ACE
Engineering Academy

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ESE- 2018 (Prelims) - Offline Test Series Test-22

ELECTRONICS & TELECOMMUNICATION ENGINEERING

FULL LENGTH MOCK TEST – 1 (PAPER - II)

01. Ans: (c)

Sol: We know

Method: (I)

$$\text{CMRR} = \frac{A_{dm}}{A_{cm}}$$

$$\text{CMRR}_{\text{in dB}} = 20\log_{10}\frac{A_{dm}}{A_{cm}}$$

$$= 20\log_{10} A_{dm} - 20\log_{10} A_{cm}$$

$$20\log_{10} A_{dm} = 35\,\text{dB},\ 20\log_{10} A_{cm} = 5\,\text{dB}$$

CMRR = 35 – 5 = 30 dB

Method: (II)

$$\text{CMRR}_{(dB)} = (A\text{dm})_{dB} - (A\text{ cm})_{dB}$$
$$= 35-5$$
$$= 30\text{ dB}$$

02 Ans: (c)

Sol: Given input off set voltage is 5mV

Voltage gain A_v = 10000

$$A_V = \frac{V_0}{V_i}$$

$V_0 = A\ V_i = 10000 \times 5 \times 10^{-3}$V

= 50V

The output voltage can never be greater than $\pm V_{sat}$. so the Answer is ±15V.

03. Ans: (c)

Sol: A_1, A_2, A_3 in dB

$A_3 = 20\log_{10} 100 = 40$dB

(A) = $A_1 + A_2 + A_3$ (in dB) = 20 + 30 + 40

= 90dB

04. Ans: (a)

05. Ans: (d)

Sol: As β is very large

$I_B \approx 0$,

V_i = 1V

06. Ans: (c)

Sol: When S_1 is opened, i.e., base terminal is open circuit. Transistor is in cut off region.

07. Ans: (b)

Sol: $P_D = V_{CE}\ I_C = (12 - 4I_c)I_c$

$$\frac{dP_D}{dI_c} = 0 = 12 - 4\times 2I_c$$

$$I_c = \frac{12}{8} = 1.5\text{Amp}$$

$P_D = [12–4(1.5)]\times 1.5$ = 9W.

08. Ans: (b)

Sol: Prime implicant is the one which can not be minimized further i.e. 2^n minterms not a part of 2^{n+1} minterms

⇒ Option b is true but not Option a.

⇒ EPI is the PI with atleast one unique term, but need not to be of all. Hence Option c is wrong.

09. Ans: (a)

Sol: Flash type of ADC require minimum conversion time.

Dual slope ADC minimizes the effect of power supply interference

Successive approximation type ADC requires a DAC inside.

10. Ans: (d)

Sol: Digital ramp conversion time

$$= (2^n - 1) \times \text{clock pulse} = 1023 \times \frac{1}{500\,K}$$

$$= 2046\ \mu s$$

Conversion time of successive approximation type

$$= (n) \times (\text{clock pulse}) = 10 \times \frac{1}{500\,K}$$

$$= 20\ \mu s$$

So, approximately 100 times slower.

11. Ans: (a)

Sol: $32\ kB = 2^5 \times 2^{10} B$

$= 2^{15}\ B$

This 32kB I.C has 15 address output lines

byte difference $= \underline{111}\ \underline{1111}\ \underline{1111}\ \underline{1111}$

$= 7\ FFFH$

Starting address = 1000H

Byte difference = 7 FFFH

End address = 8FFFH

12. Ans: (c)

Sol: The logic circuit, we have

$$F_1 = \left(\overline{\overline{x} + y}\right) = x\overline{y}$$

$$F_2 = \left(\overline{\overline{x} + \overline{y}}\right) + \left(\overline{x + y}\right) = xy + \overline{x}\,\overline{y} = x \odot y$$

$$F_3 = \left(\overline{x + \overline{y}}\right) = \overline{x}\,y$$

The truth table for the logic circuit is given below

x	y	F_1	F_2	F_3
0	0	0	1	0
0	1	0	0	1
1	0	1	0	0
1	1	0	1	0

From the truth table, we deduce the following result.

If $x > y$; then $F_1 = 1$

If $x = y$; then $F_2 = 1$

If $x < y$; then $F_3 = 1$

Therefore, given logic circuit is a comparator circuit.

13. Ans: (a)

Sol: For 8-bit ADC, we have

$n = 8$

comparator threshold $V_T = 1mV$

so, digital output and analog output for the circuit is related as

(Digital value) × resolution > $V_A + V_T$

(Digital value) × 40mV > 6.000V + 1mV

$$(\text{Digital value}) > \frac{6001\text{mV}}{40\text{mV}} = (150.025)_{10}$$

$$(151)_{10} = 10010111$$

14. Ans: (b)

Sol: In the given circuit, $T = Q_n + \overline{Q}_n = 1$, so output will toggle at each clock pulse. Therefore, output frequency will be half of the input frequency. i.e., $f_0 = \frac{f_i}{2}$

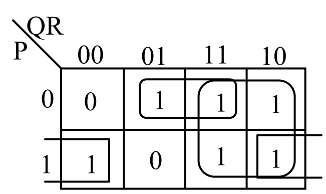
Comparing it to the given relation,

$$f_0 = af_i$$

$$\therefore\ a = 0.5$$

15. Ans: (d)

Sol: We can simplify for by using k-map



From the k-map, we get

$$x = Q + P\overline{R} + \overline{P}R$$

$$= (P \oplus R) + Q$$

i.e., we require one EX-OR and one OR gate.

