ESE- 2020 (Prelims) - Offline Test Series Test - 24
ELECTRICAL ENGINEERING

FULL LENGTH MOCK TEST-4 (PAPER-II)
Solutions

01. Ans: (b)

Sol: If AX = B is an inconsistent system of equations. Then ρ(A) must be less than 3. In which the highest possibility is 2

02. Ans: (d)

Sol: Given $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$

The characteristic equation is

$|A - \lambda I| = 0$

$\Rightarrow \begin{vmatrix} 1-\lambda & -1 \\ 2 & 3-\lambda \end{vmatrix}$

$\Rightarrow \lambda^2 - 4\lambda + 5 = 0$

$\Rightarrow \lambda = 2 \pm i$

Therefore, A has no positive characteristic roots.

03. Ans: (a)

Sol: $V(x) = \sigma_x^2 = E(x^2) - [E(x)]^2$

$\Rightarrow \lambda = E(x^2) - \lambda^2$

$\Rightarrow \lambda^2 + \lambda = 6$

$\lambda^2 + \lambda - 6 = 0$

$(\lambda + 3)(\lambda - 2) = 0$

$\lambda = 2, -3$

$\therefore \lambda = 2$

($\because$ variable can not be negative)

04. Ans: (c)

Sol: $\underset{x\to 2^-}{\text{Lt}} f(x) = \underset{x\to 2^+}{\text{Lt}} f(x)$

$\underset{x\to 2^-}{\text{Lt}} C^2 - x^2 = \underset{x\to 2^+}{\text{Lt}} C + x$

$C^2 - 4 = C + 2$

$\Rightarrow C^2 - C - 6 = 0$

$\Rightarrow C^2 - 3C + 2C - 6 = 0$

$\Rightarrow C(C - 3) + 2(C - 3) = 0$

$\Rightarrow C = 3, -2$

05. Ans: (a)

Sol: p(no. of heads = no of tails)

$$= \frac{6c_3}{2^6} = 0.3125$$

06. Ans: (c)

Sol: $f'(z) = u_x + iv_x = u_x - iu_y$

$f'(z) = (3x^2 - 3y^2 + 6x) - i(-6xy - 6y)$

put x = z and y = 0

$f'(z) = 3z^2 + 6z$

$f(z) = z^3 + 3z^2 + c$

07. Ans: (d)

Sol: The Taylor's series expansion of f(x) at x = 0 is given by

$f(x) = f(0) + x\, f'(0) + \frac{x^2}{2!} f''(0) + \ldots\ldots$ (1)

$f(x) = \sin x$ $\quad f(0) = \sin 0 = 0$

$f'(x) = \cos x$ $\quad f'(0) = \cos 0 = 1$

$f''(x) = -\sin x$ $\quad f''(0) = -\sin 0 = 0$

$f'''(x) = -\cos x$ $\quad f'''(0) = -\cos 0 = -1$

Substituting above in (1), we get

$\therefore \quad \sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} \ldots$

$\therefore$

08. Ans: (a)

Sol: The conditions of cauchy's theorem hold good for f(x) and g(x). By cauchy's theorem, there exists a value c such that

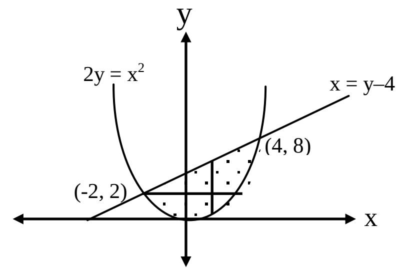
$$\frac{f'(c)}{g'(c)} = \frac{f(3) - f(2)}{g(3) - g(2)}$$

$$\Rightarrow \frac{-\frac{1}{c^2}}{\frac{-2}{c^3}} = \frac{\frac{1}{3} - \frac{1}{2}}{\frac{1}{9} - \frac{1}{4}}$$

$\Rightarrow c = 2.4$

09. Ans: (b)

Sol: Given curves are $2y = x^2$ and $x = y - 4$



The points of intersections of $y = x^2$ and $x = y - 4$ are (–2, 2) and (4, 8)

$$\therefore \text{ Area} = \int_{-2}^{4} \left[(4 + x) - \frac{x^2}{2} \right] dx = 18$$

10. Ans: (b)

Sol: The given equation can be written as

$(y\, e^{xy}\, dx + x\, e^{xy}\, dy) + 2y\, dy = 0$

$e^{xy} (y\, dx + x\, dy) + 2y\, dy = 0$

$e^{xy}\, d(xy) + 2y\, dy = 0$

$\Rightarrow e^{xy} + 2\frac{y^2}{2} = C$

$\therefore e^{xy} + y^2 = C$

11. Ans: (c)

Sol: k = 0.8

Power transferred inductively from primary to secondary

= (1–k) times of total load

= (1– 0.8) ×10 kW = 2 kW

12. Ans: (c)

Sol: Core losses = 150 W (Constant)

Copper loss at full load = 220 W

$\therefore$ Copper loss at halt full load

$$= \left(\frac{1}{2}\right)^2 220\,\text{W} = 55\text{ W}$$

$\therefore$ Total losses at half full load

$$= 150 + 55 = 205\text{ W}$$

Efficiency at half full load

$$= \frac{\frac{1}{2}\times 10^3 \times 1}{\frac{1}{2}\times 10\times 10^3 + 205}\times 100 = 96.06\%$$

13. Ans: (d)

Sol: In field flux method of speed control of dc shunt motor to eliminate the "saturation problem", we should reduce the flux below rated value only (i.e $\phi < \phi_{rated}$).

if $\phi < \phi_{rated} \Rightarrow N > N_{rated}$,

$\left[\because N \propto \frac{1}{\phi}\right]$ and $T < T_{rated}$ $[\because T \propto \phi]$

We know power, $P \propto NT$

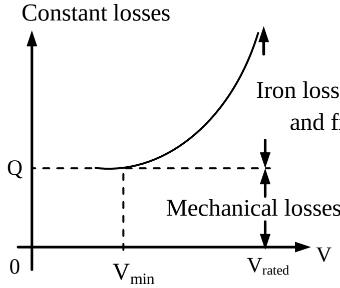
As $\phi\downarrow \Rightarrow N\uparrow$ and $T\downarrow$

$\Rightarrow$ Power maintain constant.

14. Ans: (d)

15. Ans: (b)

Sol:



The intersection 'Q' of the extrapolated curve on the Y-axis will give mechanical losses (friction and windage loss)

16. Ans: (b)

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

17. Ans: (d)

Sol: Speed $\propto N_s = \frac{120f}{P}$ as f $\downarrow$, speed $\downarrow$

Motor output = Torque $\times$ speed

But torque = constant

So motor output decreases as speed decreases

$$T_{max} \propto \frac{1}{X}\left(X\downarrow \text{as } f\downarrow\right)$$

So $T_{max}\uparrow$

18. Ans: (c)

Sol: For cylindrical motor synchronous machine $P = \frac{EV}{X}\sin\delta$

$$\frac{P_1}{P_2} = \frac{\sin\delta_1}{\sin\delta_2}$$

$$\frac{P}{2P} = \frac{\sin 30^\circ}{\sin\delta_2}$$

$$\sin\delta_2 = 1 \Rightarrow \delta_2 = 90^\circ$$

19. Ans: (b)

Sol: $E = \frac{\phi ZN}{60}\left(\frac{P}{A}\right)$

$= \frac{1.5\times10^{-3}\times55\times19\times1500}{60}\left(\frac{4}{2}\right)$

= 78.375 V

20. Ans: (d)

Sol: **Given data, V** = 250 V, N_1 = 900 rpm, I_a = 30 A , R_a = 0.4 Ω I_{a2} = 20 A and N_2 = 600 rpm

$\frac{E_{b1}}{E_{b2}} = \frac{N_1}{N_2}$

$\Rightarrow \frac{V - I_{a1}R_a}{V - I_{a2}(R_a + R_{se})} = \frac{900}{600}$

$\Rightarrow \frac{250-(30\times0.4)}{250-20(0.4+R_{se})} = \frac{900}{600}$

$\Rightarrow 20(0.4+R_{se}) = 250 - 158.6$

$\Rightarrow R_{se} = 4.17\ \Omega$

21. Ans: (a)

Sol: Given data,

X_g = 1.2 pu, V = 1 pu, X_l = 0.4 pu

P_m = 1.5 pu,

$\because P = P_m \sin\delta$

Where, $P_m = \frac{EV}{X_{eq}}$ ………(1)

$X_{eq} = X_g + X_l = 1.2 + 0.4 = 1.6$ pu

Then from equation (1),

$1.5 = \frac{E\times1}{1.6} \Rightarrow E = 2.4$ pu

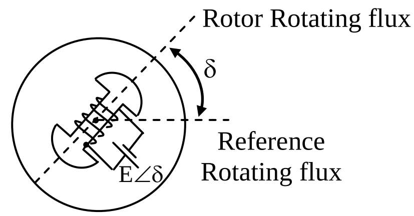
22. Ans: (b)

Sol: **Load angle/torque angle:**

It is the angle between the internal induced emf and the terminal voltage.

