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**ESE- 2019 (Prelims) - Offline Test Series** **Test-22**

**Electronics & Telecommunication Engineering**

# FULL LENGTH MOCK TEST - 1 (PAPER - II)
# SOLUTIONS

**01. Ans: (b)**

**Sol:** Output $y(n) = x(n)*h(n)$

$$y(n) = [ke^{j(\omega n+\phi)}]*[\delta(n+4)+\delta(n-4)] \qquad [x(n)*\delta(n-n_0) = x(n-n_0)]$$

$$y(n) = k[e^{j(\omega(n+4)+\phi)} + e^{j(\omega(n-4)+\phi)}]$$

$$y(n) = k[e^{j\omega n}e^{j4\omega}e^{j\phi} + e^{j\omega n}e^{-j4\omega}e^{j\phi}]$$

$$y(n) = ke^{j\omega n}e^{j\phi}[e^{j4\omega} + e^{-j4\omega}]$$

$$y(n) = 2ke^{j(\omega n+\phi)}\cos(4\omega)$$

**02. Ans: (a)**

**Sol:** A system is said to be causal, if ROC is out of the outermost circle. A system is said to be stable, if ROC includes unit circle.

If ROC is $|z| > 3$ then system is causal, but unstable.

$\frac{1}{3} < |z| < 3$ then system is non-causal and stable.

$|z| < \frac{1}{3}$ then system is non-causal and unstable.

**03. Ans: (d)**

**Sol:** Given $y(n) - \sum_{k=1}^{3} a_k y(n-k) = bx(n)$

Apply z-transform on both sides

$$Y(z) - \sum_{k=1}^{3} a_k z^{-k} Y(z) = bX(z)$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{b}{1-\sum_{k=1}^{3} a_k z^{-k}}$$

$$H(\infty) = \frac{b}{1-0} = 1$$

b = 1

**04. Ans: (a)**

**Sol:** Given $y(n) = 2y(n-1) - 0.2y(n-3) + 0.5x(n) - 0.2x(n-2)$

Apply DTFT on both sides

$$H(e^{j\omega}) = \frac{Y(e^{j\omega})}{X(e^{j\omega})} = \frac{0.5 - 0.2e^{-2j\omega}}{1 - 2e^{-j\omega} + 0.2e^{-3j\omega}}$$

$$H(e^{j(\omega-\pi)}) = \frac{0.5 - 0.2e^{-2j(\omega-\pi)}}{1 - 2e^{-j(\omega-\pi)} + 0.2e^{-3j(\omega-\pi)}}$$

$$H(e^{j(\omega-\pi)}) = \frac{0.5 - 0.2e^{-2j\omega}}{1 + 2e^{-j\omega} - 0.2e^{-3j\omega}}$$

Then the corresponding difference equation is

$y(n) + 2y(n-1) - 0.2y(n-3) = 0.5x(n) - 0.2x(n-2)$

**05. Ans: (b)**

**Sol:** Given $h_1(n)$ & $h_2(n)$ are connected in cascade. So, the resultant impulse response is $h(n) = h_1(n) * h_2(n)$

$h(n) = \delta(n) *[\delta(n) - \delta(n-2)]$

$h(n) = \delta(n) - \delta(n-2)$

Given $x(n) = u(n)$, then $y(n) = x(n) * h(n)$

$y(n) = u(n) * [\delta(n) - \delta(n-2)]$

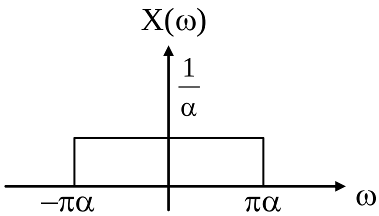
$y(n) = u(n) - u(n-2)$

$y(n) = \{1, 1\}$

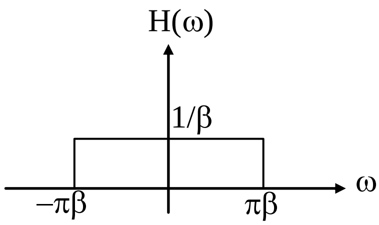
$y(n) = \delta(n) + \delta(n-1)$

**06. Ans: (b)**

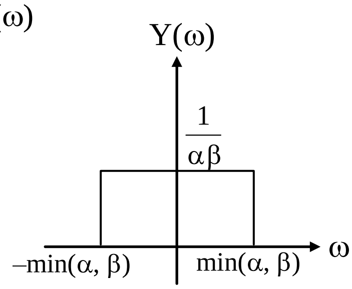
**Sol:** $x(t) = \text{Sinc}(\alpha t) = \frac{\text{Sin}(\pi\alpha t)}{\pi\alpha t} \leftrightarrow \frac{1}{\alpha}\text{rect}\left(\frac{\omega}{2\pi\alpha}\right)$




$h(t) = \text{Sinc}(\beta t) = \frac{\text{Sin}(\pi\beta t)}{\pi\beta t} \leftrightarrow \frac{1}{\beta}\text{rect}\left(\frac{\omega}{2\pi\beta}\right)$



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




$y(t) = \frac{1}{\alpha\beta}\text{Sinc}(pt)$, hence p = min(α, β)

**07. Ans: (b)**

**Sol:** Linear production (inverse filterity) model represents FIR filer

**08. Ans: (a)**

**Sol:** Given $Y(k) = X(k)e^{j\frac{2\pi}{5}3k}$, N = 5

Apply I.D.F.T

$y(n) = x((n+3))_5$

$x(3) = y(0) = 2$

$x(3) = \alpha = 2$

**09. Ans: (c)**

**Sol:** There is a potential problem for frequency sampling realization of the FIR linear phase filter. The frequency sampling realization of the FIR filter introduces poles and zeros at equally spaced points on the unit circle.

**10. Ans: (d)**

**Sol:** B. $n^2 y^2(n) + y(n) = x^2(n)$

Non-linear because of squared term, $y^2(n)$

Time variable because of multiplication by $n^2$

Memory less because of y(n) depending upon x(n) – (5)

D. y(n + 1) y(n) = 4 x(n)

Non-linear because of product term y(n+1) y(n)

Time invariant (no multiplication by function of n)

Dynamic because of y(n + 1) depending upon the previous value, y(n) – (4)

C. y(n + 1) + n y(n) = 4 n x(n)

Linear because of the absence of Non-linear terms

Time variable because of multiplication by n

Dynamic because of y(n+1) depending on the previous value y(n) – (1)

A. y(n + 2) + y(n + 1) + y(n)

= 2 x(n +1) + x(n)

Linear because of the absence of non-linear terms.

Time-invariant because of absence of Multiplication by function on n .

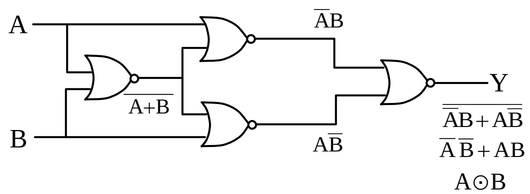
Dynamic because of dependence of y(n +1) on y(n) etc. – (2)

**11. Ans: (b)**

**Sol:** In Totem pole TTL logic gate clamping diodes are used at the input to suppress the oscillations.

**12. Ans: (b)**

**Sol:**

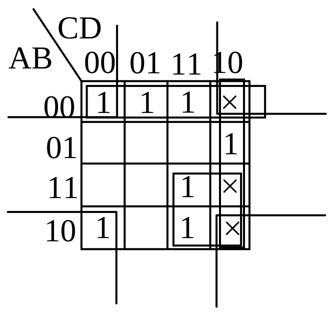



**13. Ans: (b)**

**Sol:** statements 1, 2 and 3 are correct.
Statements 4 is not correct, because MUX is converting parallel to serial.

**14. Ans: (a)**

**Sol:**




$$f(A,B,C,D)=\overline{A}\,\overline{B}+C\overline{D}+\overline{B}\,\overline{D}+AC$$

**15. Ans: (c)**

**Sol:** $(-256)_{10}$

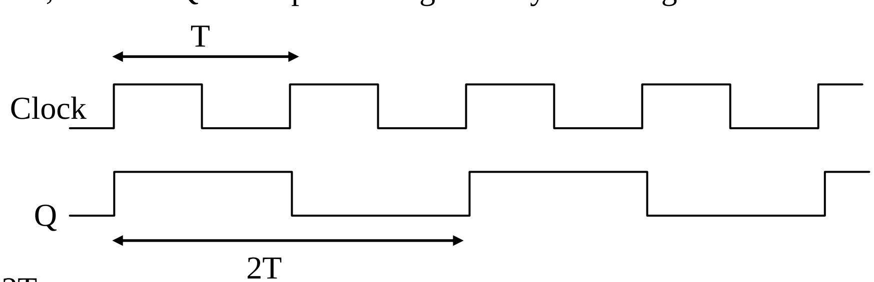
100000000 ⇒ –256 in 2's complement representation using 9 bits

1111111100000000 ⇒ –256 in 2's complement representation using 16 bits

So the number of 1's in 2's complement representation using 16 bits is '8'.

