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ESE- 2020 (Prelims) - Offline Test Series Test- 22

ELECTRONICS & TELECOMMUNICATION ENGINEERING

FULL LENGTH MOCK TEST - 2 (PAPER - II)
SOLUTIONS

01. Ans: (b)

Sol: One of the property of spectral density is it is an even function.

So, from the given options the even function is $\dfrac{1}{1+4\pi^2 f^2}$.

02. Ans: (c)

Sol: Given $X(f)=\dfrac{j3\pi f}{1+j\pi f}$

$$X(f)=3-\frac{3}{1+j\pi f}$$

Apply inverse Fourier transform

$\delta(t) \leftrightarrow 1$

$$e^{-t}u(t) \leftrightarrow \frac{1}{1+j2\pi f}$$

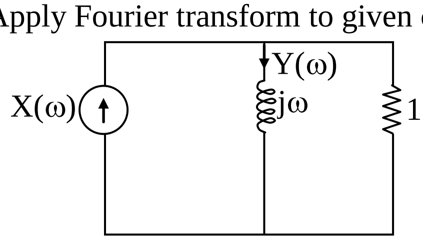
$$e^{-2t}u(2t) \leftrightarrow \frac{1}{2}\frac{1}{1+j\pi f} \quad \left[x(at) \leftrightarrow \frac{1}{|a|}X\left(\frac{f}{a}\right)\right]$$

$$e^{-2t}u(t) \leftrightarrow \frac{1}{2}\frac{1}{1+j\pi f} \quad [u(2t) = u(t)]$$

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

03. Ans: (d)

Sol: Apply Fourier transform to given circuit

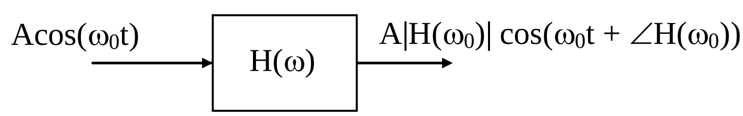


So, $Y(\omega)=\dfrac{X(\omega).1}{1+j\omega}$

$$H(\omega)=\frac{Y(\omega)}{X(\omega)}=\frac{1}{1+j\omega}$$

Given, $x(t) = \cos(t)$

So, $\omega_0 = 1$



So, $H(\omega_0)=\dfrac{1}{1+j}$

$$|H(\omega_0)|=\frac{1}{\sqrt{2}}$$

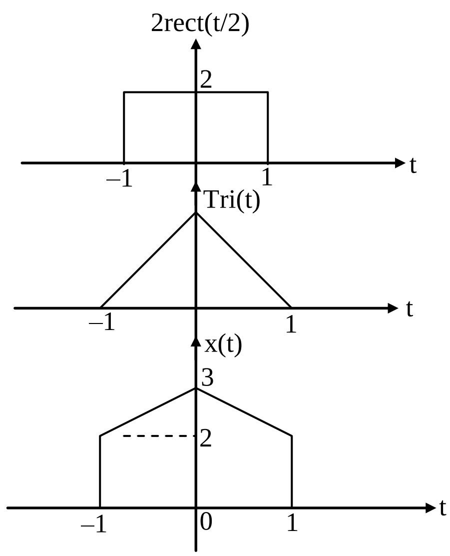
$$\angle H(\omega_0)=-45^\circ=-\frac{\pi}{4}$$

So, $y(t)=\dfrac{1}{\sqrt{2}}\cos\left(t-\dfrac{\pi}{4}\right)$

04. Ans: (b)

Sol: Given x(t) = 2 rect(0.5t) + Tri(t)

$$x(t) = 2\text{rect}\left(\frac{t}{2}\right) + \text{Tri}(t)$$



05. Ans: (c)

Sol: Take $e^{j\pi/2} = j$

$$(j)^{n/4} = (e^{j\pi/2})^{n/4} = e^{j\pi n/8}$$

$$\text{So, } \omega_0 = \frac{\pi}{8}$$

$$\frac{\omega_0}{2\pi} = \frac{1}{16} \text{ is a rational number.}$$

∴ Periodic signal

$$N_0 = \frac{2\pi}{\omega_0} m = 16m$$

$N_0 = 16$

06. Ans: (c)

Sol: Given $X(s) = \dfrac{s^3 + 2s^2 + 6}{s^2 + 3s}$

$$X(s) = s - 1 + \frac{3s + 6}{s^2 + 3s}$$

$$X(s) = s - 1 + \frac{3(s+2)}{s(s+3)}$$

$$X(s) = s - 1 + \frac{2}{s} + \frac{1}{s+3}$$

Apply ILT

$\delta(t) \leftrightarrow 1$

$\delta'(t) \leftrightarrow s$

$u(t) \leftrightarrow \frac{1}{s}$

$e^{-3t}u(t) \leftrightarrow \frac{1}{s+3}$

So, $x(t) = \delta'(t) - \delta(t) + 2u(t) + e^{-3t}u(t)$

07. Ans: (a)

Sol: Replace 's' by 'jω'

$s = j\omega$

$\omega = \frac{s}{j}$

$$|H(s)|^2 = H(s)H(-s) = \frac{4(9-s^2)}{4-5s^2+s^4}$$

$$= \frac{4(3-s)(3+s)}{(2-s)(2+s)(1-s)(1+s)}$$

Minimum phase transfer function H(s) is found by choosing only left half poles & zeros

$$H(s) = \frac{k(s+3)}{(s+1)(s+2)}$$

$|H(\omega)| = \sqrt{9} = 3$ at $\omega = 0$

$H(s) = 1.5k$ at $s = 0$

To match the design, $1.5k = 3$

$k = 2$

$$H(s) = \frac{2(s+3)}{(s+1)(s+2)}$$

08. Ans: (c)

Sol: $x(n) * \delta(n) = x(n)$

$x(n) * \delta(n - n_0) = x(n - n_0)$

Assume $x(n) = (-1)^n$

So, $(-1)^n * [\delta(n) + \delta(n-1)]$

$= x(n)*[\delta(n) + \delta(n-1)]$

$= x(n) + x(n-1)$

$= (-1)^n + (-1)^{n-1}$

$= (-1)^n - (-1)^n$

$= 0$

09. Ans: (c)

Sol: $x(n).x(n) \xleftrightarrow{DFT} \frac{1}{4} X(k) Ⓝ X(k)$

$\Rightarrow 4\,x(n).x(n) \xleftrightarrow{DFT} X(k) Ⓝ X(k)$

$$X(k) Ⓝ X(k) = \begin{bmatrix} p & s & r & q \\ q & p & s & r \\ r & q & p & s \\ s & r & q & p \end{bmatrix}\begin{bmatrix} p \\ q \\ r \\ s \end{bmatrix}$$

$X(k) Ⓝ X(k)$

$$= \begin{bmatrix} p^2+qs+r^2+qs \\ pq+pq+rs+rs \\ pr+q^2+pr+s^2 \\ ps+rq+qr+ps \end{bmatrix} = \begin{bmatrix} p^2+r^2+2qs \\ 2(pq+rs) \\ q^2+s^2+2pr \\ 2(ps+qr) \end{bmatrix}$$