Or,

It is the angle between rotor rotating flux and reference rotating flux.



23. Ans: (d)

Sol: $B \propto \frac{V}{f}$ = Constant,

The frequency of operation is reduced from 400 Hz to 50 Hz, the permissible applied voltage should also be reduced from 230 V to (230/8) V.

So kVA rating will decrease from 4 to (4/8) = 0.5

24. Ans: (b)

Sol: For series motor $\Rightarrow I_L = I_f = I_a$

but $\phi \propto I_f \propto I_a$

Developed torque in series motor,

$T \propto \phi.I_a \propto I_a^2$

$\therefore$ % increased torque $= \dfrac{T_2 - T_1}{T_1} \times 100$

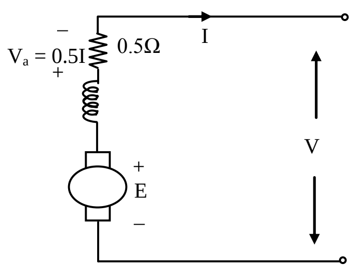
$= \dfrac{I_{a2}^2 - I_{a1}^2}{I_{a1}^2} \times 100$

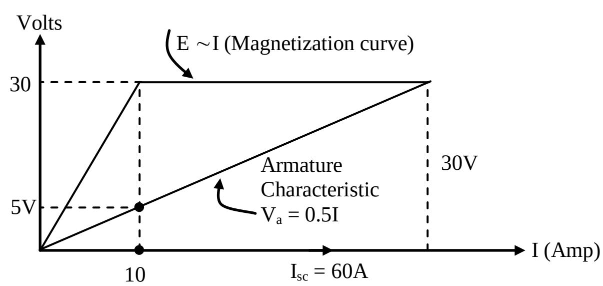
$= \dfrac{121-100}{100} \times 100$

$= 21\%$

25. Ans: (c)

Sol:





The armature characteristic (voltage drop in armature $\propto I$) and the magnetization characteristic are shown on the same axis.

Under short-circuit; E – (0.5)I = V = 0. Hence, E = 0.5I = V_a. Current corresponding to the E = V_a point (Point of intersection of the magnetization curve and armature characteristic) gives the short- circuit current. By similar triangles, it is 60A.

26. Ans: (c)

Sol: Babbit metal (or) bearing metal is any of several alloys used to provide the bearing surface in a plain bearing. Some common compositions are (90% Sn, 10% Cu), (89% Sn, 7% Sb, 4% Cu), (80% Pb, 15% Sb, 5% Sn)

27. Ans: (b)

Sol: The total number of atoms per unit cell is given by

$$N = N_{interior} + \frac{N_{face}}{2} + \frac{N_{corner}}{8}$$

For simple cubic, BCC and FCC the number of atoms per unit cell are 1, 2 & 4.

28. Ans: (a)

Sol: Ferrite (α-iron) experiences an allotropic transformation to FCC austenite (or) γ-iron at 912°C. This austenite persists upto 1394°C.

29. Ans: (b)

Sol: In superconducting state entropy and thermal conductivity decreases.

30. Ans: (c)

Sol: $H_c(T) = H_c(0)\left[1-\left(\frac{T}{T_c}\right)^2\right]$

$= 32\times10^3\left[1-\left(\frac{6}{7.26}\right)^2\right]$

$= 10.14\times 10^3$ A/m

31. 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.

32. Ans: (d)

Sol: Volume of unit cell = a^3

number of atoms per unit cell = 4

radius of Atoms = $\frac{a\sqrt{2}}{4}$

packing fraction = $\frac{4\times\frac{4}{3}\pi r^3}{a^3}$

$= 4\times\frac{4}{3}\pi\left(\frac{\sqrt{2}}{4}\right)^3$

$=\frac{\pi\sqrt{8}}{12} \Rightarrow \frac{\pi\times2\sqrt{2}}{12}$

$= \frac{\pi\sqrt{2}}{6}$

33. Ans: (c)

Sol: For a SC, susceptibility $(\chi_m) = -1$

Relative permeability = $1 + \chi_m = 0$

34. Ans: (b)

Sol: In top down technique generally a bulk material is taken and machined it to modify into the desired shape and product. Examples of this type of technique are the manufacturing of integrated circuits using a sequence of steps such as crystal growth, lithography, etching, ion implantation, etc. For nanomaterial synthesis ball – milling is an important top down approach, where microcrystalline structure are broken down to nanocrystalline structures, but original integrity of the material is retained.

35. Ans: (b)

Sol: Ferromagnetic material susceptibility is positive and large.

Paramagnetic material susceptibility is positive and small.

Diamagnetic material susceptibility is negative and small.

Superconductors are perfect diamagnetic materials having susceptibility as –1.

36. Ans: (d)

Sol: Chemically highly inactive atoms are Inert gas atoms.

Ex: Ne, Ar, Kr, etc

37. Ans: (a)

For all positive values of 'K' roots are left side of s-plane.

38. Ans: (c)

Sol: $GM = \frac{1}{0.4} = 2.5$

PM = 180° – 30° = 150°.

39. Ans: (b)

Sol: For option (a) Break point is – 6 and σ = –6

For option (b) Break point is – 4 and σ = – 4

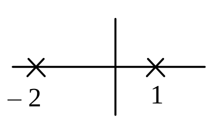
[BP = σ = – 4]

For option (c) & (d) Break point & Cancroids are not same.

Option (b) is correct

40. Ans: (c)

Sol: $G(s) = \frac{10}{(s-1)(s+2)}$



So, G(s) is unstable

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1+G(s)} = \frac{10}{(s-1)(s+2)+10}$$

$$= \frac{10}{s^2-2+2s-s+10}$$

$$= \frac{10}{s^2+s+8}$$

C.E = $s^2 + s + 8 = 0$

$$\begin{array}{c|cc} s^2 & 1 & 8 \\ s^1 & 1 & 0 \\ s^0 & 8 & \end{array}$$

There is no sign changes in the first column of RH criteria table. Therefore the closed loop $\frac{C(s)}{R(s)}$ is stable

41. Ans: (d)

Sol: Let us assume, $G(s) = \frac{K}{s(s+a)}$

s = 0 and s = –a are open loop poles

Characteristics Equation is $s^2+as+K=0$

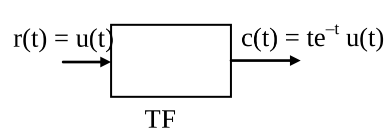
Roots of characteristics equation are s_1, s_2

$$= \frac{-a}{2} \pm \sqrt{\left[\left(\frac{a}{2}\right)^2 - K\right]}$$

When K = 0, the roots are $s_1 = 0$ and $s_2 = -a$ .i.e., they coincides with the open loop poles of system..