16. Ans: (a)

Sol: From the given multiplexer output Z is given by

$Z = \overline{S}_1\overline{S}_0 I_0 + \overline{S}_1 S_0 I_1 + S_1\overline{S}_0 I_2 + S_1 S_0 I_3$

Since, we have $I_0 = I_1 = C$

$I_2 = I_3 = \overline{C}$

$S_1 = A$

$S_0 = B$

We get

$Z = \overline{A}\,\overline{B}C + \overline{A}BC + A\overline{B}\,\overline{C} + AB\overline{C}$

$= \overline{A}C(\overline{B} + B) + A\overline{C}(\overline{B} + B)$

$= \overline{A}C + A\overline{C}$

$= A \oplus C$

17. Ans: (a)

Sol: For RST 6.5 vector address is

$6.5 \times 8 = (52)_{10} = 0034$ H

18. Ans: (b)

Sol: INR & DCR instructions don't affect carry flag but affect remaining 4 flags

19. Ans: (d)

Sol: There are 8 internal interrupts in 8085 which are all maskable & vectored interrupts i.e software interrupts

20. Ans: (c)

21. Ans: (a)

22. Ans: (a)

Sol: Threshold voltage begins to decrease as charge in the depletion region is supported by the drain and the source. Thus the gate needs to support less charge in this region, as a result V_T falls down.

23. Ans: (b)

24. Ans: (c)

25. Ans: (c)

Sol: Defect level = $1 - Y^{1-d}$

Yield (Y) = 0.9 & fault coverage (d) = 0.9

Default level = $1-(0.9)^{0.1} = 0.0105$

26. Ans: (a)

27. Ans: (d)

Sol: In n-well technology, NMOS is created in p-type substrate and the PMOS is in the n-well.

28. Ans: (c)

Sol: Attenuation (α) = 0.25dB/Km

Total cable length (ℓ) = 100Km

Input power (P_{in}) = 0.1mW

Output power (P_0) = $\dfrac{\text{Input power}(P_{in})}{\text{Loss}(L)}$

$P_0 = P_{in} - L$ (in dB)

P_{in} = 10mW = 10dBm

$L = \alpha\ell = 0.25 \times 100 = 25$dB

$P_0 = P_{in} - L = 10 - 25 = -15$dBm

29. Ans: (a)

Sol: Total power P_t = 1000W

Transmission rate R_b = 50Mbps

Energy per bit $E_b = P_t . T_b$

$= \dfrac{P_t}{R_b}$

$E_b = P_t - R_b$ (in dB) = 30 – 77

= – 47 dBW/bps

30. Ans:(a)

Sol: Target velocity V_r = 100km/h = 27.8 m/sec

Transmit frequency f = 5GHz

Doppler frequency $f_d = \dfrac{2V_r}{\lambda}$ $\quad (\lambda = \dfrac{c}{f})$

$$f_d = \frac{2 \times 27.8}{\left(\frac{3 \times 10^8}{5 \times 10^9}\right)}$$

f_d = 927Hz

31. Ans: (a)

Sol: A special class of ferrites called 'ferrox cubes' are used as computer memory elements.

32. Ans: (c)

33. Ans: (c)

Sol: If the temperature of metal increases, the lattice vibration in the crystal structure increases. Hence collision frequency increases and mobility decreases. Due to this resistivity of metal increases.

34. Ans: (b)

Sol: Point defect – Vacancy, interstitial, Substitutional, Frenkel, Skottky
Line defect – Edge and Screw dislocation
Planar defect – Grain boundary, twin boundary, stacking fault.

35. Ans: (b)

Sol: Any impurities will act as scattering centers and resistivity increases (or) conductivity decreases

36. Ans: (b)

Sol: According to Matthiersen's rule $\rho = \rho_r + \rho_T$; ρ_r depends on the structural defects of the material and imperfections. ρ_T is temperature dependent

37. Ans: (c)

Sol: Type I SC are also termed as soft SC which exhibit meissner effect and silsbee's rule.

38. Ans: (d)

Sol: Aluminum metal matrix finds application in aerospace, thermal management areas, industrial products, automotive applications such as engine piston, brake etc.

39. Ans: (b)

Sol: $$H(f) = \frac{3(j2\pi f)}{2 + j2\pi f} \xrightarrow{\text{I.F.T}} h(t) = 3\frac{d}{dt}\left[e^{-2t}u(t)\right]$$

$$= 3\delta(t) - 6e^{-2t}\, u(t)$$

40. Ans: (a)

41. Ans: (a)

Sol: (i) for $\alpha_1 = 1$, $y_1(t)$ is linear, Time invariant, causal and memoryless

(ii) for $\alpha_2 = 0$, $y_2(t)$ is linear, Time invariant, causal and memoryless

42. Ans: (b)

Sol: The given period signal contains Half-wave symmetry so $a_0 = 0$, $a_n \neq 0$ (only for odd n) and $b_n \neq 0$ (only for odd n)

43. Ans: (b)

Sol: $\delta(n) \leftrightarrow 1$

$$(-0.8)^n u(n) \leftrightarrow \frac{1}{1+0.8z^{-1}}$$

$$(-0.8)^{n-1} u(n-1) \leftrightarrow \frac{z^{-1}}{1+0.8z^{-1}}$$

$$H(z) = 0.8 + \frac{0.36z^{-1}}{1+0.8z^{-1}} = \frac{0.8+z^{-1}}{1+0.8z^{-1}}$$

$$H(e^{j\omega}) = \frac{0.8+e^{-j\omega}}{1+0.8e^{-j\omega}}$$

$$|H(e^{j0})| = 1$$

$$\left|H\left(e^{\frac{j\pi}{2}}\right)\right| = 1$$

$$|H(e^{j\pi})| = 1$$

So, it is a all pass filter with non-linear phase.