**16. Ans: (c)**

**Sol:** Including XOR gate, it is becoming T flip flop.
As T = 1, the state Q is complementing at every clock edge




$T_Q = 2T$

$$f_Q=\frac{1}{2T}=\frac{f}{2}=\frac{10M}{2}=5MHz$$

**17. Ans: (b)**

**Sol:**

| $D_3$ | $D_2$ | $D_1$ | $D_0$ |
|---|---|---|---|
| $Q_3$ | $Q_2$ | $Q_1$ | $Q_0$ |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

∴ By observing the above table , we can say that $D_1$ and $D_0$ inputs of DAC were interchanged.

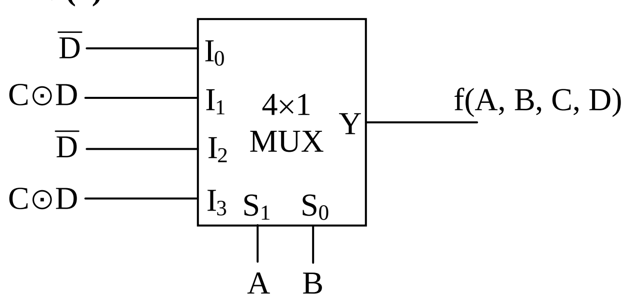
**18. Ans: (b)**

**Sol:** The number of combinations for which A is equal to B is true in n bit comparator is = $2^n$

For 10 bit comparator it is $2^{10}$

**19. Ans: (a)**

**Sol:**




| A $S_1$ | B $S_0$ | $I_0$ 0 0 | $I_1$ 0 1 | $I_2$ 1 0 | $I_3$ 1 1 |
|---|---|---|---|---|---|
| $\overline{C}\,\overline{D}$ | (00) | (0) | (4) | (8) | (12) |
| $\overline{C}D$ | (01) | 1 | 5 | 9 | 13 |
| $C\overline{D}$ | (10) | (2) | 6 | (10) | 14 |
| CD | (11) | 3 | (7) | 11 | (15) |
| | | $\overline{D}$ | $C \odot D$ | $\overline{D}$ | $C \odot D$ |

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | | 0 | 0 | |
| 01 | | 0 | | 0 |
| 11 | | 0 | | 0 |
| 10 | | 0 | 0 | |

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

**20. Ans: (d)**

**Sol:**

$\rightarrow$ SRAM is faster and more expensive than DRAM. So, SRAM is used for CPU cache, while DRAM is used for a computer's main memory.

$\rightarrow$ SRAM needs more transistors than DRAM to store a certain amount of data. DRAM requires only one transistor and one capacitor to store every bit of data, while SRAM needs 6 transistors.

$\rightarrow$ So, SRAM is less denser than DRAM.

$\rightarrow$ Flash memories are designed with either EEPROM or battery powered SRAM.

Since pen drive is given, we can not provide battery to it permanently thus EEPROM is used

$\therefore$ Only $S_3$ is correct statement.

**21. Ans: (c)**

**Sol:**

1) **Based addressing mode:**
In this addressing mode, the offset address of the operand is given by the sum of contents of BX/BP registers and 8-bit/16-bit displacements.
**Eg:** MOV DX, [BX+04]

2) **Direct addressing mode:** The addressing mode in which the effective address of the memory location is written directly in the instruction.
**Eg:** MOV [1234H], Ax

3) **Immediate addressing mode:**
The addressing mode in which the data operand is a part of the instruction itself is known as immediate addressing mode.
**Eg:** MOV AX, 1234H

4) **Indexed addressing mode:**
In this addressing mode, the operands offset address is found by adding the contents of SI or DI register and 8-bit/16-bit displacements.
**Eg:** Add AL, [SI]

**22. Ans: (a)**

**Sol:**

$$
\begin{array}{rll}
A = 44_H = & 0100 & 0100_2 \\
+B = 56_H = & \underline{0101} & \underline{0110_2} \\
 & 1001 & 1010 \\
 & \underline{1} & \underline{+0110} \text{ (AC generated here. So we have to add 0110 to lower nibble)} \\
 & 1010 & 0000 \\
 & +\underline{0110} & \\
 & 0000 & 0000 = \boxed{00_H}
\end{array}
$$

**23. Ans: (c)**

**Sol:**

**i) Status flags in 8086:**

1. Sign flag (S)
2. Zero flag (Z)
3. Auxiliary flag (AC)
4. Parity flag (P)
5. Carry flag (CY)
6. Overflow flag (O)

**ii) Control flags in 8086:**

1. Directional flag (D)
2. Interrupt flag (I)
3. Trap flag

**24. Ans: (a)**

**Sol:** ACI means add the immediate to the accumulator with carry.

37 = 00110111

+56 = 01010110

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10001101

+ 1 ← carry

-------------

10001110 = 8E H

**25. Ans: (a)**

**Sol:** Given RAM chip size = 256 K×4

$$2^8 \times 2^{10} \times 2^2 = 2^{20}$$

The address lines of microprocessors $= 2^{20} \times 8 = 2^{23}$

Required number of chips $= \dfrac{2^{23}}{2^{20}} = 2^3 = 8$

**26. Ans: (b)**

**Sol:** $N_A = 2\times10^{16}/cm^3$ $N_D = 1\times10^{16}/cm^3$

$N_A > N_D \Rightarrow$ p-type

$p = N_A - N_D$ for $N_A - N_D >> n_i$

$p = (2\times10^{16} - 1\times10^{16})$ atoms/cm$^3$ = $10^{16}$ atoms/cm$^3$

**27. Ans: (b)**

**Sol:** $\frac{C}{A}=\frac{\varepsilon}{d}=\frac{\varepsilon_o\varepsilon_r}{d}$

$$=\frac{12\times8.85\times10^{-12}}{10\times10^{-6}}$$

$= 10.62\ \mu F/m^2 \approx 11\ \mu F/m^2$

**28. Ans: (d)**

**Sol:** $V_0=\frac{KT}{q}\ln\left[\frac{N_AN_D}{n_i^2}\right] \Rightarrow V_0 \propto \ln(\text{doping})$

**29. Ans: (d)**

**Sol:** $E=\frac{V}{W}=\frac{0.5V}{4.0\times10^{-7}m}=1.25\times10^6 V/m$

**30. Ans: (d)**

**Sol:** $I=\left[\frac{AqD_p}{L_p}P_{no}+\frac{AqD_n}{L_n}n_{po}\right][e^{\frac{V}{\eta V_T}}-1]=I_0[e^{\frac{V}{\eta V_T}}-1]$

Where, $I_0=\frac{AqD_p}{L_p}P_{no}+\frac{AqD_n}{L_n}n_{po}=\frac{AqD_p}{L_p}\frac{n_i^2}{N_D}+\frac{AqD_n}{L_n}\frac{n_i^2}{N_A}$

**31. Ans: (d)**

**Sol:** Point contact junction or Schottky diode junction has least junction capacitance.

**32. Ans: (d)**

**Sol:** $\alpha=0.98\Rightarrow\beta=\frac{\alpha}{1-\alpha}=\frac{0.98}{1-0.98}=49$

$I_C=\frac{0.6}{600}=1mA$

$I_B=\frac{I_C}{\beta}=\frac{1mA}{49}=0.02mA$

**33. Ans: (a)**

**Sol:** $g_m=\frac{I_C}{V_T}=\frac{\beta I_B}{V_T}$

$$=\frac{100\times\left(\frac{3-0.7}{100k}\right)}{25mV}$$

$=92mA/V$

**34. Ans: (b)**

**Sol:** $\sigma = qN_D\mu_n \Rightarrow qN_D = \frac{\sigma}{\mu_n} = \frac{1}{\rho\mu_n}$

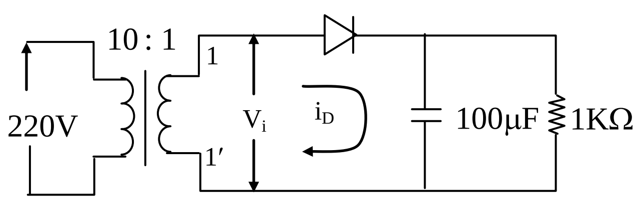
$$V_p = \frac{qN_D}{2\varepsilon}a^2 = \frac{a^2}{2\rho\mu_n\varepsilon} = \frac{(2\times10^{-4})^2}{2\times5\times1300\times9\times10^{-14}\times12} = 2.85V$$