42. Ans: (c)

Sol:



$$TF = \frac{L.T[\text{output}]}{L.T[\text{input}]}$$

$$= \frac{L.T[te^{-t}]}{L.T[u(t)]}$$

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

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

43. Ans: (c)

Sol: $\text{Transfer Function} = \left.\frac{5}{s^2+s+5}\right|_{s=j\omega}$

$$= \frac{5}{-\omega^2+j\omega+5} = \frac{-5}{\omega^2-j\omega-5}$$

44. Ans: (d)

Sol: $|20\log 2\zeta| = \left|\left(20\log 2\frac{1}{8}\right)\right| = 12\text{ dB}$

45. Ans: (b)

Sol: Shifting the take off point before the block.

46. Ans: (c)

Sol: PI compensator is equivalent to adding the pole at origin

47. Ans: (b)

Sol: By applying Mason's gain formula

$$\frac{C(s)}{R(s)} = \frac{K}{s^2(s+25)+KK_ts+K(1+0.02s)}$$

$R(s) = \frac{1}{s}$ (step input)

$$C(s) = \frac{K}{s\left(s^2(s+25)+KK_ts+K(1+0.02s)\right)}$$

$$C(\infty) = \lim_{s\to 0} sC(s)$$

$$= \lim_{s\to 0} s\frac{K}{s\left(s^2(s+25)+KK_ts+K(1+0.02s)\right)}$$

$$= 1$$

48. Ans: (d)

Sol: Given $\phi(t) = e^{At} = \begin{bmatrix} e^{4t} & 0 \\ e^{2t}-e^{4t} & e^{2t} \end{bmatrix}$

'A' is obtained as follows

$$\frac{d}{dt}[e^{At}] = A\,e^{At}$$

Put t = 0

$$\frac{d}{dt}[e^{At}]_{t=0} = A$$

$$\Rightarrow A = \frac{d}{dt}\begin{bmatrix} e^{4t} & 0 \\ e^{2t}-e^{4t} & e^{2t} \end{bmatrix}_{t=0}$$

$$A = \begin{bmatrix} 4e^{4t} & 0 \\ 2e^{2t}-4e^{4t} & 2e^{2t} \end{bmatrix}_{t=0}$$

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

49. Ans: (b)

Sol: $T_{sweep} = 2 \times T_{signal}$ (since 2 cycles displayed)

$= 2 \times \frac{1}{100\,\text{Hz}}$

$= 2 \times 10$ ms

$= 20$ ms

50. Ans: (b)

Sol: $S_{AC} = 0.9 \times 1$ kΩ/V

$= 0.9$ kΩ/V

$= 900$ Ω/V

51. Ans: (a)

52. Ans: (b)

53. Ans: (b)

Sol: If P is the power, I current and R resistance,

then $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{4}{10000}} = 0.02\,\text{A}$

So, voltage across R is $10000 \times 0.02 = 200$V

Sensitivity = 200/50 = 4.0V/mm.

54. Ans (a)

Sol: **Error:** Error is defined as the difference between the measured value and true value.

Resolution: The smallest change in measured value to which the instrument will respond is called resolution.

Sensitivity: Sensitivity of an instrument is defined as the ratio of magnitude of the output signal or response to the magnitude of input signal or response of the quantity being measured.

55. Ans: (a)

Sol: Meter constant to given data

$K = \frac{40 \times 60 \times 60}{5 \times 60} = 480$ rev/kWh

But it is given that meter constant is 500.

Therefore % error in meter constant

$= \frac{480 - 500}{500} \times 100$

$= -4\%$

56. Ans: (d)

Sol: Thermocouple voltmeter measures true rms voltage

$V_{\text{rms (true)}} = \sqrt{1^2 + \left(\frac{2}{\sqrt{2}}\right)^2}$ V

$= \sqrt{3}$ V

57. Ans: (c)

Sol: Schering Bridge is used for measurement of capacitance, Dielectric loss, D-factor.

58. Ans: (a)

Sol: $\frac{2dT_i}{dt} + T_i = T_a$

Apply Laplace transform on both sides

$\frac{T_i(s)}{T_a(s)} = \frac{1}{2S + 1}$

$\frac{T_i(s)}{T_a(s)} = \frac{0.5}{S + 0.5}$

$\omega_c = 0.5$

$$f_c = \frac{1}{4\pi}\text{Hz}$$

59. Ans: (a)

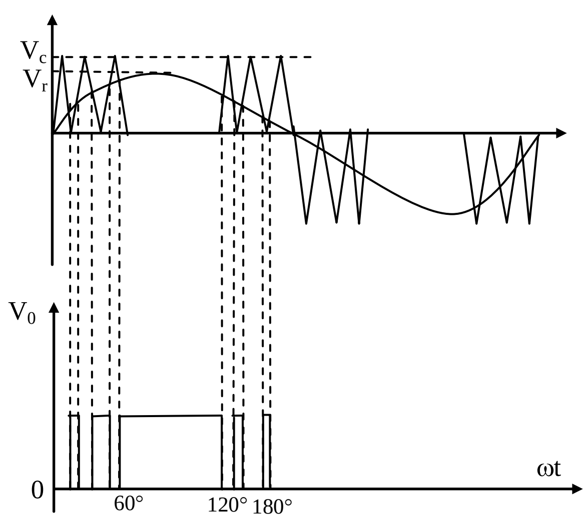
Sol. $f_{new} = \dfrac{f_{old}}{2}$ $\left(\because C_\ell \propto \dfrac{1}{f}\right)$

60. Ans: (a)

Sol: IGBT has smaller values of C_{gs}, C_{gd} because its effective cross sectional area is smaller than MOSFET. The IGBT has smaller area even though its current rating is identical to MOSFET's rating because IGBT uses conductivity modulation of drift region to significantly reduce the specific on-state resistance.

61. Ans: (a)

Sol:



Modified sinusoidal pulse width modulation switching scheme.

62. Ans: (a)

Sol: In a continuous mode of operation, switch is turned on before the secondary current falls to zero. The continuous mode can provide higher power capability for the same value of peak current I_P. It means that, for the same output power, the peak currents in the discontinuous mode are much higher than those in continuous mode. As a result, a more expensive power transistor with a higher current rating is need. Moreover, the higher secondary peak currents in the discontinuous mode can have a larger transient spike at the instant of turn-off. However, despite all these problems, the discontinuous mode is still more preferred than the continuous mode. There are two main reasons. First, the inherently smaller magnetizing inductance in the discontinuous mode has a quicker response and a lower transient output voltage spike to sudden change in load current or input voltage. Second, the continuous mode has a right-half plane zero in its transfer function, thereby making the feedback control circuit more difficult to design.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63. Ans: (b)

Sol: The average value of new output voltage?

$$V_0 = V_s\left(\frac{1}{1-D}\right) = D = \frac{2}{3}, T_{on} = 100\mu\sec, T_{off} = 50\mu\sec$$

Now, $T_{off\,2} \Rightarrow \left(\frac{T_{off}}{2}\right) = 25\mu\sec$

$T_{on\,2} = 100 + 25 = 125\mu\sec$ ($\because$ f = constant)

$$V_0 = V_s\left(\frac{1}{1-D}\right)$$

$$= 150\left(\frac{1}{\left(1-\frac{5}{6}\right)}\right) = 900\,V$$

64. Ans: (a)

Sol: $V_0 = \frac{3V_{mL}}{\pi}\cos\alpha - 0.10\left(\frac{3V_{mL}}{\pi}.\cos\alpha\right)$

$$V_0 = 0.90\left(\frac{3V_{mL}}{\pi}.\cos\alpha\right)$$

$$440 = 0.90\left(\frac{3\times 415\sqrt{2}}{\pi}.\cos\alpha\right)$$

$\alpha = 29.27°$

65. Ans: (c)

Sol: 1-ϕ full converter,

$$\Delta V = \frac{V_m}{\pi}[\cos\alpha - \cos(\alpha+\mu)] - 4f\,L_s I_0$$

ΔV = constant

Because f, I_0= constant

as, V_m decreases, [$\cos\alpha - \cos(\alpha+\mu)$] decreases

cos ($\alpha + \mu$) increase so μ increases.

Commutation overlap not only reduces average output voltage, but also reduces the extension angle (Υ) which may cause commutation failure in the inverting mode of operation.

