

"Although" is a conjunction and must be followed by a subject + finite verb (e.g., "although she had no qualifications").

Here it is incorrectly followed by just the participle "having", so the phrase is ungrammatical.

Correct versions would be:

- "Smitha was offered the job although she had no qualifications."
- "Smitha was offered the job despite having no qualifications.

Q9 Text Solution:

Initial ratio 1 : 4.

Always cutting the longer side.

1^{st} Cut ratio 1 : 2

2^{nd} Cut ratio 1 : 1

3^{rd} cut ratio (any side) 2 : 1.

4^{th} Cut ratio again 1 : 1.

Thus Never it will come again to same ratio 1 : 4.

Q10 Text Solution:

In 30 seconds net cupcakes in display = 1 (2-1)

1 cup cake in 30 seconds

18 cupcakes in 30 × 18 = 540 seconds.

In the next 30 seconds chef adds 2 cupcakes to make it 20.

Thus total earliest time = 540 + 30 = 570 seconds.

Note: The last moment can't be withdrawal as the display holds only 20 cupcakes.

Q11 Text Solution:

$D_t = 1$ (Directivity)

$$E_0 = \frac{\sqrt{30 W_t D_t}}{R} = \frac{\sqrt{30 \times 100 \times 1}}{5} = 10.95\ V/m$$

$$H_0 = \frac{E_0}{\eta} = \frac{10.95}{120\pi}\ A/m = 29.06\ mA/m$$

Q12 Text Solution:

$V^+ = \frac{V_i}{\left(R+\frac{1}{Cs}\right)} \cdot \frac{1}{Cs} = \frac{V_i}{sRC+1}$ ...(i)

$V_0 = \frac{V^+}{R} \cdot \frac{1}{Cs} + V^+ = V^+\left(1+\frac{1}{sRC}\right)$

$V_0 = V^+\left(\frac{sRC+1}{sRC}\right)$ ....(ii)

$\frac{V_0}{V_i} = \frac{1}{sRC}$

It is low pass filter.

Hence, option A is correct.

Q13 Text Solution:

3-input XOR operation is

$y = A \oplus B \oplus C$

For $A \oplus B = P$ 4 NAND gate - 2input

then $y = P \oplus C$ 4NAND gate - 2input

So total 8 NAND gates of 2-input will be required.

Q14 Text Solution:

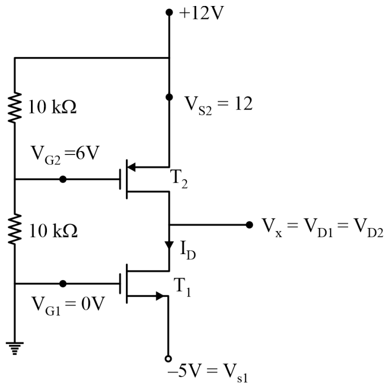
In p-type MOSFET Substrate is n-type and in n-type SC a inversion layer (channel) is created at certain gate to source voltage and majority charge carriers in inversion layer all holes.

Q15 Text Solution:

Given for both MOSFETS, $|V_T|$ = 2V

$k_n'\left(\frac{W}{L}\right) = 0.1\ mA/V^2$

Checking the values of saturation currents of both MOSFETs to find the maximum value of I_D :-



For T_1 (NMOS):-

$V_{G1} = 0V \quad V_{S1} = -5V \quad V_{D1} = V_x\ (\text{Let})$

$(V_{GS})_{T_1} = V_{G1} - V_{S1} = 5V$

Overdrive voltage $(V_{GS} - V_T)_{T_1}$ = 5 – 2 = 3V

$(I_{D1})_{sat} = \frac{1}{2} k_n'\left(\frac{W}{L}\right)(V_{GS} - V_T)^2_{T_1}$

$= \frac{1}{2} \times 0.1 \times 10^{-3} \times 9 = 0.45 mA$

Condition for saturation

$(V_{DS})_{T_1} > (V_{GS} - V_T)_{T_1}$

$\Rightarrow V_x - (-5) > 3 \Rightarrow \boxed{V_x > -2V}$

For T_2 (PMOS) :-

$V_S = 12V, V_G = 6V, V_D = V_x, |V_T| = 2V$

$(V_{SG})_{T_2} = V_S - V_G = 6V$

Overdrive voltage

$(V_{SG} - |V_T|)_{T_2} = 6 - 2 = 4V$

$(I_{D2})_{sat} = \frac{1}{2} k_p'\left(\frac{W}{L}\right)(V_{SG} - |V_T|)^2$

$= \frac{1}{2} \times 0.1 \times 10^{-3} \times 16 = 0.8 mA$

$(I_{D1})_{sat} = 0.45 mA \quad (I_{D2})_{sat} = 0.8 mA$

So, PMOS is capable of supplying more current.

Condition for saturation of T_2 :-

$V_S > (V_{SG} - |V_T|)$

$\Rightarrow 12 - V_x > 4 \Rightarrow \boxed{V_x < 8V}$

As both the devices are connected in series and saturation currents for both are not equal, so they can't be in saturation simultaneously. NMOS saturation current 0.45 mA is much smaller than the saturation current of PMOS, so NMOS forces the current to reduce and hence PMOS must reduce its effective source to drain voltage V_{SD} so that it enters into its triode region.

As source is fixed at V_s = 12V, Voltage at drain of T_2, i.e., V_x will have to increase to reduce V_{SD} (= V_S – V_D).

Triode current euation of PMOS,

$I_{D2} = \frac{1}{2} k_p'\left(\frac{W}{L}\right)\left[2(V_{SG} - |V_T|)V_{SD} - V_{SD}^2\right]$

$= \frac{1}{2} \times 0.1 \times 10^{-3}\left[2 \times 4 \times (12 - V_x) - (12 - V_x)^2\right]$

$= 0.05 \times 10^{-3}(12 - V_x)[8 - 12 + V_x]$

$I_{D2} \Rightarrow 0.05 \times 10^{-3}(12 - V_x)(V_x - 4)$

Equating drain currents of $T_1 \& T_2$ as they are in series

$0.45 \times 10^{-3} = 0.05 \times 10^{-3}\left(12V_x - 48 - V_x^2 + 4V_x\right)$

$\Rightarrow 9 = -V_x^2 + 16V_x - 48$

$\Rightarrow V_x^2 - 16V_x + 57 = 0$

$\Rightarrow V_x = 10.645 \text{ or } V_x = 5.354$

For $V_x = 10.645 = V_{D1} = V_{D2}$,

PMOS T_2 Triode $I_{D2} = 0.45$ mA

NMOS T_1 saturation $I_{D1} = 0.45$ mA

So all conditions are satisfied hence we can say that NMOS works in saturation and limits the value of current to 0.45 mA and PMOS follows this current being in triode region.

