ACE Engineering Academy

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TEST ID: 207

ESE- 2020 (Prelims) - Offline Test Series Test - 13

ELECTRICAL ENGINEERING

SUBJECT: Control Systems + Basic Electronics Engineering + Analog and Digital Electronics - SOLUTIONS

01. Ans: (d)

Sol: $$\frac{C}{R} = \frac{G_1G_2 + G_1G_3}{1-\left(-H_1G_1 - H_2G_2 + G_1G_3H_1H_2\right)}$$

$$\frac{C}{R} = \frac{G_1G_2 + G_1G_3}{1+H_1G_1 + H_2G_2 - G_1G_3H_1H_2}$$

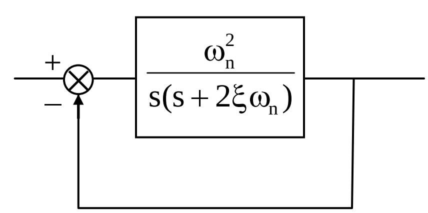
02. Ans: (a)

Sol: The main objective of drawing the root locus plots are

- To find out closed loop stability of system
- To find the range of K to make the system stable
- To find out relative stability of system
- To obtain a clear picture of the closed loop poles of the system
- To obtain a clear picture of the transient response of the system for varying gain K.
- To find out K-value for undamped, under damped, critical damped, over damped systems.

03. Ans: (c)

Sol:



CE = $s^2 + 4s + 4 = 0$

$\omega_n^2 = 4$

ω_n = 2 rad/sec

04. Ans: (b)

Sol: PD controller is very sensitive to noise.

05. Ans: (b)

Sol: Since the value of resistance is independent of the frequency, the system is stable for all frequencies.

06. Ans: (a)

Sol: Angle condition

$$\angle G(s)H(s)\Big|_{s_1=-\frac{1}{2}+j\frac{\sqrt{3}}{2}} = \frac{\angle K}{\angle\left(-\frac{1}{2}+\frac{j\sqrt{3}}{2}+1\right)^3}$$

$$= \frac{\angle K}{\angle\left(\frac{1}{2}+\frac{j\left(\sqrt{3}\right)}{2}\right)^3}$$

$$= -3\tan^{-1}\left(\sqrt{3}\right)$$

$= -180°$ satisfies angle condition s_1 is on root locus

$$\angle G(s)H(s)\Big|_{S_2=\left(-\frac{1}{2}+j\frac{1}{2}\right)} = \frac{\angle K}{\angle\left(-\frac{1}{2}+j\frac{1}{2}+1\right)^3}$$

$$= \frac{\angle K}{\angle\left(\frac{1}{2}+j\frac{1}{2}\right)^3}$$

$$= -3\tan^{-1}(1) = -135°$$

$\rightarrow$ Not satisfies angle condition

$\rightarrow$ s_2 is not on Root Locus

07. Ans: (a)

Sol: $\xrightarrow{CE} 1+G(s)H(s)=0$

$\xrightarrow{CE} s^3 + 6s^2 + Ks^2 + 11s + 6 + K = 0$

$\xrightarrow{CE} (s^3 + 6s^2 + 11s + 6) + K(s^2 + 1) = 0$

$$G(s)\,H(s) = \frac{K\left(s^2+1\right)}{s^3+6s^2+11s+6}$$

No.of Asymptotes N= |P–Z| =|3–2|=1

$$\theta_0 = \frac{(2\ell+1)180°}{(P-Z)} = \frac{(2\times 0+1)180^\circ}{1} = 180°$$

08. Ans: (d)

Sol: Option (a) is lag compensator which is wrong

Options (b), (c) & (d) are lead compensators.

Here required to verify stability with Gain K

$$G(s) = \frac{1}{s-1},\ G_c(s) = K\left(\frac{s+2}{s+10}\right)$$

$$G(s)\Big|_{\omega_c} = \frac{K(s+2)}{(s-1)(s+10)},\ H(s)=1$$

$\xrightarrow{CE} 1+G(s)\Big|_{\omega_c} = 0$

$\xrightarrow{CE} s^2 + 10s - s - 10 + Ks + 2K = 0$

$\xrightarrow{CE} s^2 + 9s - 10 + Ks + 2K = 0$

$\xrightarrow{CE} s^2 + s(K+9) + (2K-10) = 0$

s^2	1	2K–10
s^1	(K+9)	
s^0	(2K–10)	