IDFT $\{X(k) Ⓝ X(k)\} = 4\,x(n)\,x(n)$

IDFT $Y(k) = y(n) = 4\,x(n).\,x(n)$

$y(n) = \{4a^2, 4b^2, 4c^2, 4d^2\}$

$y(0) = 4a^2$

10. Ans: (c)

Sol: Given, $H(s) = \frac{s+0.5}{(s+0.5)^2+5^2}$

Resonant frequency of analog filter is

$\Omega r = 5$ rad/sec

also given, resonant frequency of digital filter is

$$\omega_r = \frac{\pi}{2}\text{rad/sec}$$

By Bilinear transformation,

$$\Omega_r = \frac{2}{T}\tan\left(\frac{\omega_r}{2}\right)$$

$$5 = \frac{2}{T}\tan\left(\frac{\pi/2}{2}\right)$$

$$\Rightarrow 5 = \frac{2}{T}\tan\left(\frac{\pi}{4}\right) \Rightarrow T = \frac{2}{5}\tan\left(\frac{\pi}{4}\right)$$

$$\Rightarrow T = 0.4$$

By Bilinear Z-transformation,

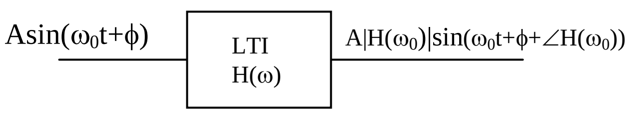
$$s = \frac{2}{T}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)$$

$$s = \frac{2}{0.4}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)$$

$$s = 5\left(\frac{1-z^{-1}}{1+z^{-1}}\right)$$

11. Ans: (c)

Sol:



The output has same frequency as input and there may be chance that change in amplitude and phase.

12. Ans: (d)

Sol: The rms voltage of the transformer primary is $V_p = 120V$

$$\frac{2V_s}{V_p} = \frac{2}{10} \Rightarrow 2V_s = \frac{2}{10}\times 120 \Rightarrow V_s = 12V$$

The rms voltage of the transformer half-secondary is $V_s = 12V$

The peak voltage of each half-secondary is

$$V_m = \sqrt{2}\times 12 = 16.97\text{ V}$$

13. Ans: (a)

Sol: $S = 0.4 = \dfrac{1}{1+\beta A}$, $BW_f = 1MHz$

$BW_f = (1+\beta A).BW$

$$\Rightarrow BW = \frac{BW_f}{1+\beta A} = 10^6 \times 0.4$$

$= 0.4MHz$

14. Ans: (c)

Sol: Duty cycle $= \dfrac{\text{ON Time}}{\text{ON Time} + \text{OFF Time}}$

$$= \frac{(R_A + R_B)C}{(R_A + R_B)C + R_BC}$$

$$= \frac{(R_A + R_B)}{(R_A + 2R_B)}$$

Duty cycle of the output waveform V_0, does not depend upon capacitor 'C'.

15. Ans: (d)

Sol: Z_{in} feedback $= Z_{in}(\text{Open})[1+A]$

$= 10^7[1+10^6]$

$= 10^{13}\Omega$

16. Ans: (b)

Sol: Low frequency generation is not practically possible in the Hartely oscillator because of the low inductance values only.

17. Ans: (c)

Sol: In common collector amplifier, the input resistance is high. So, it is used in impedance matching, the current gain is high and voltage gain is very low (nearly unity.)

18. Ans: (b)

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

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

Now, $V_{GS} - V_{TH} = 1$ V ($\because$ $V_{GS} = 2V$)

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

When MOSFET is in saturation.

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

$$\frac{0.8}{I_{DS_2}} = \left(\frac{3-1}{2-1}\right)^2 = 4$$

$I_{DS_2} = 0.2$ mA

19. Ans: (a)

Sol: Transition frequency is limited by the internal capacitances C_π and C_μ of the BJT. The collector-base capacitance C_μ is small; however, it has a magnified influence on the frequency response as a result of the miller effect.

20. Ans: (d)

Sol: At $T_0 = 25°C$, $V_{TD}(T_0) = 0.7V$

The temperature coefficient for silicon is $K_{TC} = -2mV/°C$

At $T_j = 100°C$,

$V_{TD}(T_j) = V_{TD}(T_0) + K_{TC}(T_j - T_0)$

$= 0.7 - 2 \times 10^{-3}(100 - 25)$

$V_{TD}(100) = 0.55V$

At $T_j = -100°C$,

$V_{TD}(-100) = 0.7 - 2 \times 10^{-3}(-100 - 25)$

$= 0.95V$

21. Ans: (a)

Sol: 20 log CMRR = 100dB

$$\Rightarrow \text{CMRR} = \left|\frac{A_d}{A_c}\right| = 10^5$$

$\rightarrow$ The differential voltage,

$V_d = V_2 - V_1 = 1005\ \mu V - 995\ \mu V$

$= 10\ \mu V$

$\rightarrow$ The common-mode voltage,

$$V_c = \frac{V_1 + V_2}{2} = \frac{1005\mu V + 995\mu V}{2}$$

$= 1000\mu V$

$$\rightarrow \left|\frac{A_d}{A_c}\right| = 10^5 \Rightarrow |A_c| = \frac{|A_d|}{10^5} = \frac{2\times 10^5}{10^5} = 2$$

$\rightarrow V_0 = A_dV_d + A_cV_c$

$= (2\times10^5\times10\mu V) + (2\times1000\mu V)$

$= 2 + 0.002$

$= 2.002$

22. Ans: (c)

Sol: **Spatial Locality**: In spatial locality we access each element of the array in order

Temporal Locality: In temporal locality element is accessed frequently.

23. Ans: (b)

Sol: Contiguous allocation supports both sequential and direct accesses. But, chained allocation is best for sequential files.

24. Ans: (a)

Sol: strcat function concatenates str1, str2 and resultant string is stored in str1.

25. Ans: (a)

Sol: Memory capacity $= 2^{34} \times 16$ bits

$= 2^{34} \times 2 \times 8$

$= 2^{35}$ Bytes

$= 32$ GB

26. Ans: (a)

Sol: i range is from –128 to +127

once it reaches 127 then increment of i becomes –128.

27. Ans: (b)

Sol: **Maskable interrupt:** CPU can accept/reject the interrupt.

28. Ans: (d)

Sol: $ABD^+ = A, B, C, D, E$

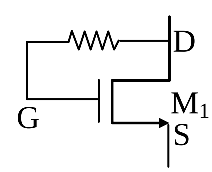
29. Ans: (c)

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

30. Ans: (c)

Sol:

$\rightarrow$ In deep triode, MOSFET works as voltage controlled resistor and in saturation, MOSFET works as voltage controlled current source.



$I_G = 0$

$\therefore V_D = V_G$

For saturation, $V_D > V_G - V_{TH}$ which is always true for M_1 and M_2.

Therefore, M_1 and M_2 are always in saturation region.
Hence only (3) is true

31. Ans: (d)
Sol: $V_{GS} < V_{FB}$ $\Rightarrow$ Accumulation mode
$V_{FB} < V_{GS} < V_{TH}$ $\Rightarrow$ Depletion mode
$V_{GS} > V_T$ $\Rightarrow$ Inversion mode

32. Ans: (b)
Sol: FET has drift current
PN Junctions has diffusion current

33. Ans: (d)
Sol: For M_2 to be in saturation,
$V_{D_2} > V_{G_2} - V_{TH}$
$3.3 > 2 - 1$
$\therefore$ M_2 is in saturation
For M_1 to be in saturation
$V_{D_1} > V_{G_1} - V_{TH}$
$V_0 > 2–1$
$V_0 > 1$ for saturation, but if $V_0 > 1$,
M_2 will be OFF
[$\because V_{GS_2} > V_{TH}$ for M_2 to be ON]
$2 – V_0 > 1$
$V_0 < 1$ for M_2 to be ON)
Therefore, M_1 is in triode region

34. Ans: (b)
Sol: I_{DSS} is the maximum drain current for a JFET and is defined by the conditions $V_{GS} = 0$ and $V_{DS} > |V_P|$.