So the maximum possible value of drain current I_D is 0.45 mA

Q16 Text Solution:

$x(n) = \cos\left(\frac{\pi n}{2}\right)$

So, $\omega_0 = \frac{\pi}{2}$

Period = $\frac{2\pi}{\frac{\pi}{2}} = 4$ i.e., $N_0 = 4$

So, $x(n) = \frac{1}{2}e^{j\omega_0 n} + \frac{1}{2}e^{-j\omega_0 n}$

$x(n) = \frac{1}{2}e^{j\frac{\pi}{2}n} + \frac{1}{2}e^{-j\frac{\pi}{2}n}$

DTFS $x(n) = \sum_{n=1}^{N_o-1} c_k\, e^{ik\omega_o n}$ ...(1)

So, DTFS indices are:

k = 0, 1, 2, 3

Compare with,

$e^{j\frac{\pi}{2}n} \Rightarrow k = 1$

$e^{-j\frac{\pi}{2}n} \Rightarrow e^{j\left(2\pi - \frac{\pi}{2}\right)n} = e^{j\frac{3\pi}{2}n} \Rightarrow k = 3$

This gives $C_1 = \frac{1}{2}$ and $C_3 = \frac{1}{2}$, both are non-zero quantities.

Q17 Text Solution:

Trivalent impurity conc^n $N_A = \frac{3n_i}{2}$

As trivalent impurity is added therefore it will definitely be p-type SC with

hole conc^n $p = N_A + \Delta p$

& e^- conc^n $n = \Delta n = \Delta p$

According to Mass action law:

$n.p = n_i^2$

$\Delta n\,(N_A + \Delta p) = n_i^2$

$\Delta p\,(N_A + \Delta p) = n_i^2$

$\Delta p^2 + N_A \Delta p - n_i^2 = 0$

$\Delta p^2 + \frac{3}{2}n_i \Delta p - n_i^2 = 0$

$(\Delta p + 2n_i)\left(\Delta p - \frac{n_i}{2}\right) = 0$

$\Delta p = \frac{n_i}{2}, -2n_i$

But –Ve value is not possible so

$\Delta p = n_i/2$

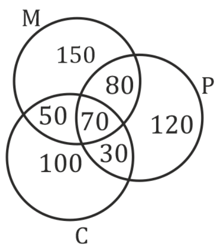
$p = N_A + \Delta p = 2n_i$

$n = \Delta n = \Delta p = \frac{n_i}{2}$

Hence (c) is correct option

Q18 Text Solution:

Total students = 800



No. of students like at least one subject

= No. of students like one subjects + No. of students like two subjects + No. of students like all three subjects

= (150 + 120 + 100) + (50 + 30 + 80) + (70) = 600

No. of students who like none of the subjects = 800 – 600 = 200

Q19 Text Solution:

$x(t) = m(t) + \cos(2\pi f_0 t)$

So $y_1(t) = x^2(t) = m^2(t) + \cos^2(2\pi f_0 t) + 2m(t)\cos(2\pi f_0 t)$

- Since $m(t)$ is a low pass signal $m^2(t)$ will also be low pass signal.
- $\cos^2(2\pi f_0 t)$ Sinusoid of frequency $2f_0$
- $2m(t)\cos(2\pi f_0 t)$ DSBSC at f_0 frequency

Now $y_2(t)$ i.e. output of BPF [centre frequency f_0] when $y_1(t)$ is

Input $y_2(t) = 2m(t)\cos(2\pi f_0 t)$

So $y_3(t) = y_2(t)\,.\cos(2\pi f_0 t)$

$2m(t)\cos^2(2\pi f_0 t)$

$\Rightarrow 2m(t)\frac{(1+\cos(4\pi f_0 t))}{2}$

$m(t) + m(t)\cos(4\pi f_0 t)$

So from $y_3(t)$ the LPF produce $m(t)$ as output

Since output = $m(t)$ so bandwidth of output = W

Q20 Text Solution:

$$\varepsilon_r = 2.25,\quad Z_0 = 300\ \Omega,\quad \gamma = 0.6\ mm$$

$$Z_0 = 120\sqrt{\frac{\mu_r}{\varepsilon_r}}\ln\left(\frac{d}{\gamma}\right)$$

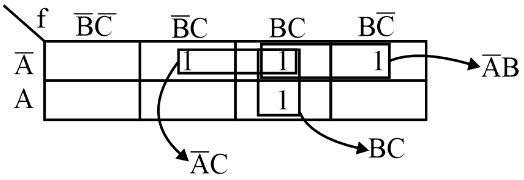
$$\Rightarrow \quad 300 = 120\sqrt{\frac{1}{2.25}}\ln\left(\frac{d}{\gamma}\right)$$

$$\Rightarrow \quad \ln\left(\frac{d}{\gamma}\right) = 3.75 \quad \Rightarrow \quad d = \gamma e^{3.75}$$

$$\Rightarrow \quad d = (e^{3.75} \times 0.6)\ mm = 25.5126\ mm$$

Q21 Text Solution:

Given function is $f(A,B,C) = \overline{A}B + \overline{A}C + BC$. KMap of f will be



So in final simplication we get three pairs and result will be $f(A,B,C) = \overline{A}B + \overline{A}C + BC$

Q22 Text Solution:

From the given root locus diagram, the OLTF can be written as, G(s)H(s) = $\frac{k}{s(s+3-j)(s+3+j)}$

(k = dc gain, s = 0 and –3 ± j are poles).

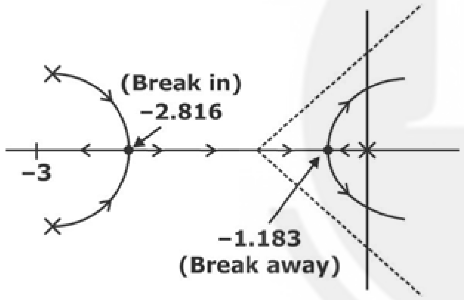
Characteristic equation is, 1 + G(s) H(s) = 0

k + s (s^2 + 6s + 10) = 0

For break point, $\frac{dk}{ds} = 0 \quad \Rightarrow \quad \frac{dk}{ds}$ = $3s^2$ + 12s + 10 = 0

s = –1.183, –2.816

The root locus is as shown



$$\frac{\text{Break in point}}{\text{Break away point}} = \frac{2.816}{1.183} = 2.38$$

Q23 Text Solution:

X(t) and *Y*(t) are orthogonal so $\overline{X(t)Y(t)} = 0$

So *u*(*t*) = *X*(*t*) + *Y*(*t*)

Now,

$R_U(\tau) = \overline{u(t)u(t-\tau)}$

$\overline{(X(t)+Y(t))(X(t-\tau)+Y(t-\tau))}$

$= \overline{X(t)X(t-\tau)} + \overline{Y(t)Y(t-\tau)}$

$R_u(\tau) = R_X(\tau) + R_Y(\tau)$

So, *V*(*t*) = 2*X*(*t*) + 3*Y*(*t*)

Now,

$R_V(\tau) = \overline{V(t)V(t-\tau)}$

$= \overline{(2X(t)3Y(t))(2X(t-\tau)+3Y(t-\tau))}$

$= \overline{4X(t)X(t-\tau)} + \overline{9Y(t)Y(t-\tau)}$

$R_u(\tau) = 4R_X(\tau) + 9R_Y(\tau)$

$R_{UV}(\tau) = \overline{u(t).\, v(t-\tau)}$

$= \overline{(X(t)+Y(t))(2X(t-\tau)+3Y(t-\tau))}$

$R_{UV}(\tau) = 2R_X(\tau) + 3R_Y(\tau)$

Q24 Text Solution:

$F = \overline{x}y + x\overline{y}\,\overline{z} + xy\,\overline{z}$

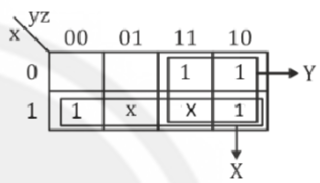
$= \overline{x}y(z + \overline{z}) + x\overline{y}\,\overline{z} + xy\,\overline{z}$

$= \overline{x}yz + \overline{x}y\overline{z} + x\overline{y}\,\overline{z} + xy\,\overline{z}$

As given x = z = 1, then it will show don't care about the truth table: -

x	y	z	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	×
1	1	0	1
1	1	1	×

K-map:-



F = x + y

Q25 Text Solution:

If message is m(t) then DSBSC is m(t) cos ω_ct

When message is m_1(t) then

DSBSC⇒y_1(t) = m_1(t) cos ω_ct

When message is m_2(t) then

DSBSC ⇒ y_2(t) = m_2(t) cos w_ct

FM signal will be

$A_c \cos\left(\omega_c t + 2\pi K_F \int m(\tau)d\tau\right)$

FM signal for m1(t) message

$y_1(t) = A_c \cos\left(\omega_c t + 2\pi K_F \int m_1(\tau)d\tau\right)$

FM signal for m_2(t) message

$y_2(t) = A_c \cos\left(\omega_c t + 2\pi K_F \int m_2(\tau)d\tau\right)$

New message is m_1(t) + m_2(t) the DSBSC signal will be

= [m_1(t) + m_2(t)] cos ω_ct

= y_1(t) + y_2(t)

If message is m_1(t) + m_2(t) then

FM signal ⇒ $A_c \cos\left(\omega_c t + 2\pi K_F \int m_1(\tau)+m_2(\tau)dt\right)$

≠ y_1(t) + y_2(t)

Q26 Text Solution:

$\varepsilon_r = 1, \quad \mu_r = 1$ (Air filled)

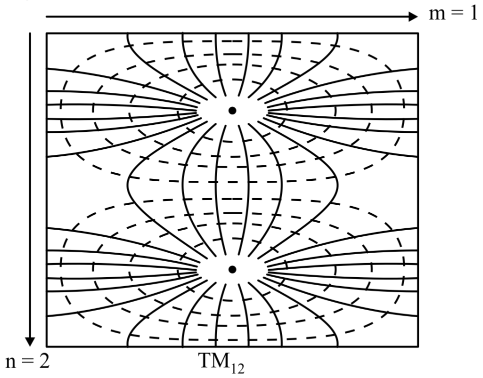
f = 10 GHz, TE_{10} = Dominant mode

$$f = 1.25 f_{C_{10}} = 1.25 \frac{C_0}{Za}$$

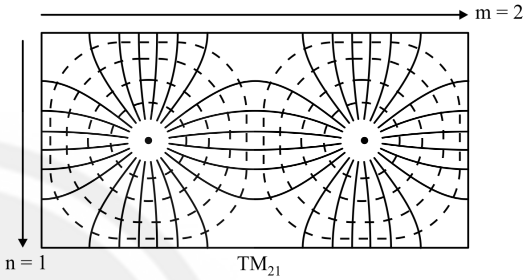
$$a = \frac{1.25 \times 3 \times 10^8}{2 \times 10^{10}} m = 1.875\ cm$$

Q27 Text Solution:

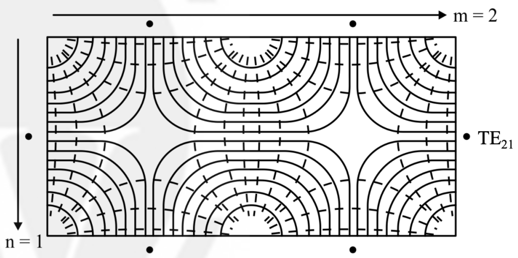
Option (a)



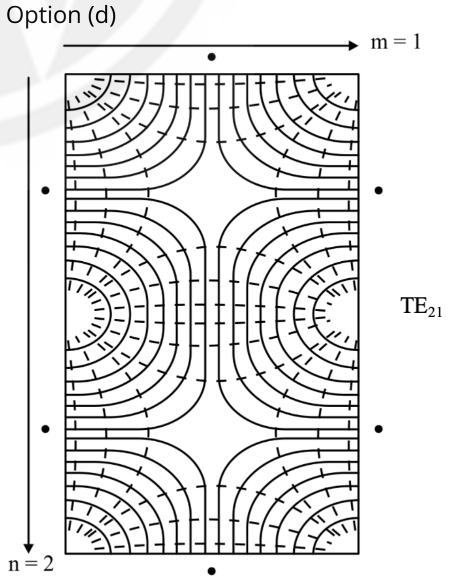
Option (b)



Option (c)



Option (d)



Q28 Text Solution:

$L = \lim_{x\to 0}\left(\frac{1}{x}\right)^{\tan x}$

Take log both side

$\ln L = \lim_{x\to 0} \tan x\left(-\ln x\right) = \lim_{x\to 0}\frac{-\ln x}{\cot x}, \ \left(\frac{\infty}{\infty}\right)\text{form}$

using L'hospital rule

$\lim_{x\to 0}\frac{-\frac{1}{x}}{-\cos ec^2 x} = \lim_{x\to 0}\left(\frac{\sin^2 x}{x}\right) = \lim_{x\to 0}\left(\frac{\sin x}{x}\cdot \sin x\right) = 0$

$\ln L = 0$

$L = e^0 = 1$

Q29 Text Solution:

Using the formula:

$I_{(max)} = I_{Z(max)} + I_{L(min)}$

$I_{(min)} = I_{Z(min)} + I_{L(max)}$

For the Zener diode to operate in worst case condition,

$I_{(max)} = \frac{18-8}{100} = \frac{10}{100}$ = 100 mA = $I_{Z(max)}$

$P_{Z(max)} = V_Z I_{Z(max)}$ = 100 × 8 = 800 mW

Hence, option b,d is correct.

Q30 Text Solution:

A demultiplexer selects one of many outputs, whereas a decoder selects an output corresponding to the coded input hence a demultiplexer can be used as a decoder.

Duality can be obtained of any expression by just interchanging the operator [•, +].

If any identity (0 or 1) is present in the expression, then interchange 0 by 1 and 1 by 0.

The input to output pin ratio of a multiplexer with n control inputs is $2^n : 1$.

Q31 Text Solution:

Let X(z) = log(1 – 5z)

$\frac{dX(z)}{dz} = \frac{-5}{1-5z}$

$\frac{-z\, dx(z)}{dz} = \frac{5z}{1-5z} = \frac{-5z}{5z-1} = \frac{-1}{1-\frac{1}{5}z^{-1}}$

Applying the Inverse Z-transform,

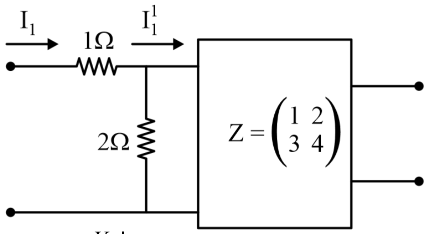
nX(n) = $\left(\frac{1}{5}\right)^n u\left(-n-1\right)$ since $|z| < \frac{1}{5}$

So, X(n) = $\frac{\left(\frac{1}{5}\right)^n u\left(-n-1\right)}{n}$

So, $\alpha = \frac{1}{5};\ \beta = +1$

So, $\alpha\beta = \frac{1}{5}$ = 0.2

Q32 Text Solution:



$Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0}$

$V_1 = V_1^1 = -2I_1^1 = 1\times I_1^1 + 2I_2$

$-3I_1^1 = 2I_2$

$\boxed{I_1^1 = \frac{-2}{3}I_2}$

$V_1 = Z_{11} I_1 + Z_{12} I_2$

$V_2 = Z_{21} I_1 + Z_{22} I_2$

$\begin{bmatrix}V_1\\V_2\end{bmatrix} = \begin{bmatrix}Z_{11} & Z_{12}\\ Z_{21} & Z_{22}\end{bmatrix}\begin{bmatrix}I_1\\I_2\end{bmatrix}$

$Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0} = \left(-2\right)\times\frac{-2}{3} = \frac{4}{3}$

$Z_{12} = \frac{4}{3} = 1.33\ \Omega$

Q33 Text Solution:

At no applied bias, diode remains at equilibrium with net current I = 0.