$(K+9) > 0 \Rightarrow K > -9$,

$(2K-10) > 0 \Rightarrow K > 5$

K > 5 Given system with lead compensator becomes stable. Option (d) is correct

09. Ans: (a)

Sol: $$\alpha = \frac{R_2}{R_1+R_2} = \frac{1}{1+1} = \frac{1}{2}$$

$$\phi_m = \sin^{-1}\left(\frac{1-\alpha}{1+\alpha}\right)$$

$$= \sin^{-1}\left(\frac{1-\frac{1}{2}}{1+\frac{1}{2}}\right) = \sin^{-1}\left(\frac{1}{3}\right)$$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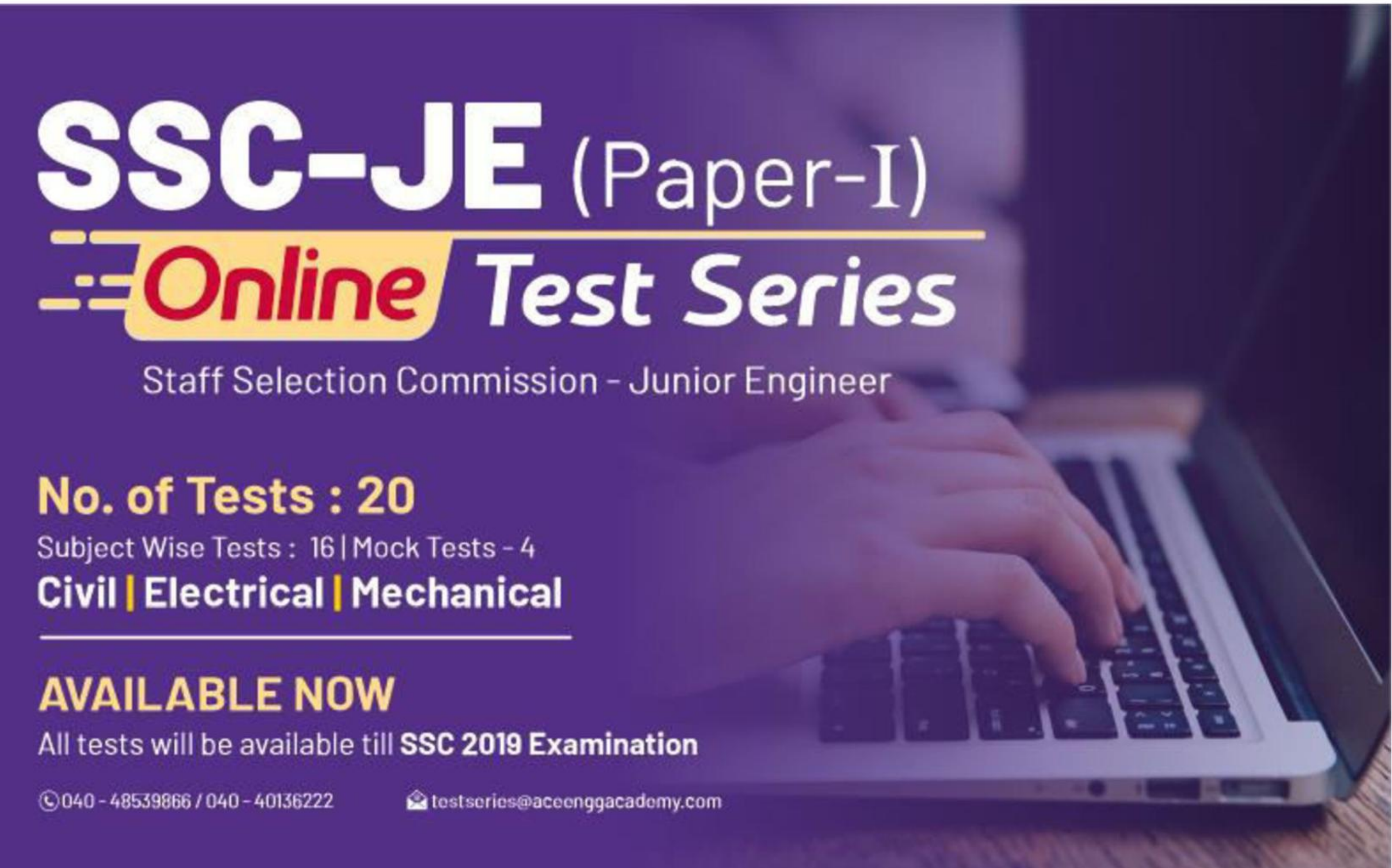
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10. Ans: (c)

Sol: If the poles are located in left side of s – plane, then the system is stable. (or)

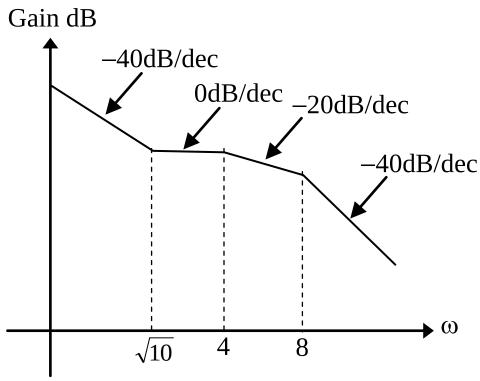
The IR of a causal and stable system must be absolutely integrable between the limits 0 and ∞ $\int_0^\infty |IR|\,dt < \infty$

If the roots are located on imaginary axis which are repeated then the system is unstable. $\int_0^\infty |IR|\,dt = \infty$

When non-repeated or simple poles poles are located on imaginary axis, then the system is marginally or limitedly or critically or just stable (or) When time t $\rightarrow \infty$ IR is neither approaches to '0' nor goes to '∞' and will have fixed IR.