35. Ans: (a)
Sol: At zero Kelvin fastest moving electron is the electron whose energy is E_F

$$E_F = \frac{1}{2} m_n V_F^2$$

$$V_F = \sqrt{\frac{2E_F}{m_n}} = \sqrt{\frac{2\times 9.1\times 10^{-19}}{0.5\times 9.1\times 10^{-31}}}$$

$= 2 \times 10^6$ m/sec

36. Ans: (a)
Sol: The minimum conductivity is given by

$$\sigma_{min} = 2n_i q\sqrt{\mu_n \mu_p}$$

$$\sigma_{min} = 2n_i q\sqrt{\mu_n \mu_p} = 1.728\times 10^{-3}\ \mho/\text{cm}$$

37. Ans: (b)
Sol: Using the law of the junction

$$p_n = p_{no} e^{\frac{V}{V_T}}$$

$$p_{no} = \frac{n_i^2}{N_D} = 4.5\times 10^3 / \text{cm}^3$$

$$p_n = 4.5\times 10^3 e^{0.55/0.026}$$

$= 4.5 \times 10^3 \times 1.5 \times 10^9/\text{cm}^3$
$= 6.75 \times 10^{12}\text{cm}^{-3}$

38. Ans: (d)
Sol: 1. $W_B \uparrow$ recombinations $\uparrow \rightarrow I_B \uparrow \rightarrow \beta \downarrow$

$$\left(\because \beta = \frac{I_C}{I_B}\right)$$

2. $N_B \uparrow \rightarrow$ recombinations $\uparrow \rightarrow I_B \uparrow$ $\beta \downarrow$

39. Ans: (b)
Sol: At very high frequencies, transit time noise is dominant.

40. Ans: (c)
Sol: $BW_{FM} = 2\Delta f + 2f_m = 2K_f A_m + 2f_m$
$BW_{PM} = 2\Delta f + 2f_m = 2K_p A_m f_m + 2f_m$
$= 2f_m (K_P A_m + 1)$
figure of merit for single tone modulation,

$$FOM_{FM} = \frac{3}{2}\beta^2 \quad FOM_{PM} = \frac{1}{2}\beta^2$$

$$P_{FM} = \frac{A_c^2}{2}, \qquad P_{PM} = \frac{A_c^2}{2}$$

41. Ans: (c)
Sol: $f_{m1} = 100$Hz, $f_{m2} = 200$Hz, $f_{m3} = 300$Hz
$f_c = 400$Hz
DSBSC modulated signal contains $f_c \pm f_{m1}$, $f_c \pm f_{m2}$, $f_c \pm f_{m3}$, i.e., 300, 500, 200, 600, 100, 700Hz.

42. Ans: (a)

Sol: $s(t) = 10\cos(2\pi \times 10^6 t + 5\cos(2\pi \times 10^3 t) + 10\cos(4\pi \times 10^3 t)]$

$\Delta\phi = \theta_{i,max} - \theta_c$

$= |5\cos(2\pi \times 10^3 t) + 10\cos(4\pi \times 10^3 t)|_{max}$

$= 15$ radians

43. Ans: (c)

Sol: $FOM_{AM} = \dfrac{\mu^2}{2+\mu^2} = \dfrac{1/4}{2+1/4} = 1/9$

44. Ans: (a)

Sol: $f_s = 8$kHz (nyquist rate)

$f_{i/p} = 5$kHz

Alias frequency $= f_s - f_{i/p} = 8k - 5k$

$= 3$ kHz

45. Ans: (d)

Sol: $\theta = 8\pi t^3 + 6\pi t^2 + 4\pi t + 5$

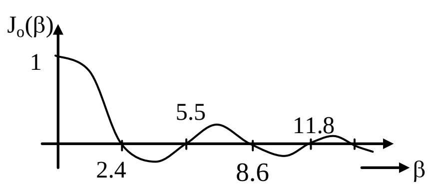
$\omega = \dfrac{d\theta}{dt} = 24\pi t^2 + 12\pi t + 4\pi$

$f = \dfrac{1}{2\pi}\omega = 12t^2 + 6t + 2$

$f\big|_{at\, t=1} = 12 + 6 + 2 = 20\text{Hz}$

46. Ans: (b)

Sol: $J_o(\beta) = 0$ for $\beta = 2.4, 5.5, 8.6, 11.8, \ldots$



47. Ans: (a)

Sol: Output SNR in DM system

$$= \frac{3f_s^3}{8\pi^2 f_m^2 f_M} = \frac{3\times(32\times10^3)^3}{8\pi^2\times(10^3)^2\times4\times10^3}$$

$$= \frac{3\times(2^5\times10^3)^3}{8\times10\times(10^3)^2\times2^2\times10^3} = 25\text{dB}$$

48. Ans: (a)

Sol: Baud rate $= \dfrac{R_b}{\log_2 M} = \dfrac{12\times10^3}{\log_2 16}$

$= \dfrac{12\times10^3}{4}$

$= 3000$ symbols/sec

49. Ans: (a)

Sol: Given $E_x = -9\sin\left(\dfrac{2\pi}{a}y\right)\sin(\omega t - 100\pi z)$

We know that, $\beta^2 = \beta_x^2 + \beta_y^2 + \beta_z^2$

$\therefore \dfrac{\omega^2}{c^2} = \beta_y^2 + \beta_z^2 = (100\pi)^2 + (100\pi)^2 = 2(100\pi)^2$

$\left(\because \beta_x = 0, \beta_y = \dfrac{2\pi}{2\times10^{-2}} = 100\pi \text{ and } \beta_z = 100\pi\right)$

$\therefore \omega = \sqrt{2c^2(100\pi)^2} = \sqrt{2}c(100\pi)$

$\therefore f = \dfrac{\sqrt{2}(100\pi)\times3\times10^8}{2\pi} = 15\sqrt{2}\text{GHz}$

50. Ans: (a)

Sol: For TE_{10} mode, $E_z = 0$, $H_z \neq 0$.

$E_y = E_{y0}\sin\left(\dfrac{\pi}{a}x\right)e^{-j\beta_z z}$

$H_x = H_{x0}\sin\left(\dfrac{\pi}{a}x\right)e^{-j\beta_z z}$

$H_z = H_{z0}\cos\left(\dfrac{\pi}{a}x\right)e^{-j\beta_z z}$

Standing wave patterns in the x-direction.