At equilibrium diffusion current flows from p to n direction & drift current flows from n to p direction where $I_{drift} = I_0$

$I_{diff} + I_{drift} = 0$

$I_{diff} = -I_{drift} = -I_0$ (–Ve sign signifies that current is from p to n (where I_{drift} is from n to p).

$I_{diff} = 10^{-8}$ A from p to n

I_{diff} = 10 nA from p to n

Q34 Text Solution:

We know that,

$\text{sgn}\left(t\right) \rightleftharpoons \frac{2}{j\omega}$

By using the duality property:

$\frac{2}{jt} \rightleftharpoons 2\pi\times sgn\left(-\omega\right)$

$\frac{1}{\pi t} \rightleftharpoons jsgn\left(-\omega\right)$

sgn(ω) is an odd function, then sgn(–ω) = –sgn(ω)

$\because\ \frac{1}{\pi t} \rightleftharpoons -j\,sgn\left(\omega\right)$

$\because\ h\left(t\right) = \frac{1}{\pi t} \rightleftharpoons -j\,sgn\left(\omega\right) = H\left(\omega\right)$

$h\left(t\right) = \frac{1}{\pi t}$

Q35 Text Solution:

1. $\text{Var}\left(aX\right) = a^2\left(\text{Var}\left(X\right)\right)$

2. for independent X and Y

$\text{Var}(aX \pm bY) = a^2\text{Var}(X) + b^2\text{Var}(Y)$

(A) $\text{Var}(2X) = 2^2\times\text{Var}(X) = 4\times 4 = 16$

(B)

$\text{Var}(X-Y) = \text{Var}(X) + \text{Var}(Y) = 4+9 = 13$

(C)

$\text{Var}(2X+3Y) = 2^2\text{Var}(X) + 3^2\text{Var}(Y) = 4\times 4 + 9\times 9 = 97$

(D)

$\text{Var}\left(\frac{Y}{3}\right) = \text{Var}\left(\frac{1}{3}Y\right) = \left(\frac{1}{3}\right)^2\text{Var}Y = \frac{1}{9}\times 9 = 1$

Q36 Text Solution:

$S = \frac{1}{2} - \frac{1}{6} + \frac{1}{24} - \frac{1}{120} + ...$

$= \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \frac{1}{5!} + ...$

$= 1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \frac{1}{5!} + ...$

$= e^{-x}\big|_{x=1} = e^{-1} = 0.3678 \approx 0.368$

Q37 Text Solution:

Given:

x + y + 5z = 3

x + 2y + 2z = 5

2x + 4y + 4z = k

A X= B

$[A|B] = \begin{bmatrix} 1 & 1 & 5 & 3 \\ 1 & 2 & 2 & 5 \\ 2 & 4 & 4 & k \end{bmatrix}$

For the system to have infinitely many solutions,

Rank(A) = Rank(A|B) < 3

All 3 × 3 minors of [A|B] should be zero.

consider a 3 × 3 minor of [A|B]

$\begin{vmatrix} 1 & 5 & 3 \\ 2 & 2 & 5 \\ 4 & 4 & k \end{vmatrix} = 0$

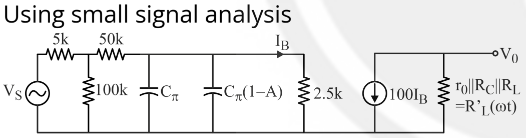
1(2k – 20) – 5(2k – 20) + 3 (0) = 0

2k – 20 = 0

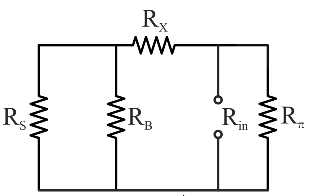
k = 10

Q38 Text Solution:

Using small signal analysis



where R'_L = (100k) || 8k || 5k = 2.98 kΩ



$A = \frac{V_0}{V_\pi} = \frac{-\beta I_B R'_L}{I_B r_\pi} = \frac{-100 \times 2.98\ k\Omega}{2.5\ k\Omega} = -119.4$

$C_{eq} = C_\pi + C_\mu(1 - A) = 7 + 1(1 + 119.4) = 127.4$ pF

$R'_m = [[R_s || R_B) + R_x] || R_\pi = 1.64$ kΩ

$f_H = \frac{1}{2\pi R_{in} C_{eq}} = 762.1$ kHz

Q39 Text Solution:

$$x(n) \overset{DTFT}{\longleftrightarrow} X(e^{j\omega})$$

$$x(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x(n)\, e^{-j\omega_n}$$

$$x(e^{j0}) = \sum_{n=-\infty}^{\infty} x(n)$$

Since $nX(n) \overset{DTFT}{\longleftrightarrow} j\frac{dX(e^{j\omega})}{d\omega}$

or $j\frac{dX(e^{j\omega})}{d\omega} = \sum_{n=-\infty}^{\infty} nX(n)\, e^{-j\omega_n}$

or $j\frac{dX(e^{j\omega})}{d\omega}\Big|_{\omega=0} = \sum_{n=-\infty}^{\infty} n X(n)$

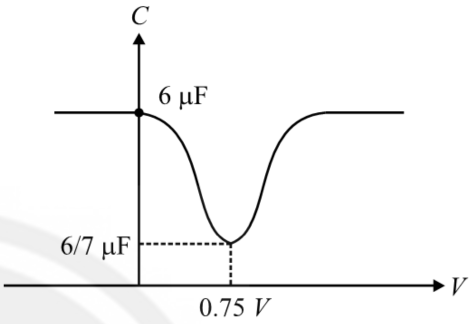
So, $A = \frac{j\frac{dX(e^{j\omega})}{d\omega}\Big|_{\omega=0}}{X(e^{j0})}$

From graph given, $\frac{dX(e^{j\omega})}{d\omega}\Big|_{\omega=0} = 0$ and $X(e^{j0})$ = 1

So, $A = \frac{0}{1} = 0$

Q40 Text Solution:

Lets draw the C-V characteristic:



From characteristic

C_{Max} = 6 μF = C_{ox}

$$C_{Min} = \frac{6}{7}\mu F$$

= C_{ox} in series with $(C_{dep})_{min}$

$(C_{dep})_{min}$ = 1 μF

$$\frac{\in A}{W_{Max}} = 1\mu F = 10^{-6}\ F$$

$$\frac{\in}{W_{Max}} = \frac{10^{-6} F}{A} = \frac{10^{-6}\ F}{1\ cm^2} = 10^{-6}\ F/cm^2$$