66. Ans: (b)

Sol: The quality of output voltage will be improved by increasing frequency along with output voltage.

67. Ans: (a)

Sol: Total load, P_{load} = 500 MW

$P_{G_1} + P_{G_2} = 500$ …. (1)

Cost curves $C_1 = P_{G_1} + 0.01P_{G_1}^2$

$C_2 = 5P_{G_2} + 0.02P_{G_2}^2$

Most economical load scheduling

$$\frac{dc_1}{dP_{G_1}} = \frac{dc_2}{dP_{G_2}}$$

$1+0.02\,P_{G_1} = 5 + 0.04P_{G_2}$

$0.02\,P_{G_1} - 0.04P_{G_2} = 4$

$2P_{G_1} - 4P_{G_2} = 400$

$P_{G_1} - 2P_{G_2} = 200$ ….. (2)

Equation (1) & (2)

$$P_{G_1} + P_{G_2} = 500$$
$$P_{G_1} - 2P_{G_2} = 200$$
$$3P_{G_2} = 300$$
$$P_{G_2} = 100MW$$

$P_{G_1} = 400 MW$

68. Ans: (d)

Sol: A sudden large disturbance includes application of faults, clearing of faults, sudden load changes and inadvertent tripping of lines and generators. The maximum power which can be transferred through the systems without the loss of stability under sudden disturbance is referred as transient stability limit.

69. Ans: (a)

Sol: Average RRRV= $\dfrac{\text{Peak re-striking voltage}}{\text{Time to reach peak value}}$

$$= \frac{100kV}{50\mu sec} = 2kV/\mu sec$$

70. Ans: (c)

Sol: $I^2 \alpha\, r^3$

$$\left(\frac{I_2}{I_1}\right)^2 = \left(\frac{r_2}{r_1}\right)^3$$

$$r_2 = r_1 \times \left(\frac{I_2}{I_1}\right)^{2/3}$$

$$= 0.8 \times \left(\frac{1}{8}\right)^{2/3} = 0.2\,mm$$

71. Ans: (b)

Sol: Sending end voltage is given as

$$V_S = AV_r + BI_r$$

Receiving end current under open condition is zero

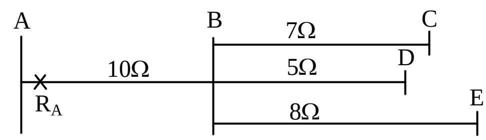
$I_R = 0$

$V_S = AV_R$

$$V_R = \frac{V_S}{A} \Rightarrow \frac{400}{0.8} = 500\ kV$$

72. Ans: (a)

Sol:



$R_{AB} \times 100\% + R_{BD} \times 50\%$

$= 10\ \Omega + 2.5\ \Omega$

$= 12.5\ \Omega$

73. Ans: (b)

Sol: SIL $= \dfrac{V^2}{Z_{Co}}$ Z_{Co} is surge impedance with compensation

$Z_{Co} = Z_C\sqrt{\dfrac{1-K_{se}}{1-K_{sh}}}$ where Z_C is surge impedance of uncompensated line K_{se} & K_{sh} are degree of series and shunt compensations

From data $K_{se} = 0.5$, $K_{sh} = 0.5$

So, $Z_{Co} = Z_C$ and no change in SIL

$$P_{max} = \frac{|V_S||V_r|}{|B|} = \frac{|V_s|V_r|}{Z_c \sin\beta\ell} = \frac{|V_s|V_r|}{Z_c\beta\ell}$$

$$= \frac{|V_s|V_r}{X_{line}}$$

With 50% series compensation,

$$P_{max\ new} = \frac{|V_s|V_r|}{X_{line} - 0.5X_{line}}$$

$$= 2.\frac{|V_s|V_r|}{X_{line}}$$

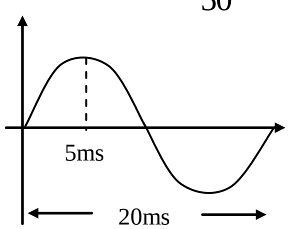
P_{max} increased by 2 times

74. Ans (b)

Sol: Voltage zero means current is peak

For 50Hz,

Time period (T) = $\frac{1}{50}$ msec = 20msec



$1\frac{1}{2}$ cycle circuit breaker ⇒circuit breaker open time = 20+10 =30ms

Arcing time = 5ms

Circuit breaker operating time

= open time+ arcing time

= 30+5 = 35ms

75. Ans: (a)

Sol: $Q = \frac{\Delta V}{X} \Rightarrow Q = (5\%)\ \frac{1}{X}$

$$\Rightarrow Q\ (MVAr) = 0.05 \times \frac{BaseMVA}{X}$$

$= 0.05 \times 2000$

$= 100$ MVAr

76. Ans: (c)

Sol: $3I_{a0} = j\,6 \Rightarrow I_{a0} = j\,2$ p.u., $I_{a1} = -j\,3$ p.u.

LLG $\Rightarrow I_{a1} + I_{a2} + I_{a0} = 0$, $I_{a2} = j\,1$ p.u.

77. Ans: (d)

Sol: Insulation resistance of a cable is given as,

$$R_{ins} = \frac{\rho}{2\pi\ell}\ell n\frac{r_2}{r_1}$$

where; ρ is the resistivity

l is the length of the cable

r_2 is the outer radius and

r_1 is the inner radius.

$$\Rightarrow R_{ins} \alpha \frac{1}{\ell}$$

$$\Rightarrow \frac{R'_{ins}}{R_{ins}} = \frac{\ell}{\ell'}$$

∵ R_{ins} = 500 MΩ for *l* = 1km

then for l' = 8 km,

$$Rin's = 500 \times \frac{1}{8} = 62.5M\Omega$$

78. Ans: (a)

Sol: Given data, L = 0.625 mH/km,

C = 0.25 μF/km, V = 50 kV,

Then, Surge impedance = $Z_c = \sqrt{\frac{L}{C}}$

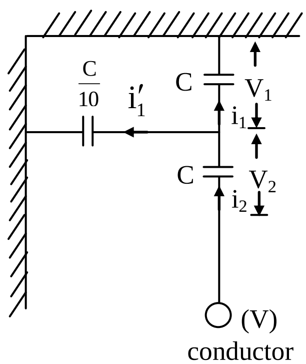
$$\Rightarrow Z_c = \sqrt{\frac{0.625 \times 10^{-3}}{0.25 \times 10^{-6}}} = 50\ \Omega$$

Then, surge impedance loading of the line would be,

$$SIL = \frac{V^2}{Z_c} = \frac{50\times50\times10^6}{50} = 50MW$$

79. Ans: (d)

Sol:



Given data,

V_2 = 11 kV (maximum) as, to obtain the maximum safe working voltage of the insulator string, the unit nearest to the conductor bears the maximum safe working voltage. (see the figure)