51. Ans: (c)

Sol: Given: $f_c\big|_{TE_{10}} = 2\text{GHz} = 2\times10^9\text{ Hz}$

$a' = a\sqrt{3}, b = a$

So, now

$$\frac{c}{2a'} = 2\times10^9 \Rightarrow a' = \frac{3\times10^{10}}{4\times10^9} = \frac{30}{4}\text{cm}$$

$$\Rightarrow a\sqrt{3} = \frac{30}{4} \Rightarrow a = \frac{30}{4\sqrt{3}} = \frac{5}{2}\sqrt{3}\text{cm}$$

$$\text{So, } f_c\Big|_{TE11} = \frac{c}{2}\times\sqrt{\left(\frac{m}{a'}\right)^2+\left(\frac{n}{b}\right)^2}$$

$$= \frac{3\times10^{10}}{2}\times\sqrt{\left(\frac{1}{\frac{5}{2}\times3}\right)^2+\left(\frac{1}{\frac{5}{2}\times\sqrt{3}}\right)^2}$$

$$= \frac{3\times10^{10}}{2}\times\sqrt{\frac{4}{225}+\frac{4}{75}}$$

$$= \frac{3\times10^{10}}{2}\times\frac{4}{15} = 4\text{GHz}$$

52. Ans: (b)

Sol: $\vec{E} = E_0 \sin\omega\left(t-\frac{x}{c}\right)$

$$\overline{B} = B_0\sin\omega\left(t-\frac{x}{c}\right)$$

$$\omega = 2\pi f = 2\pi\frac{c}{\lambda}$$

$$E = E_0\sin\frac{2\pi}{\lambda}(ct-x) = 30\sin\left(\frac{2\pi}{5\times10^{-3}}(ct-x)\right) = 30\sin\left(0.4\pi\times10^3(ct-x)\right)\text{V/m}$$

$$B = \mu_0 H = \mu_0\frac{E}{\eta_0} = \frac{4\pi\times10^{-7}}{120\pi}\times30\sin\left(0.4\pi\times10^3(ct-x)\right) = 10^{-7}\sin\left(0.4\pi\times10^3(ct-x)\right)\text{T}$$

53. Ans: (c)

Sol: Given:

$Z_0 = 80\Omega$

$Z_R = -j60\Omega$

$$K = \frac{Z_R - Z_0}{Z_R + Z_0} = \frac{-j60-80}{-j60+80}$$

$$|K| = \frac{\sqrt{60^2+80^2}}{\sqrt{60^2+80^2}} = 1$$

$$\text{VSWR} \equiv \frac{1+|K|}{1-|K|} = \frac{1+1}{1-1} = \infty$$

Note: when the transmission line is terminated by reactive (capacitive or inductive) impedance, then the VSWR is infinity

54. Ans: (c)

Sol: We know that $\hat{a}_H = \hat{a}_k \times \hat{a}_E$

So, H contains both x and y component.

55. Ans: (b)

Sol: Given

Transmission line of characteristic impedance, Z_0

A. $Z_R = \infty$ (open circuit)

$$K = \frac{Z_R - Z_0}{Z_R + Z_0} = 1$$

$|K| = 1$

$$\text{VSWR} = \frac{1+|K|}{1-|K|} = \frac{1+1}{1-1} = \infty$$

B. $Z_R = 3Z_0$

$$K = \frac{3Z_0 - Z_0}{3Z_0 + Z_0} = \frac{1}{2}$$

$$\text{VSWR} = \frac{1+\left|\frac{1}{2}\right|}{1-\left|\frac{1}{2}\right|} = 3$$

C. $Z_R = 0$ (short-circuit)

$$K = \frac{0 - Z_0}{0 + Z_0} = -1$$

$|K| = 1$

$$VSWR = \frac{1+1}{1-1} = \infty$$

D. $Z_R = Z_0$ (matched load)

$$K = \frac{Z_0 - Z_0}{Z_0 + Z_0} = 0$$

$|K| = 0$

$$VSWR = \frac{1+0}{1-0} = 1$$

Therefore the correct matching code is
A–3, B–4, C–1, D–2
(or)
A–1, B–4, C–3, D–2

56. Ans: (d)
Sol: All the given statements are correct.

57. Ans: (d)
Sol: $G_p = \eta D$

Where G_p : power gain of antenna
η : efficiency of antenna
D : Directivity of antenna

$$\eta = \frac{R_r}{R_r + R_\ell}$$

$R_r =$ Radiation resistance

$R_\ell =$ loss resistance

Given : $R_r = 50\,\Omega$, $R_\ell = 10\Omega$

Efficiency, $\eta = \frac{50}{50+10} = \frac{5}{6}$

$G_p = \left(\frac{5}{6}\right)6 = 5$

Power gain of the antenna is, $G_p = 5$

58. Ans: (b)
Sol: Conversion time for Dual slope ADC $(t_c)_{max} = (2^{n+1} - 1)\,T_{clk}$

$$= \frac{(2^{8+1} - 1)}{1\times10^6} = \frac{511}{1\times10^6}$$

$= 511\ \mu s = 0.511ms$

59. Ans: (d)
Sol: After reset, the CS register is set to value FFFFH and the IP register is set to 0000H. Thus after reset 8086 starts executing of instructions from physical address FFFF0H.

60. Ans: (c)
Sol: On reset of Microcontroller 8051 all registers store their default value. So, SP stores its default 07H address of RAM.

61. Ans: (d)
Sol: $\rightarrow$ (HL) = 1234H

$\rightarrow$ ××H $\oplus$ ××H = 00H = A

$\rightarrow$ A – 1 = 00H – 01H = FFH

$\rightarrow$ Comparing with H

FFH $\sim$ 12H

$FFH + \overline{12H} + 1$

12H = 0001 0010

$\overline{12H} = 1110\ 1101$

$\overline{12H} + 1 = 1110\ 1110$

$FFH + \overline{12H} + 1$

FFH = 1111 1111
EEH = 1110 1110
EDH=1110 1101
CY=1,P = 1,AC=1,Z = 0, S=1

But result not stored in accumulator since it is comparison operator

$\Rightarrow$(A) = FFH, (flag reg) = 10010101
= 95H

$\therefore$(PSW) = FF95H

62. Ans: (d)
Sol: $M = S_3 + S_1.[\overline{\overline{S_2}.\overline{S_3}}] = S_3 + S_1(S_2 + S_3)$

$= S_3 + S_1S_2 + S_1S_3$

$= S_3 + S_1S_2.$

63. Ans: (a)

Sol: $Y = (A \oplus B).\overline{B + C} = (\overline{A}B + A\overline{B})(\overline{B}.\overline{C})$

$Y = A.\overline{B}\,\overline{C} = \overline{\overline{A} + B + C}$

64. Ans: (c)

Sol:

CLK	Q	Q_2	Q_1	Q_0	NAND Output
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	1
4	0	1	0	0	1
5	1	1	0	1	0
6	1	1	0	0	1
7	1	0	1	1	1
8	1	0	1	0	1
9	1	0	0	1	1
10		0	0	0	1

65. Ans: (c)

Sol: Y = H(F + R) = H.F + H.R

66. Ans: (c)

Sol: On application of a pulse $Q_A\ Q_B\ Q_C\ Q_D = 1000 = 8_{10}$

CLK	Serial input $= Q_C \oplus Q_D$	Q_A	Q_B	Q_C	Q_D
0	–	1	0	0	$0 = 8_{10}$
1	0	0	1	0	$0 = 4_{10}$
2	0	0	0	1	$0 = 2_{10}$
3	1	1	0	0	$1 = 9_{10}$
4	1	1	1	0	$0 = 12_{10}$
5	0	0	1	1	$0 = 6_{10}$
6	1	1	0	1	$1 = 11_{10}$
7	0	0	1	0	$1 = 5_{10}$

The value of $Q_A\ Q_B\ Q_C\ Q_D = 0101 = 5_{10}$.

