EC: Electronics & Communication Engineering

Duration: Two and Half Hours *Maximum Marks*: 85

Read the Instructions carefully.

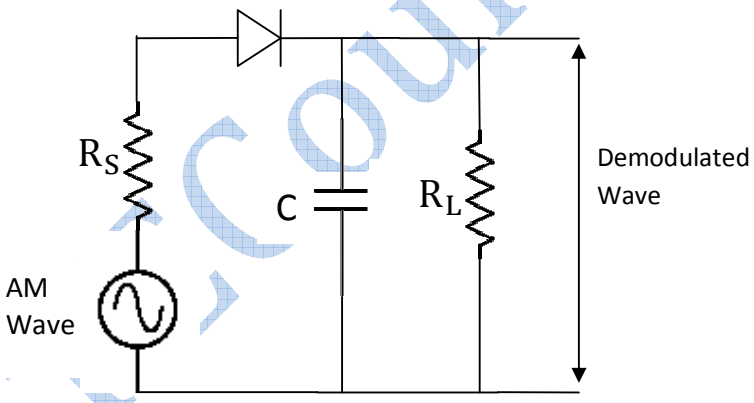
1. ***All Questions in this Paper are Objective type.***
2. ***There are a total of 55 questions carrying 85 marks.***
3. ***Questions Q.1 – Q. 25 will carry 1-mark each, questions Q.26 – Q.55 carry 2-marks each.***
4. ***Questions Q.50 – Q.51are commondata questions and question pairs(Q.52 – Q.53), and (Q.54 – Q.55) are linked answer questions. The answer to the second questions of the linked answer question depends on the answer to the first question of the pair. If the first question is wrongly answered or is un-attempted, then the answer to the second question will not be evaluated.***
5. ***Un-attempted questions will carry zero marks.***
6. ***Wrong answers will carry NEGATIVE marks. For Q.1 – Q.25, 1/3mark will be deducted for each wrong answer. For Q.26 – Q.51, mark will be deducted for each wrong answer. The questions pairs (Q.52 – Q.53), and (Q.54 – Q.55) are questions with linked answers. There will be negative marks only for wrong answers to the first question of the linked answer question pair i.e. for Q.52 and Q.54, 2/3 will be deducted for wrong answer. There is no negative marking for Q.53 and Q.55.***

Q.1 – Q.25 carry one mark each.

1. If the determinant of 2×2 matrix is 96 and trace of the matrix is 22, then what are the Eigen values?
   (a) 16, 6
   (b) 24, 4
   (c) 11, 11
   (d) 12, 8

2. If $A_{5\times5}$ has a eigen values -1, -1, 0, 1 and 1, then $|A^{100} + 2I| = ?$
   (a) 0
   (b) 32
   (c) 162
   (d) None of these

3. For narrowband AM wave, the suitable component values for designing an envelope detector for its demodulation are? f_C is carrier frequency and W is bandwidth of the message signal.



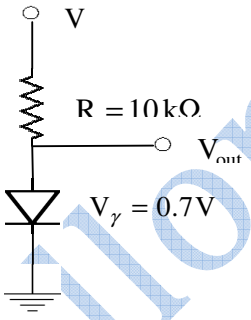
   (a) $\frac{1}{f_c} \ll \frac{1}{W} \ll R_SC \ll R_LC$
   (b) $R_SC \ll R_LC \ll \frac{1}{f_c} \ll \frac{1}{W}$
   (c) $R_SC \ll \frac{1}{f_c} \ll R_LC \ll \frac{1}{W}$
   (d) $\frac{1}{f_c} \ll R_SC \ll R_LC \ll \frac{1}{W}$

4. A super heterodyne receiver having no RF amplifier is tuned to 1000 KHz. If intermediate frequency is 455 KHz, Q=100, then calculate image rejection ratio of the receiver.
   (a) 138.6
   (b) 0.0712

(c) 0.1386

(d) None

5. For the above circuit a Si diode with ideality factor $\eta = 2$ and cutting voltage $V_\gamma = 0.7V$ is used. The voltage V is given by $V(t) = 10 + \sin 100\pi t$. Then voltage at output, $V_{out}(t)$



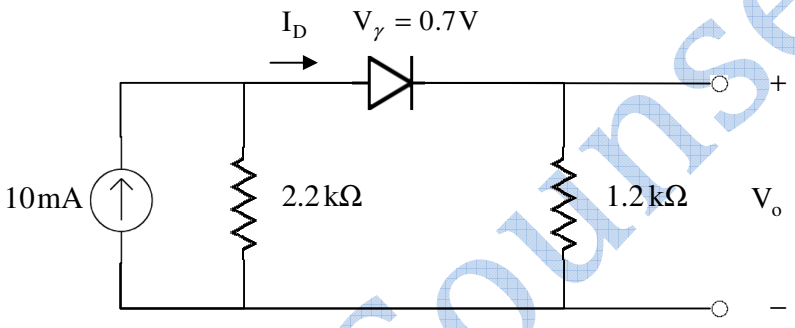
(a) $5.56 \times 10^{-3} \sin 100\pi t$ V