Applying KCL,

$i_2 = i_1 + i_1'$

$$\Rightarrow V_2(\omega C) = V_1(\omega C) + V_1\left(\omega\frac{C}{10}\right)$$

$$\Rightarrow V_2 = V_1\left(1+\frac{1}{10}\right) = 1.1V_1$$

$$\Rightarrow V_1 = \frac{V_2}{1.1} = \frac{11}{1.1} = 10kV$$

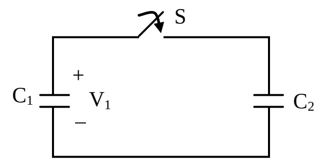
Then,

$$V_{max} = V_1/_{max} + V_2/_{max}$$

$= 10+11 = 21$ kV

80. Ans: (b)

Sol: Consider below circuit,



Initial charge = C_1V_1

Final charge = $C_1V + C_2V$

By charge conservation principle

$\Rightarrow C_1V_1 = C_1V + C_2V$

$$\Rightarrow V = \frac{C_1V_1}{C_1+C_2}$$

81. Ans: (c)

Sol: $$|e| = L\frac{di}{dt} = L\left[\frac{i_2 - i_1}{\Delta t}\right]$$

$$= (0.1)\left[\frac{5-(-5)}{10\times10^{-3}}\right]$$

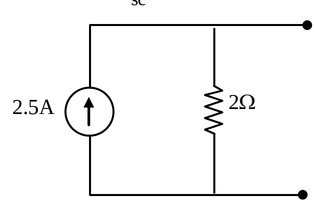
$$= \frac{1000}{10} = 100 Volts$$

82. Ans: (d)

Sol: $V_{oc} = V_{th} = 5$Volts

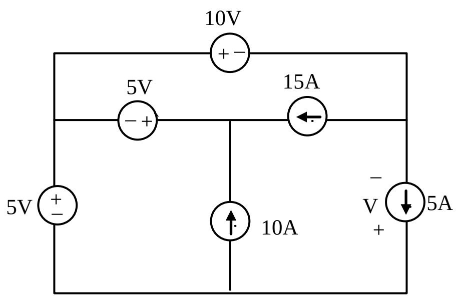
$$I_{sc} = \frac{5}{2}A = 2.5\ A$$

So, $R_{th} = \frac{V_{oc}}{I_{sc}} = \frac{5}{5/2} = 2\Omega$



83. Ans: (a)

Sol:



Apply KVL in outer loop

$5 - 10 + V = 0$

$\Rightarrow V = 5$

$\therefore$ Power delivered by 5A source is P_{del}

$= 5 \times 5$

$= 25$ Watts

84. Ans: (a)

Sol: $M = \dfrac{N_2\phi_{12}}{i_1} = \dfrac{K\phi_1 N_2}{i_1}$

$\Rightarrow M = \dfrac{(0.6)(0.1)\times 10^{-3}\times 2000}{1}$

$\Rightarrow M = 0.12H$

85. Ans: (a)

86. Ans: (a)

Sol: Average Power = $P_{avg} = \dfrac{V_{rms}^2}{R} = \dfrac{\left(\frac{2}{\sqrt{2}}\right)^2 + \left(\frac{4}{\sqrt{2}}\right)^2}{4}$

$= \dfrac{2+8}{4} = \dfrac{10}{4} = 2.5$ Watts

87 Ans: (b)

Sol: Bandwidth $= \dfrac{1}{\tau} = \dfrac{1}{RC}$

So, $R = \dfrac{1}{BW \times C}$

$= \dfrac{1}{10\times 10^3 \times 100 \times 10^{-12}}$

$= \dfrac{10^6}{1} = 10^6\ \Omega$

$\Rightarrow R = 1M\Omega$

88. Ans: (b)

Sol: Given, $V = 100\angle 30°$

$I = 5\angle -30°$

We know, $S = VI^*$

$= (100\angle 30°)(5\angle 30°)$

$= 500\angle 60°$

Here $\phi = 60°$

$\therefore$ Power factor $= \cos\phi$

$= \cos 60°$

$= 0.5$ (lag)

89. Ans: (b)

Sol: $P_1 = 36$

$I = \dfrac{P_1}{V_1} \Rightarrow I = \dfrac{36}{12} \Rightarrow I = 3A$

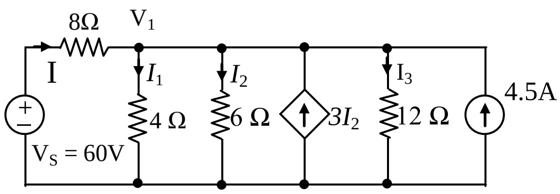
$P_2 = V_2 I = -4\times 3$

$P_2 = -12W$

$P_2 = 12W$ supplied

90. Ans: (b)

Sol:



KCL:

$I + 3I_2 + 4.5 = I_1+I_2+I_3$

and $I = \dfrac{V_S - V_1}{8}$

$$\frac{V_S - V_1}{8} + 3\left(\frac{V_1}{6}\right) + 4.5 = \frac{V_1}{4} + \frac{V_1}{6} + \frac{V_1}{12}$$

$3(60) – 3V_1 + 12V_1 + 108 = 6V_1+4V_1+2V_1$

$3V_1 = 288$

$V_1 = 96V$

$$I_1 = \frac{V_1}{4} = \frac{96}{4} = 24A$$

91. Ans: (d)

Sol: $R_{eq} = \{[[(8+2) || 10] +1] || 3\} + 1$

$R_{eq} = (6 || 3) + 1 = 3\Omega$

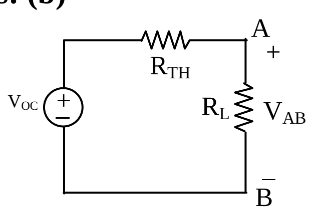
$$I_s = \frac{12}{R_{eq}} = \frac{12}{3} = 4$$

$R^1 = [(R_8 + R_2) || R_{10}] + R_1 = 6\Omega$

$$I_x = \left(\frac{6}{3+6}\right)(4) = \frac{24}{9} = \frac{8}{3}A$$

92. Ans: (b)

Sol:



$$V_{AB} = \left(\frac{R_L}{R_L + R_{TH}}\right)(V_{OC})$$

$$16 = \left(\frac{8k}{8k + R_{TH}}\right)(V_{OC})$$

$$V_{OC} = \left(\frac{16(8k + R_{TH})}{8k}\right)$$

And $$8 = \left(\frac{2k}{2k + R_{TH}}\right)(V_{OC})$$

$$\frac{16(8k + R_{TH})}{8k} = \frac{8(2k + R_{TH})}{2k}$$

$R_{TH} = 4k\Omega$

$$V_{OC} = \frac{16(8k + 4k)}{8k} = 24V$$

$$V_{AB} = \left(\frac{20k}{20k + 4k}\right)(24) = 20V$$

93. Ans: (b)

Sol: The voltage across the unknown capacitor C_x is (using KVL).

$24 = 8 + V_x$

$V_x = 16V$

$q = CV$

The capacitors are connected in series and the charge is the same.

$q = 60\mu\ (8) = 480\mu C$

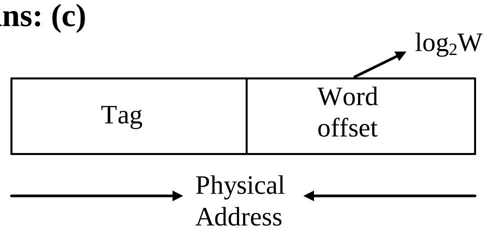
$$C_x = \frac{q}{V_x} = \frac{480\mu}{16} = 30\mu F$$

94. Ans: (d)

Sol: All the given characteristics are belonging to RISC processor.

95. Ans: (c)

Sol:



In fully associative mapping technique,

W = Number of words in a cache memory block

96. Ans: (c)

Sol: In set associative mapping, Tag field size = $\log_2 \frac{M}{S}$, where M = number of blocks in main memory and S = number of sets in cache memory.

Here $S = \frac{Q}{4}$

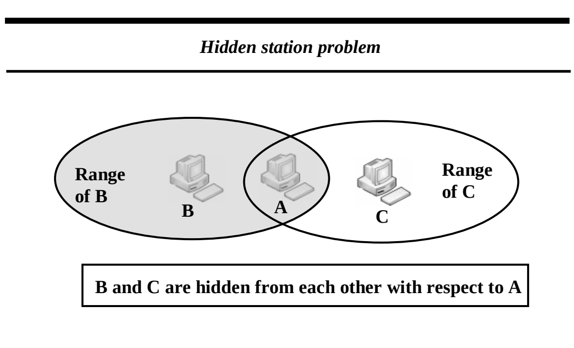
Hence tag field size $\log_2 \frac{P}{Q/4} = \log_2 \frac{4P}{Q}$

97. Ans: (a)

Sol: DES has 4 components: an expansion permutation, an XOR operation, S-boxes and a straight permutation

98. Ans: (b)

Sol:



99. Ans: (c)

Sol: It is necessary to assign name of inner structure at the time of declaration otherwise we cannot access the member of inner structure. So correct declaration is:

```
struct outer {
  int a;
  struct inner {
          char c;
  } name;
};
```

100. Ans: (d)

Sol: Parameters are evaluated from right to left so in abc(++a, a++); first a++ evaluated, later ++a evaluated

$\therefore$ abc(22,20); i.e. passing values 22,20 to abc(int x, int y).