**35. Ans: (c)**

**Sol:** $V_{DC} = \frac{V_m}{\pi}, V_m = \pi V_{DC} = \pi\times10 = 31.42V$

$$V_{rms_2} = \frac{V_m}{\sqrt{2}} = \frac{31.42}{\sqrt{2}}$$

Turns ratio $= \frac{n_p}{n_s} = \frac{V_{rms_1}}{V_{rms_2}} = \frac{220\sqrt{2}}{31.42} = 9.9:1 \cong 10:1$




$\therefore$ Primary($n_p$) and secondary($n_s$) turns are 10,1

**36. Ans: (b)**

**Sol:** Transformer - coupled class B push pull power amplifiers

→ It suffers from cross over distortion

→ It eliminates even harmonic distortion

→ It's device ratings lower than class – A power amplifier

→ Theoretical efficiency 78% which is less than class C

**37. Ans: (c)**

**Sol:** At t = 5ms, i ≠ 0, but the voltage suddenly drops to zero value i.e, the element acts as a short circuit. As the voltage across a capacitor cannot change instantaneously, the element is not a capacitor. And also the voltage is not proportional to the current; there fore the element is not a resistance.

$\therefore$ We conclude that the element is an inductor.

From the figure, $\frac{di}{dt} = \frac{1}{5\times10^{-3}} = 200A/S$ and $V = 5V$

$$\therefore V = L\frac{di}{dt} \Rightarrow L = \frac{V}{di/dt} = \frac{5}{200} = 25mH$$

**38. Ans: (d)**

**Sol:** $V_0 = 2(0 - V_{in}) = -2V_{in}$

$$I_{in} = \frac{V_{in} - V_0}{R_F} = \frac{V_{in} + 2V_{in}}{R_F} = \frac{3V_{in}}{R_F}$$

$$\frac{V_0}{I_{in}}(\text{transresistance}) = \frac{-2V_{in}}{\left(\frac{3V_{in}}{R_F}\right)} = \frac{-2R_F}{3}$$

**39. Ans: (c)**

**Sol:** $Q_2$ pulls its current $I_2$ from a load where as
$Q_5$ pushes its current $I_5$ into a load.
Therefore, $Q_5$ is called current source and $Q_2$ should more properly be called a current sink.

**40. Ans: (b)**

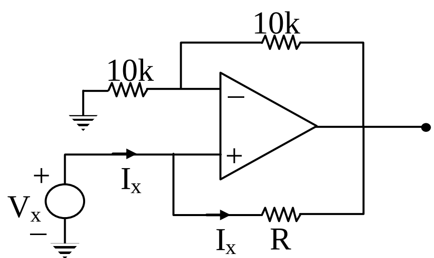
**Sol:** $Q = CV = \text{Farad. Volt} = \frac{fF}{\mu m^2}.\mu m.\mu m \text{ Volt}$

$= C_{ox}\, W.L\, [V_{gs} - V_t] = 10\frac{f}{\mu^2}.5\mu.0.1\mu[1]$

$= 5fC$

**41. Ans: (b)**

**Sol:**

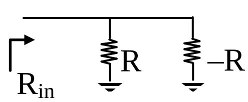



$V_0 = \left(1 + \frac{10k}{10k}\right)V_x$
$= 2V_x$

$$I_x = \frac{V_x - 2V_x}{R} = \frac{-V_x}{R}$$

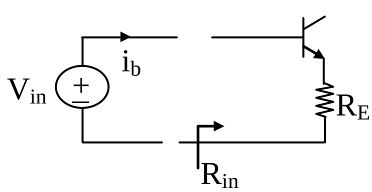
$$\frac{V_x}{I_x} = -R$$

$$R_{in} = \frac{R(-R)}{R - R} = \infty$$




**42. Ans: (c)**

**Sol:**




$V_{in} = V_{be} + i_e R_E = i_b r_\pi + (1+\beta)\, i_b R_E$

$$\frac{V_{in}}{i_b} = R_{in} = r_\pi + (1+\beta)R_E$$

**43. Ans: (c)**

**Sol:** The gain Bandwidth product is always constant.

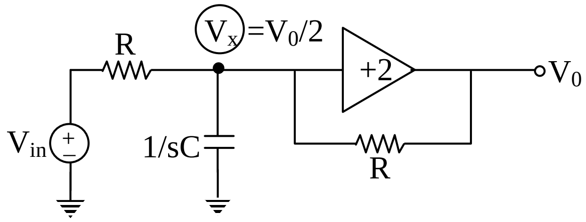
i.e., $G_1 \times (B.w)_1 = G_2 \times (B.w)_2$

$$(B.w)_2 = \frac{G_1 \times (B.w)_1}{G_2} = \frac{-20 \times 30k}{-1}$$

$$= 600KHz$$

**44. Ans: (c)**

**Sol:**




KCL

$$\frac{\frac{V_0}{2} - V_{in}}{R} + \frac{V_0}{2}[sC] + \frac{\frac{V_0}{2} - V_0}{R} = 0$$

$$\frac{V_0}{2R} - \frac{V_{in}}{R} + V_0\left[\frac{sC}{2}\right] - \frac{V_0}{2R} = 0$$

$$\frac{V_{in}}{R} = \frac{V_0(sC)}{2}$$

$$\frac{V_0}{V_{in}} = \frac{2}{sCR}$$

Circuit behaves as non-inverting integrator

**45. Ans: (a)**

**Sol:** Modulation index, $\mu = \frac{7.5V_p}{20V_p} = 0.375$

$\therefore$ % of modulation = 37.5%

**46. Ans: (b)**

**Sol:** $\mu_t = \sqrt{\mu_1^2 + \mu_2^2 + \mu_3^2} = \sqrt{(0.2)^2 + (0.4)^2 + (0.5)^2}$

$\mu_t = \sqrt{0.45}$

$$P_t = P_c\left[1 + \frac{\mu_t^2}{2}\right]$$

$$P_t = 100\left[1 + \frac{(\sqrt{0.45})^2}{2}\right]$$

$P_t$ = 122.445 W

**47. Ans: (a)**

**Sol:** $A_c\,[1+\mu] = 52 = V_{max}$

$A_c\,[1-\mu] = 24 = V_{min}$

$$\Rightarrow A_c = \frac{V_{max}+V_{min}}{2} = \frac{76}{2} = 38V$$

**48. Ans: (a)**

**Sol:** Bandwidth Improvement Factor is given by

$$BIF = \frac{B_{RF}}{B_{IF}}$$

$$BIF = \frac{200\times 10^3}{10\times 10^3} = 20$$

$\therefore$ NF = $10\log_{10}20 = 10\log_{10}10\times 2 = 10\log_{10} 10 + 10\log_{10} 2 = 10 + 3 = 13$dB

Improvement = 13 dB

**49. Ans: (d)**

**Sol:** A squelch circuit keeps the audio section of the receiver turned off or muted in the absence of a received signal.

**50. Ans: (a)**

**Sol:** Sum of all gains is 33 + 47 + 25 = 105 dB

Sum of all losses is 3 + 6 + 8 = 17 dB

$\therefore$ Net receiver gain is

G = 105–17 = 88 dB

The audio signal level at the output of receiver is

–80 dBm + 88 dB = 8 dBm

**51. Ans: (d)**

**Sol:** QAM is similar to DSB–SC but sends two message signals over the same spectrum

$S(t)_{QAM} = m_1(t)\text{Cos}\omega_c t + m_2(t)\text{Sin}\omega_c t$

The demodulation uses coherent detection ie. $m_1(t)$ is multiplied with $\text{Cos}\omega_c t$ and $m_2(t)$ is multiplied with $\text{Sin}\omega_c t$. Assume there is a phase mismatch of 'θ' when demodulating signal $m_1(t)$. Then the output of LPF will be $[m_1(t)\,\text{Cos}\theta - m_2(t)\text{Sin}\theta]$

For a given value of 'θ' the output of the LPF is having both the message components $m_1(t)$ as well as $m_2(t)$. This results in Co-channel interference.