44. Ans: (b)

Sol: $x(n) \neq 0 \quad N_2 \leq n \leq N_3$

$h(n) \neq 0 \quad N_0 \leq n \leq N_1$

$y(n) = x(n) * h(n) \neq 0 \quad N_4 \leq n \leq N_5$

$N_4 = N_0 + N_2$, $N_5 = N_1 + N_3$

45. Ans: (c)

Sol: $$\sin(at)u(t) \leftrightarrow \frac{a}{s^2+a^2}$$

$$\frac{\sin(at)}{t}u(t) \leftrightarrow \int_s^{\infty} \frac{a}{s^2+a^2}\,ds = a\frac{1}{a}\tan^{-1}\left(\frac{s}{a}\right)\Bigg|_s^{\infty}$$

$$= \frac{\pi}{2} - \tan^{-1}\left(\frac{s}{a}\right)$$

$$X(s) = \cot^{-1}\left(\frac{s}{a}\right)$$

$$X(a) = \cot^{-1}\left(\frac{s}{a}\right)$$

$$X(a) = \cot^{-1}(1) = \frac{\pi}{4}$$

46. Ans: (c)

Sol: Properties:

$S_X(\omega)$ is a real function of ω

$S_X(\omega)$ is even

$S_X(\omega) \geq 0$ for all ω

47. Ans: (a)

Sol: $x(n)e^{j\omega_0 n} \leftrightarrow X\left(e^{j(\omega-\omega_0)}\right)$

$x(n)e^{j\pi n} \leftrightarrow X\left(e^{j(\omega-\pi)}\right)$

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

$$= \frac{2}{1+\frac{1}{2}e^{-j\omega}}$$

48. Ans: (d)

Sol: From the given pole-zero plot of the digital filter, the system function is

$$H(z) = \frac{(z+1)(z-1)\left(z+\frac{1}{2}\right)\left(z-\frac{1}{2}\right)(z+2)\ (z-2)}{z^6}$$

$$= \frac{1}{z^6}\left[(z^2-1)\left(z^2-\frac{1}{4}\right)(z^2-4)\right]$$

$$= z^{-6}\left[\left(z^4-1.25z^2+\frac{1}{4}\right)(z^2-4)\right]$$

$$= z^{-6}\left[z^6-4z^4-1.25z^4+5z^2+\frac{1}{4}z^2-1\right]$$

$$= z^{-6}\left[z^6-5.25z^4+5.25\ z^2-1\right]$$

$$= 1-5.25z^{-2}+5.25z^{-4}-z^{-6}$$

$$h(n) = \{1,0,-5.25,0,5.25,0,-1\}$$

As the impulse response,

h(n) = Inverse Z.T of H(z) has only finite duration = 7 samples, the given digital filter is an FIR filter.

49. Ans: (d)

Sol: $s(t) = A_c\cos\omega_c t + \frac{1}{2}\mu A_c[\cos(\omega_c+\omega_m)t]$

$+\frac{1}{2}\mu A_c[\cos(\omega_c-\omega_m)t]$

Comparing with given equation

$\frac{1}{2}\mu A_c = 6$ & $A_c = 20$

$\mu = 0.6$

50. Ans: (b)

Sol: $x(t) = A_c\cos(\omega_c t + \theta)$

Auto correlation function (ACF) of X(t) is

$$R_X(\tau) = \frac{A_C^2}{2}\cos\omega\tau$$

Power spectrum $(S_X(f))$, which is Fourier transform of $R_X(\tau)$ is

But we know that

$$F\{\cos\omega_0\tau\} = \frac{1}{2}[\delta(f+f_0)+\delta(f-f_0)]$$

$$\therefore S_X(f) = \frac{A_c^2}{4}[\delta(f+f_0)+\delta(f-f_0)]$$

51. Ans: (c)

Sol: Peak amplitude of matched filter $= \frac{A^2.T_0}{2}$

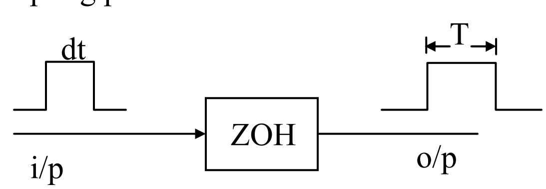
$$= \frac{(20)^2.(0.2)}{2}$$

$= 40$mV

Maximum amplitude occurs at 0.3ms

52. Ans: (b)

Sol: A zero-order hold (ZOH) circuit holds the input signal value for a period of T. i.e., for an input of short duration (dt) pulse, it produces an output pulse of duration T, the sampling period.



i.e., For an input $\delta(t)$, the output is $u(t) - u(t-T)$

i.e., a rectangular pulse

$x(t) = \delta(t) \Rightarrow X(S) = 1$

$y(t) = u(t) - u(t-T)$

$$\Rightarrow Y(s) = \frac{1-e^{-TS}}{S}$$

The transfer function

$$H(s) = \frac{Y(s)}{X(s)} = \frac{1-e^{-TS}}{S}$$

53. Ans: (b)

Sol: $(SNR)_q = (1.8 + 6n)$ dB = 40dB

$\Rightarrow n = 6.37$

We take n = 7bits/sample

$\therefore$ Minimum Storage Capacity = 20 × 8k × 7 = 1.12Mbits = 140Kbytes

54. Ans: (a)

55. Ans: (c)

Sol: $E[Y] = E[2x - 3] = 2\bar{x} - 3 = 2(-3) - 3 = -9.$

$$E\left[Y^2\right] = E\left[(2x-3)^2\right] = 4\overline{x^2} - 12\bar{x} + 9$$

$$= 4(11) - 12(-3) + 9 = 89$$

$$\sigma_Y^2 = \overline{Y^2} - \left(\overline{Y}\right)^2 = 89 - 9^2 = 8$$

56. Ans: (a)

Sol: I(XY) = H(X) + H(Y)– H(X,Y) ------(1)

(or)

We know,

H(XY) = H(X) + H(Y/X)

H(XY) = H(Y)+ H(X/Y) -------(2)

Substitute (2) in (1) we get

I(XY) = H(X) – H(X/Y)

(or)

I(XY) = H(Y) – H(Y/X)