101. Ans: (d)

Sol: Ideal speed up = number of stages = 5

For 'A', Pipeline time = (5 + 99) × 20 ns = 2080 ns

and non pipeline time = 10000 ns

$\therefore$ speed up = 4.8

then $\eta = \frac{4.8}{5} = 96$

For 'B', Pipeline time = 1004 × 20 = 20080ns

non pipeline time = 1000 × 5 × 20 = 100000

Speed up = 4.98, then $\eta = \frac{4.98}{5} = 99.6$

102. Ans: (b)

Sol: When stack is distributed on 2 pages, then might possible that one activation record is stored on 2 pages. Half in last of page 1 and half in starting of page 2.

But stack will always be LIFO.

103. Ans: (b)

Sol: In virtual memory system CPU generates virtual address, so for translation first of all TLB should be accessed. As given in case of TLB miss, memory system should be accessed. In memory system the first access should be of cache before main memory.

104. Ans: (d)

Sol: From Gauss law of magnetic field:

$\nabla . \vec{B} = 0$

From Ampere's law for steady current:

$\nabla \times \vec{H} = \vec{J}$

$\nabla^2 \vec{A} = -\mu_0 \vec{J}$ is called vector poisson's equation

From equation of vector potentional of magnetic field $\nabla \times \overline{A} = \overline{B}$

Therefore correct code is given by:

P-3, Q-1, R-4, S-2

105. Ans: (a)

Sol: Here N=5

I=4A

Area =24m^2

The normal to the loop is along positive z-axis.

There fore magnetic dipole moment is given by

$\overline{m} = 5 \times 4 \times 24\hat{a}_z$

$= 480\hat{a}_z \text{ Am}^2$

106. Ans: (d)

Sol: $V = \frac{1}{4\pi \in_0}\left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right]$

Since $Q_1 = Q_2 = Q = 10\times10^{-9}$ C

$$V = 9\times10^9 \times 10 \times 10^{-9}\left[\frac{1}{2}+\frac{1}{3}\right] = 90 \times \frac{5}{6} = 75\text{V}$$

107. Ans: (d)

Sol: $\bar{J} = \nabla \times \overline{H} = \frac{1}{\rho}\begin{vmatrix} \hat{a}_\rho & \rho\hat{a}_\phi & \hat{a}_z \\ \frac{\partial}{\partial\rho} & \frac{\partial}{\partial\phi} & \frac{\partial}{\partial z} \\ H_\rho & \rho H_\phi & H_z \end{vmatrix}$

$$= \frac{1}{\rho}\begin{vmatrix} \hat{a}_\rho & \rho\hat{a}_\phi & \hat{a}_z \\ \frac{\partial}{\partial\rho} & \frac{\partial}{\partial\phi} & \frac{\partial}{\partial z} \\ 0 & \rho\left[\frac{2}{\pi\rho}\left(1+\frac{10^7\rho^3}{6}\right)\right] & 8 \end{vmatrix}$$

$$= \frac{1}{\rho}\left[\frac{2}{\pi}\left(\frac{3\times10^{7}\rho^{2}}{6}\right)\right]\hat{a}_z$$

$$= \frac{10^7}{\pi}\rho\hat{a}_z\,(A/m^2)$$

$$\therefore \bar{J} = \frac{10^7}{\pi}\rho\hat{a}_z \text{ for } 0\le\rho\le 0.01(m)$$

$$\therefore \bar{J}/\text{at}\,\rho = 0 = \frac{10^7}{\pi}(0)\hat{a}_z = (0)\hat{a}_z = 0$$

108. Ans: (b)

Sol: When active low is applied to $\overline{\text{RESET IN}}$, PC sets to 0000H and resets the interrupt enable and HLDA flip-flops and affects the contents of processor's internal register randomly.

109. Ans: (c)

Sol: $(444)_3 = (4\times3^2 + 4\times3 + 4)_{10}$

$= 4 \times 9 + 12 + 4$

$= (52)_{10}$

$(4000)_3 = (4\times 3^3)_{10} = (27\times 4)_{10} = (108)_{10}$

$(4440)_3 = 4\times 3^3 + 4\times3^2 + 4\times3 + 0$

$= 108 + 36 + 12$

$= (156)_{10}$

$(2000)_3 = [3^3 \times 2] = 27\times 2 = (54)_{10}$

$(0000)_3 = (00)_{10}$

$\therefore$ $(2000)_3$ comes immediately after 444.

110. Ans: (b)

Sol: Characteristics equation for a J-K FF is

$$Q(t+1) = J\overline{Q}(t) + \overline{K}Q(t) \quad -(1)$$

From the diagram input of D FF can be written as

$$D = \overline{Q(t)}X + Q(t)\overline{Y} \quad -(2)$$

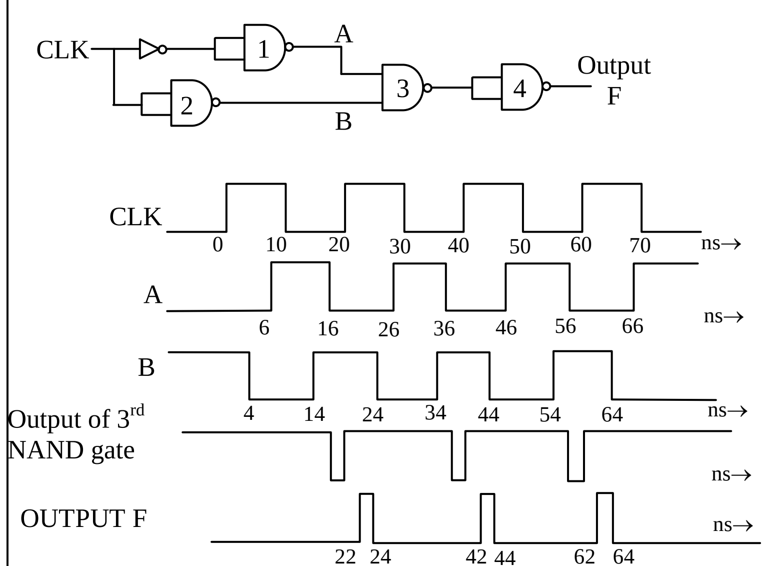
Comparing (1) & (2)

J = X, K = Y

$\therefore$ JK FF with J = X, K = Y

111. Ans: (d)

Sol: The waveform at input of 3rd NAND gate is



Duty cycle of waveform at

$$F = \frac{2}{20}\times 100 = 10\%$$

112. Ans: (a)

113. Ans: (b)

Sol: $K_a=1$

$$\mu_1 = A_{m_1} = \frac{1}{2}$$

$$\mu_2 = A_{m_2} = \frac{1}{2}$$

$$\mu_f = \sqrt{\frac{1}{4}+\frac{1}{4}}$$

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

$$= 0.707$$

114. Ans: (a)

Sol: f_c= 12MHz , Δf = 3.2kHz, f_{osc}= 10MHz.

After down conversion $f_c - f_{osc}$

= 12MHz – 10MHz = 2MHz

115. Ans: (c)

Sol: BW = $2\Delta f + 2f_m \Rightarrow$ As Δf and f_m gets doubled, BW also gets doubled.