67. Ans: (c)

Sol:
$$S = \overline{W}\,\overline{X}.Y + \overline{W}X.0 + W\overline{X}.Z + W.X.1$$
$$= \overline{W}\,\overline{X}Y\overline{Z} + \overline{W}\,\overline{X}YZ + W\overline{X}\,\overline{Y}Z + W\overline{X}YZ$$
$$+ WX\overline{Y}\,\overline{Z} + WX\overline{Y}Z + WXY\overline{Z} + WXYZ$$
$$= m_2 + m_3 + m_9 + m_{11} + m_{12} + m_{13} + m_{14} + m_{15}$$

68. Ans: (a)

69. Ans: (d)

Sol: Power dissipation

Logic family	CMOS	TTL	LSTTL	ECL
Power dissipation (in mW) per gate	<0.1	10	2	40-50

70. Ans: (a)

Sol: A SR flip flop can be used as a latch.
A D flip flop can be used as a delay element
A master flip flop does not have race around problem.
A JK flip flop can be used in shift register.

71. Ans: (b)

Sol: Microprocessor is used as general-purpose processor when large embedded software has to be located in the external memory chips.

72. Ans: (d)

Sol: → 8051 microcontroller has 12MHz clock
→ 8051 microcontroller has no cache and no memory management unit.

73. Ans: (b)

Sol: In slow start phase of TCP for every successful ACK, CWND increases by one.

74. Ans: (a)

Sol:

LAN	**Protocol**
Ethernet LAN (IEEE 802.3)	CSMA / CD
Wireless LAN (IEEE 802.11)	CSMA / CA

75. Ans: (c)

Sol:

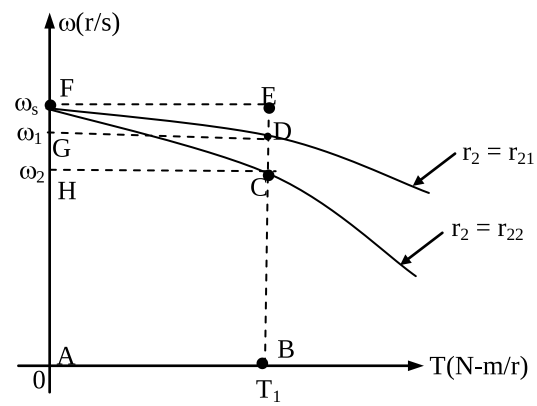
- Physical address is MAC address (48 bit) which belongs to Data link layer
- Logical address is IP address IP(v4) - 32 bits, IP(v6) - 128 bits which belongs to Network layer
- Service point address is Port address (16 bit) which belongs to transport layer.

76. Ans: (b)

Sol: HLEN = 8 words = (8×4) Bytes
TL = 308 Bytes
Payload size = $(308 - 8 \times 4)$ Bytes
= 276 Bytes
Payload size is not multiple of 8, definitely it is last fragment (M = 0).
276 Bytes and M = 0

77. Ans: (b)

Sol: Speed ~torque characteristics corresponding to the stable operating region with two different values for the rotor resistance/ph are shown in fig.1.



Rotor resistance/ph = r_2.
$r_{21} < r_{22}$

Fig. 1

For a torque T_1,

Rotor power input = $T_1\ \omega_s$ = area BEFA = constant.
Mechanical power developed with (r_2 equalling r_{21}) = BDGA.

Rotor input - mechanical power developed for (r_2 equalling r_{21}) = DEFG.
Mechanical power developed with (r_2 equalling r_{22}) = BCHA.
Rotor input – mechanical power developed for (r_2 equalling r_{22}) = CEFH.
In both cases, (rotor input – mechanical power developed)
= rotor copper losses + rotor iron losses.
Thus, for a given torque, as speed varies mechanical power developed varies, but rotor input is constant. Statement 1 is true.
As speed decreases, mechanical power developed decreases. As speed decreases, the relative speed between the rotating field and the rotor increases. Rotor core losses directly depend on this relative speed. So rotor core losses increase. But the increase is usually quite small. (Since mechanical power developed decreases, rotor copper losses +rotor iron losses increase. Since the increase in core losses is small, rotor copper losses also increase). Statement 2 is wrong. Option (b) is correct.

78. Ans: (d)

Sol: $T_{pull\text{-}out} = \frac{P_{max}}{\omega} = \frac{EV}{X_s}$

As excitation changes, the value of E changes, therefore pull-out torque changes.

$P = \frac{EV}{X_s}\sin\delta$

$\Rightarrow$ For constant load, E and δ changes, then power factor and I_a changes; but no change in P_{out}.

79. Ans: (a)

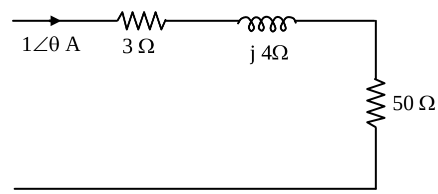
Sol: Speed does not depends on the input voltage only depends on the frequency.

80. Ans: (a)

Sol: An autotransformer needs less copper (as compared to a 2 - winding transformer of the same ratings) since a part of the winding is common to both primary and secondary. (2) is correct.
There does exist a conducting path between supply and load (unlike the 2-winding transformer where supply and load are electrically isolated). (3) is correct.
There is less leakage and so leakage reactance and voltage regulation are smaller. (1) is wrong.
Magnetizing current depends on the reluctance of the flux path, which is same in both cases. (4) is wrong.

81. Ans: (b)

Sol: The open-circuit equivalent circuit ref primary is shown below



Power input = power drawn by the circuit $1^2(53) = 53$ W
Given core losses = 53 W
Actual core losses = $1^2 \times 50$
= 50 W (remaining is copper loss)
For 50 W; error is 3 W
Percentage error = 6

82. Ans: (b)

Sol: **Full load upf:** output = 96,000 W.
Input = 96,000/0.96 = 100,000 W.
$W_{core} + W_{cu_{fl}} = 4000$ ………… (i)
1/4 full load, upf: output = 24,000 W.
Input = 24,000/0.96 = 25,000 W.

$W_{core} + \frac{1}{16}W_{cu_{fl}} = 1000$ ……… (ii)

[copper loss at (1/4)th full-load = (1/16) copper loss at full load]
By solving (i) & (ii)
$W_{cu_{fl}} = 3200$ W.
W_{core} = core loss (constant if voltage applied is the rated value)
= 800 W

83. Ans: (b)

Sol: $\dfrac{120\times 50}{6} = 1000\ \text{RPM}$

= synchronous speed
= speed at which stator mmf rotates ref stator

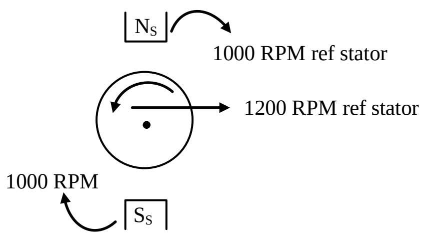
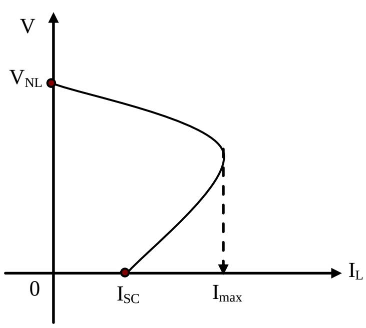


Fig .1

From fig.1 we see that the rotating field rotates relative to the rotor at (1000 + 1200) = 2200 rpm. Hence frequency of rotor emfs = (PN/120) = (6 × 2200) /120 = 110 Hz.