(b) $5.56 \times 10^{-3} \sin 200\pi t$ V

(c) $0.7 + 5.0 \times 10^{-2} \sin 200\pi t$ V

(d) $0.7 + 5.56 \times 10^{-3} \sin 100\pi t$ V

6. The output voltage V_0 is,



(a) 21.7V

(b) 15V

(c) 7.51V

(d) 4.32V

7. Find the equivalent Transfer function to the given system $\frac{1}{(s+1)(s+10)(s+100)}$

(a) $\frac{1}{(s+1)(s+10)}$

(b) $\frac{1}{(s+1)}$

(c) $\frac{0.01}{(s+1)(s+10)}$

(d) $\frac{0.001}{(s+1)}$

8. The CLTF of a UFB control system is given by

$$\frac{C(s)}{R(s)} = \frac{1}{s+3}, \text{and } r(t) = 5\cos(6t + 36°),$$

then find the steady state output,

(a) $\frac{5}{\sqrt{3}}\cos(6t + 27.43°)$

(b) $\frac{\sqrt{5}}{3}\cos(6t - 27.43°)$

(c) $\frac{\sqrt{5}}{3}\cos(6t + 27.43°)$

(d) $\frac{5}{\sqrt{3}}\cos(6t - 27.43°)$

9. If the VSWR of a transmission line is infinity then

(a) Line is terminated with short load.

(b) Line is terminated with the open load.

(c) Line is terminated with the matched load.

(d) Line is terminated with any load.

10. At the boundary of two dielectric media, which condition will not be satisfied?

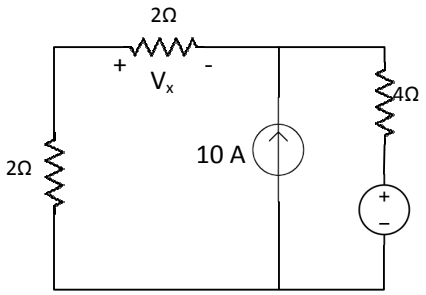
(a) $E_{t1} = E_{t2}$

(b) $\mathbf{a_n} \times (H_{t2} - H_{t1}) = J_S$

(c) $D_{n1} = D_{n2}$

(d) $B_{n1} = B_{n2}$

11. In the circuit shown in figure, the value of V_x is



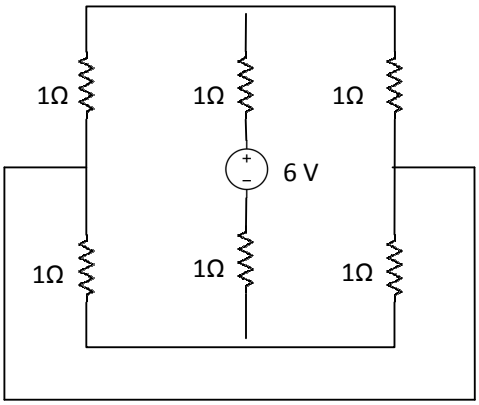
(a) 17.5 V

(b) -17.5 V

(c) 35 V

(d) -35 V

12. The power delivered by the source in the following circuit is



(a) 3 W

(b) 6 W

(c) 9 W

(d) 12 W

13. How many memory IC's of 4K Nibble capacity are required toconstruct 26K Bytes of memory?

(a) 13

(b) 14

(c) 15

(d) 16

14. Consider the below subroutine

LXI SP,2400H
MVI C,01H
PUSH B
POP PSW
RET

After execution of this subroutine contents in the zero flag and carry flag will be respectively….

(a) set, reset

(b) set, set

(c) reset, set

(d) Not effected

15. Find the direction derivative of $f(x, y, z) = 2x^2 + 3y^2 + z^2$ at $P(2, 1, 3)$ in the direction of $a(1, 0, -2)$

(a) + 1.789

(b) – 1.789

(c) + 17.89

(d) – 17.89

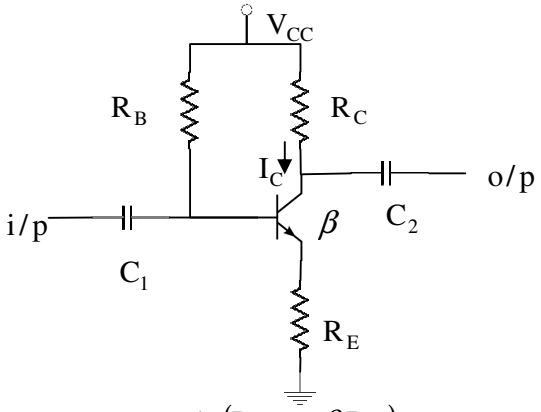
16. Given two circuit,The circuit whose currentI_C is more sensitive with respect to temperature is (β is assumed to be constant),