116. Ans: (c)

Sol: BW of the modulated signal depends on the message signal frequency only

117. Ans: (c)

Sol: By definition of I.D.F.T,

$$g(n) = \frac{1}{2\pi}\int_{-\pi}^{\pi} G\left(e^{j\Omega}\right)e^{j\Omega n}.d\Omega$$

$\because$ $G(e^{j\Omega}) = -j2\Omega$

$$g(n) = \frac{1}{2\pi}\int_{-\pi}^{\pi}(-j2\Omega)e^{j\Omega n}d\Omega$$

$$= \frac{-j2}{2\pi}\int_{-\pi}^{\pi}\Omega.e^{j\Omega n}d\Omega$$

$$= \frac{-j}{\pi}\left[\Omega\left(\frac{e^{j\Omega n}}{jn}\right)-1\left(\frac{e^{j\Omega n}}{-n^2}\right)\right]_{\Omega=-\pi}^{\Omega=\pi}$$

$$g(n) = \frac{-j}{\pi}\left[\left\{\frac{\pi}{jn}e^{jn\pi}+\frac{e^{jn\pi}}{n^2}\right\}-\left\{\frac{-\pi}{jn}e^{-jn\pi}+\frac{e^{-jn\pi}}{n^2}\right\}\right]$$

$$g(n) = \frac{-j}{\pi}\left[\frac{\pi}{jn}(-1)^n+\frac{(-1)^n}{n^2}+\frac{\pi}{jn}(-1)^n-\frac{(-1)^n}{n^2}\right]$$

$$= \frac{-j}{\pi}\left(2\frac{\pi}{jn}(-1)^n\right)$$

$$g(n) = \frac{-2(-1)^n}{n} \;;\; n \neq 0$$

Now,

$$\sum_{n=1}^{5} g(n) = 2\left[1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}\right]$$

$$= 2\times\frac{47}{60} = \frac{47}{30}$$

118. Ans: (b)

Sol: $y(n) = \frac{1}{2}[x(n)+x(n-1)]$

$$Y(z) = \frac{1}{2}\left[X(z)+z^{-1}X(z)\right]$$

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

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

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

$$=\frac{1}{2}\left[1+\cos\omega-j\sin\omega\right]$$

$$H\left(e^{j\omega}\right)=\frac{1}{2}\left[(1+\cos\omega)-j\sin\omega\right]$$

$$\left|H\left(e^{j\omega}\right)\right|=\frac{1}{2}\sqrt{(1+\cos\omega)^2+\sin^2\omega}$$

$$=\frac{1}{2}\sqrt{1+1+2\cos\omega}$$

$$=\frac{1}{2}\sqrt{2(1+\cos\omega)}$$

$$=\frac{1}{2}\sqrt{2\times2\cos^2\left(\frac{\omega}{2}\right)}$$

Magnitude spectrum $=\left|H\left(e^{j\omega}\right)\right|=\left|\cos\left(\frac{\omega}{2}\right)\right|$

$$\&\quad \theta(\omega)=\tan^{-1}\left[\frac{-\frac{\sin\omega}{2}}{\left(\frac{1+\cos\omega}{2}\right)}\right]$$

$$=-\tan^{-1}\left(\frac{2\sin\frac{\omega}{2}.\cos\frac{\omega}{2}}{2\cos^2\frac{\omega}{2}}\right)$$

$$\theta(\omega)=-\tan^{-1}\left(\tan\frac{\omega}{2}\right)$$

phase spectrum $\theta(\omega)=-\frac{\omega}{2}$

119. Ans: (b)

Sol: From differentiation in time domain property

$$x(t)\leftrightarrow C_k$$

$$\frac{dx(t)}{dt}\leftrightarrow[jk\omega_0]C_k$$

$$\frac{dx(t)}{dt}\leftrightarrow[jk\pi]\left[-k2^{-|k|}\right]$$

$$\leftrightarrow -jk^2\pi\, 2^{-|k|}$$

120. Ans: (C)

Sol: From standard fourier transform pair

$$\text{sgn}(t)\leftrightarrow\frac{2}{j\omega}$$

From duality property

$$\frac{2}{jt}\leftrightarrow 2\pi\,\text{sgn}(-\omega)$$

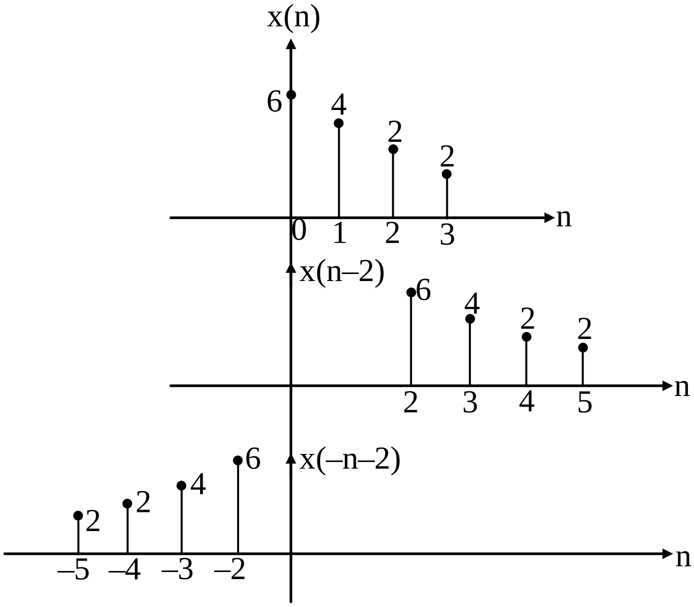
$$\text{sgn}(-\omega)=-\text{sgn}(\omega)$$

$$\frac{2}{jt}\leftrightarrow -2\pi\,\text{sgn}(\omega)$$

$$\frac{1}{\pi t}\leftrightarrow -j\,\text{sgn}(\omega)$$

121. Ans: (c)

Sol:



Assume y(n) = x(–n – 2)

$$E_{y(n)} = \sum_{n=-\infty}^{\infty}|y(n)|^2 = \sum_{n=-5}^{-2}|y(n)|^2 = 4+4+16+36$$

$= 60$

122. Ans: (B)

Sol: Given $s(t) = (1 - e^{-t})u(t)$

$$h(t) = \frac{ds(t)}{dt}$$

$h(t) = \delta(t) - \{-e^{-t}u(t) + e^{-t}\delta(t)\}$

$$e^{-t}\delta(t) = e^{-0}\delta(t) = \delta(t)$$

$h(t) = e^{-t}u(t)$

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

Given $y(t) = (2-3e^{-t} + e^{-3t})u(t)$

Apply Laplace transform

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

$$= \frac{2s^2+8s+6-3s^2-9s+s^2+s}{s(s+1)(s+3)}$$

$$Y(s) = \frac{6}{s(s+1)(s+3)}$$

$$X(s) = \frac{Y(s)}{H(s)}$$

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

Apply inverse laplace transform

$x(t) = 2(1-e^{-3t})u(t)$

123. Ans: (D)

Sol: Given $\frac{dy(t)}{dt} + y(t) = 4t\,u(t)$

Apply Laplace transform

$$sY(s) + Y(s) = \frac{4}{s^2}$$

$$Y(s) = \frac{4}{s^2(s+1)} = \frac{A}{s^2} + \frac{B}{s} + \frac{C}{s+1}$$

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

$y(t) = 4tu(t) - 4u(t) + 4e^{-t}u(t)$

124. Ans: (d)

Sol: $$f(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos(n\omega_0 t) + \sum_{n=1}^{\infty} b_n \sin(n\omega_0 t)$$

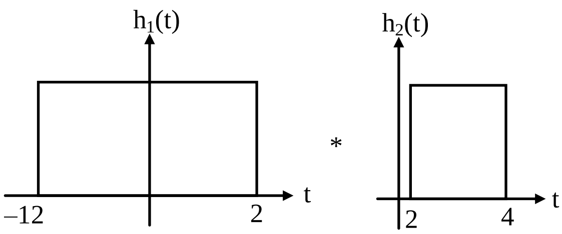
$= a_0 + A_n \cos(n\omega_0 t + \phi_n)$

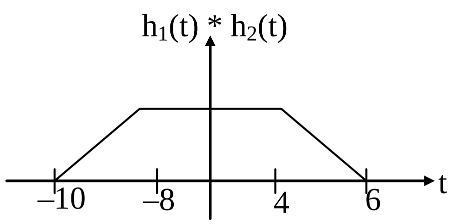
A_n and ϕ_n (Amplitude and phase spectra) occur at discrete frequencies.

Waveform symmetries (Even, odd, Half-wave) simplify the evaluation of FS coefficients.