**52. Ans: (a)**

**Sol:** The given random variable 'X' represents mixed random variable

$\frac{1}{2}e^{-x}u(x)$ is continuous, $\frac{1}{4}\delta(x+1), \frac{1}{8}\delta(x)$ and $\frac{1}{8}\delta(x-1)$ are discrete functions on 'X'

$$\therefore P[0 < x < 1] = \int_0^1 \frac{1}{2} e^{-x} dx + 0 + 0 + 0 = -\frac{1}{2}\left[e^{-1} - 1\right]$$

$$= \frac{1}{2}\left[1 - e^{-1}\right]$$

**53. Ans: (d)**

**Sol:** Pre emphasis and de emphasis used in FM receivers.
Balanced modulator used to generate DSB – SC signal
Companding is used in PCM to suppress higher amplitude signals
Envelope detector is used to demodulate AM signal

**54. Ans: (b)**

**Sol:** Audio is frequency modulated.
Video transmitted using VSB modulation.

**55. Ans: (d)**

**Sol:** NA = $\sin(\theta_A)$ $(\because \theta_A = 30^0)$
NA = $\sin 30^0 = 0.5$

**56. Ans: (a)**

**Sol:** Total losses = 2dB ×10 = 20dB
Received power, $P_r$ = sensitivity + power margin = 10dBm + 5dB = 15dBm
15dBm = 15dB – 30dB = –15dBm
Losses = $(P_t)$dB – $(P_r)$dB
$(P_t)$dB = (Losses)dB + $(P_r)$dB
= 20dB – 15dB
= 5dB

**57. Ans: (b)**

**58. Ans: (a)**

**59. Ans: (c)**

**60. Ans: (b)**

**Sol:** 16 Bytes (128 bits)

**61. Ans: (b)**

**Sol:** Gold diffuse easily in silicon and creates deep trap states

**62. Ans: (c)**

**Sol:** VLSI design flow:
Specification → Architecture → RTL description
→ Synthesis → Gate level netlist → Physical design → layout → Fabrication → Testing

**63. Ans: (b)**

**Sol:** Silicon wafer is placed in a reactor with silane gas ($SiH_4$), and they are heated to grow polysilicon layer by chemical vapour deposition

**64. Ans: (a)**

**Sol:** Polishing is done to remove excess material on the surface, to make it clean and to make the surface flat

**65. Ans: (a)**

**Sol:** $\lambda_1 = \frac{c}{f} = \frac{3\times10^8}{3\times10^6} = 100\text{m}$

$f_1$ = 3MHz

$$v = \frac{3\times10^8}{\sqrt{\varepsilon_r}} = \frac{3\times10^8}{2}$$

$$\lambda_2 = \frac{3\times10^8}{2\times3\times10^6} = \frac{100}{2} = 50\text{m}$$

$$\lambda_2 = \frac{\lambda_1}{2}$$

$f_2 = f_1$

**66. Ans: (b)**

**Sol:** B = 20nT

$$H = \frac{B}{\mu_0} = \frac{20\times10^{-9}}{4\pi\times10^{-7}}$$

$$\frac{E}{H} = \eta = 120\pi$$

E= ($120\pi$) H

$$E = (120\pi)\left(\frac{20\times10^{-9}}{4\pi\times10^{-7}}\right) = 6\text{V/m}$$

**67. Ans: (c)**

**Sol:** Given $\vec{A} = 3x^2yz\hat{a}_x + x^3z\hat{a}_y + (x^3y - 2z)\hat{a}_z$

Consider $\nabla.\vec{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$

$$= \frac{\partial}{\partial x}(3x^2yz) + \frac{\partial}{\partial y}(x^3z) + \frac{\partial}{\partial z}(x^3y - 2z)$$

= 6xyz + 0 – 2

$\nabla.\vec{A} = 6xyz - 2 \neq 0$, hence $\vec{A}$ is not solenoidal consider $\nabla \times \vec{A} = \begin{vmatrix} \hat{a}_x & \hat{a}_y & \hat{a}_z \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ 3x^2yz & x^3z & (x^3y - 2z) \end{vmatrix}$

$$= \hat{a}_x\left[x^3 - x^3\right] - \hat{a}_y\left[3x^2y - 3x^2z\right] + \hat{a}_z\left[3x^2z - 3x^2z\right]$$

$\therefore \nabla \times \vec{A} = 0$ (A null vector)

Therefore the vector field $\vec{A}$ is said to be conservative (or) irrotational

**68. Ans: (a)**

**Sol:**

1. From magnetic boundary conditions across current-free interface

$H_{t_1} = H_{t_2}$ & $\frac{B_{t_1}}{\mu_1} = \frac{B_{t_2}}{\mu_2}$

Tangential components of magnetic field intensity are continuous and magnetic flux density are discontinuous

2. Work done around any closed path is zero

$$W = -q\oint_L \vec{E}.\,d\vec{\ell} = 0$$

$$\oint_L \vec{E}.\,d\vec{\ell} = 0$$

from Stokes's theorem

$$\int_s \nabla \times \vec{E}.\,d\vec{S} = 0$$

$$\nabla \times \vec{E} = 0$$

therefore an electrostatic field is irrotational (or) conservative.

3. From faraday's experiment,

displacement flux density is independent of permittivity of medium and electric field intensity is dependent on permittivity of medium

$$\vec{D} = \frac{Q}{4\pi r^2}\hat{a}_r C/m^2$$

$$\vec{E} = \frac{Q}{4\pi\varepsilon r^2}\hat{a}_r V/m$$

$\therefore$ statement '3' is incorrect.

4. From ampere's law

$$\nabla \times \vec{H} = \vec{J} \;\&\; \nabla \times \frac{\vec{B}}{\mu} = \vec{J}$$

assume the medium is homogeneous,

$$\nabla \times \vec{B} = \mu\vec{J}$$

If the medium is current-free, then $\nabla \times \vec{B} = 0$ and hence magnetic flux density is irrotational

5.From electric boundary condition

$D_{n1} - D_{n2} = \rho_s$ &

$\varepsilon_1 E_{n1} - \varepsilon_2 E_{n2} = \rho_s$
if $\rho_s = 0$ (charge-free)
then $D_{n1} = D_{n2}$ & $\varepsilon_1 E_{n1} = \varepsilon_2 E_{n2}$
therefore across charge-free interface, normal components of electric flux density are continuous and electric field intensity are discontinuous.
$\therefore$ statements 1, 2, 4 and 5 are correct.

**69. Ans: (c)**

**Sol:** $\rightarrow$ In broad-side array the maximum radiation is achieved perpendicular to the axis of array
$\theta_{max} = 90^o$ & $270^o$
$\rightarrow$ In end-fire array the maximum radiation occurs along the axis of array
$\theta_{max} = 0^o$ & $180^o$
$\rightarrow$ Directivity & Beam area are related as $D = \frac{4\pi}{\Omega_A}$
where $\Omega_A$ is beam area (or) beam solid angle (sr).
So, directivity of antenna decreases with increase in beam area.
Directive gain (or) directivity and aperture area of antenna are related as
$D = \left(\frac{4\pi}{\lambda^2}\right)A_e$ (or) $G = \left(\frac{4\pi}{\lambda^2}\right)A_e$
When aperture area of an antenna increases, then its directivity increases.
So, statements 1, 3 and 4 are correct.

**70. Ans: (a)**

**Sol:** Consider n-element uniform linear array
BWFN of broad side array is given by
BWFN = $\frac{2\lambda}{\ell}$ radians
directivity of broad side array is
$D = \frac{2\ell}{\lambda}$
BWFN (or) FNBW of end-fire array is
FNBW = $2\sqrt{\frac{2\lambda}{\ell}}$ radians
Directivity of end-fire array is
$D = \frac{4\ell}{\lambda}$
where, '$\ell$' : length of array, $\ell = (n-1)d$
d : spacing between the elements
$\lambda$ : Wavelength
$\therefore$ correct code is : A - 4, B - 3, C - 2, D - 1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**71. Ans: (b)**

**Sol:** Given

$Z_0 = 50\Omega$

$V_{max} = 4V$

$V_{min} = 2V$

Standing wave ratio, $S = \frac{V_{max}}{V_{min}} = 2$

As voltage minimum is found at the load and hence the corresponding load impedance will be minimum

$$Z_{L(min)} = \frac{Z_0}{S} = \frac{50}{2} = 25\Omega$$

reflection coefficient at the load is given by

$$K = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{25-50}{25+50}$$

$$= \frac{-25}{75}$$

$$\therefore K = \frac{1}{3}\angle 180^{\circ}$$

**72. Ans: (d)**

**Sol:** $\because$ $E_z \neq 0$, the mode is $TM_{mn}$.

For $TM_{mn}$

$$E_y = \frac{-j\beta_z}{h^2}\frac{\partial E_z}{\partial y} = \frac{-j\beta_z}{h^2}\left[25(80\pi)\sin(50\pi x)\cos(80\pi y)e^{-j\beta_z z}\right]$$

$$E_x = \frac{-j\beta_z}{h^2}\frac{\partial E_z}{\partial x} = \frac{-j\beta_z}{h^2}\left[25(50\pi)\cos(50\pi x)\sin(80\pi y)e^{-j\beta_z z}\right]$$

$$\therefore \frac{E_y}{E_x} = \frac{8}{5}\tan(50\pi x)\cot(80\pi y) = 1.6\tan(50\pi x)\cot(80\pi y)$$

**73. Ans: (c)**

**Sol:** In a parallel plate waveguide cut-off frequency $f_{c_m} = \frac{mc}{2a\sqrt{\varepsilon_r}}$

For the modes to propagate inside the waveguide, their cut-off frequencies must be less than the operating frequency f = 1GHz.