84. Ans: (a)

Sol: External characteristic of DC shunt generator.



During short circuit, main field flux = residual flux.

85. Ans: (b)

Sol: $T_L \propto N^2$ $\qquad N_2 \propto \dfrac{1}{2}N_1$

$T_{lm} = I_a^2$

In series motor, $\phi \propto I_a$

$$\left(\frac{I_{a2}}{I_{a1}}\right)^2 = \left(\frac{N_2}{N_1}\right)^2 \Rightarrow \frac{I_{a2}}{I_{a1}} = \frac{N_2}{N_1} = \frac{1}{2}$$

$$\Rightarrow \frac{N_2}{N_1} = \frac{V_2}{V_1}\times\frac{\phi_1}{\phi_2}$$

$$\Rightarrow \frac{N_2}{N_1} = \frac{V_2}{V_1}\times\frac{I_{a1}}{I_{a2}}$$

$$\Rightarrow \frac{1}{2} = \frac{V_2}{V_1}\times 2 \Rightarrow V_2 = \frac{1}{4}V_1$$

$$\%\ \text{change} = \frac{V_1 - V_2}{V_1}\times 100$$

$$= \left(1-\frac{1}{4}\right)\times 100 \quad = 75\%$$

86. Ans: (a)

Sol: Large size nuclear power plants can be used as base load plant.

87. Ans: (a)

Sol: $G_P(s) = \dfrac{2}{s(s+3)}$

$$G'(s) = G_C(s)G_P(s) = \left(K_P + \frac{K_i}{s}\right)\frac{2}{s(s+3)}$$

$$= \left(1+\frac{K_i}{s}\right)\frac{2}{s(s+3)}\ \text{for}K_P = 1$$

$$= \frac{2(s+K_i)}{s^2(s+3)}$$

Input, r(t) = R u(t)

$\underset{s\to 0}{\text{Lt}}\ G'(s) = \infty = K_p$

= Positional error constant

$e_{ss} = \dfrac{R}{1+K} = 0$

Lowest value of $K_i = 0$

i.e., $e_{ss} = 0$, even if integral control is not applied.

88. Ans: (a)

Sol: $\angle GH(s)\Big|_{s=-1+j1} = \dfrac{\angle K\angle(s+1-j1)\angle(s+1+j1)}{\angle s\angle(s+1)}$

$$= \frac{\angle K\angle 0\angle j2}{\angle(-1+j1)\angle(j1)} = \frac{0^\circ + 0^\circ + 90^\circ}{135^\circ + 90^\circ}$$

$$= -135^\circ$$

$\phi_A = 180^\circ - \angle\ GH = 180^\circ + 135^\circ = -45^\circ$

89. Ans: (d)

Sol: Slope from 1 to ω_1 = 40 dB/dec

$$= \frac{30-6}{\log\omega_1 - \log 1} = 40$$

ω_1 = 4 rad/sec

Slope from 20 to ω_3 = – 6 dB/oct

$$= \frac{6-30}{\log\omega_3 - \log 20} = -20$$

ω_3 = 320 rad/sec

90. Ans: (c)

Sol: $L_1 \Rightarrow -H_4$

$L_2 \Rightarrow -H_1G_1$

$L_3 \Rightarrow -H_2G_2$

$L_4 \Rightarrow -H_3G_3$

$L_5 \Rightarrow -H_1\,H_2\,H_3G_4G_5$

$\therefore$ Total 5 loops

91. Ans: (d)

Sol: Premative termination of the array indicates that roots are symmetrical w.r.t origin. So, the option (d) matches.

92. Ans: (c)

Sol: No damped oscillations means system is undamped. By Routh's criteria, let us find K where system is undamped

1 + G(s)H(s) = 0 is characteristic equation

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

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

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

$s^4 + 4s^3 + 6s^2 + 4s + K = 0$

s^4	1	6	K
s^3	4 (1)	4 (1)	
s^2	5	K	
s^1	$\frac{5-K}{5}$	0	
s^0	K		

At K = 5, system is undamped, Auxiliary equation is $5s^2 + K = 0$

For undamped system, its poles will lie on imaginary axis

$5s^2 + 5 = 0 \Rightarrow s = \pm j$

Poles are on imaginary axis and frequency of oscillations is 1 rad/sec

$\omega = 2\pi f$

$\Rightarrow f = \frac{1}{2\pi}$ = 0.16 cycles/sec

93. Ans: (b)

Sol: Given response is under damped system response.

Hence damping ratio $0 < \zeta < 1$.

94. Ans: (c)

Sol: Since two poles are given, the given transducer can be considered as a 2nd order system.

We know that the unit step response of a standard 2nd order control system

$$c(t) = 1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}}\sin(\omega_d t + \phi)$$

As $t \to \infty$ (steady state response)

$e^{-\infty} = 0$

c(t) = 1 – 0 = 1

95. Ans: (c)

Sol:
$$\frac{C}{R} = \frac{G_1G_2}{1-(-H_1G_1 - H_2G_2 - H_3G_1G_2) + (-H_1G_1 \times -H_2G_2)}$$

$$= \frac{G_1G_2}{1+H_1G_1 + H_2G_2 + H_3G_1G_2 + H_1H_2G_1G_2}$$

96. Ans: (b)

Sol: C.E. is $s^2 + 5s + 20 = 0$

$\omega_n = \sqrt{20} \quad 2\zeta\omega_n = 5$

$$t_s(2\%\,\text{tolerance}) = \frac{4}{\zeta\omega_n} = \frac{4}{2.5} = 1.6\,\text{sec}$$

97. Ans: (a)

Sol: Super conductor properties:

1. A super conductor is a perfect diamagnetic with magnetic susceptibility $= -1$.
2. A super conductor has bound electron pairs also known as cooper pairs within it cooper pair showed that an arbitrarily small attraction between electrons.
3. A super conductor becomes a normal conductor when

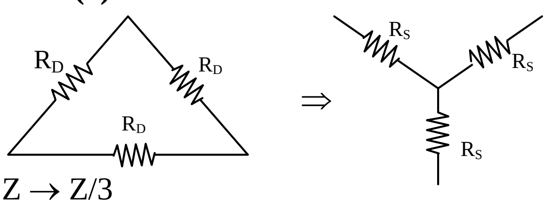
(a) Increasing temperature above transition temperature
(b) Increasing magnetic field above critical field
(c) Increasing current above critical current

98. Ans: (b)

Sol: Elements if physically separable from the network are lumped elements otherwise distributed elements.