11. Ans: (d)

Sol:



$\omega = 0 \quad \angle TF = -180°$

12. Ans: (c)

Sol: $\angle \frac{e^{\frac{-\pi}{2}j\omega}}{j\omega} = -\pi$

$-\left(\frac{\pi}{2}\omega + \frac{\pi}{2}\right) = -\pi$

ω_{pc} = 1 rad/sec

$\left|\frac{e^{\frac{-\pi}{2}j\omega}}{j\omega}\right| = \frac{1}{\omega} = 1$

$\therefore$ GM = 1 or 0 dB

$\left|\frac{e^{\frac{-\pi}{2}j\omega}}{j\omega}\right| = 1$

ω_{gc} = 1 rad/sec

PM = 180° – 90° $-\frac{\pi}{2}\omega_{gc}$

= 180° –90° –90° = 0°

PM = 0°

13. Ans: (a)

Sol: $G(s) = \frac{8}{(S+10)^2}$

S = jω

$G(j\omega) = \frac{8}{(j\omega+10)^2}$

$|G(j\omega)| = \frac{8}{\left(\sqrt{\omega^2+10^2}\right)^2}$

O/p amplitude = I/p amplitude × $|G(\omega)|$

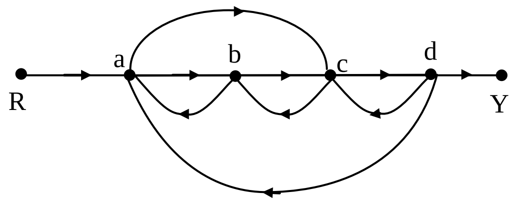
$= 2.\frac{8}{\left(\sqrt{\omega^2+10^2}\right)^2}$

Where ω = 3 rad/sec

$$\text{o/p amplitude} = \frac{2\times 8}{\left(\sqrt{100+9}\right)^2} = \frac{16}{109} = 0.146$$

14. Ans: (a)

Sol:



No. of forward paths = 2

RabcdY

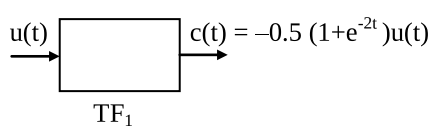
RacdY

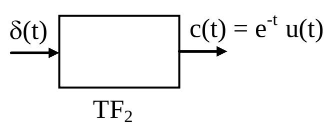
No. of two non touching loops = 1

aba, cdc

15. Ans: (a)

Sol:





$$TF_1 = \frac{L.T\left[-0.5\left(1+e^{-2t}\right)\right]}{L.T[u(t)]}$$

$$= \frac{-0.5\left(\frac{1}{s}+\frac{1}{s+2}\right)}{\frac{1}{s}} = \frac{-(s+1)}{s+2}$$

$$TF_2 = \frac{1}{s+1}$$

Overall transfer function of system

$$TF = TF_1.TF_2 = \frac{-1}{s+2}$$

16. Ans: (c)

Sol: There are two loops

Loop gain 1 = $-H_1G_1G_2$

Loop gain 2 = $-H_2\,G_3$

17. Ans: (d)

Sol: $$TF = \frac{R+\frac{1}{Cs}}{R+Ls+R+\frac{1}{Cs}}$$

$$= \frac{RCs+1}{LCs^2+2RCs+1}$$

2 poles, 1 zero

18. Ans: (b)

Sol: $$TF = \frac{2}{s^2+3s+2} = \frac{2}{(s+1)(s+2)}$$

Real and unequal roots, then system is over damped.