125. Ans: (D)

Sol: 1.





Which is non-causal. So, statement (1) is false.

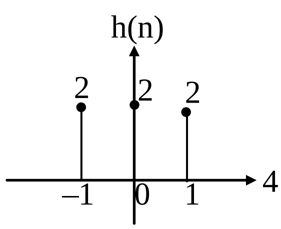
2. The condition for causality is h(n) = 0 for n < 0

The condition for stability is

$$\sum_{n=-\infty}^{\infty}|h(n)| < \infty$$

So, statement (2) is false.

3.



The above system is non-causal & stable.

So, statement-3 is false.

4. $\sum_{n=-\infty}^{\infty}|h(n)| = \sum_{n=-\infty}^{10}(3)^n = \sum_{n=-10}^{\infty}\left(\frac{1}{3}\right)^n < \infty$

So, system is stable system.

126. Ans: (b)

Sol: Here diodes are in parallel so, for positive cycle D_1 conducts. For negative cycle D_2 conducts. So, current always flows hence, it contains all harmonics of 'f '.

127. Ans: (b)

Sol: → Advantages of crystal oscillator:

i. It is one of the most stable oscillator

ii. High Q - factor of range of 10^4 to 10^6 compared to 10^2 for LC oscillator.

→ Phase shift oscillator is used in audio range frequency.

128. Ans: (c)

Sol: For the given configuration, Feedback Input impedances output impedances

Series-shunt	$R_i(1+A\beta)$	$\frac{R_0}{(1+A\beta)}$
Shunt-Series	$\frac{R_i}{(1+A\beta)}$	$R_0(1+A\beta)$

So, input impedances of shunt-series impedance is low and output impedance is high compared to series-shunt feedback.

129. Ans: (b)

Sol: A = 250, β = 0.8

$$A_f = \frac{A}{1+A\beta} = \frac{250}{1+(250\times 0.8)} = 1.2438$$

Given, $\frac{\delta A}{A} = 20\%$ and

$$S_A^{A_f} = \frac{\delta A_f / A_f}{\delta A / A} = \frac{1}{1+\beta A}$$

$$\frac{\delta A_f}{A_f} = \frac{1}{1+\beta A}.\frac{\delta A}{A} = \frac{1}{1+(250\times 0.8)}\times 20\%$$

$$\frac{\delta A_f}{A_f} = 0.1\%$$

$\delta A_f = 0.1\% \times A_f = 0.1\% \times 1.2438$

$= 0.124\%$

130. Ans: (b)

Sol: gain = 30 dB

$$30\text{dB} = 10\log_{10}\left(\frac{P_o}{P_i}\right)$$

$$3 = \log_{10}\left(\frac{P_o}{P_i}\right)$$

$$\frac{P_o}{P_i} = 10^3$$

$P_0 = 10^3 \times P_i$

$P_0 = 10^3 \times 1 \times 10^{-6}$

$P_0 = 10^{-3}$ W

$P_0 = 1$mW

$$P_0(\text{in dB}) = 10\log_{10}10^{-3} = -30\text{dB}$$

$$P_0(\text{in dBm}) = -30+30 = 0\text{dBm}$$

131. Ans: (b)

Sol: $$W = \sqrt{\frac{2\in V_j}{q}\left(\frac{1}{N_A}+\frac{1}{N_D}\right)}$$

$$W \propto \sqrt{V_j}$$

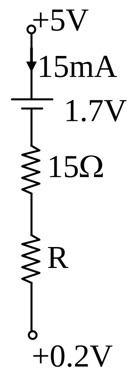
$$\Rightarrow \frac{W_1}{W_2} = \sqrt{\frac{V_0+V_{R1}}{V_0+V_{R2}}}$$

$$\frac{4\mu m}{W_2} = \sqrt{\frac{0.7+1.3}{0.7+7.3}} = \sqrt{\frac{2}{8}} = \frac{1}{2}$$

$\Rightarrow W_2 = 8\mu$m

132. Ans: (c)

Sol:



$5 = 1.7 + (15 + R) \times 15 \times 10^{-3} + 0.2$

$3.1 = 15\times10^{-3}\,(15+R)$

$R = 191.67\Omega$

$\approx 192\Omega$

133. Ans: (B)

Sol: Given data: $\tau = 20\mu sec$

$T = 300K$

$I = 26mA$

Diffusion capacitance

$$C_D = \frac{I\tau}{\eta V_T} \quad (\because C_D = \tau g)$$

$$= \frac{26\times10^{-3}\times20\times10^{-6}}{1\times26\times10^{-3}}$$

$= 20\mu F$

134. Ans: (c)

Sol: 1. p-n junction diode is a passive component

2. $W \propto V_j^{1/n}$ (n = 2 for non-linear junction n =3 for linear junction) and $V_j = V_0 - V_B \rightarrow$ For forward biasing

135. Ans: (d)

Sol: The drain current in

Saturation region:

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS}-V_T)^2(1+\lambda V_{DS})$$

Linear region:

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}\left(2(V_{GS}-V_T)^2 V_{DS} - V_{DS}{}^2\right)$$

From the above equations $I_D \, \alpha \, \frac{1}{L}$

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

$$I_{D2} = I_{D1}\frac{L_1}{2L_1} \Rightarrow I_{D2} = \frac{I_{D1}}{2}$$

136. Ans: (d)

137. Ans: (c)

Sol: Aliasing occurs when the sampling frequency is less than twice the maximum frequency in the signal. So, Statement-I is true.

Aliasing is a irreversible process. So, Statement-II is false.

138. Ans: (a)

139. Ans: (a)

Sol: MMU is a hardware device which maps virtual address to physical address. Mapping is done by adding the value in the base register to every address generated by a user process, it is treated as offset at the time it is sent to memory.

140. Ans: (b)

141. Ans: (a)

Sol: Diode is a nonlinear and unilateral device. Hence, Thevenin's theorem cannot be applied. Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.

142. Ans: (d)

143. Ans: (c)

Sol: We know that power transferred

$$P_e = \frac{EV}{X_{eq}} \sin \delta$$

$$P_{max} = \frac{EV}{X_{eq}}$$

By using Parallel transmission linear, the equivalent reactance (X_{eq}) of the transmission line will be decreased, hence the maximum power transferred (P_{max}) will increase and the stability of the power system can be improved.

Statement (I) is correct but statement (II) is not correct.

144. Ans: (b)

Sol: For single phase semi converter DPF = $\cos\frac{\alpha}{2}$

For single phase full converter DPF = $\cos\alpha$

(IPF = DPF × DF)

$\therefore$ IPF $\propto$ DPF

IPF of full converter is less then IPF of semi converter

Statement II is also true but does not satisfy statement I.

145. Ans: (a)

146. Ans: (a)

Sol: Nyquist stability criteria states that (–1, j0) critical point should be encircled in the counter clock wise direction as many number of times as the number of right half of s-plane poles of loop transfer function.

Nyquist contour encircles the right half of s-plane and drawn in the clockwise direction.

Both statements are correct. Statement (II) is correct explanation for statement (I).

147. Ans: (d)

Sol: Resistance inversely proportional to the area of cross section of the wires, so the thicker wire has low resistance. Since heat produced is directly related to resistance ($H = i^2R_t$), it should be less in the thicker wire.

148. Ans: (a)

Sol: The Curie temperature is the critical point where a material's intrinsic magnetic moments change direction. Magnetic moments are permanent dipole moments within the atom which originate from electrons angular momentum and spin. Materials have different structures of intrinsic magnetic moments that depend on temperature. At a material's Curie Temperature those intrinsic magnetic moments change direction.

149. Ans: (c)

Sol: Armature core is laminated to reduce eddy current loss to lower value.

150. Ans: (b)

Sol: Statement (II):

$E = 4.44\ K_p.\ K_d\ \phi_{/pole}.f.T_{/phase}$

$\Rightarrow$ airgap flux $(\phi) \propto \dfrac{E}{f} \propto \dfrac{V}{f}$

As V, f are constants

$\Rightarrow \phi_{airgap}$ is constant.