(i.e) $f_{c_m} < f$

$$\frac{mc}{2a\sqrt{\varepsilon_r}} < 1\times10^9$$

$$\therefore m < \frac{1\times10^9 \times 2a\sqrt{\varepsilon_r}}{c}$$

$$m < \frac{1\times10^9 \times 2\times 50\times 3}{3\times10^{10}}$$

$\Rightarrow m < 10$

$\therefore$ m = 0 to 9

For m = 0 the only mode is $TM_0$ mode

For m = 1 to 9 we have $TE_1$ to $TE_9$ and $TM_1$ to $TM_9$

$\therefore$ Total number of modes = $\underbrace{TM_0}_{1} + \underbrace{TE_1 \text{ to } TE_9}_{9} + \underbrace{TM_1 \text{ to } TM_9}_{9}$

= 1 9 9

= 19 modes

**74. Ans: (b)**

**Sol:** $$TF = \frac{k\left(1+\frac{s}{\omega_2}\right)}{s\left(1+\frac{s}{\omega_1}\right)}$$

For any value of $\omega_1$ and $\omega_2$ the system is stable for k = 0 to k = $\infty$

$\therefore$ It is always stable

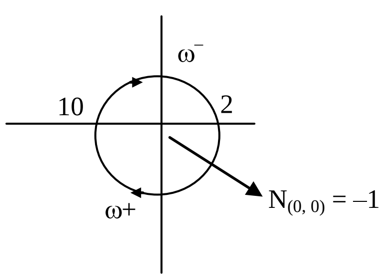
**75. Ans: (d)**

**Sol:** Phase and gain cross over frequencies does not exist

$\therefore$ GM = $\infty$ and PM = $\infty$

**76. Ans: (b)**

**Sol**:



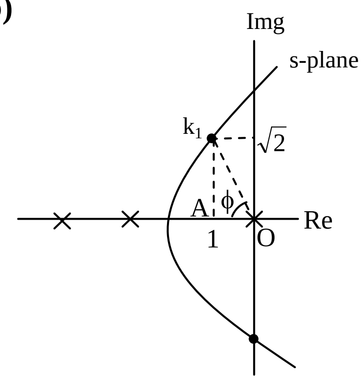

$$M = \left|\frac{10(2-j\omega)}{j\omega+10}\right| = 10\sqrt{\frac{(2^2+\omega^2)}{\omega^2+10^2}}$$

$$\phi = -\tan^{-1}\frac{\omega}{2} - \tan^{-1}\frac{\omega}{10}$$

| ω | M | φ |
|---|---|---|
| 0 | 2 | $0^\circ$ |
| ∞ | 10 | $-180^\circ$ |

**77. Ans: (b)**

**Sol:**




$$\zeta = \cos\phi = \frac{AO}{k_1O} = \frac{1}{\sqrt{1^2+\left(\sqrt{2}\right)^2}} = \frac{1}{\sqrt{3}}$$

**78. Ans: (c)**

**Sol:** Apply KVL at node A

$$\frac{V_A - V_I}{R} + \frac{V_A}{\frac{1}{Cs}} = 0$$

Apply KVL at node B

$$\frac{V_B - V_I}{R} + \frac{V_B - V_0}{R} = 0$$

$V_I = V_A(s+1)$

$2V_B = V_I + V_0$

$\because V_A = V_B$ (By virtual ground concept)

$$\frac{V_0}{V_I} = \frac{1-s}{1+s}$$

**79. Ans: (d)**

**Sol:**

| | | | |
|---|---|---|---|
| $s^5$ | 1 | –2 | +1 |
| $s^4$ | –1 | 2 | –1 |
| $s^3$ | 0(–1) | 0(+1) | 0 → Zero row |
| $s^2$ | 1 | –1 | 0 |
| $s^1$ | 0(2) | 0 | 0 → Zero row |
| $s^0$ | –1 | | |

$$AE_1 = -2s^4 + 4s^2 - 2 = 0$$

$-s^4 + 2s^2 - 1 = 0$

$$AE_1' = -4s^3 + 4s$$

$AE_2 = s^2 - 1 = 0$

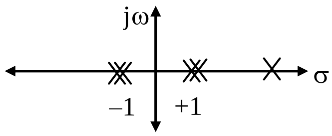
| | |
|---|---|
| $s^5$ | +ve |
| $s^4$ | –ve |
| $s^3$ | –ve |
| $s^2$ | +ve |
| $s^1$ | +ve |
| $s^0$ | –ve |

AE roots:

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

$s^4 - 2s^2 + 1 = 0$

$s = \pm 1, \pm 1$




There are three poles lies on RHS plane but only two are having the symmetricity

**80. Ans: (c)**

**Sol:** From fig.(i)

Number of individual loops = 3 (ad, be, cf)

Number of forward paths = 1 (abc)

$$\text{Transfer function (T.F)} = \frac{abc}{1-[ad+be+cf]+[adbe+adcf+becf]-[adbecf]}$$

From fig.(ii)

Number of individual loops = 3 (ad, be, cf)

Number of forward paths = 1 (abc)

$$\text{Transfer function (T.F)} = \frac{abc}{1-[ad+be+cf]+[adcf]}$$

**81. Ans: (c)**

**Sol:** C. E is $s^3 + s^2(1+T) + sT + 30 = 0$

Routh's Tabulation

| | | |
|---|---|---|
| $s^3$ | 1 | T |
| $s^2$ | 1+T | 30 |
| $s^1$ | $\frac{(1+T)T-30}{1+T}$ | |
| $s^0$ | 30 | |

For Stability,

$1 + T > 0$ and $\frac{(1+T)T-30}{1+T} > 0$

$T > -1$ $(1+T)\,T > 30$

$T^2 + T - 30 > 0$

$(T+6)(T-5) > 0$

$T + 6 > 0$ and $T - 5 > 0$

$T > -6$ $T > 5$

$\therefore$ T > 5 (the system is stable)

**82. Ans: (b)**

**Sol:** $$\text{T.F} = \frac{8/s(s+2)}{1+\dfrac{8(1+as)}{s(s+2)}+\dfrac{8}{s(s+2)}} = \frac{8}{s^2+(8a+2)s+16}$$

$2\zeta\omega_n = 8a+2$

$2\times\frac{1}{4}\times 4 = 8a + 2$

$\Rightarrow 8a = 0$

$a = 0$

**83. Ans: (b)**

**Sol:** Given that, $40\frac{dx}{dt} + 2x = f(t)$

Applying LT on both sides with Zero initial conditions

$40s\,X(s) + 2X(s) = F(s)$

$$\frac{X(s)}{F(s)} = \frac{1}{40s+2}$$

$$Y(s) = \frac{X(s)}{F(s)} = \frac{0.025}{s+\frac{1}{20}}$$

$y(t) = 0.025e^{-t/20}$

$\therefore$ Time constant T= 20sec.