57. Ans: (a)

Sol: We have $\mu_y = \mu_x H(0)$

But H(f) of an ideal differentiator = $j2\pi f$

$\therefore$ H(0) = 0. It then follows that $\mu_y = 0$

$S_Y(f) = S_x(f) . |H(f)|^2$

$|H(f)|^2 = H(f). H^*(f) = j2\pi f(-j2\pi f) = 4\pi^2 f^2$

$S_Y(f) = 4\pi^2 f^2 S_X(f)$

Here, $S_X(f) = F[R_X(\tau)]$

$S_Y(f) = 4\pi^2 f^2 [F\{R_X(\tau)\}] = 4\pi^2 f^2 S_X(f)$

58. Ans: (a)

Sol: $BV_{CEO} = BV_{CBO}\left(\frac{1}{h_{fe}}\right)^{\frac{1}{n}}$

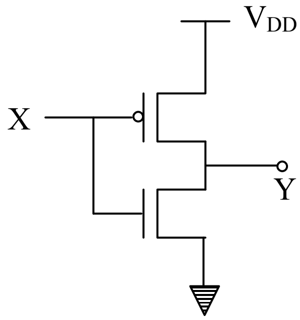
n: 2 to 10

Ex: For Ge, n = 6

Hence, $BV_{CBO} > BV_{CEO}$ ($\because h_{fe} >> 1$)

59. Ans: (d)

Sol: **CMOS inverter**



CMOS inverter has one P-channel and one n-channel MOSFET's. Power dissipation takes when i/p is '1' or i/p is '0' because any one transistor exhibits ON position.

60. Ans: (d)

Sol: At t = 0, still the diode is in forward bias but polarity of voltage source is changed, so that current is same in magnitude because of stored charge, but in reverse direction.

Hence at t = 0, reverse recovery current: 100mA

61. Ans: (a)

Sol: $\sigma_n = n_n e\mu_n = N_D e\mu_n$

$\sigma_i = n_i(\mu_n + \mu_p)e$

$\mu_n + \mu_p = \mu_n + 0.4\mu_n = 1.4\mu_n$

$\frac{\sigma_n}{\sigma_i} = \frac{N_D\mu_n}{n_i \times 1.4\mu_n}$

$\therefore \frac{\sigma_n}{\sigma_i} = \frac{4.2\times10^8}{1.5\times10^4\times1.4} = 20000$

62. Ans: (b)

Sol: $V_{GS} - V_T = 2V$

$\because V_{DS} > V_{GS} - V_T$ the MOSFET is in saturation and has drain current of 0.8 mA.

Now, $V_{GS} - V_T = 1$ V

$\therefore V_{DS} > V_{GS} - V_T$; MOSFET is in saturation.

When MOSFET is in saturation.

$\frac{I_{DS_1}}{I_{DS_2}} = \left(\frac{V_{GS1} - V_T}{V_{GS2} - V_T}\right)^2$

$\frac{0.8}{I_{DS2}} = \left(\frac{3-1}{2-1}\right)^2 = 4$

$I_{DS2} = 0.2$ mA

63. Ans: (a)

Sol: We know rate of generation for minority carriers

$\frac{dp}{dt} = \frac{\text{Excess hole concentration}}{\text{minority carrier life time}}$

At equilibrium (steady state) $\Delta p = \Delta n$

$\frac{dp}{dt} = \frac{\Delta p}{\tau_p} = \frac{10^{15}}{10\times10^{-6}}$

$= 10^{20}$ electron hole pairs/cm^3/s

64. Ans: (a)

Sol: $g_m = \frac{1}{\frac{dV_{GS}}{dI_D}}$ or $\frac{dI_D}{dV_{GS}}$ (V_{DS} = constant)

In saturation region,

$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$

$$\frac{dI_D}{dV_{GS}} = \frac{-2I_{DSS}}{V_P}\left(1-\frac{V_{GS}}{V_P}\right)$$

$$g_m = \frac{-2I_{DSS}}{V_P}\left(1-\frac{V_{GS}}{V_P}\right)$$

65. Ans: (c)

Sol: In saturation region, the drain current of an n-channel enhancement mode MOSFET is given by $I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS}-V_T)^2$

From the above equation $I_D \propto \frac{1}{L}$

$$\frac{I_{D1}}{I_{D2}} = \frac{L_2}{L_1}$$

$$\frac{I_D}{2I_D} = \frac{L_2}{L_1}$$

$$\frac{L_2}{L_1} = \frac{1}{2}$$

$$L_2 = \frac{L_1}{2}$$

66. Ans: (b)

Sol: Schottky barrier diode is a majority carrier device (recall there are no minority carriers in a metal).The storage time is negligible and the reverse recovery time includes only the transition time.

67. Ans: (d)

Sol:

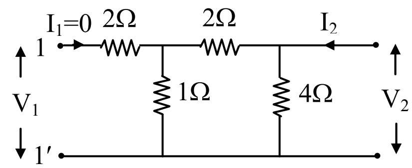
Type / parameter	Emitter-Base Junction	Collector Base Junction	Applica-tions
Saturation	Forward bias	Forward bias	ON switch
Cutoff	Reverse bias	Reverse bias	OFF switch
Active	Forward bias	Reverse bias	Amplifi-cation
Inverse Active	Reverse bias	Forward bias	Attenuator.

68. Ans: (a)

Sol: $V_1 = h_{11}I_1 + h_{12}V_2$

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

$$h_{12} = \left.\frac{V_1}{V_2}\right|_{at\, I_1=0}$$



$$V_1 = 1\left(\frac{4}{7}\right)I_2 \quad \& \quad V_2 = 4\left(\frac{3}{7}\right)I_2$$

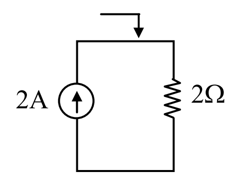
$$\frac{V_1}{V_2} = \frac{1}{3}$$

69. Ans: (d)

Sol: **Step1:** $t < 0$

Before switch is closed

C ⇒ No source so $V_C(0^-) = V_C(0^+) = 0V$

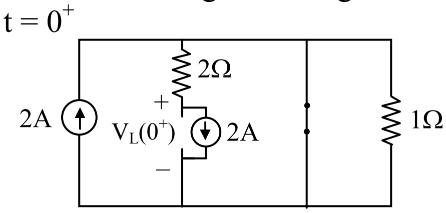


Inductor is short circuited.

$I_L(0^-) = i_L(0^+) = 2$ A

Step2: inductor doesn't allow sudden change in current and capacitor doesn't allow sudden change in voltage.