Initial value

$$c(0) = \underset{s\to\infty}{Lt}\, sC(s) = \underset{s\to\infty}{Lt}\frac{2}{(s+1)(s+2)} = 0$$

Final value

$$C(\infty) = \underset{s\to 0}{Lt}\frac{2}{(s+1)(s+2)} = 1$$

19. Ans: (c)

Sol: The bandwidth for first order system,

$BW = \frac{1}{T}$, Here 'T' is time constant

OLTF: $G(s) = \frac{1}{s+1}$

$$G(s) = \frac{1}{sT+1}$$

Time constant, T = 1

$$\text{Bandwidth} = G(s) = \frac{1}{1} = 1 \text{ rad/s}$$

$$\text{CLTF} = \frac{1}{s+2} = \frac{\frac{1}{2}}{1+\frac{s}{2}}$$

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

$$\text{Bandwidth} = \frac{1}{T} = 2 \text{ sec.}$$

20. Ans: (a)

Sol:

$+x^6$	1	–2	–16	32
$+x^5$	1	0	–16	0
$-x^4$	–2	0	32	
$-x^3$	0(–8)	0	0	
$+x^2$	0(ε)	32		
$+x^1$	$\frac{(32)(8)}{\varepsilon}$			
$+x^0$	32			

$AE = -2x^4 + 32$

$$\frac{\partial AE}{\partial x} = -8x^3$$

No. of RH roots = 2

jω roots = 2

LH roots = 2

21. Ans: (a)

Sol: Delay time → 0 to 50% of the final value

Rise time → 10 to 90% of the final value

22. Ans: (b)

Sol: $$T(s) = \frac{Y(s)}{X(s)}$$

$$= \frac{G(s)}{1+G(s)H(s)}$$

$$= \frac{\frac{K(s+4)}{s(s+1)}}{1+\frac{1}{s+2}\cdot\frac{K(s+4)}{s(s+1)}}$$

$$= \frac{K(s+4)(s+2)}{s(s+1)(s+2)+K(s+4)}$$

C.E = 1+ G(s)H(s) = 0

$s^3 + 3s^2 + 2s + Ks + 4K = 0$

$s^3 + 3s^2 + (2+K)s + 4K = 0$

RH table:

s^3	1	2+K
s^2	3	4K
s^1	$\frac{6+3K-4K}{3}$	
s^0	4K	

For marginal stable: s^1-row must be zero

$$\frac{6-K}{3} = 0$$

K = 6

23. Ans: (a)

Sol: $$\text{T.F} = \frac{L[\text{output}]}{L[\text{input}]} = \frac{L[c(t)]}{L[\text{unit step}]}$$

$$= \frac{L\left[1 - e^{-10t} - 10t\, e^{-10t}\right]}{L[u(t)]} = \frac{\frac{1}{s} - \frac{1}{s+10} - \frac{10}{(s+10)^2}}{\frac{1}{s}}$$

$$\Rightarrow \frac{C(s)}{R(s)} = \frac{100}{s^2 + 20s + 100} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

$\omega_n = 10$ rad/sec; $2\zeta\omega_n = 20$

$$2\zeta(10) = 20$$

$$\zeta = 1$$

Impulse response in time domain = L^{-1} [transfer function]

$$= L^{-1}\left[\frac{100}{s^2 + 20s + 100}\right]$$

$$= L^{-1}\left[\frac{100}{(s+10)^2}\right] = 100\ t\ e^{-10t}$$

24. Ans: (b)

Sol: $\Rightarrow$ Electron density (n) $\simeq N_D - N_A$

$$= 3 \times 10^{14} - 0.5 \times 10^{14}$$

$$= 2.5 \times 10^{14}/\text{cm}^3$$

25. Ans: (b)

Sol: $V_p = \mu_p E$

$$V_p = \frac{\mu_p V}{\ell} = \frac{500 \times 10 \times 10^{-4}}{1 \times 10^{-3}}$$

$$= 500 \text{ m/sec}$$

26. Ans: (b)

Sol:

→ Depletion region penetrates more into lightly doped side of PN junction. So, '1' is false.

→ A barrier voltage is created by charge carrier depletion effect, positive on n-side and negative on p-side. So, '2' is true.

→ Thermal voltage $V_T = \frac{kT}{q}$.Hence ,it is dependent on temperature. So, '3' is false.

27. Ans: (d)

28. Ans: (b)

Sol: Given $A_v = 100$, $Z_i = 1\text{k}\Omega$, $Z_0 = 5\text{k}\Omega = Z_L$

Current-Shunt Negative feed back Amplifier gain is Current gain

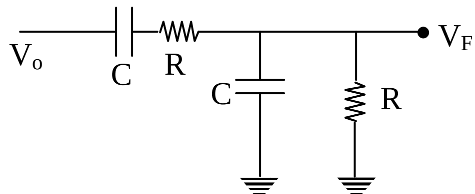
$$A_v = \frac{A_I . Z_L}{Z_i} \Rightarrow A_I = \frac{A_v . Z_i}{Z_L} = \frac{100 \times 1}{5} = 20$$

$$1 + \beta A_I = 1 + 0.2\ (20) = 5$$

$$Z_{if} = \frac{Z_i}{1 + \beta A_I} = \frac{1}{5}\text{k}\Omega$$

29. Ans: (b)

Sol: The feedback circuit of Wein Bridge oscillator is as below.