**84. Ans: (a)**

**Sol:**

**Unit ramp**

$r(t) = t\,u(t)$ $t \geq 0$

$= 0$ $t < 0$

$L\{r(t)\} = \frac{1}{s^2}$

**Unit step**

$u(t) = 1,\ t \geq 0$

$= 0,\ t < 0$

$L\{u(t)\} = \frac{1}{s}$

**Unit impulse**

$\delta(t) = 1$ $t = 0$

$= 0$ $t \neq 0$

$L\{\delta(t)\} = 1$

**Unit doublet = $\delta^1(t)$**

$L[\delta^1(t)] = s$

**85. Ans: (b)**

**Sol:** In fully associative mapping, main memory address format is

x

| Tag | Byte offset |
|---|---|
| 16 bits | 6 bits |

⟹ 22 bits

**86. Ans: (c)**

**Sol:** If cache is full then it is capacity miss or else it will be conflict miss.

**87. Ans: (d)**

**Sol:** Suppose n 2-address instructions supported are

**2-address instruction:**

16

| opcode | add 1 | add 2 |
|---|---|---|
| 4 bits | 6 bits | 6 bits |

max opcodes = 16

<u>used opcodes = n</u>

unused opcodes = 16 – n

1 address instruction

16

| opcode | add |
|---|---|
| 10 bits | 6 bits |

max opcode = $(16 - n) * 2^6 = 192$

$n = 13$

**88. Ans: (c)**

**Sol:** For the above reason, the block size should be larger. While designing the cache memory.

**89. Ans: (d)**

**Sol:** Tasks are assigned priorities in RTS

**90. Ans: (b)**

**91. Ans: (c)**

**Sol:** The collection of information stored in a database at a particular moment is called instance.

**92. Ans: (c)**

**Sol:** Given that $V_e$ is the difference between $V_s$ and measured voltage.

$\therefore V_e = V_s$ – measured value

$$\Rightarrow \text{measured voltage} = V_s \times \frac{R_m}{R_m + R_s}$$

$$\Rightarrow 1 - \frac{V_e}{V_s} = \frac{R_m}{R_m + R_s}$$

$$\Rightarrow 1 - \frac{V_e}{V_s} = \frac{1}{1 + \frac{R_s}{R_m}}$$

$$\Rightarrow \frac{V_e}{V_s} = 1 - \frac{1}{1 + \frac{R_s}{R_m}} \Rightarrow \frac{V_e}{V_s} = \frac{\frac{R_s}{R_m}}{\frac{R_s}{R_m} + 1}$$

$$\Rightarrow \frac{V_e}{V_s} = \frac{\alpha}{\alpha + 1}$$

**93. Ans: (c)**

**Sol:** Actual energy per minute

$$E = \frac{240 \times 10 \times 0.8}{1000} \times \frac{1}{60} = 0.032 \text{kwh}$$

Speed of the disc in rpm = Energy supplied per minute× meter constant in rev/kwh

= 0.032 ×600

= 19.2 rpm

**94. Ans: (d)**

**Sol:** In Kelvin's double bridge two sets of readings are taken when measuring low resistance, one with current in one direction and the other with the direction of current reversed. This is done to eliminate the effect of thermoelectric emf

**95. Ans: (c)**

**Sol:** In 3-$\phi$, power measurement by two wattmeter method,

$W_1 = VI \cos(30 - \phi)$

$W_2 = VI \cos(30 + \phi)$

Pure capacitance is connected as a load

$\therefore$ load p.f = ZPF lead

Load power factor angle, $\phi = -90°$

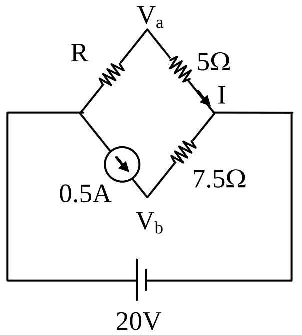
$$\therefore W_1 = VI \cos[30 - (-90)] = -\frac{VI}{2}$$

$$W_2 = VI \cos[30 + (-90)] = \frac{VI}{2}$$

$\therefore$ Statement iii & iv are correct.

**96. Ans: (c)**

**Sol:** At bridge is balanced




$V_a = V_b$

$$V_b = 7.5 \times \frac{1}{2} = 3.75V$$

$V_a = 3.75V$

$$I = \frac{3.75}{5} = 0.75A$$

Voltage drop across R = 20 – 3.75
= 16.25V

Unknown resistance, $R = \dfrac{16.25}{0.75}$

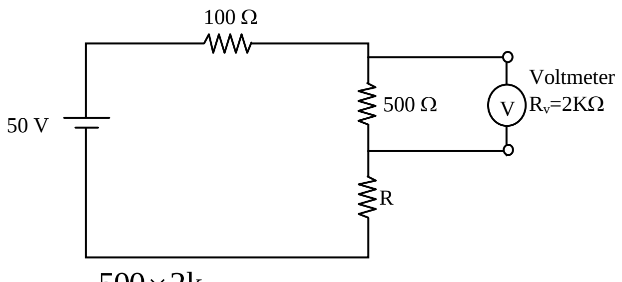
R = 21.67 Ω

**97. Ans: (a)**

**Sol:** In resistive hygrometer some hygroscopic sort exhibits a change in resistivity with humidity example lithium chloride

**98. Ans: (c)**

**Sol:**




$$R_{eq} = \frac{500 \times 2k}{2k + 500} = 400\ \Omega$$

Current flowing through 400Ω is

$$I = \frac{5}{400}$$

50 – 100 I – 5 – IR = 0

[100 +R] I = 45

$$100 + R = \frac{45}{\left[\frac{5}{400}\right]} = \frac{45 \times 400}{5} = 3600$$

R = 3.5 kΩ

**99. Ans: (b)**

**Sol:** A – 3
B – 4
C – 1
D – 2

**100. Ans: (b)**

**Sol:** Statement 1 & 4 are correct

**101. Ans: (c)**

**Sol:** We Know $R_p C_p = R_i C_i$

$\Rightarrow$ 9 MΩ $\times C_p$ = 1M ×45 pF

$$\Rightarrow C_p = \frac{1M\Omega \times 45pF}{9M\Omega}$$

= 5 pF

**102. Ans: (a)**

**Sol:** Variable capacitance device used for pressure measurement. Orifice meter used for flow measurement. Thermistors are used for temperature measurement.

**103. Ans: (b)**

**Sol:** Given data spacing (1, 1, 1)

Inter planner distance $\lambda = \frac{a}{\sqrt{h^2 + k^2 + \ell^2}}$

$$\frac{a}{\sqrt{1^2 + 1^2 + 1^2}} = \frac{a}{\sqrt{3}}$$

4R = $\sqrt{3}$ a ; R = 0.125 nm

a = $\frac{4R}{\sqrt{3}} \Rightarrow 0.2886$

$$\lambda = \frac{0.2886}{\sqrt{3}}$$

= 0.1666 nm

**104. Ans: (c)**

**Sol:** If the radius ratio X = 0.414, a more stable configuration is possible with six anions bonding with a cation. This configuration called the octahedral configuration is stable for $0.414 < X < 0.732$. Here the cation occupies the void created by six anions forming an octahedral structure.

**105. Ans: (b)**

**Sol:** Carbon-11 $\rightarrow$ Agriculture
Iodine-131 $\rightarrow$ Medical therapy
Krypton-35 $\rightarrow$ Industry
Cesium-137 $\rightarrow$ Calibrate equipment

**106. Ans: (a)**

**Sol:** High humidity allows conduction and high temperature is the favorable condition chemical reactions.

**107. Ans: (d)**

**Sol:** The critical magnetic field, $H_c$ for type-I super conductors is of the order of 0.1 Tesla (or) less so. High magnetic fields cannot be produced by type-I super conductor.

**108. Ans: (d)**

**Sol:** Structural formula for ferrites is $AOB_2O_3$ or $AB_2O_4$.

**109. Ans: (b)**

**Sol:** Useful superconducting materials have very low critical temperatures.

**110. Ans: (b)**

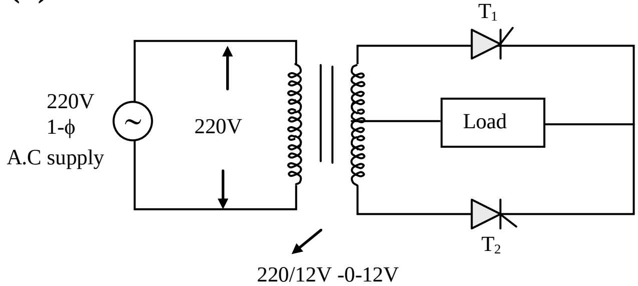
**Sol:** The reduction in the particle size in the case of semiconductors results in the increased in the bandgap which results in the shift of the light absorption towards in the high-energy region (blue shift). In addition, the band edge position of valance and the conduction bands are stabilized and destabilized respectively. The rate of recombination of photo excited electron hole pair is greatly reduced.

**111. Ans: (c)**

**Sol:** Chemical Vapor Deposition Method involves decomposing a hydrocarbon gas such as methane ($CH_4$) at $1100^0$C. As the gas decomposes, carbon atoms are produced. Carbon atoms then condense on a cooler substrate that contains various catalysts such as iron. This method produced tubes with open ends.