99. Ans: (a)

Sol:

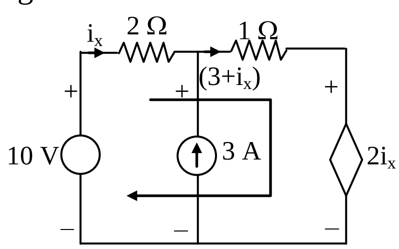


$Z \to Z/3$

$R_{DELTA} \to \dfrac{R_{DELTA}}{3} = R_{STAR}$

100. Ans: (d)

Sol: The given circuit can be redrawn as



By KVL,

$-10 + 2i_x + 1(3 + i_x) + 2i_x = 0$

$\Rightarrow 5i_x = 7 \Rightarrow i_x = \dfrac{7}{5} = 1.4\,A$

101. Ans: (d)

Sol: Here $R_L = 30\ \Omega$ is fixed, where power dissipation is to be maximum.

$\therefore$ $P_{30\Omega}$ is maximum, when $I_{30\Omega}$ is maximum, which happens when R = 0.

102. Ans: (b)

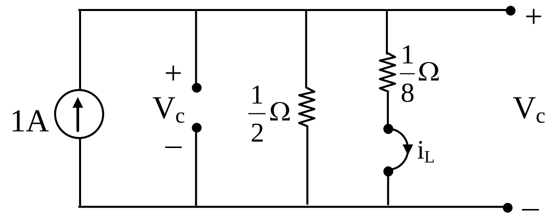
103. Ans: (a)

Sol: $\tau = RC$, $R = 2 \parallel 3 = \dfrac{6}{5}\ \Omega$, $C = 5 \times 10^{-6}$ F

$$\tau = \frac{6}{5} \times 5 \times 10^{-6} = 6\ \mu\text{sec}$$

104. Ans: (c)

Sol: The given circuit at steady state is represents as follow



$$\therefore V(t) = 1\left(\frac{1}{2} // \frac{1}{8}\right) = \frac{\frac{1}{2} \times \frac{1}{8}}{\frac{1}{2} + \frac{1}{8}}$$

$\Rightarrow$ V(t) = 0.1 Volts

105. Ans: (d)

Sol: A low-pass filter circuit is shown in below figure

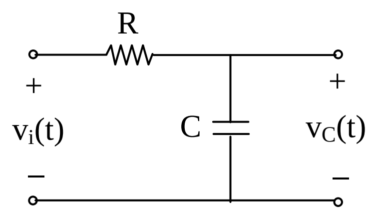


Fig.

$$RC\frac{dv_C(t)}{dt} + v_C(t) = v_i(t)$$

For $\tau = RC >> 1$ = Large time constant

$$RC\frac{dv_C(t)}{dt} = v_i(t)$$

$$\therefore v_C(t) = \frac{1}{RC}\int v_i(t)\,dt$$

Thus, output voltage is integration of the input voltage. Therefore, a low-pass filter is basically an integrating circuit.

106. Ans: (a)

Sol:

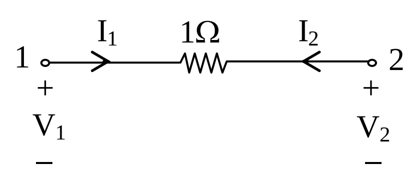


Fig.

For the series element
2 port NW shown,

$$y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} = 1℧ = y_{22}$$

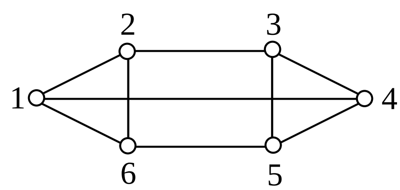
$$y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} = -1℧ = y_{12}$$

$$Y_B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$[Y] = [Y_A] + [Y_B]$$

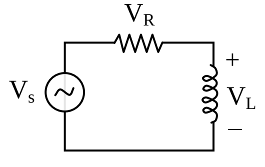
$$= \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} + \begin{bmatrix} 4 & 2 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 5 & 1 \\ 0 & 2 \end{bmatrix}$$

107. Ans: (d)
Sol:



It is a regular & connected graph
It is not complete graph
$\because\ b \neq n_{C_2}$

108. Ans: (c)
Sol:



$V_R = V_L$
$\Rightarrow I \times R = I(\omega L)$
$\Rightarrow R = \omega L$

If frequency doubles $\Rightarrow X_L\uparrow \Rightarrow V_L\uparrow$
$\Rightarrow V_L > V_R$

109 Ans: (c)

Sol: As Resistance (R) = $\dfrac{\text{Voltage (V)}}{\text{current (I)}}$

The limiting errors of voltage and current add up
% limiting error of resistance = 2% + 2%
= 4%

Resistance (R) = $\dfrac{V}{I} = \dfrac{50V}{50mA} = 1000\ \Omega$

Limit within which resistance can be measured = $1000 \times \dfrac{4}{100} = 40\ \Omega$

110. Ans: (b)
Sol: In an energy meter the pressure coil current should lag voltage across pressure coil by 90° for accurate readings. Hence pressure coil circuit is designed in such a way that it is highly inductive and has low resistance.

111. Ans: (c)

112. Ans: (a)
Sol: If secondary winding of CT gets opened, secondary current I_2 becomes zero, secondary MMF N_2I_2 becomes zero, Then opposing MMF becomes zero, which results in large amount of flux, then core gets saturated.

113. Ans: (c)
Sol: Dual slope integrating DVM integrates input voltage for a fixed time period & gives average value of input.

114. Ans: (a)
Sol:

(i) Given $T_d = KI$
$T_C = K_1\theta$ for spring control
$T_C = K_2\text{Sin}\theta$ for gravity control
At balance position

For spring:
$T_d = T_C$
$\Rightarrow K_1\theta = KI$
$\Rightarrow \theta = \left(\dfrac{K}{K_1}\right) I \Rightarrow$ linear scale

For gravity:
$T_d = T_C$
$\Rightarrow K_s\sin\theta = KI$

$$\sin\theta = \frac{KI}{K_2}$$

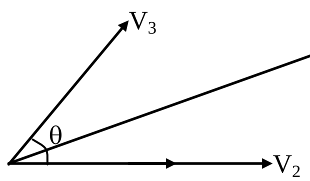
$$\Rightarrow \theta = \text{Sin}^{-1}\left(\frac{KI}{K_2}\right) \Rightarrow \text{non linear}$$

(ii) compared to EDM type moving iron instrument has high torque to weight ratio because EDM type instrument has more weight.

(iii) electrostatic instrument measures voltage in the order of KV range so it has negligible loading effect.

115. Ans: (a)

Sol: The phasor diagram for the given circuit is



$\therefore$ Power consumed in the load is

$P = V_3 I\cos\theta$

But $V_2 = RI$

And

$$V_1^2 = V_2^2 + V_3^2 + 2V_2V_3\cos\theta$$

$$V_1^2 - V_2^2 - V_3^2 = 2(RI)V_3\cos\theta$$

$$= 2R(V_3 I\cos\theta)$$

$$= 2\,RP$$

$$\Rightarrow P = \frac{V_1^2 - V_2^2 - V_3^2}{2R}$$

116. Ans: (c)

Sol: Frequency ranges of the detectors used in AC bridges are as follows:

1. Head phones or Telephone detectors 250Hz to 3KHz
2. Vibration galvanometers 5Hz to 100Hz
3. Tunable amplifiers 10Hz to 100KHz.

D'Arsonval galvanometer is used to check for bridge balance in D.C bridges.

117. Ans: (c)

Sol: g = voltage sensitivity

$$= \frac{\text{Voltage generated / m}}{\text{stress}}$$

$$= \frac{V/m}{N/m^2} = \frac{Vm}{N} = Vm/N$$

d = charge sensitivity $= \dfrac{\text{charge}}{\text{Force}}$ C/N

118. Ans: (a)

119. Ans: (c)

Sol: In metal strain gauge the basic effect is a change of resistance with strain.