E_{Max} at surface =

$$\frac{q}{\in} N_S . W_{Max}$$

$$= \frac{q}{\left(\frac{\in}{W_{Max}}\right)} . N_S = \frac{1.6 \times 10^{-19}}{10^{-6}} \times 2 \times 10^{16}$$

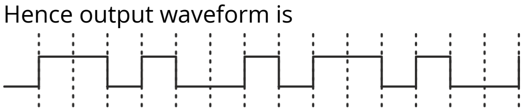
$E_{Max} = 3.2 \times 10^3$ V/cm = 3.2 KV/cm

Q41 Text Solution:

For An EX-NOR gate output is high when

Both inputs are same i.e. both 0 and both 1,

Hence output waveform is



The output Y is repeating itself after 8μsec

Hence, T_0 = 8 μsec

$$f = \frac{1}{T_0} = \frac{1}{8\mu} = 125\ \text{kHz}$$

Q42 Text Solution:

To calculate average power of V_2 we have to find PSD of O/P

$PSD_{O/P} = PSD_{I/P}.|H(\omega)|^2$

We can see that $H(\omega) = \frac{R}{R+j\omega L}$

So,

$$PSD_0 = \frac{N_0}{2}.\left(\frac{R^2}{R^2+4\pi^2 f^2 L^2}\right)$$

$$P_{avg} = \int_{-\infty}^{\infty} PSD_0\, df$$

$$= \frac{N_0}{2} R^2 \int_{-\infty}^{\infty} \frac{1}{R^2+4\pi^2 f^2 L^2} df$$

$$= \frac{N_0}{2} \frac{R^2}{4\pi^2 L^2} \int_{-\infty}^{\infty} \frac{1}{\frac{R^2}{4\pi^2 L^2}+f^2}$$

$$= \frac{N_0}{2} \frac{R^2}{4\pi^2 L^2} \frac{1}{R/2\pi L}\left[\left(\tan^{-1}\frac{f}{R/2\pi L}\right)_{-\infty}^{\infty}\right]$$

$$\Rightarrow \frac{N_0}{2}.\frac{R}{2\pi L}(\pi)$$

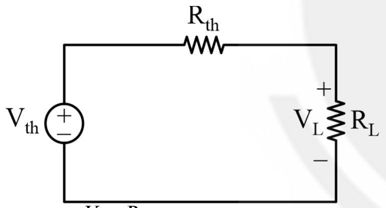
$$\Rightarrow \frac{N_0 R}{4L}$$

Q43 Text Solution:

For maximum power transfer,

$R_L = R_{th} = 10\Omega$

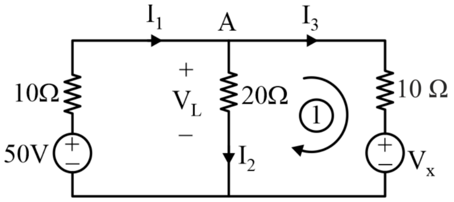
$V_{th} = 50V$



$$V_L = \frac{V_{th}\times R_L}{R_L+R_{th}}$$

$$V_L = \frac{50\times10}{10+10} = 25V$$

Now in circuit,



Voltage across 20Ω resistor = V_L = 25V

$$I_1 = \frac{50-V_L}{10} = \frac{50-25}{10} = 2.5\ A$$

$$I_2 = \frac{V_L}{20} = \frac{25}{20} = 1.25\ A$$

KCL at node A,

$I_3 = I_1 - I_2 = 2.5 - 1.25 = 1.25$ A

KVL in loop (1)

$-V_L + 10I_3 + V_x = 0$

$-25 + 10(1.25) + V_x = 0$

$V_x = 12.5$ V

Q44 Text Solution:

Let $\frac{Y(s)}{U(s)} = \frac{10(s+3)}{(s^3+6s^2+11s+6)} \cdot \frac{X(s)}{X(s)}$

Then, Y(s) = (s + 3) X(s) ...(i)

$10U(s) = (s^3 + 6s^2 + 11s + 6)\ X(s)$ ...(ii)

From inverse Laplace transform,

$$\frac{d^3x(t)}{dt} + 6\frac{d^2x(t)}{dt^2} + 11\frac{dx(t)}{dt} + 6x\left(t\right) = 10u(t)$$ ...(iii)

Let $x = x_1 \Rightarrow \dot{x}_1 = x_2 \Rightarrow \dot{x}_2 = x_3$

So, from equation (iii),

$\dot{x}_3 + 6\dot{x}_2 + 11\dot{x}_1 + 6x_1 = 10u(t)$ ...(iv)

$= -6x_1(t) - 11x_2(t) - 6x_3(t) + 10u(t)$

$\dot{x}_2 = x_1$

$\dot{x}_1 = x_1$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$$

Also, Y(s) = (s + 3) X(s)

$y(t) = +3x_1 = x_2 + 3x_1$

$y(t) = 3x_1(t) + x_2(t) + 0.x_3(t)$

$C = [3\ 1\ 0] = [C_1\ C_2\ C_3]$

$$\frac{b_1+C_1}{b_2+C_2} = \frac{0+3}{0+1} = 3.0$$

Q45 Text Solution:

Given, $x_1(t) = te^{-|t|}$

$e^{-|t|} = e^{-t}u(t) + e^{t}u(-t)$

$$e^{-|t|} \overset{FT}{\leftrightarrow} \frac{1}{1+j\omega} + \frac{1}{1-j\omega} = \frac{2}{1+\omega^2}$$

$$t\,x\left(t\right) \overset{FT}{\leftrightarrow} j\frac{d}{d\omega}X(\omega)$$

$$j\frac{d}{d\omega}\left(\frac{2}{1+\omega^2}\right) = \frac{-4j\omega}{(1+\omega^2)^2}$$

$$X_1(\omega) = \frac{-4j\omega}{(1+\omega^2)^2}$$ ...(i)

Also, $x_2(t) = \frac{t}{(1+t^2)^2}$

$$e^{-|t|} \overset{FT}{\leftrightarrow} \frac{2}{1+\omega^2}$$

$$te^{-|t|} \overset{FT}{\leftrightarrow} \frac{-j4\omega}{(1+\omega^2)^2}$$

By the duality property,

$$x(t) \overset{FT}{\leftrightarrow} X(\omega)$$

$$x(t) \overset{FT}{\leftrightarrow} 2\pi\ X(-\omega)$$

$$\frac{-4jt}{(1+t^2)^2} \overset{FT}{\leftrightarrow} 2\pi(-\omega)\ e^{-|\omega|}$$

Or $x_2(t) = \frac{t}{(1+t^2)^2} \overset{FT}{\leftrightarrow} \frac{2\pi}{4j} \times \omega \times e^{-|\omega|}$

$X_2(\omega) = -\frac{\pi}{2}\ j\omega e^{-|\omega|}$

$$\frac{X_1(\omega)}{X_2(\omega)} = \frac{-4j\omega}{(1+\omega^2)^2} \times \frac{1}{\frac{-\pi}{2}j\omega e^{-|\omega|}} = \frac{8}{\pi}\ \frac{1}{(1+\omega^2)^2} \times \frac{1}{e^{-|\omega|}}$$