At $t = 0^+$



$\Rightarrow -V_L(0^+) - 4 = 0$

$\Rightarrow V_L(0^+) = -4$ V

70. Ans: (d)

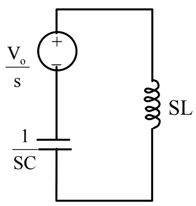
71. Ans: (b)

Sol: To find $R_{th,}$ suppress the independent sources 1A is O.C. and 1 V is S.C.

$R_{th} = 2\ \Omega$

72. Ans: (b)

Sol:



Applying KVL in s-domain,

$$I(s) = \frac{V_o/s}{\frac{1}{CS} + LS} = \frac{V_oC}{LCS^2 + 1}$$

$$\Rightarrow \; i(t) = V_o\sqrt{\frac{C}{L}}\sin\frac{1}{\sqrt{LC}}t$$

$$\Rightarrow \; i(\max) = V_o\sqrt{\frac{C}{L}} = 10\sqrt{\frac{10^{-6}}{0.1\times10^{-3}}} = 1A$$

73. Ans: (d)

Sol: Current in the original network is directly becoming voltage in its dual networks and hence 'R' in the original network with automatically becomes the conductance same value in its dual network.

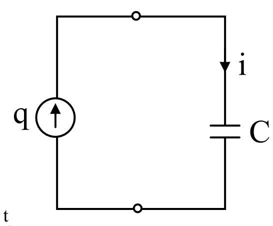
74. Ans: (d)

Sol: For dc i.e. a unit step signal, the inductor will act as a short circuit in steady state. So the source current entirely flows through 'L' only and hence the 1 A current.

75. Ans: (c)

76. Ans: (d)

Sol:



$\Rightarrow i = \frac{dq}{dt}$

$\Rightarrow q = \int_{-\infty}^{t} i(t).dt$

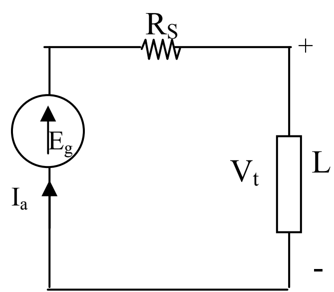
$\Rightarrow q = \int_{0}^{t} i(t)dt = \int_{0}^{t} (10t).dt = 5t^2$ Coulombs

At t = 1 sec ⇒ q = 5 Coulombs

So, $E_C\big|_{t=1sec} = \frac{q^2}{2C} J = \frac{5^2}{2\times100\times10^{-6}} J = 125kJ$

77. Ans: (a)

Sol:



Series current, armature current and load current are equal.

$I_{se} = I_a = I = 100$ A

Armature resistance, $R_a = 0.2\Omega$

Series filed resistance, $R_{se} = 0.055\Omega$

$E_g = V_t + I(R_a+R_{se})$

$= 250 + 100\ (0.2 + 0.055)$

$= 275.5V$

78. Ans: (c)

Sol: $s_1 = 0.05$, $s_2 = 0.15$, $r_2 = 0.2\Omega$, r_{ex} = ?

$$T_e = \frac{3}{s\omega_s}\frac{E_2^2}{\left(\frac{r_2}{s}\right)^2 + X_2^2} r_2$$

As slip is near to zero

$\left(\frac{r_2}{s}\right)^2 >>> X_2^2 \Rightarrow X_2^2$ can be neglected

$T_e \propto \frac{s}{r_2}$

Assuming constant torque, $r_2 \alpha s$

$$\frac{r_2}{r_2 + r_{ex}} = \frac{s_1}{s_2} \Rightarrow \frac{0.2}{0.2 + r_{ex}} = \frac{0.05}{0.15}$$

$0.6 = 0.2 + r_{ex}$

$r_{ex} = 0.4\ \Omega$.

79. Ans: (b)

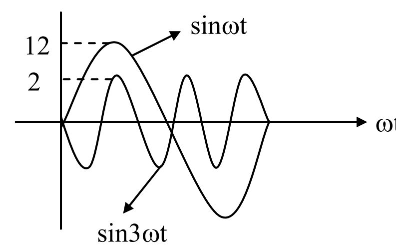
Sol: To reverse the phase sequence of voltage generated in the alternator, we should interchange any two of its phase terminals.

80. Ans: (c)

Sol: $e = 12\sin\omega t + 2\cos(3\omega + 90^o)$

$= 12\sin\omega t - 2\sin(3\omega t)$

$[\ \because \cos(90 + \theta) = -\sin\theta\ ]$



At $\omega t = \frac{\pi}{2}$

$e_{peak} = 12\sin(90) - 2\sin(270^o)$

$= 12 + 2 = 14V$

81. Ans: (b)

Sol: Load factor $= \frac{\text{Average demand}}{\text{Maximum demand}}$

82. Ans: (b)

Sol: Canadian Deuterium Uranium (CANDU) Reactor employs natural uranium as the fuel and heavy water as both the coolant and the moderator .The power output can be varied by varying the level of moderator in this reactor. Hence control rods are not required.

83. Ans: (a)

Sol: 1. If LV winding is placed nearer to the core; the amount of insulation required for the transformer can be reduced

2. By open and short circuits test the copper and core losses will be find out respectively.

3. Large power transformer can not be physically loaded up to rated current; so to allow rated current in the winding without actually loading the transformer short circuit is conducted.