(a) Circuit A

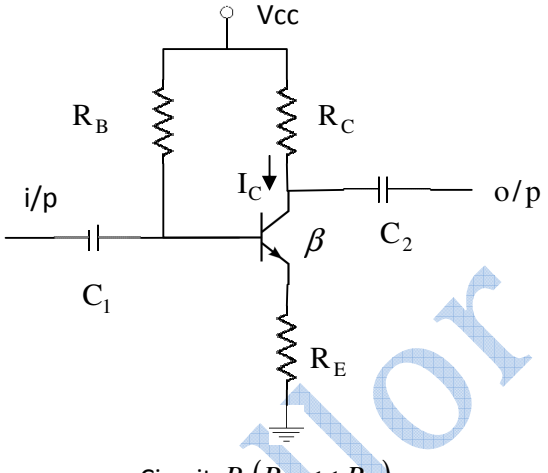
(b) Circuit B

(c) Both circuit are equally sensitive

(d) Circuit A if V_{CC} is quite high



Circuit A $(R_B >> \beta R_E)$



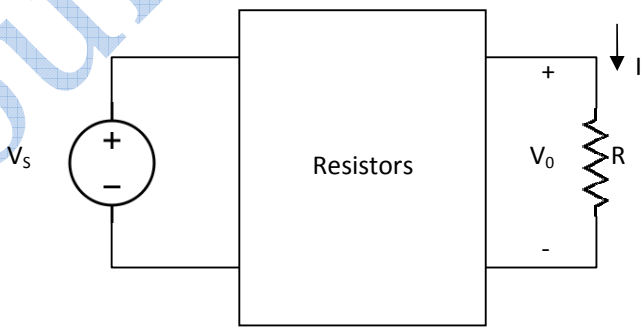
Circuit B $(R_B << R_E)$

17. In the following circuit, R is varied but the other elements remaining the same:

when R = ∞, V_0 = 6 V

when R = 0, I = 3 A

when R = 4Ω, the value of V_0 is



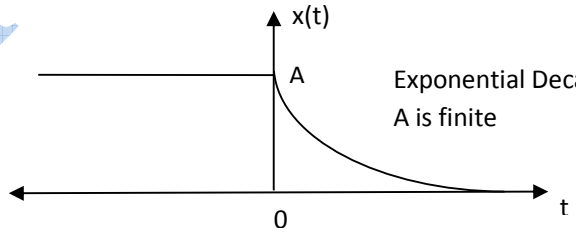
(a) 4 V

(b) 2 V

(c) 1 V

(d) 3 V

18. Find the type of the signal x(t) as



Exponential Decay (Ae^{-t}),
A is finite

shown,

(a) Power signal with $P=A^2$

(b) Energy Signal with $E=A^2/2$

(c) Power Signal with $P=A^2/2$

(d) Neither Energy nor Power Signal.

19. The energy in a signal x[n] is 12 units and the even component is

$$x_e[n] = \left(\frac{1}{3}\right)^{|n|}$$

Find the energy in the odd part,

(a) 9 units

(b) 9.75 units

(c) 10 units

(d) 10.75 units

20. Match the following,

I	II
1. $\cos 50t + \sin 50\pi t$	A. Periodic
2. $\cos\left(\frac{4\pi}{3}t\right) + \sin\left(\frac{2\pi}{3}t\right)$	B. Aperiodic
3. $\cos(5t + 37°) + 7\sin(7t) + \cos 3t$	
4. $\cos\left(\frac{2\pi}{5}n\right) + \sin\left(\frac{\pi}{7}n\right)$	

(a) 1-A, 2-B, 3-A, 4-B

(b) 1-B, 2-B, 3-A, 4-A

(c) 1-B, 2-A, 3-B, 4-A

(d) 1-B, 2-A, 3-A, 4-A

21. If $X = 1$ in the logic equation,

$$X\bar{Y}Z(Z + \bar{X}Y + XYZ) + YZ(\bar{X} + Y) = 1$$

Then,

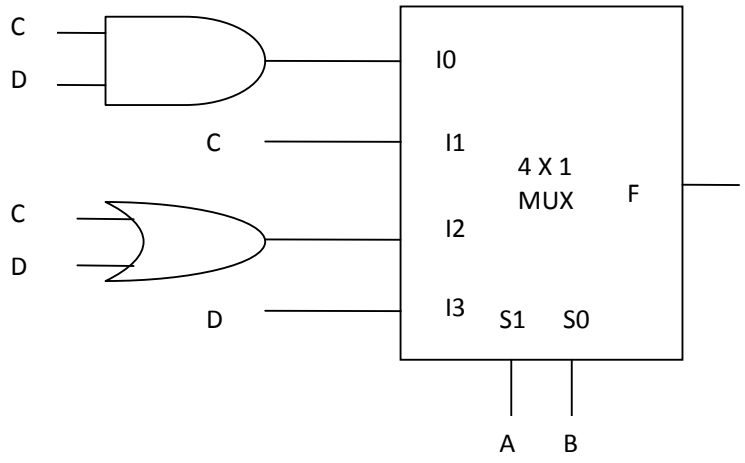
(a) $\bar{Y} = Z$

(b) $Y = Z$

(c) $Y = 1$

(d) $Z = 1$

22.