At ω = π

$\frac{8}{\pi} \times \frac{1}{(1+\pi^2)^2} \times \frac{1}{e^{-\pi}} = 0.4987 \approx 0.50$

Q46 Text Solution:

Given:

$L^{-1}\left\{\frac{s+3}{s^2-4s+13}\right\} = e^{2t} \cdot \cos 3t + \alpha \cdot e^{2t} \cdot \sin 3t$

$\Rightarrow$

$\frac{s+3}{s^2-4s+13} = L\left\{e^{2t} \cdot \cos 3t\right\} + \alpha \cdot L\left\{e^{2t} \cdot \sin 3t\right\}$

$\because L\left\{\sin \ at\right\} = \frac{a}{s^2+a^2}$

$\Rightarrow L\left\{e^{bt} \cdot \sin \ at\right\} = \frac{a}{(s-b)^2+a^2}$

Similarly

$L\left\{e^{bt} \cdot \cos \ at\right\} = \frac{s-b}{(s-b)^2+a^2}$

$\therefore \frac{s+3}{(s-2)^2+9} = \frac{s-2}{(s-2)^2+9} + \frac{\alpha \cdot (3)}{(s-2)^2+9}$

$\Rightarrow \frac{s+3}{(s-2)^2+9} = \frac{s+(3\alpha-2)}{(s-2)^2+9}$

$\Rightarrow 3 = 3\alpha - 2$

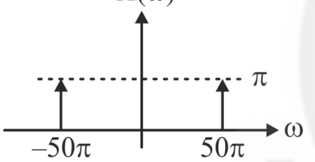
$\Rightarrow \alpha = \frac{5}{3} = 1.667$

$\therefore \alpha = 1.667$

Q47 Text Solution:

Sampling frequency (ω_s) =

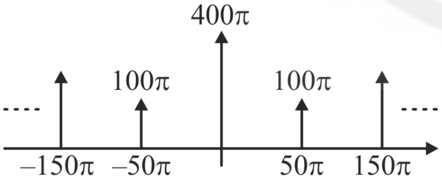
$\frac{2\pi}{T_s} = \frac{2\pi}{0.01} = 200\pi \ \text{rad/sec}$



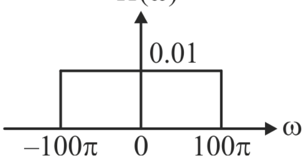
Output of samples $X_s(\omega)$ =

$\frac{1}{T_s} \sum_{n=-\infty}^{\infty} X(\omega - 100)$

$= 100 \sum_{n=-\infty}^{\infty} X(\omega - 200\pi n)$



$\Downarrow$



So, $Y(\omega)$ = $X(\omega)H(\omega)$ =

$4\pi\delta(\omega) + \pi[\delta(\omega + 50\pi) + \delta(\omega - 50\pi)]$

Gives y(t) after using inverse Fourier transform,

y(t) = 2 + cos(500t)

Therefore, A = 2

Q48 Text Solution:

We know that 20 dB/decade = 6 dB/octave

So, '2' poles at origin 1 zero at ω_1 = 2 rad/sec, 1 pole at ω_2 = 20 rad/sec

(Initial slope = –40 dB/dec)

$T(s) = \frac{k\left(1+\frac{s}{2}\right)}{s^2\left(1+\frac{s}{20}\right)}$

At ω_1 = 2, magnitude = 0 dB

from approximate Bode analysis,

Gain at (ω_0) = 0 dB = 20 log(k) + slope × log(ω_0)

$(\omega_0$ = 2 rad/sec)

0 = 20 log k – 40 log2

k = 4

So, $T(s) = \frac{4\left(1+\frac{s}{2}\right)}{s^2\left(1+\frac{s}{20}\right)}$ = G(s) for an input $\frac{5t^2}{2}u\left(t\right)$

e_{ss} for $\frac{\lambda t^2}{2}u\left(t\right) = \frac{\lambda}{k_a}$ where, k_a = $\lim_{s\to 0} s^2 G\left(s\right)$

$k_a = \lim_{s\to 0} s^2 \times \frac{4}{s^2} \frac{\left(1+\frac{s}{2}\right)}{\left(1+\frac{s}{20}\right)} = 4$

So, for $\frac{5t^2}{2} u\left(t\right)$ $e_{ss} = \frac{5\times 1}{k_a} = \frac{5}{4}$= 1.25

Q49 Text Solution:

$\frac{V_0}{V_{in}} = \frac{\left(-R_2 \| \frac{1}{sC}\right)}{R_1} = \frac{-R_2/R_1}{1+sR_2C} = \frac{-R_2/R_1}{1+j\omega CR_2}$

If $\omega >> \frac{1}{R_2C}$;

$\frac{V_0}{V_{in}} = \frac{-R_2/R_1}{1+j\omega CR_2} = \frac{-R_2/R_1}{1+j\omega/(1/R_2C)}$

For $\omega >> \frac{1}{R_2C}$; $\left[\omega/\left(1/R_2C\right)\right] >>> 1$, so gain can be approximated to

$\frac{V_0}{V_{in}} = \frac{\left(-\frac{R_2}{R_1}\right)}{j\omega \ R_2C} = \frac{-1}{j\omega R_1 C}$

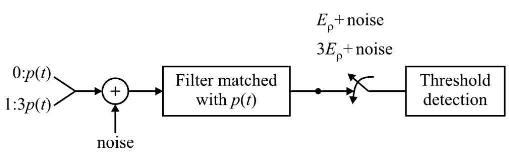
Or $V_0 = \frac{-1}{R_1C} \int V_{in} dt$ acts as integrator.

If $\omega << \frac{1}{R_2C}$;

$\frac{V_0}{V_{in}} = \frac{\left(-\frac{R_2}{R_1}\right)}{1}$

Or $\left|\frac{V_0}{V_{in}}\right| = \frac{R_2}{R_1} \Rightarrow V_0 = \left(\frac{R_2}{R_1}\right)V_{in}$ acts as amplifier.

Q50 Text Solution:

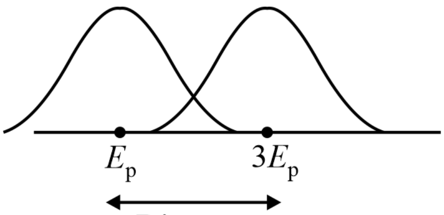


Noise at input of match filter has Variance $\frac{N_0}{2}$

Noise at output of match filter has Variance $\frac{N_0}{2} E_p$

At input of threshold device E_ρ + noise (gaussian noise at E_ρ)

3 E_ρ + noise (gaussian noise at 3 E_ρ)



$P_e = Q\left(\frac{d/2}{\sigma}\right)$

$= Q\left(\frac{2E_{p/2}}{\sqrt{\frac{N_0}{2}\varepsilon_p}}\right)$

$= Q\left(\sqrt{\frac{2E_p}{N_0}}\right)$

Now bit 0 $p(t)$ energy E_p

bit 1 $3p(t)$ energy 9 E_p

So average bit energy

$E_b = \frac{E_p+9E_p}{2}$

$E_b \Rightarrow 5E_p$

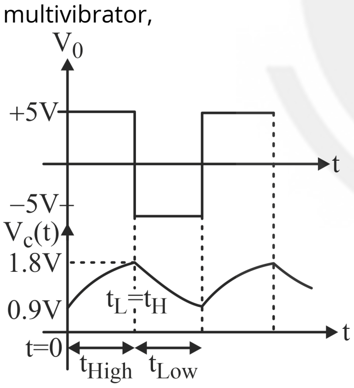
So Pe $= Q\left(\sqrt{\frac{2E_{b/5}}{N_0}}\right)$

Q51 Text Solution:

Given, V_{LT} = 0.9V, V_{UT} = 1.8V

C = 0.4 μF, R = 10k, $\pm V_{sat}$ = ±5V

The circuit is behaving as a astable multivibrator,



To find t_{High},

Assume t = 0 and t = t_H as shown,

$V_c(0^+)$ = 0.9V, $V_c(\infty)$ = +5V

$V_c(t_{High})$ = 1.8V

$V_c(t) = V_c(\infty) + [V_c(0^+) - V_c(\infty)]\, e^{-t/\tau}$

= RC = $10^4 \times 0.4 \times 10^{-6} = 0.4 \times 10^{-2}$ sec.