84. Ans: (c)

Sol: Induced voltage, $E = 4.4\ N\ B_m\ A_n\ f$ volts

Given data: N = 20, E = 100 V, f = 50 Hz, $B_{max} = 1\ Wb/m^2$

$100 = 4.44 \times 20 \times 1 \times A_n \times 50$

$A_n = 0.0225\ m^2$

85. Ans: (d)

Sol: Energy stored in a magnetic field per unit volume is $E = \frac{1}{2} BH\ \text{Joule/m}^3$

$E \propto BH$; $B = \mu H \Rightarrow H = \frac{B}{\mu}$

$$E \propto (B)\left(\frac{B}{\mu}\right)$$

$$E \propto \frac{B^2}{\mu}$$

86. Ans: (b)

Sol: $T = \frac{180}{2\pi N_s} \times \frac{sE_2^2 R_2}{R_2^2 + (sx_2)^2}$

$T \propto V_1^2$

$T_2 = (2)^2 \times T_1$

$T_2 = 4\ T_1$

87. Ans: (c)

Sol: According to standards set forth in Internet Engineering Task Force (IETF) document RFC-1918, the following IPv4 address ranges have been reserved by the IANA for private internets, and are *not* publicly routable on the global internet:

- **10.0.0.0/8 IP addresses:** 10.0.0.0 - 10.255.255.255
- **172.16.0.0/12 IP addresses:** 172.16.0.0 - 172.31.255.255
- **192.168.0.0/16 IP addresses:** 192.168.0.0 - 192.168.255.255

88. Ans: (a)

Sol: TCP is transport layer;
IP,ICMP and IGMP are network layer
where as DNS is application layer

89. Ans: (b)

Sol: The top 4 layers: TL, SL, PL and AL
The bottom 3 layers in the communication subnet are physical layer, data link layer and network layer

90. Ans: (c)

Sol: Generally swamping resistances are used in series with measuring meters to eliminated the effect of temperature variations. So the swamping resistance should have low temperature coefficient such that change in resistance is small for large temperature variations and they should have the value of 20 to 30 times the coil resistance.

91. Ans: (d)

Sol: By using electronic instruments we can detect dynamic changes in parameters and the response is very fast on account of small inertia of electrons and they have a higher degree of reliability than their mechanical and purely electrical counter parts.

92. Ans: (d)

Sol: In a measurement system ideal situation, when an element used for any purpose may be for signal sensing, conditioning or detection is introduced the original signal must remain undistorted. But in practical conditions that any introduction of element in a system results in extraction of energy form the system there by distorting the original signal. This distortion may be attenuation, waveform distortion or phase shift. This effect is known as loading effect.

93. Ans: (b)

94. Ans: (d)

Sol: As the breaking magnet is move away from the disc it will bypass lesser and large amount of flux will cut disc, resulting larger breaking torque (as $T_B \, \alpha \phi^2$) and speed is inversely proportional to breaking torque ,so speed will be reduced.

95. Ans: (d)

Sol: 50 cm $\rightarrow$ 1.0185V

65cm $\rightarrow$?

$$\frac{65\times 1.0185V}{50} = 13\times 1.0185 = 1.324$$

$$\% \text{ error} = \frac{A_m - A_t}{A_t}\times 100$$

$$\frac{1.324-1.33}{1.33}\times 100 = -0.45\%$$

96. Ans: (c)

Sol: $\text{Resolution} = \dfrac{\text{full scale reading}}{2^n}$

$$5\text{mV} = \frac{10}{2^n} \Rightarrow 2^n = 2000$$

Minimum number of bits = 11

97. Ans: (c)

Sol: The transducer is used for flow rate measurement of air in aeroplane is hot wire anemometer.

98. Ans: (d)

Sol: EMFM output is dependent on conductivity of fluid and EMFM output voltage is directly proportional to average velocity of fluid. Hence both

99. Ans: (b)

Sol: Residue effect is observed in inductive transducer.

100. Ans: (b)

101. Ans: (c)

Sol: Rhodium-Indium thermocouple used for high temperature measurement in power plant.

102. Ans: (d)

Sol: **BIOS** $\Rightarrow$ Basic input output system is set of programs written in ROM. BIOS is used for system start-up and booting process.

103. Ans: (b)

Sol: Word size = 16 bits

So memory size = 2^{31} words

$\therefore$ 31 address bits are needed

104. Ans: (b)

Sol: Between memory & I/O DMA transfer data is fastest, but between CPU & I/O interrupt driven I/O is fastest

105. Ans: (b)

Sol: In I/O mapped I/O, devices have separate addresses.

106. Ans: (d)

Sol: All a, b and c are types of file system.

107. Ans: (d)

Sol: Transaction T_3 performs read on A, which is updated by T_1 and committed before T_1 does.

108. Ans: (c)

Sol: Precedence graph for the schedule is $T_1 \rightarrow T_2$.

109. Ans: (b)

Sol: P = 0.01 (1%)

Effective access time

= P × page fault service time

+ (1 – P) (2 × memory access time)

= 0.01 × 500 + 0.99 × 2 × 5 = 5 + 9.9

= 14.9 msec

Note: 2 memory accesses required ⇒ one for page table and one for data

110. Ans: (a)

Sol: Closed loop transfer function

$$= \frac{3}{s+2} = \frac{1.5}{0.5s+1} = \frac{K}{s\tau+1}, \ \tau = 0.5$$

111. Ans: (d)

Sol: This is unstable system, so output is unbounded.

112. Ans: (c)

Sol: C.E is $(s+1)^3+k = 0$

$s^3+1+3s^2+3s+k = 0$

by RH criteria,

s^3	1	3
s^2	3	k+1
s^1	$\frac{9-k-1}{3}$	0
s^0	k+1	

By RH tabulation,

$\frac{8-k}{3} > 0, \quad k+1 > 0$

$k < 8, k > -1$

maximum value of k = 8

Steady state error for unit step input

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

$k_p = \underset{s\to 0}{Lt} \ G(s)$

$k_p = \underset{s\to 0}{Lt} \ \frac{k}{(s+1)^3} = k$

Minimum $e_{ss} = \frac{1}{1+k_{max}} = \frac{1}{1+8} = 0.11$

113. Ans: (c)

Sol: Inner loop transfer function = $\frac{G(s)}{1+G(s)}$

Characteristic equation 1 + G(s) = 0 stable for k < 30

Total transfer function = $\frac{G(s)}{1+3G(s)}$

Characteristic equation 1 + 3G(s) = 0 stable for 3k < 30 ⇒ k < 10

∴ 0 < k < 10

114. Ans: (c)

Sol:

s^3	1	3
s^2	k	30
s^1	$\frac{3k-30}{k}$	
s^0	30	

3k – 30 = 0

∴ k = 10

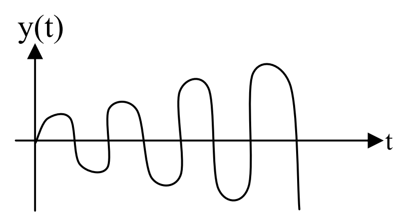
115. Ans: (d)