$$\frac{V_F - V_o}{R + \frac{1}{SC}} + SCV_F + \frac{V_F}{R} = 0$$

$$V_F\left(\frac{1}{R + \frac{1}{SC}} + SC + \frac{1}{R}\right) = \frac{V_o}{R + \frac{1}{SC}}$$

$$\frac{V_o}{V_F} = 1 + SC\left(R + \frac{1}{SC}\right) + \frac{1}{R}\left(R + \frac{1}{SC}\right)$$

$$= 1 + SCR + 1 + 1 + \frac{1}{SCR}$$

$$= 3 + SCR + \frac{1}{SCR}$$

$$\Rightarrow \frac{V_o}{V_F} = 3 + j\left(\omega RC - \frac{1}{\omega RC}\right)$$

At resonant frequency

$$\frac{V_o}{V_F} = 3 \;(\because \text{ Imaginary part is zero})$$

$\therefore$ Attention factor (or) feedback factor,

$$\beta = \frac{V_F}{V_o} = \frac{1}{3}$$

30. Ans: (c)

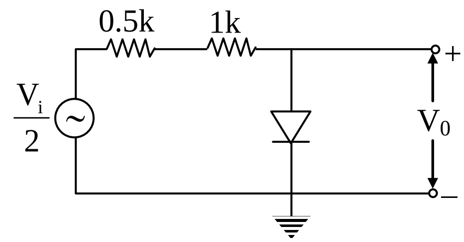
Sol: Given A = 300 , D = 16% , $\beta = \frac{5}{100}$

$$1 + \beta A = 1 + \frac{5}{100} \times 300 = 16$$

$$D_f = \frac{D}{1 + \beta A} = 1\%$$

31. Ans: (d)

Sol: The equivalent circuit is



When $\frac{V_i}{2} > 0.7V$

D-ON $\Rightarrow V_0 = 0.7V$

When $\frac{V_i}{2} \le 0.7V$

D-OFF $\Rightarrow V_0 = \frac{V_i}{2} = 2.5\sin\omega t$

$\Rightarrow V_{0\,min} = -2.5V$

$\therefore (V_0)_{max} = 0.7V$, $(V_0)_{min} = -2.5V$

32. Ans: (b)

Sol: Input power = $V_i \times I_i$

$= 0.5 \times 2 \times 10^{-3} = 1mW$

Output power = $V_0 \times I_0 = 16 \times 15 \times 10^{-3}$ = 240mW

Power gain = $\frac{P_0}{P_i} = 240$

33. Ans: (a)

Sol: Astable Multivibrator can generate square waveforms.

Mono stable Multivibrator is used for pulse width modulation.

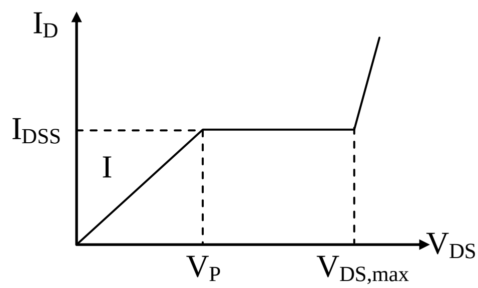
Bi-stable is using to storing binary information.

34. Ans: (a)

Sol: Transformer coupling provides high impedance matching. So, it requires less number of stages for achieving same gain compared to RC coupling.

35. Ans: (c)

Sol:



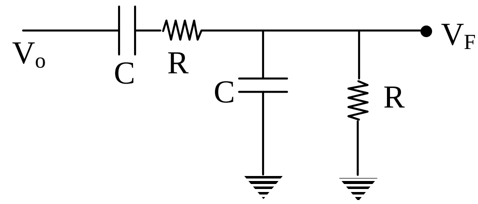
JFET operating in region 'I' if $I_D < I_{DSS}$, I_D is linearly related to V_{DS}, so it behavior like a resistor

36. Ans: (c)

Sol:
- $\rightarrow$ Placing a BJT around an op-amp provides a logarithmic function.
- $\rightarrow$ Placing a diode around an op-amp leads to precision rectifier i.e., a circuit that can rectify very small input swings.
- $\rightarrow$ Integrators suffer from op-amp imperfections like DC offsets and input bias currents.
- $\rightarrow$ The speed of op-amp circuits is limited by the bandwidth of the op-amps. For large signals, the op-amp suffers from a finite slew rate, distorting the output waveform.