$V_c(t_{High}) = 5 + (0.9 - 5)\, e^{-t/RC}$

$1.8 = 5 - 4.1e^{-t/RC}$

$e^{-t_H/RC}$ = 0.7805 $\quad -t_H/RC = \ln(0.7805) =$ -0.2478

t_H = 0.2478 × 4 msec

t_H = 0.9913 msec

Q52 Text Solution:

So we know that Pe = $\theta\left(\frac{d/2}{\sigma}\right)$

d Distance b/w the symbols in constellation diagram

σ Standard deviation of noise

d From diagram S_1 (1, 1) and S_0 (−1, −1)

$d = \sqrt{2^2 + 2^2} \Rightarrow \sqrt{8}$

Variance of noise $(\sigma^2) = \frac{1}{2}$

So $\sigma = 1/\sqrt{2}$

So $P_e = Q\left(\frac{\sqrt{8}}{2} \Big/ 1/\sqrt{2}\right)$

Q(2)

Q53 Text Solution:

Given: DE is $(D^2 + 1)$ y = sin t

A.E: $D^2 + 1 = 0$

$D = \pm i$

$\Rightarrow y_c = c_1\cos t + c_2 \sin t$

$PI: (y_p) = \frac{1}{D^2+1}\sin(t) \qquad D^2 \ -1^2$

$= \frac{1}{-1+1}\sin(t)$ (Denominator = 0)

$= \frac{t}{2D}\sin t = \frac{t}{2}(-\cos t) = -\frac{t}{2}\cos t$

$y = y_c + y_P$

$y = c_1\cos t + c_2 \sin t - \frac{t}{2}\cos t$

$y(0) = c_1 \times 1 + 0 - 0$

$\Rightarrow \boxed{0 = c_1}$

$y' = -c_1 \sin t + c_2 \cos t - \frac{1}{2}\cos t - \frac{t}{2}(-\sin t)$

$y'(0) = -0 + c_2 - \frac{1}{2}$

$0 = c_2 - \frac{1}{2}$

$\Rightarrow \boxed{c_2 = \frac{1}{2}}$

$y = \frac{1}{2}\sin t - \frac{t}{2}\cos t$

$y(\pi) = \frac{1}{2}\sin\pi - \frac{\pi}{2}\cos\pi = \frac{\pi}{2} = 1.57$

Q54 Text Solution:

$Q_{n+1} = D = \overline{X}\, Q_n + Y\, \overline{Q_n} \quad (Z = Q_n)$

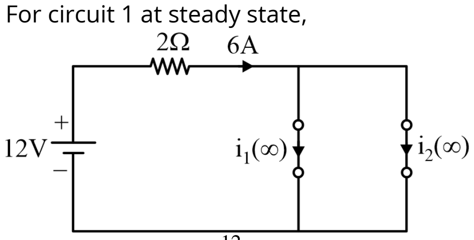
Comparing with characteristic equation of JK-FF,

$Q_{n+1} = J\, \overline{Q_n} + \overline{K}\, Q_n$

$X = K,\ Y = J$

Q55 Text Solution:

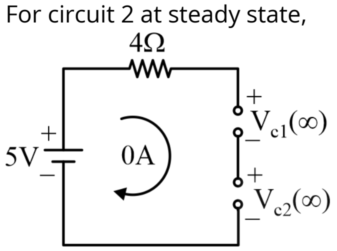
For circuit 1 at steady state,



$I(\infty) = i_1(\infty) + i_2(\infty) = \frac{12}{2} = 6A$

From current divisions $i_1(\infty) = 6 \times \frac{2}{2+1} = \frac{12}{3} =$ 4A

For circuit 2 at steady state,



From voltage division

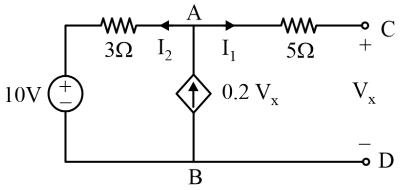
Rule, $V_{c2}(\infty) = 5 \times \frac{3}{3+6}$

$V_{c2}(\infty) = \frac{15}{9} = \frac{5}{3}V$

$\frac{V_{c2}(\infty)}{i_1(\infty)} = \frac{5}{3} \times \frac{1}{4} = \frac{5}{12}\Omega = 416.67\ m\Omega$

Q56 Text Solution:

Calculation for V_{th}



$V_{th} = V_x$

$I_1 = 0$ [open circuit]

$I_2 = 0.2\ V_x$

$V_{AB} = V_x = V_{th}$

Apply KVL in left loop,

$-V_x + 3I_2 + 10 = 0$ ....(1)

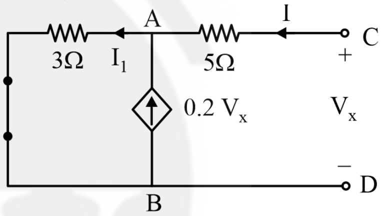
Put I_2 in equation (1)

$-Vx + 3(0.2V_x) + 10 = 0$

$V_x = 25V$ $V_{th} = 25V$

Calculation for R_{th}

Voltage source short circuit



KCL at Node A,

$I_1 = 0.2V_x + I$

Apply KVL in total loop,

$-V_x + 5I + 3(I_1) = 0$

$-V_x + 5I + 3\ (0.2V_x + I) = 0$ [$I_1 = 0.2\ V_x + I$]

$-V_x + 5I + 0.6V_x + 3I = 0$

$-\ 0.4V_x + 8I = 0$

$0.4V_x = 8I$

$R_{th} = \frac{V_x}{I} = \frac{8}{0.4} = 20\Omega$

Q57 Text Solution:

$$\frac{Y(s)}{R(s)} = \frac{\frac{2}{(s^3+5s^2+6s+3)}\left(\frac{K_P s+K_i}{s}\right)}{1+\frac{2(K_P s+K_i)}{s^4+5s^3+6s^2+3s}}$$

$$\frac{Y(s)}{R(s)} = \frac{2K_P s+2K_i}{s^4+5s^3+6s^2+(3+2K_P)s+2K_i}$$

Characteristic Equation:

$s^4 + 5s^3 + 6s^2 + (3 + 2K_P)s + 2K_i = 0$

$$\begin{array}{c|cc} s^4 & 1 & 6 \\ s^3 & 5 & (3+2K_P) \\ s^2 & \frac{(30-3-2K_P)}{5} & 2K_i \\ s^1 & \frac{\left(\frac{27-2K_P}{5}\right)(3+2K_P)-10K_i}{\left(\frac{27-2K_P}{5}\right)} & 0 \\ s^0 & 2K_i & 0 \end{array}$$

$2K_i > 0 \quad K_i > 0$ ...(1)

$27 - 2K_P > 0 \quad K_P < 13.5$ ...(2)

$$\frac{\left(\frac{27-2K_P}{5}\right)(3+2K_P)-10K_i}{\left(\frac{27-2K_P}{5}\right)} = (3+2K_P) - \frac{50K_i}{27-2K_i} > 0$$

$$(3+2K_P) > \frac{50K_i}{27-2K_i}$$

$81 - 6K_P + 54K_P - 4K_P^2 > 50K_i$

$-4K_P^2 + 48K_P + 81 > 50K_i$

$K_i < \frac{-4K_P^2+48K_P+81}{50}$

$\frac{dK_i}{dK_P} = -8K_P + 48 = 0$

$K_P = 6$

Therefore, $K_i = 4.5$

Hence, option A and B both are correct.

Q58 Text Solution:

$x^3 - 5x + 3 = 0$

As sum of the root is $\left(\frac{-b}{a}\right)$

So, $a + b + c = \frac{0}{1} = 0$

$$\because \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$$

$c_1 \to c_1 + c_2 + c_3$

$$\Rightarrow \begin{vmatrix} a+b+c & b & c \\ a+b+c & c & a \\ a+b+c & a & b \end{vmatrix}$$

$$\Rightarrow \left(a+b+c\right) \begin{vmatrix} 1 & b & c \\ 1 & c & a \\ 1 & a & b \end{vmatrix}$$

$\Rightarrow 0$

Q59 Text Solution:

Due to Early effect:

(i) I_E

(ii) I_C

(iii) α, β & γ

Thus (c) is not correct option.

Q60 Text Solution:

For solenoidal $\vec{\nabla} \cdot \vec{A} = 0$

For Harmonic $\nabla^2 \vec{A} = \vec{0}$

$$\vec{\nabla} \times \left(\vec{\nabla} \times \vec{A}\right) = \vec{\nabla}\left(\vec{\nabla} \cdot \vec{A}\right) - \nabla^2 \vec{A}$$

$$\vec{\nabla}\left(\vec{\nabla} \times \vec{A}\right) = 0$$

Q61 Text Solution:

Maximum electric field at surface inside substrate is

$$E_0 = \frac{2\phi_s}{W} = \frac{2 \times 0.45}{10\mu m} = \frac{0.9}{10 \times 10^{-4}\ cm} = 900\ V/cm$$

From continuity equation

$E_2 \in_{SiO_2} = E_1 \in_{Si}$ [E_2 electric field at surface inside SiO_2]

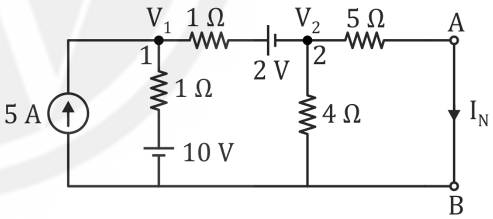
$$E_2 = \frac{\in_{Si}}{\in_{SiO_2}} E_1 = 2.5 \times 900 = 2250\ \text{V/cm}$$

= 2.25 KV/cm

As inside oxide layer, electric field is constant therefore E_{max} inside oxide layer will be equal to E_2.

Q62 Text Solution:

For Norton current load, terminal is short circuited



KCL at node 1,

$$5 = \frac{V_1 - 10}{1} + \frac{V_1 - (V_2+2)}{1}$$

$$5 = V_1 - 10 + V_1 - V_2 - 2$$

$2V_1 - V_2 = 17$ .... (1)

KCL at node 2,

$$\frac{V_2}{4} + \frac{V_2}{5} + \frac{V_2+2-V_1}{1} = 0$$

$$0.25V_2 + 0.2V_2 + V_2 - V_1 + 2 = 0$$

$$1.45V_2 - V_1 = -2$$

$2.90V_2 - 2V_1 = -4$ .... (2)

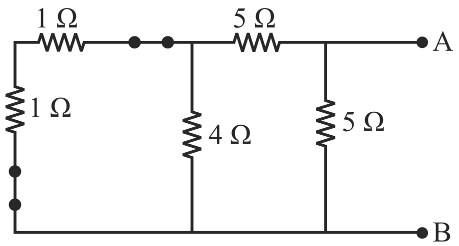
Solving (1) and (2),

$$1.9V_2 = 13$$

$$V_2 = \frac{13}{1.9} = 6.84 \text{ volts}$$

Norton's current $I_N = \frac{V_2}{5} = \frac{6.84}{5} = 1.368$ A

For R_N



$R_N = [((1+1)||4)+5]||5$

$R_N = 2.79\ \Omega$

Q63 Text Solution:

$Z_0 = 50$, $Z_L = R_L + jX_L$, VSWR = 2

$|\Gamma_L| = \frac{2-1}{2+1} = \frac{1}{3}$ ....(1)

$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{(R_L-50)+jX_L}{(R_L+50)+jX_L} \Rightarrow |\Gamma_L| = \sqrt{\frac{(R_L-50)^2+X_L^2}{(R_L+50)^2+C_L^2}}$

3....(2)

Equating Equation (1) & (2)

$\frac{(R_L-50)^2+X_L^2}{(R_L+50)^2+X_L^2} = \left(\frac{1}{3}\right)^2$

$\Rightarrow 9R_L^2 + 9X_L^2 + 9\times 2500 - 900R_L = R_L^2 + 2500 + 100R_L + X_L^2$

$\Rightarrow R_L^2 - 125R_L + 2500 + X_L^2 = 0$

$\Rightarrow R_L^2 - 2(62.5)R_L + 3906.25 + X_L^2 + 2500 - 3906.25 = 0$

$\Rightarrow (R_L - 62.5)^2 + X_L^2 = 1406.25 = (37.5)^2$

$(R_L - 62.5)^2 + X_L^2 = (37.5)^2$

$R = 37.5\Omega$

Q64 Text Solution:

We know that $CH^T = 0$ for a valid code word

$$(0100011)\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & b & 1 \\ 1 & 0 & a \end{bmatrix} \Rightarrow [0+1+1,\ 1+b+0,\ 0+1+a]$$

For $CH^T = (000)$

So in modulo 2 addition 0 is result when we add two 1's

So,

$1 + b = 0$, $b = 1$

$1 + a = 0$, $a = 1$

Q65 Text Solution:

$d\vec{s} = r^2 \sin\theta\, d\theta\, d\phi\, \hat{a}_r|_{r=2}$

$I = \iint \vec{J}\,.\,d\vec{s} = \iint r^3 \sin\theta\, d\theta\, d\phi|_{r=2} = 8\int_0^{\pi/2} \sin\theta\, d\theta \int_{\pi/6}^{\pi/3} d\phi$

$= 8(-\cos\theta)_0^{\pi/2}\left(\frac{\pi}{3} - \pi/6\right) = 2(1)\left(\pi/6\right) = \frac{\pi}{3} = 1.05\ A.$