Sol: CE is $s^2 - 4s + 20 = 0$

Roots of the CE = 2 ± j4

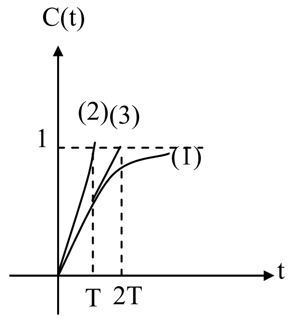
Roots are complex and lie on right-half of the s-plane

∴ response is unbounded with oscillation as below



116. Ans: (a)

Sol: 1^{st} order system with unit step applied, if the initial rate is maintained throughout the journey, then system will reach steady state value 1, at time = Time constant



(1) Represents normal output waveform for unit step applied

(2) Represents slope or rate of c(t) at t = 0,

$\therefore$ If same rate as at t = 0 is maintained throughout the journey, it will reach steady state at t = T

Similarly, at t = T, if c(t) has some rate as shown in (3) and same rate is maintained after t = T, at t = 2T it will reach output 1.

$$\frac{C(s)}{R(s)} = \frac{\frac{1}{2s}}{1+\frac{1}{2s}} = \frac{1}{2s+1}$$ comparing with standard 1st order CLTF = $\frac{K}{s\tau+1}$, we get

T = 2 sec

117. Ans: (c)

Sol: Number of branches terminates at infinity

= Number of Asymptotes

N = P – Z = 5 – 3 = 2

118. Ans: (b)

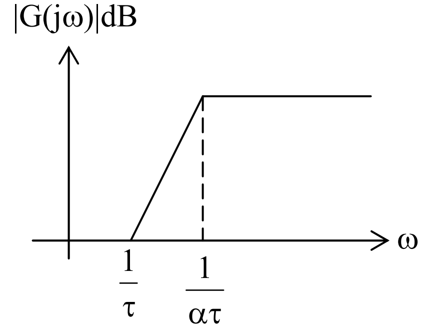
Sol: From D(s) to C(s), one forward path exists and there is a single loop

$$\frac{C(s)}{D(s)} = \frac{\frac{1}{s(s+2)}}{1-\left[\frac{4}{s(s+2)}(-1)\right]}$$

$$= \frac{1}{s^2+2s+4}$$

119. Ans: (c)

Sol: Approximate Bode plot of lead compensator is,



ω_m = The frequency at which maximum phase lead occur.

ω_m = Geometric mean of two corner frequencies

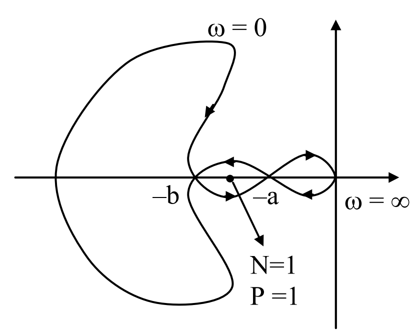
$$\omega_m = \frac{1}{T\sqrt{\alpha}} = \sqrt{\frac{1}{\tau}\frac{1}{\alpha\tau}}$$

From the given plot, $\frac{1}{\tau} = 2$, $\frac{1}{\alpha\tau} = 4$

$\therefore$ $\omega_m = \sqrt{8} = 2.8$ rad/sec

120. Ans: (d)

Sol:

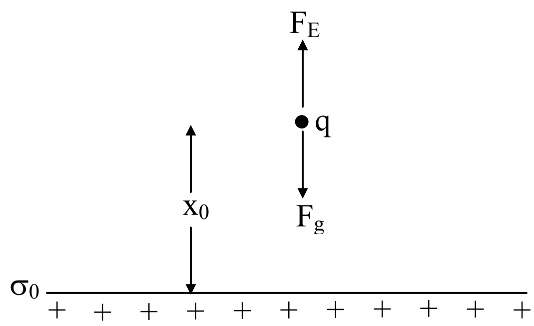


Z = P–N = 1–1= 0

$\therefore$ Stable

121. Ans: (d)

Sol:



For charge q to be stationary $F_E = F_g$

(i.e.) Eq = mg

We have $E = \frac{\sigma_0}{2\varepsilon_0}\hat{a}_n$.

$$\therefore \frac{\sigma_0}{2\varepsilon_0} q = mg$$

$$\Rightarrow \sigma_0 = \frac{2mg\varepsilon_0}{q}$$

$$= \frac{9.1\times10^{-18}\times9.8\times2\times\frac{1}{36\pi}\times10^{-9}}{\frac{1}{36\pi}\times10^{-18}}$$

$$= 9.1\times9.8\times2\times10^{-9}$$

$$= 178.36\text{nC/m}^2$$

122. Ans: (c)

Sol: (1) If $\theta_I = \theta_B$, then $\Gamma_{\parallel} = 0$ but $\Gamma_{\perp} \neq 0$. Therefore the reflected wave has only Perpendicularly polarized component and hence the reflected wave is always linearly polarized if the incident wave is circular (or) elliptical.

(2) Critical angle doesn't exist if $\varepsilon_2 > \varepsilon_1$

(3) $\varepsilon_1 > \varepsilon_2 \Rightarrow$ medium 1 is denser and medium 2 is rarer medium. So as the wave moves from denser to rarer its velocity increases and the wave will move away from the normal.