37. Ans: (c)

Sol: The feedback circuit of Wein Bridge oscillator is as below



$$\frac{V_F - V_o}{R + \frac{1}{SC}} + SCV_F + \frac{V_F}{R} = 0$$

$$V_F\left(\frac{1}{R + \frac{1}{SC}} + SC + \frac{1}{R}\right) = \frac{V_o}{R + \frac{1}{SC}}$$

$$\frac{V_o}{V_F} = 1 + SC\left(R + \frac{1}{SC}\right) + \frac{1}{R}\left(R + \frac{1}{SC}\right)$$

$$= 1 + SCR + 1 + 1 + \frac{1}{SCR} = 3 + SCR + \frac{1}{SCR}$$

$$\Rightarrow \frac{V_o}{V_F} = 3 + j\left(\omega RC - \frac{1}{\omega RC}\right)$$

Feedback factor

$$\beta = \frac{V_F}{V_o} = \frac{1}{3 + j\left(\omega RC - \frac{1}{\omega CR}\right)}$$

At frequency of Oscillations, imaginary part is zero, $\beta = 1/3$, $A = 3$

38. Ans: (b)

Sol: The given circuit is a voltage regulator. Then

(i) The unregulated input voltage, V_S should be more than the break down voltage of zener diode, V_Z

(ii) By applying KCL at node A in the circuit, $I_1 = I_2 + I_L \Rightarrow I_L = I_1 - I_2$

(iii) The dynamic resistance of zener diode r_z when it is in break down is very small when compared with the resistance R_S.

i.e R_S should be more than r_z, so that it maintains the current into zener diode between and $I_{Z_{max}}$

39. Ans: (b)

Sol:

A. E-B junction forward bias and C-B junction reverse bias-High gain amplifier

B. Both E-B and C-B junctions forward bias- Saturation condition

C. E-B junction reverse bias and C-B junction forward bias- Very low gain amplifier

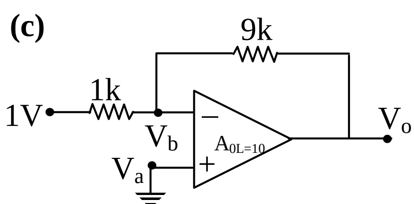
D. Both E-B and C-B junctions reverse bias- Cut-off condition

40. Ans: (b)

Sol: $I_{CQ} = \dfrac{V_{CC}}{R_{AC} + R_{DC}} = \dfrac{V_{CC}}{R_C + R_C} = \dfrac{V_{CC}}{2R_C}$

41. Ans: (c)

Sol:



$$V_b = \frac{V_0(1k) + (1V)(9k)}{10k}$$

$$V_b = \frac{V_0 + 9}{10}$$

$$V_0 = A(V_a - V_b)$$

$$V_0 = 10\left(0 - \frac{V_0 + 9}{10}\right)$$

$$V_0 = -V_0 - 9$$

$$2V_0 = -9$$

$$\therefore V_0 = -4.5\text{Volts}$$

42. Ans: (d)

Sol: In broadcast television, the number of scanning per frame is chosen to be an odd number to make interlacing easier.

43. Ans: (c)

Sol: $\text{SQNR} = \dfrac{3}{2}L^2$

Where L is number of quantization levels

44. Ans: (a)

Sol: Advantages of PCM:

PCM permits regeneration of pulses along the transmission path, this reduces noise interference

Multiplexing of various PCM signals is easily possible.

Effect of channel noise and interference is reduced

Larger bandwidth is not an advantage. It is disadvantage.

45. Ans: (a)

Sol: Quantization levels L = $2^n = 2^6 = 64$

Each sample requires n = 6 bits

$\therefore$ sampling rate (f_s) = $2\times f_m$ = 10kHz

$\therefore$ Bit Transmission rate(R_b) = n x f_s

= 6×10 = 60kbps.

46. Ans: (c)

Sol: % Power saving = $\frac{\text{Power saved}}{\text{total power}}\times 100$

$$= \frac{P_C}{P_C\left[1+\frac{\mu^2}{2}\right]}\times 100 = \frac{1}{1+\frac{0.8^2}{2}}\times 100$$

= 75.76%

47. Ans: (d)

Sol: One of main functions of the RF amplifiers in a superheterodyne receiver is to improve the rejection of the image frequency.

48. Ans: (d)

Sol: Pre-Emphasis in FM system defined as the process of boosting high frequencies of an audio signal, such that the signal to Noise ratio is greater than one.