The output F is given by,

(a) $\overline{A+B}.\bar{C}D+\overline{(\bar{A}+B)}.C\bar{D}+ABCD$

(b) $\overline{A+B}.CD+(A\oplus B).C+AD$

(c) $(\bar{A}+B)\bar{C}\bar{D}+\overline{(A+\bar{B})}.CD+AB\bar{C}\bar{D}$

(d) $(\bar{A}+\bar{B}).\bar{C}D+\overline{(A+B)}.CD+ABC\bar{D}$

23. Number of comparators needed in a flash A/D converter of n bits is,

(a) 2^{n-1}

(b) 2^n

(c) $2^{n-1}-1$

(d) 2^n-1

24. Match the following, $x(t)\leftrightarrow X(\omega)$

I	II
1. $x(2t-3)$	A. $\frac{1}{2}X\left(\frac{\omega}{2}\right)e^{-j3\omega}$
2. $x(-2t-3)$	B. $\frac{1}{2}X\left(\frac{\omega}{2}\right)e^{-j3\frac{\omega}{2}}$
3. $x(2(t-3))$	C. $\frac{1}{2}X\left(\frac{\omega}{2}\right)e^{j3\frac{\omega}{2}}$
4. $x(-2(t-3))$	D. $\frac{1}{2}X\left(-\frac{\omega}{2}\right)e^{j3\frac{\omega}{2}}$
	E. $\frac{1}{2}X\left(-\frac{\omega}{2}\right)e^{-j3\omega}$

(a) 1-B, 2-D, 3-A, 4-E

(b) 1-D, 2-B, 3-E, 4-C

(c) 1-B, 2-A, 3-D, 4-C

(d) 1-C, 2-E, 3-B, 4-A

25. If $f(z) = \frac{z}{z^2+1}$ then the sum of residues of $f(z)$ is equal to

(a) $2\pi i$

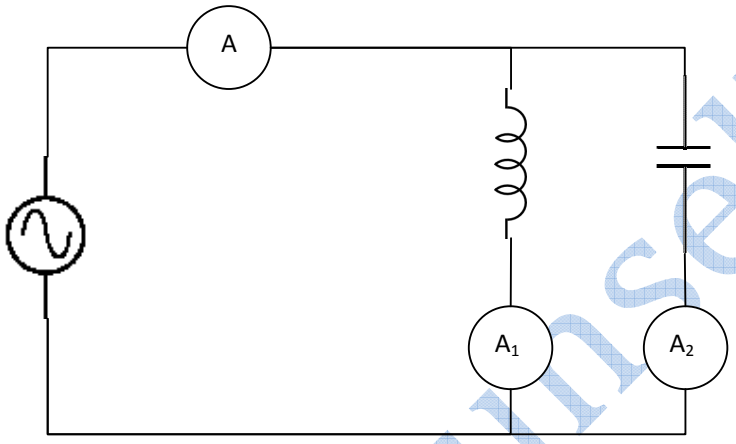
(b) $-1/2$

(c) 0

(d) 1

Q.26 – Q.55 carry two marks each.

26. Consider the following circuit



The ammeter A_1 reads 5 A and A_2 reads 3 A. The reading of ammeter A is

(a) 8 A

(b) 0 A

(c) 2 A

(d) 5.83 A

27. Find the system gain, type and order for

$$\frac{C(s)}{R(s)} = \frac{70(s+9)^3}{s^2(s+7)^2(s+4)^3}$$

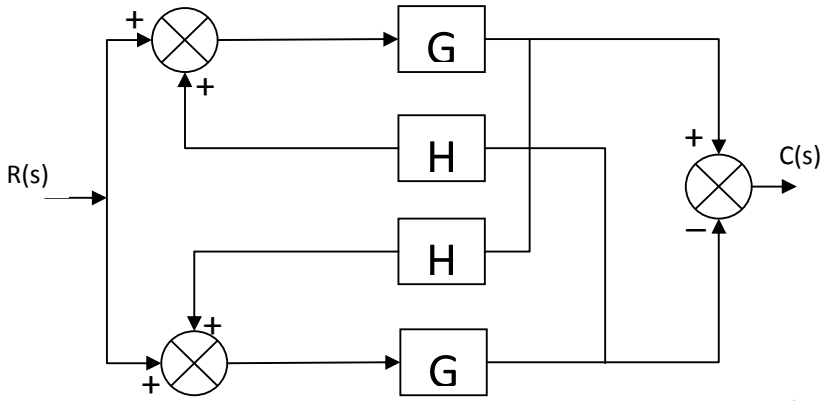
(a) 70,3,7

(b) 70,2,3

(c) 16.27,2,7

(d) 16.27,3,7

28. Find the gain of the system given below,



(a) $\frac{2G}{1-GH}$

(b) 0

(c) $\frac{2G}{1+GH}$

(d) $\frac{2G(1+GH)}{1-G^2H^2}$

29. Match the following,

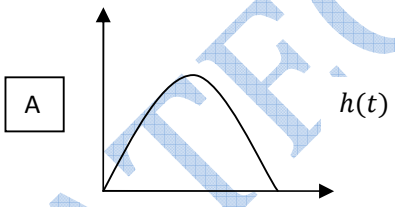
H(s):