123. Ans: (a)

Sol: $Z_0 = \sqrt{\frac{L}{C}}$

$$= \sqrt{\frac{1\times10^{-6}}{0.1\times10^{-9}}}$$

$$= \sqrt{10^4}$$

$$= 100\Omega$$

124. Ans: (b)

Sol: Given: β = 50rad/m

$v = c = 3\times10^8$m/sec

$$v = \frac{\omega}{\beta}$$

$$\Rightarrow \omega = v\times\beta$$

$$= 3\times10^8\times50$$

$$= 150\times10^8$$

$$= 1.5\times10^{10}\text{ rad/sec}$$

125. Ans: (b)

Sol: $Z_0 = \sqrt{Z_{SC}Z_{OC}}$

$$= \sqrt{100\times36}$$

$$= 60\Omega$$

126. Ans: (b)

Sol: Brewster angle is also called separating angle for which reflected wave is always linear.

127. Ans: (c)

Sol: $\beta(\omega) = \omega\sqrt{\mu\varepsilon}$

$$= \omega\sqrt{\mu_0\varepsilon_0\varepsilon_r} = \frac{\omega}{c}\sqrt{\varepsilon_r} = \frac{\omega}{c}n(\omega)$$

$$= \frac{\omega}{c} \times \frac{n_0\omega}{\omega_0} = \frac{n_0\omega^2}{c\omega_0}$$

Now $\frac{d\beta}{d\omega} = \frac{d}{d\omega}\left(\frac{n_0\omega^2}{\omega_0 c}\right) = \frac{n_0}{\omega_0 c} \times 2\omega = \frac{2n_0\omega}{\omega_0 c}$

So that $v_g = \frac{d\omega}{d\beta} = \frac{\omega_0 c}{2n_0\omega}$

The group velocity at ω_0 is $v_g(\omega_0) = \frac{c}{2n_0}$

The phase velocity at ω_0 is

$$v_p(\omega_0) = \frac{\omega}{\beta(\omega_0)} = \frac{c}{n_0}$$

$$\therefore \frac{v_g(\omega_0)}{v_p(\omega_0)} = \frac{\frac{c}{2n_0}}{\frac{c}{n_0}} = \frac{1}{2}$$

128. Ans: (a)

Sol: Here, the wave incident from a medium of high refractive index than that of the medium beyond the boundary which is free space. As the angle of incident is given as the critical angle, from Snell's law $n_1 \sin\theta_c = n_2 \sin\theta_t$ ------- (1)

where θ_t is the transmitted angle corresponding to the incidence angle θ_c.

We have $\sin\theta_c = \frac{n_2}{n_1}; n_2 < n_1$.

The above equation can only be satisfied it $\sin\theta_t = 1$. Hence transmitted angle can be given as $\theta_t = \sin^{-1}(1) = 90°$

We have $n_2 = 1$, now from (1),

$$n_1 = \frac{1}{\sin\theta_c}$$

$$= \frac{1}{\sin 30}$$

$$= 2$$

So relative permittivity $\varepsilon_{r1} = n_1^2 = 2^2 = 4$

129. Ans: (b)

Sol: $v = \frac{3\times10^8}{\sqrt{4\times9}}$

$$= \frac{3\times10^8}{2\times3}$$

$$= 0.5\times10^8\,m/s$$

130. Ans: (c)

Sol: The normalized power pattern of Hertzian dipole is $f^2(\theta) = \sin^2\theta$. The directivity of Hertzian dipole is 1.5.

131. Ans: (a)

Sol: Because of feedback, the closed loop system stability is a major problem in closed loop system

132. Ans: (a)

133. Ans: (c)

Sol: Because memory indirect type addressing mode instructions require two memory visits in its execution cycle.

134. Ans: (d)

Sol: RSA is asymmetry key cryptography

135. Ans: (a)

Sol: The loads, requiring high starting torque such as for hoists, cranes and traction type loads, series motors are best suitable machine. Since series motor produces high starting torque.

136. Ans: (d)

Sol: Tellegen's theorem states that the sum of power delivered to each branch of any electric network is zero. It is applicable for any lumped network having elements which are linear or non-linear, active or passive, time-varying or time-invariant.

137. Ans: (a)

Sol: For a reactance function, either a pole or zero should occur at the origin.

As $\frac{dX}{d\omega} > 0$, poles and zeros alternate on the jω-axis

138. Ans: (d)

Sol: For same drain current rating p-channel MOSFET occupies more area than n-channel MOSFET.

139. Ans: (b)

Sol: To obtain high Switching speed BJT operated in active region. In the active region BJT works as a linear element.

140. Ans: (d)

Sol: If the receiver is tuned to f_s, the local oscillated frequency (f_ℓ) should be adjusted so that the output of the mixer is always equals to the intermediate frequency (IF)

$\therefore\ f_\ell - f_s = IF$

→ For superheterodyne AM receiver

Tuning range : 550 kHz →1650 kHz

IF : 455 kHz

→For superheterodyne FM receiver

Tuning range : 88 MHz → 108MHz

IF : 10.7 MHz

141. Ans: (a)

Sol: $\left(\frac{2}{3}\right)^n u(n) \leftrightarrow \frac{1}{1-\frac{2}{3}z^{-1}}$

$$\left(\frac{2}{3}\right)^{n+2} u(n+2) \leftrightarrow \frac{z^2}{1-\frac{2}{3}z^{-1}}$$

(From time shifting property of z-transforms $x(n-n_0) \leftrightarrow z^{-n_0}\, x(t)$)

$$\left(\frac{2}{3}\right)^{n} u(n+2) \leftrightarrow \frac{\frac{9}{4}z^2}{1-\frac{2}{3}z^{-1}}$$

142. Ans: (b)

143. Ans: (c)

Sol: Hard magnetic materials have wide and large and wide hysteresis loop.

144. Ans: (c)

Sol: Gunn metal contains 88% Cu, 10% Sn and 2% Zn.

145. Ans: (a)

146. Ans: (a)

147. Ans: (c)

Sol: Electric fields tend to be increased at smaller geometrics since device voltages are difficult to scale to arbitrarily small values. As a result, various hot carrier effects appear in short channel devices.

148. Ans: (b)

149. Ans: (c)

150. Ans: (c)

Sol: BJT is a current controlled device. The output current is controlled by the input current. The current in BJT due to both electrons and holes.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