**112. Ans: (d)**

**Sol:**



Emf/turn = 1 V
by the voltage notation of 220 V/ – 12 V – 0 V – 12 V, it is concluded that it's centre tapped transformer.
On secondary, each half should have "12 V".
So EMF/ turn = 1 V
for 12 V, we require "12" turns [for each half]. So total "24" turns with centre tap

**113. Ans: (d)**

**Sol:** Fraction of power transferred through inductively = (1–k) times of total power.

$$= \left(1 - \frac{V_2}{V_1}\right)$$

$$= \left(\frac{V_1 - V_2}{V_1}\right) \text{ times of total power}$$

**114. Ans: (a)**

**115. Ans: (b)**

**Sol:** Short circuit test is performed to find copper losses open circuit test is performed to find Iron losses

**116. Ans: (b)**

**Sol:** Induced EMF in generator,
$E = V + I_a.R_a$

$$\Rightarrow \quad I_a = \frac{E - V}{R_a} = \frac{240 - 220}{0.2} = 100\,A$$

constant losses = $I_a^2 R_a$ (variable loss)
$= (100)^2 (0.2) = 2000$ W

**117. Ans: (c)**

**Sol:** The field winding loss $V_f I_f$ and the rotational losses $\omega_0$ remain approximately constant. The maximum efficiency occurs when variable losses $I_a^2 r_a$ are equal to the constant losses $V_f I_f + \omega_0$

**118. Ans: (c)**

**Sol:** In dc machines $E \propto \phi N$

$$\frac{E_2}{E_1} = \frac{\phi_2}{\phi_1} \times \frac{N_2}{N_1}$$

$$\frac{250}{220} = \frac{\phi_2}{\phi_1} \times \frac{700}{750}$$

$\Rightarrow \phi_2 = 1.217\phi_1$
Change in flux = $\phi_2 - \phi_1 = 1.217\phi_1 - \phi_1$
$= 0.217\phi_1$
$\therefore$ % increased = 21.7%

**119. Ans: (d)**

**Sol:** Break down torque of a 3-phase induction motor is also called maximum torque, defined as torque produced by the induction machine which pulls the rotor from stable operation to unstable operation. Its equation is,

$$T_{max} = \frac{180}{2\pi N_S}.\frac{E_2^2}{2.X_2} \Rightarrow T_{max} \propto \frac{1}{X_2}$$

**120. Ans: (b)**

**Sol:** Induction motor is a constant flux machine. As statement 3 is false, option (b) is correct answer

**121. Ans: (a)**

**Sol:** Induction motor rotates at slightly less than the synchronous speed [1500 rpm]

$$N_s = \frac{120\,f}{P}$$

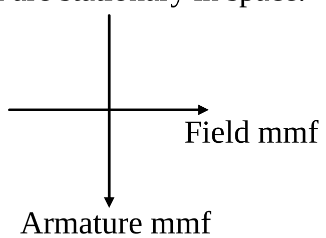
$$1500 = \frac{120 \times 50}{P}$$

$$\Rightarrow P = 4$$

**122. Ans: (a)**

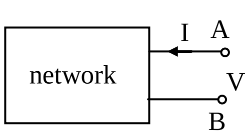
**Sol:** Field on stator and armature on rotor.

Both are stationary in space.




**123. Ans: (c)**

**Sol:**




$$R_N = \frac{V_{oc}}{I_{sc}}$$

From the given equation

$V_{oc}$ is obtained when i = 0

$16V_{oc} = 80 - 0$

$V_{oc} = 5v$

It is obtained when V = 0

$0 = 80 - 2I_{sc}$

$I_{sc} = 40$

$$R_N = \frac{V_{oc}}{I_{sc}} = \frac{5}{10} = \frac{1}{8}\Omega$$

**124. Ans: (c)**

**Sol:** Number of possible trees= det$|[A_r][A_r]^T|$

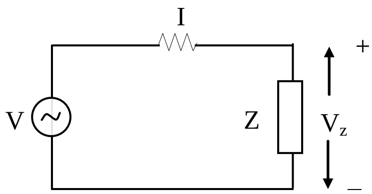
Where $[A_r]$= reduced incidence matrix.

$$\begin{bmatrix}1 & 1 & 0 & 0 & 1\\ 0 & -1 & 1 & 0 & 0\\ -1 & 0 & -1 & -1 & 0\end{bmatrix}\begin{bmatrix}1 & 0 & -1\\ 1 & -1 & 0\\ 0 & 1 & -1\\ 0 & 0 & -1\\ 1 & 0 & 0\end{bmatrix} \Rightarrow \begin{bmatrix}3 & -1 & -1\\ -1 & 2 & -1\\ -1 & -1 & 3\end{bmatrix}$$

$\therefore$ Determinant = $3(6 – 1) + 1( – 3 – 1) –1(3) = 15 – 4 – 3 = 8$

**125. Ans: (a)**

**Sol:**




$i(t) = 2\cos(10t)A$

$V_z(t) = 6\sqrt{2}\cos(10t + 45°)V$

$\omega = 10$ rad/sec

$\bar{I}_1 = 2\angle 0° = 2e^{j0}A$

$\bar{V}_2 = 6\sqrt{2}\angle 45° = 6\sqrt{2}e^{j45°}$

$$\therefore \text{Impednance} = Z = \frac{\bar{V}_z}{\bar{I}} = \frac{6\sqrt{2}e^{j45}}{2e^{j0}} = \frac{6}{\sqrt{2}}e^{j45}$$

$$= \frac{6}{\sqrt{2}}(\cos 45° + j\sin 45°)$$

$$= \frac{6}{\sqrt{2}}\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}\right) = 3 + j3$$

For inductive load

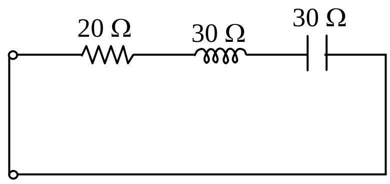
$\therefore\ Z = R + j\omega L \Rightarrow 3 + j(10) \times 0.3$

$\Rightarrow R = 3\Omega$, inseries with $L = 0.3$ H

**126. Ans: (c)**

**127. Ans: (a)**

**Sol:**



$i = \frac{V}{20} A$

$= \frac{100}{20} \sin\left(100\pi t + 30^0\right)$

$= 5 \sin(100\ \pi t + 30°)$

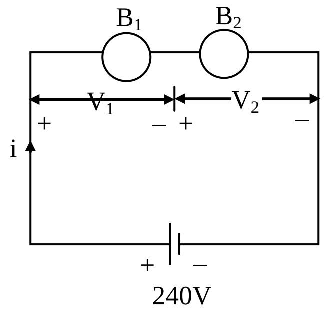
p.f. = unity

**128. Ans: (d)**

**Sol:** A capacitor acts like a open circuit to d.c. and voltage cannot change abruptly.
A Inductor acts like a short circuit to d.c. and current cannot change abruptly.

**129. Ans: (d)**

**Sol:**




Power across Bulb 1 ($P_1$) = 40 =$V_1$ I

Power across Bulb 2 ($P_2$) = 20 = $V_2$ I

$\frac{V_1}{V_2} = 2$

$V_1 = 2V_2$

$V_1 + V_2 = 240V$

$3V_2 = 240V$

$V_2 = 80V$

$\Rightarrow \quad V_1 = 160V$

$\therefore$ For Bulb 2, resistance value $R_2$ is $\frac{V_2^{\ 2}}{R_2} = P_2$

$\Rightarrow R_1 = \frac{(80)^2}{20} = 320\Omega$

When bulb 2,alone is connected across 120 V; Power consumed by it

$P = \frac{V^2}{R_2}$.