49. Ans: (c)

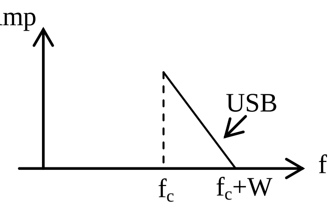
Sol: Given data: IF = 455 kHz, f_s = 1200 kHz

Image frequency $f_{si} = f_s + 2\times IF$

= 1200 + 2 × 455 = 2110 kHz

50. Ans: (a)

Sol:



USB = Upper side band

f_c = 60kHz

f_c to $f_c + f_m$

Lowest USB = 60k + 300Hz = 60.3kHz

($\because$ W = 300Hz)

Highest USB = 60k+3000Hz = 63 kHz

($\because$ W = 3000Hz)

$\therefore$ The range of upper side band is 60.3 to 63 kHz

51. Ans: (b)

Sol: conversion time $t_A = 10\mu s$

Sampling frequency $f_{s(max)} = \frac{1}{t_A} = \frac{1}{10\mu s}$

= 0.1 MHz = 100 KHz

$f_{s(max)} = 2f_{m(max)}$

Maximum input signal frequency

$$f_{m(max)} = \frac{f_{s(max)}}{2} = \frac{100KHz}{2} = 50 \text{ KHz}$$

52. Ans: (a)

Sol: Let number of Flip-flops required be N.

$2^N \geq 6000$

N ≥ 13

N = 13

53. Ans: (a)

Sol: No flags will be affected when data transfer instructions are executed.

54. Ans: (c)

Sol: In this

$J_A = \overline{B}+\overline{C}, K_A = BC, J_B = A, K_B = \overline{A}, J_C = B, K_C = \overline{B}$

CLK	J_A K_A	J_B K_B	J_C K_C	A B C
0				0 0 0
1	1 0	0 1	0 1	1 0 0
2	1 0	1 0	0 1	1 1 0
3	1 0	1 0	1 0	1 1 1
4	0 1	1 0	1 0	0 1 1
5	0 1	0 1	1 0	0 0 1
6	1 0	0 1	0 1	1 0 0

0, 4, 6, 7, 3, 1, 4,…..

Hence, modulus of the counter is 5.

55. Ans: (a)

Sol: $x_2 = b_2 \oplus b_1 \oplus b_1 = b_2 \oplus 0 = b_2$

$x_1 = b_2 \oplus b_1$

$x_0 = b_0 \oplus b_1$

b_2	b_1	b_0	x_2	x_1	x_0
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	1
0	1	1	0	1	0

i.e., binary to gray code converter

56. Ans: (d)

Sol: ADC	**Conversion time**
Counter type ADC	$(2^n-1)T_{CLK}$
Flash type ADC	$1.T_{CLK}$
Successive Approx. ADC	$N.T_{CLK}$
Dual Slope ADC	$2^{n+1}.T_{CLK}$

So, Dual Slope ADC has maximum conversion time.

57. Ans: (c)

Sol:

```
        MVI   C, 0A H = 7T
        XRA   A       = 4T
LOOP:   DCR   C       = 4T
        INC   A       = 4T
        JNZ   LOOP    = 7T/10T
```

So,

Number of T states required

$= 7T + 4T + (09 \times 18)\ T + 4T + 4T + 7T$

$= 7T + 4T + 162T + 4T + 4T + 7T$

$= 188T$

58. Ans: (d)

Sol: $f(x,y,z) = \sum (m_o, m_2, m_7) = \sum m(0, 2, 7)$

$f'(x,y,z) = \sum (m_1, m_3, m_4, m_5, m_6) = \prod (M_0, M_2, M_7)$

59. Ans: (d)

Sol: size $= 2^x \times y \times n$

Let n be the number of chips.;

$x \rightarrow$ no. of address lines

$y \rightarrow$ no. of data lines

$2^x \times y \times n = 32$ KB

$$2^{12} \times 4 \times n = 32 \times 1024 \times 8$$

$$n = \frac{32 \times 1024 \times 8}{2^{12} \times 4} = 16$$

$n = 16$

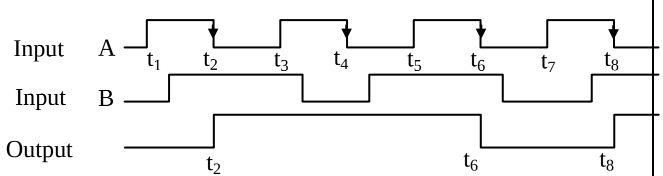
60. Ans: (b)

Sol: XOR gate, Half adder, Full subtractor are combinational circuits

Register is a Sequential circuit.