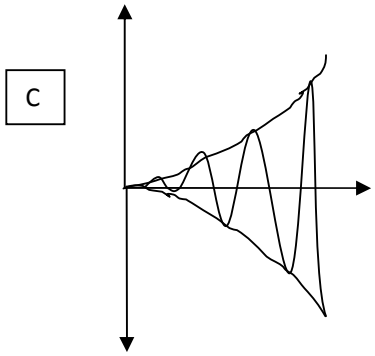
(a) $\frac{1}{(s+a)^2}$

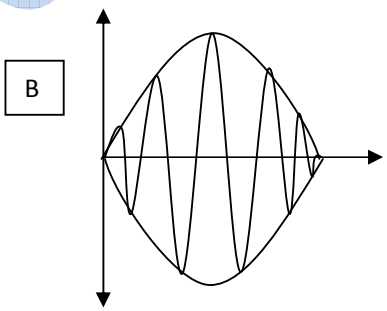
(b) $\frac{1}{(s+a)^2+b^2}$

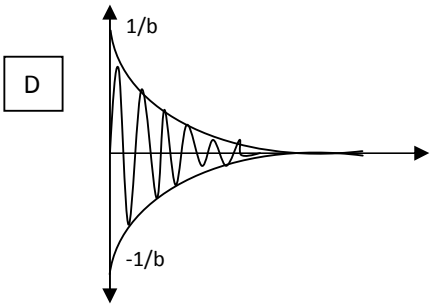
(c) $\frac{1}{[(s+a)^2+b^2]^2}$

(d) $\frac{1}{[(s-a)^2+b^2]^2}$









(a) 1-A, 2-B, 3-C, 4-D

(b) 1-B, 2-D, 3-A, 4-C

(c) 1-D, 2-C, 3-A, 4-B

(d) 1-A, 2-D, 3-B, 4-C

30. An LTI system is invertible if,

(a) $h[n] \cdot hinv[n] = \delta[n]$

(b) $h[n] * hinv[n] = 1$

(c) $h[n] * hinv[n] = \delta[n]$

(d) $h[n] \cdot hinv[n] = 1$

Where, hinv[n] is impulse response of inverse system of h[n].

31. x(t) and C_n are Continuous Time Fourier series pair,

i.e. $x(t) \leftrightarrow C_n$, $\omega_o = \frac{2\pi}{T}$; T = Time Period

For, $x(\alpha t) \leftrightarrow d_n$; d_n and ω_o' are,

(a) $d_n = C_n$; $\omega_o' = \omega_o$

(b) $d_n = \alpha C_n$; $\omega_o' = \omega_o$

(c) $d_n = C_n$; $\omega_o' = \alpha\omega_o$

(d) $d_n = \frac{C_n}{\alpha}$; $\omega_o' = \frac{\omega_o}{\alpha}$

32. A two port network is known to have the following scattering matrix

(a) Network is reciprocal.

(b) Network is lossy.

(c) Both (a) and (b) are right.

(d) Both (a) and (b) are wrong.

33. Poynting Vector is a measure of which one of the following?

(a) Maximum power flow through a surface surrounding the source.

(b) Average power flow through a surface.

(c) Instantaneous power flow through a surface.

(d) Power dissipated by the surface.

34. A boundary is separated by two magnetic materials of permeability μ_1 and μ_2. The magnetic vector in μ_1 is H1with normal component H_{n1} and tangential component

H_{t1} while that in μ_2 is H_2 with normal component H_{n2} and tangential component H_{t2}. Then the derived condition would be

(a) $H_1 = H_2$ and $H_{t1} = H_{t2}$

(b) $H_{t1} = H_{t2}$ and $\mu_1 H_{n1} = \mu_2 H_{n2}$

(c) $H_1 = H_2$ and $\mu_1 H_{n1} = \mu_2 H_{n2}$

(d) $H_1 = H_2, H_{t1} = H_{t2}$ and $\mu_1 H_{n1} = \mu_2 H_{n2}$

35. Out of the following interrupt of 8085 microprocessor which is not a vectored one?

(a) RST 5.5

(b) TRAP

(c) RST 6.5

(d) INTR

36. Which of the following statement is/are correct?

1. Moore machine has its output values dependent on input and present state.
2. Mealy machine has its output values dependent on input and present state.
3. Moore machine has its output values dependent on present state only.
4. Mealy machine has its output values dependent on present state only.