$= \frac{(120)^2}{320}$

= 45 W

**130. Ans: (a)**

**Sol:** $V_1 = I_1 + (I_1 + I_2) = 2I_1 + I_2$ …….. (1)

$V_2 = I_2 + (I_1 + I_2) = I_1 + 2I_2$ …….. (2)

At $V_2 = 0$, Eq. (1) and (2) becomes

$0 = I_1 + 2I_2$

$\Rightarrow I_1 = -2I_2$

And $V_1 = 2I_1 - \frac{I_1}{2} = I_1 \times 1.5$

$$h_{11} = \left.\frac{V_1}{I_1}\right|_{V_2=0} = 1.5$$

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} = -0.5$$

At $I_1 = 0$, Eq. (1) and (2) becomes

$V_1 = I_2$ and $V_2 = 2I_2$

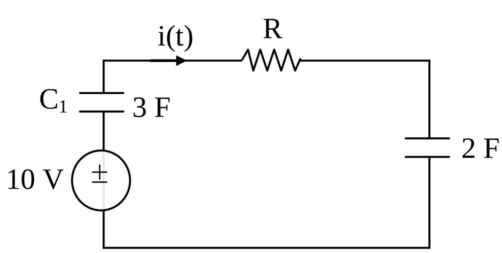
$$h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1=0} = 0.5$$

$$h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0} = 0.5$$

$$\begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} = \begin{bmatrix} 1.5 & 0.5 \\ -0.5 & 0.5 \end{bmatrix}$$

**131. Ans: (a)**

**Sol:**




$$R_i + \frac{1}{2}\int_0^t i\,dt + \frac{1}{3}\int_0^t i\,dt = 10$$

$$R\frac{di}{dt} + \frac{1}{2}i + \frac{1}{3}i = 0$$

$$\frac{di}{dt} + \frac{5i}{6R} = 0$$

$$i(t) = Ae^{\frac{-5}{6R}t}$$

At $t = 0^+$, $i(t) = \frac{10}{R}$

$i(t) = \frac{10}{R} e^{\frac{-5}{6R}t}$

$W = \int_0^\infty \frac{100}{R} e^{\frac{-10}{6R}t} dt$

$= \frac{100}{R} \frac{6R}{(-10)} e^{\frac{-10}{6R}t} \Big|_0^\infty$

= 60 Joules

Since this is independent on R, at R = 5 Ω, energy = 60 J.

**132. Ans: (d)**

**Sol:** $V_1 = -20\cos(\omega t+70^0) = 20\cos(\omega t+70-180^0)$

$= 20\cos(\omega t-110^0)$

$V_2 = 40\sin(\omega t-20^0) = 40\cos(\omega t-20-90^0)$

$= 40\cos(\omega t-110^0)$

Hence the phase angle between $V_1$ and $V_2$ is $110 - 110 = 0^0$

**133. Ans: (a)**

**Sol:** $a^n u(n) \longrightarrow \frac{z}{z-a}, |z|>|a|$

$-a^n u(-n-1) \longrightarrow \frac{z}{z-a}, |z|<|a|$

**134. Ans: (b)**

**Sol:** Sampling in one domain makes the signal to be periodic in the other domain. So, statement (I) is correct. According to multiplication in time domain property, multiplication in one domain is the convolution in the other domain.

**135. Ans: (d)**

**Sol:** → An asynchronous sequential circuit may be regarded as a combinational circuit "with" Feedback.

So statement (I) is wrong.

→ Statement (II) is correct.

Because of the feedback among logic gates, an asynchronous sequential circuit may become unstable at times.

**136. Ans: (c)**

**Sol:** As temperature increases vibrations and possibility of collision increases hence probability of ionizing collision decreases hence $V_z$ should increase.

**137. Ans: (b)**

**Sol:** Pulse width can be altered by changing R and C values of monostable multivibrator.

Monostable multivibrator has a single stable state. But both statements are correct but not related.

**138. Ans: (c)**

**Sol:** De-emphasis is performed after demodulation. So, statement (II) is false.

**139. Ans: (b)**

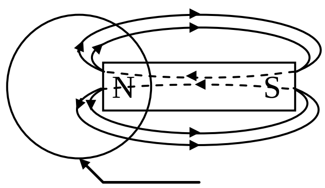
**Sol:** Both the Statements are true but statement II is not a correct explanation of statement (I).

**140. Ans: (b)**

**Sol:** Both I & II are individually true, but II is not correct reason of I.

**141. Ans: (a)**

**Sol:** For a magnetic bar (or) current carrying conductor, as isolated magnetic charge does not exist and hence always magnetic flux lines are continuous closed loops and they close upon themselves.




As the number of magnetic flux lines entering equal to number of flux lines leaving and hence the net magnetic flux leaving a closed surface is equal to zero.

$$\Phi\big|_{net} \equiv \oint_s \vec{B}.d\vec{S} = 0$$

(or)

$\oint_s \vec{B}.d\vec{S} = 0$, this is generally known as law of conservation of magnetic flux (or) Gauss's law of magnetic field.

therefore statement I & II are individually correct and statement II is the correct explanation for statement I

**142. Ans: (b)**

**Sol:** **Statement (I):**

Nyquist path (or) contour: It encloses the entire right side of s-plane and it should not pass through poles of G(s)H(s) which are on the $j\omega$ axis and at the origin.

**Statement (II):**

Nyquist stability criteria (NSC):Nyquist plot will encircle (–1, j0) critical point as many number of times as the difference between, the number of right side poles and zeros of F(s) = 1 + G(s)H(s) = 0.

N = P – Z

N = Number of encirclements of (-1, j0) by the Nyquist plot.

P = Number of right side poles of F(s) (or) right side poles of G(s)H(s)

Z = Number of right side zeros of F(s) (or) poles of closed loop TF

There is no relation between statement (I) and statement (II).

**143. Ans: (a)**

**144. Ans: (d)**

**Sol:** Pipeline doesn't reduce the time taken to perform an individual task but it achieves speed up by processing the tasks in parallel.

**145. Ans: (d)**

**Sol:** Multitasking OS uses Round-Robin scheduling for process execution.

**146. Ans: (b)**

**Sol:** Both the statements are correct

**147. Ans: (b)**

**Sol:** Unit cell is a basic building block in a lattice, by repetition in 3-dimension lattice is created. A non-crystalline material possesses more hardness and brittleness due to random orientation of atoms.

**148. Ans: (d)**

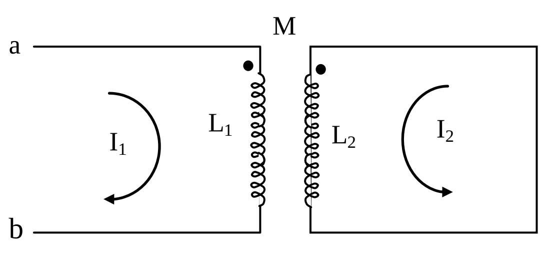
**Sol:** Ferroelectric materials have already domains with permanent dipoles.
On application of electric field, they are aligned in the direction of electric field hence statement (I) is wrong. Statement (II) is correct.

**149. Ans: (d)**

**Sol:** Hydro electric plants with run-off river are suitable for base load plants, so assertion is wrong. For a plant to be used as base load plant the unit cost of energy generated by the plant should low.
So Statement (II) is true.

**150. Ans: (c)**

**Sol:** (Case 1) Both currents entering the dotted terminals




By KVL

$$L_1\frac{dI_1}{dt}+\frac{MdI_2}{dt}=V \text{ ….. (1)}$$

$$L_2\frac{dI_2}{dt}+\frac{MdI_1}{dt}=0 \text{ ……. (2)}$$

$$\frac{dI_2}{dt} = \frac{-M}{L_2}\frac{dI_1}{dt}$$

Substitute $\frac{'dI_2'}{dt}$ value in equation (1)

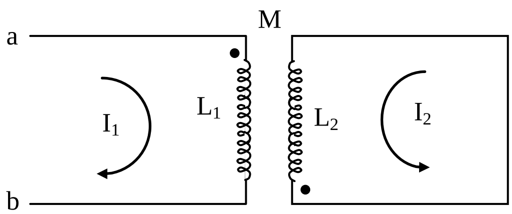
$$\Rightarrow L_1\frac{dI_1}{dt} + M\left(\frac{-M}{L_2}\right)\frac{dI_1}{dt} = V$$

$$\left[L_1 - \frac{M^2}{L_2}\right]\frac{dI_1}{dt} = V$$

$$\therefore\ L_{eff} = L_1 - \frac{M^2}{L_2}$$

$\therefore$ Left is $= \left[L_1 - \frac{M^2}{L_2}\right]$ Irrespective at the polarity of the coils. So option 'C' is correct.

**(Case 2)** One current entering the dotted terminal and other current leaving the dotted terminal




By KVL

$$L_1\frac{dI_1}{dt} - \frac{MdI_2}{dt} = V \text{ ….. (1)}$$

$$L_2\frac{dI_2}{dt} - \frac{MdI_1}{dt} = 0 \text{ ……. (2)}$$

$$\frac{dI_2}{dt} = \frac{M}{L_2}\frac{dI_1}{dt}$$

Substitute $\frac{'dI_2'}{dt}$ value in equation (1)

$$\Rightarrow L_1\frac{dI_1}{dt} - M\left(\frac{M}{L_2}\right)\frac{dI_1}{dt} = V$$

$$\left[L_1 - \frac{M^2}{L_2}\right]\frac{dI_1}{dt} = V$$

$$\therefore\ L_{eff} = L_1 - \frac{M^2}{L_2}$$

$\therefore$ $L_{eff}$ is $= \left[L_1 - \frac{M^2}{L_2}\right]$ Irrespective at the polarity of the coils. So option 'C' is correct.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