61. Ans: (c)

Sol: A is connected as negative edge clock input for T-flip-flop. So, for every negative edge B is applied to FF. $Q(t+1) = T \oplus Q(t)$



62. Ans: (b)

Sol:

A	B	Y_0
1	0	0
1	1	0
0	0	0
0	1	1

If A=1, then irrespective of 'B' output is '0'. Since transistors are ON

If A = 0, then transistors are OFF &

If B= 0, diode ON $\Rightarrow Y_0=0$

If B= 1, diode OFF $\Rightarrow Y_0=1$

$\Rightarrow Y_0 = \bar{A}B$

63. Ans: (a)

Sol: F(A,B,C,D)

$= \bar{A}B\bar{D}.C + A\bar{B}\bar{D}.1 + \bar{A}BD.1 + A\bar{B}D.\bar{C}$

$= \bar{A}BC\bar{D} + A\bar{B}\bar{D} + \bar{A}BD + A\bar{B}\bar{C}D$

$= \bar{A}B(C\bar{D} + D) + A\bar{B}(\bar{D} + \bar{C}D)$

$= \bar{A}B(C+D) + A\bar{B}(\bar{C}+\bar{D})$

64. Ans: (c)

Sol: $F = (B\bar{C} + \bar{A}D)(A\bar{B} + C\bar{D})$

$F = B\bar{C}A\bar{B} + B\bar{C}C\bar{D} + \bar{A}DA\bar{B} + \bar{A}DC\bar{D} = 0$

$\bar{F} = 1$

Number of literals in $\bar{F} = 1$ is 0.

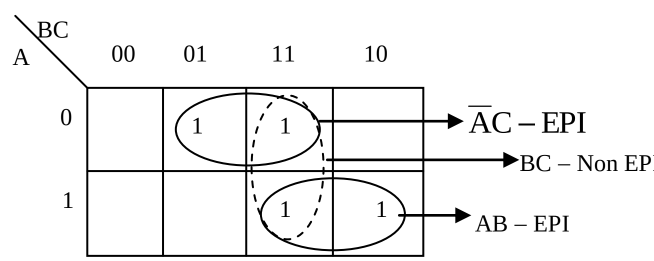
65. Ans: (a)

Sol: F(A, B, C) =

$AB + \bar{A}C + BC$ =

$AB(C+\bar{C}) + \bar{A}(B+\bar{B})C + (A+\bar{A})BC$

$= ABC + AB\bar{C} + \bar{A}BC + \bar{A}\bar{B}C + ABC + \bar{A}BC$



66. Ans: (c)

Sol: $(23E)_X = 2X^2+3X+E$

In the given number 'E' is the highest digit so we can take its radix from greater than equal to F. So,

$= 2(15)^2 + 3(15)^1 + E(15)^0$

$= 2(225) + 3(15) + 14 = 509$

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67. Ans: (c)

Sol: Adding two n-bit numbers,

ROM inputs = n+n = 2n

Adding two n-bit numbers largest result size = (n+1) bits

$\therefore$ ROM size = $2^{2n} \times (n+1)$ bits

68. Ans: (c)

Sol: ROM, Hard disk, Magnetic disk – Non-Volatile

RAM – Volatile

69. Ans: (b)

Sol: Any Boolean function can be realized by using a suitable multiplexer. So, statement (I) is true

A multiplexer can be realized using NAND and NOR gates, which are universal gates. So, statement (II) is true

Statement (I) and Statement (II) are individually true but Statement (II) is not correct explanation for Statement (I).

70. Ans: (c)

Sol: All Software interrupts of 8085 are Maskable and Vectored. So, Statement (I) is true.

Software interrupts are random in nature. So, Statement (II) is false.

71. Ans: (d)

Sol: Need of modulation:

1. To avoid the mixing of the signals.
2. To increase the range of communication
3. To decrease the length of transmitting and receiving antenna
4. To improve the quality of reception i.e. increasing the value of S/N ratio
5. To allows the multiplexing of the signals
6. To remove the interference.

72. Ans: (d)

Sol: A fixed bias BJT circuit cannot exhibit better performance as compared to self bias BJT circuit. Hence **Statement (I)** is false.

73. Ans: (c)

Sol: When PN junction is reverse biased, depletion region acts like an insulator. While P and N type regions on either side act as plate.

Hence it can be treated as parallel plate capacitor. So, statement (I) is true.

Transition or space charge capacitance

$$C_T \propto \frac{1}{(V_k + V_R)^n}$$

It is voltage dependent. So, statement (II) is false.

74. Ans: (c)

Sol: Transfer function applicable for only linear time invariant systems.

75. Ans: (a)

Sol: T.F = $\dfrac{40}{(s+2)(s+20)}$

DC gain should not change after removing far pole.

DC gain before removing far pole = $\dfrac{40}{(0+2)(0+20)} = 1$

T.F after removing far pole = $\dfrac{K}{s+2}$

DC gain = $\dfrac{K}{0+2} = \dfrac{K}{2}$

$\therefore \dfrac{K}{2} = 1 \Rightarrow K = 2$

T.F = $\dfrac{2}{s+2}$

Comparing with standard 1st order T.F $\dfrac{A}{s+T}$

$\therefore$ Time constant = $\dfrac{1}{T} = \dfrac{1}{2}$

2% Settling time, $t_s = 4 \times \dfrac{1}{2} = 2$ sec which depends on dominant pole.