Gauge factor of semiconductor strain gauges is large than metal strain gauges.

Gauge factor of semiconductor strain gauge varies with strain.

Metal strain gauges are sensitive to temperature.

120. Ans: (d)

Sol: At every node of the circuit, 2 stuck-at-faults are possible. They are stuck-at-0 and stuck-at-1. If there are 'n' nodes in the circuit, then total number of stuck-at-fault possible will be '2n'.

121. Ans: (b)

122. Ans: (d)

123. Ans: (a)

Sol: The optical power in watts measured at a given distance from a power source can be determined mathematically as,

$$P = P_t \times 10^{\frac{-Al}{10}}$$

where P = measured power level (watts)

P_t = Transmitted power level (watts)

A = cable power loss (dB/km)

l = cable length (km)

$P = 0.1\text{mW} \times 10^{-3}$

$P = 0.1\mu\text{W}$

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124. Ans: (a)

Sol: Noise figure (in dB) = 3

$10 \log_{10} F = 3$

Noise factor, $F \approx 2$

$T_e = T(F-1)$

Where T_e = equivalent noise temperature

T = temperature of the environment

$T_e = 300(2-1) = 300K$

125. Ans: (c)

Sol: Fade margin is included in system gain equation as a loss.

126. Ans: (a)

127. Ans: (d)

128. Ans: (c)

Sol: Losing or gaining electrons
→ Ionic bond. Sharing of electrons
→ Covalent bond.

129. Ans: (a)

Sol: Ceramic crystals are mostly ionic. The ionic bond is formed by the transfer of the electron. The one which loses an electron and becomes positively charged is called the cation. Due to the excess number of protons the attractive force on electrons is more and hence the radius of cation is smaller than the neutral atom. Similarly the one which gains that electron becomes negatively charged and is called the anion. Hence the ratio of the cation radius to that of anion radius is less than unity.

130. Ans: (a)

Sol: Manganin alloy has the lowest temperature coefficient of resistance: 0.0000002 Ω /°C.

131. Ans: (c)

Sol:

Material	Band gap (eV)
Ge	0.72
Si	1.1
GaAs	1.44
GaP	2.26

So the order is Ge-Si-GaAs-Gap.

132. Ans: (a)

Sol: Semiconductors have a moderate forbidden gap between 0.5 to 2 eV.

133. Ans: (c)

Sol: Higher the conductivity of the material, larger the eddy currents and higher the eddy current losses (i^2R losses).

134. Ans: (a)

Sol: Soft magnetic materials have high eddy current losses.

135. Ans: (c)

Sol: Hard magnetic materials are used for making permanent magnets because they have wide and large hysteresis loop, high retentivity and coercivity.

136. Ans: (d)

Sol: Measurement of voltage magnitude by a CRO is not fast compared to other techniques of measurement of same voltage by AVM or DVM.

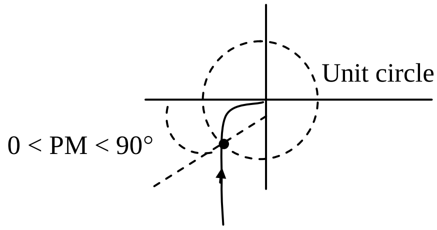
As such, statement (I) is false but statement (II) is true.

137. Ans: (b)

Sol: When the variable frequency of the source is set at $\omega_0 = \frac{1}{\sqrt{LC}}$, the series R, L, C circuit resonates as the input impedance is minimum equal to R and current is maximum at that frequency. The resonant frequency f_0 is related to half power frequencies f_1 and f_2 as $f_0 = \sqrt{f_1 f_2}$. Both A and R are true, but R is not a correct explanation of A.

138. Ans: (a)

Sol:



139. Ans: (b)

Sol: Both the statements are correct with respect to synchronous machine but not correct explanation.

140. Ans: (b)

Sol: **Statement (I):** It is well known that an induction motor, working on an existing 3-phase supply, when driven at super synchronous speed in the same direction is which it was running, acts as a generator delivering real power to the mains. **Statement (I) is true.**

Statement (II): The prime mover is a mechanical device and cannot supply any reactive power. **Statement (II) also is correct.**

However statement (II) cannot be assumed to imply that the prime mover does supply real power.

(The induction generator does need lagging reactive power, mainly to maintain the air-gap flux. This is supplied by the existing 3-phase supply).

141. Ans: (d)

Sol: RSA is asymmetric key cryptography

142. Ans: (c)

Sol: HA is faster because $S = A \oplus B$, $C = AB$. But FA implementation requires 2 - level logic to get sum and carry output.

143. Ans: (d)

Sol: Number of programmable switches in a PLA is very high as both AND & OR planes are programmable.

Therefore, it is difficult to fabricate.

144. Ans: (d)

Sol: Input impedance of lossless $\frac{\lambda}{8}$ transmission line is given by

$$Z_{in} = Z_0\left(\frac{Z_R + jZ_0}{Z_0 + jZ_R}\right)$$

For lossless transmission line: $Z_0 = R_0$ (purely resistive).

If $Z_R = R_R$ (purely resistive load)

then $Z_{in} = R_0\left(\frac{R_R + jR_0}{R_0 + jR_R}\right)$

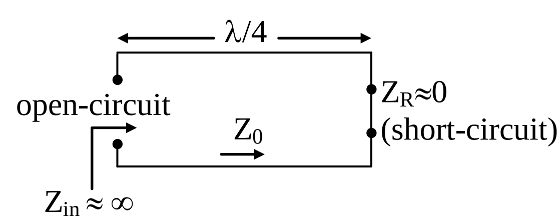
$$|Z_{in}| = R_0\left(\frac{\sqrt{R_R^2 + R_0^2}}{\sqrt{R_0^2 + R_R^2}}\right)$$

$\therefore |Z_{in}| = R_0$

If $Z_R = R_R \pm jX$ (complex load), then $|Z_{in}|$ can not be equal to characteristic impedance. .

Hence for $\frac{\lambda}{8}$ line, for any load, magnitude of input impedance is not equal to characteristic impedance, rather only for resistive load $|Z_{in}|$ will be equal to characteristic impedance.

Consider lossless $\frac{\lambda}{4}$ transmission line



$$Z_{in} = \frac{Z_0^2}{Z_R}$$

At $Z_R \approx 0$

$Z_{in} \approx \infty$

Therefore S1 is false and S2 is true.

145. Ans: (d)

Sol: The thermal noise power is independent of frequency.

146. Ans: (c)

Sol: In avalanche photo diodes current amplification occurs.

147. Ans: (a)

148. Ans: (b)

Sol: Memory protection is provided by OS and specifically memory management unit of OS. But dual mode of operation protects I/O devices and other software resources.

149. Ans: (a)

Sol: The reverse saturation current (I_s) is directly proportional to the cross section area (A_i) of the diode. i.e., $I_s \propto A_j$

Diode forward current $i = I_s\left(e^{V/\eta V_T} - 1\right)$

$\Rightarrow i \propto I_s$

Hence, both statements are correct and statement (II) is the correct reason for statement (I).

150. Ans: (b)

Sol: Both are Dirichlet's conditions for existence of Fourier series. But there is no relation between each other.