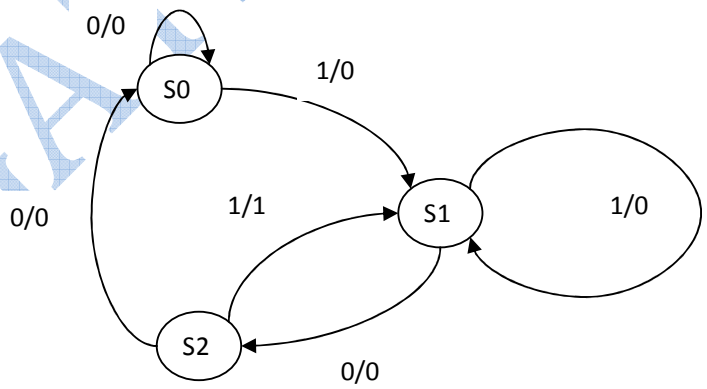
(a) 1 and 4

(b) 2 and 3

(c) 1

(d) 4

37. The above state graph can detect 'X' in a sequence and given output '1'. Here 'X' is,



(a) 110

(b) 100

(c) 011

(d) 101

38. A p-n-p transistor has base to emitter voltage of 0.6 Volts. If reverse saturation current $I_s = 4.75 \times 10^{-14}$A& β=100, then base current for this transistor at room temperature is

(a) 50 μA

(b) 9 μA

(c) 5 μA

(d) 0.1μA

39. In an n-p-n transistor the reverse bias across base-collector region is increased. Which of the following statement is true?

1. Large signal current gain α increases
2. Base current increases
3. The width of base region is reduced due to increase in depletion width at base collector junction
4. The resistance between base and collector increases

(a) 1, 2 & 3

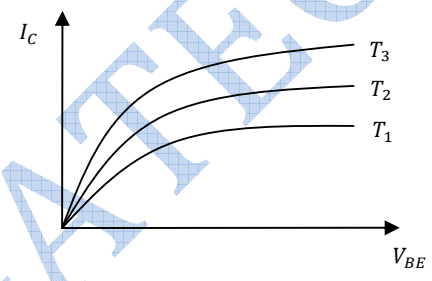
(b) 1, 3 & 4

(c) 2 & 4

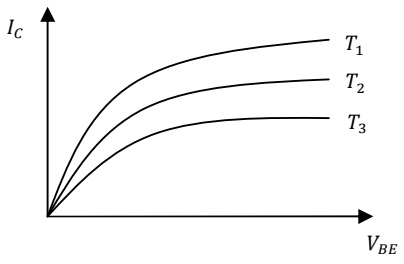
(d) 1 & 3

40. The variation of collector current a BJT with base to emitter voltage V_{BE} at different temperatures T_1, T_2& T_3 ($T_1 > T_2 > T_3$) is given by

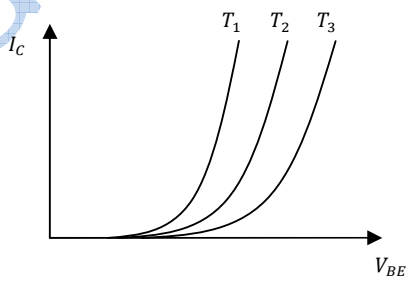
(a)



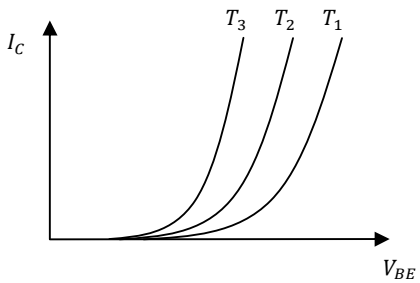
(b)



(c)



(d)



41. Consider a Binary Symmetric Channel (BSC) with probability of error being p. To transmit a bit, say 1, we transmit a sequence of three 1s. The receiver will interpret the received sequence to represent 1 if at least two bits are 1. The probability that the transmitted bit will be received in error

(a) $p^3 + 3p^2(1-p)$

(b) p^3

(c) $(1-p)^3$

(d) $p^3 + p^2(1-p)$

42. When the number of quantization levels is increased from 4 to 256, the bandwidth required for the transmission of a PCM signal increases by a factor of

(a) 2

(b) 6

(c) 8

(d) 4

43. The transconductance of a MOSFET with fixed dimensions varies, in saturation region

1. Linearly with drain current
2. As square root of drain current
3. As square root of (V_{GS} - V_T)
4. Linearly with (V_{GS} - V_T)

The correct statement is/are

(a) 1 & 3

(b) 2 & 4

(c) 2 only

(d) 1 only

44. For single tone modulation, $m(t) = A_m \cos 2\pi f_c\, t$ where, K_f is FM sensitivity, K_P is PM sensitivity. β_{FM}(Frequency modulation index), β_{PM} (Phase modulation index), $\Delta\emptyset$(Maximum phase deviation in FM), Δf(Maximum frequency deviation in PM) are respectively:

(a) $\frac{K_f A_m}{f_m}, K_P A_m, \frac{K_f A_m}{f_m}, \frac{K_P A_m}{f_m}$

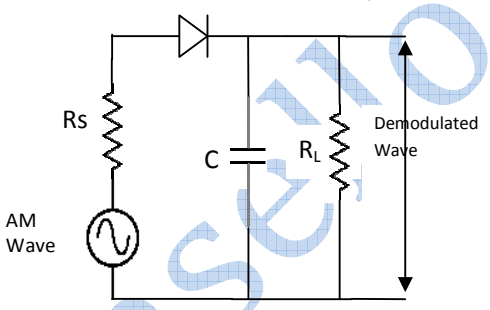
(b) $\frac{K_f A_m}{f_m}, K_P A_m, \frac{f_m}{K_f A_m}, \frac{K_P A_m}{f_m}$

(c) $\frac{K_f A_m}{f_m}, K_P A_m, \frac{K_f A_m}{f_m}, K_P A_m f_m$

(d) $K_p A_m, \frac{K_f A_m}{f_m}, \frac{K_f A_m}{f_m}, K_P A_m f_m$

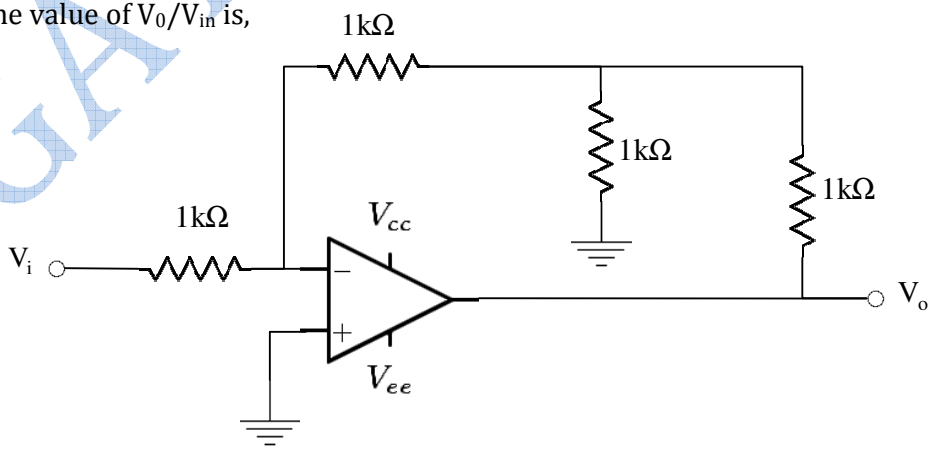
45. A 1mW video signal having bandwidth of 100 MHz is transmitted through a channel that has 40dB loss, if the one sided power spectral density of noise is 10^{-20} W/Hz. The signal to noise ratio at the input of the receiver is?
    (a) 50 dB
    (b) 30 dB
    (c) 40 dB
    (d) 60 dB

46. The values of frequency of message signal and carrier frequency whichcan be demodulated using given AM demodulator is? Given R_L=1KΩ, C=10μF, Rs=10Ω
    (a) 5 Hz, 20 KHz
    (b) 80 Hz, 5 KHz
    (c) 80 Hz, 100 KHz
    (d) 50 Hz, 10 KHz



47. A received binary NRZ signal assumes the voltage levels of 500mV & -500mV for 1 and 0 transmissions. The signal is affected by additive white Gaussian noise with a two sided power spectral density of No/2=10^{-6}W/Hz. The received signal is compared with a threshold value of 0V at the comparator. Determine the bit rate so that probability of error is 10^{-5}. Given, Q (4.27) = 10^{-5}.
    (a) 1.471 KHz
    (b) 14.71 KHz
    (c) 13.71 KHz
    (d) 137.1 KH

48. The value of V_0/V_{in} is,

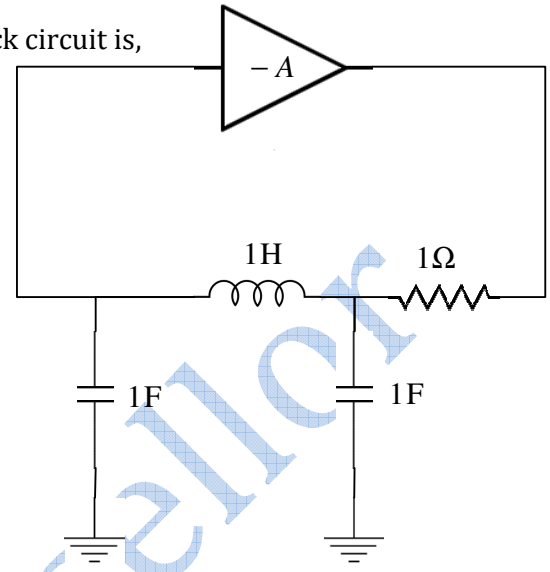


    (a) -3
    (b) -4

(c) -2

(d) -3/2

49. The Oscillation frequency of the positive feedback circuit is,



(a) $\sqrt{2}$ Hz

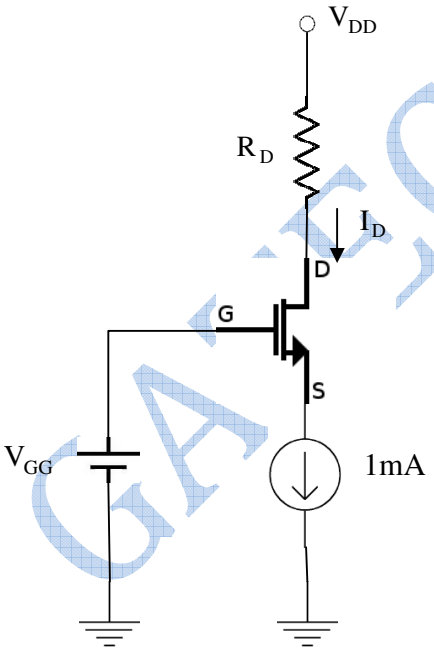
(b) $\sqrt{3}$Hz

(c) $\frac{\sqrt{3}}{\pi}$Hz

(d) $\frac{1}{\pi\sqrt{2}}$Hz

Common Data for Questions 50 & 51:

50. A MOSFET having μ_n=600cm^2/Vs, t_{ox}=10nm, V_T=1V, W/L=50 with an oxide layer of dielectric constant $\varepsilon_{ox}=11.3\varepsilon_o$. Assuming transistor is in Saturation, the transconductance is



(a) 4.52 × 10^{-4}A/V

(b) 7.75 × 10^{-3}A/V

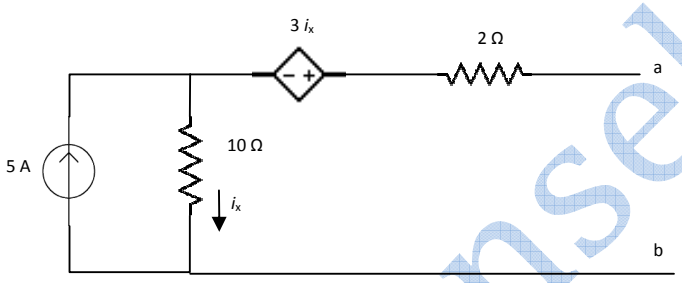
(c) 3.18 × 10^{-2}A/V

(d) 7.75 × 10^{-4}A/V

51. In previous question, if V_{GG}=5V, V_{th}=1V and R_D=6KΩ, The minimum value of V_{DD} for transistor to be in saturation is,
    (a) 8V
    (b) 12V
    (c) 6V
    (d) 10V

Linked Answer Questions for Q.52-Q.53

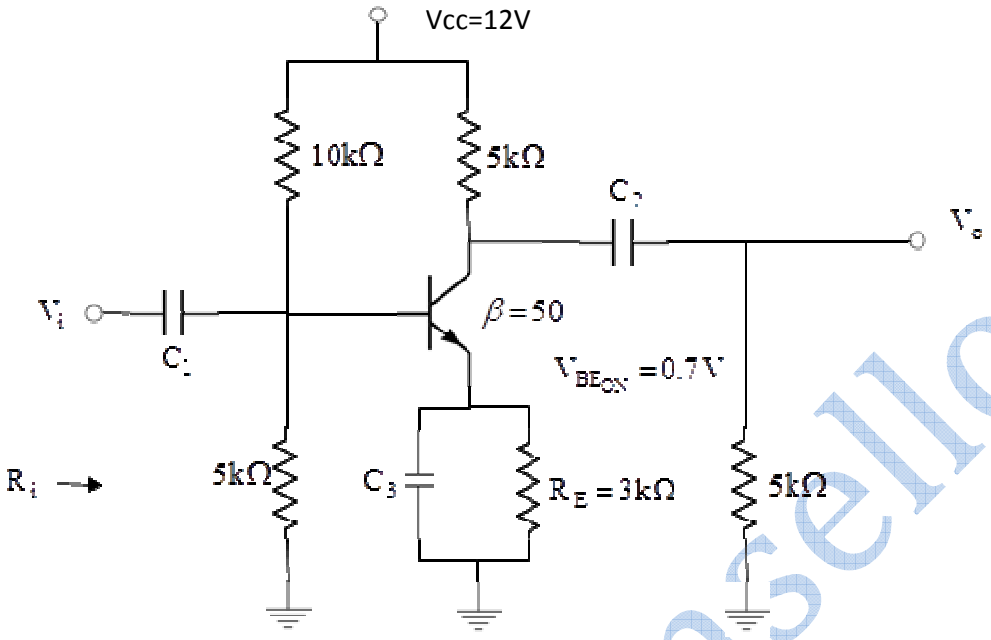
Consider the network shown below



52. The Norton equivalent across terminals a and b is
    (a) 15 A, 4.33 Ω
    (b) 4.33 A, 15 Ω
    (c) 1.5 A, 43.3 Ω
    (d) 43.3 A, 1.5 Ω

53. If a variable load resistor R_L is connected to the terminals a and b, then maximum power dissipated in R_L is
    (a) 35.21 W
    (b) 70.42 W
    (c) 105.63 W
    (d) 80.21 W

Linked Answer Questions for Q.54-Q.55



54. For this circuit, value of V_{CEQ}& I_{CQ} are,

(a) 3.52V, 0.8mA

(b) 6.75V,1.05mA

(c) 3.52V, 1.05mA

(d) 6.75V,0.8mA

55. For previous question, the input resistance and ac voltage gain V_0/V_{in} is

(a) 3.33KΩ, -101.5

(b) 0.73KΩ, -203

(c) 0.73KΩ, -101.5

(d) 3.33KΩ, -203