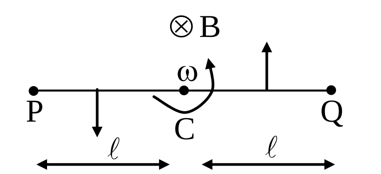
ESE- 2019 (Prelims) - Offline Test Series Test - 24

ELECTRICAL ENGINEERING

Mock-2 (Paper - II) - SOLUTIONS

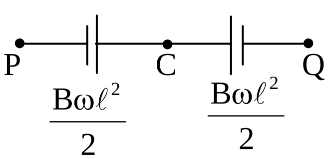
01. Ans: (a)

Sol:



$$V_{CP} = \frac{B\omega\ell^2}{2}$$

$$V_{CQ} = \frac{B\omega\ell^2}{2}$$



$$V_{PC} = \frac{-B\omega\ell^2}{2}$$

$$V_{PQ} = 0$$

02. Ans: (c)

Sol: A, B, C, D, E are the points on the equipotential surface.

So, the work done is zero.

03. Ans: (a)

Sol: $\bar{\tau} = \bar{M} \times \bar{B}$

$\bar{M} = NIA\hat{n}$

$\bar{M} = 100 \times 5 \times 10^{-1} \times 4 \times 8 \times 10^{-4} \hat{a}_x$

$\bar{M} = 0.16\hat{a}_x$ A.m^2

$\bar{\tau} = \bar{M} \times \bar{B}$

$\bar{\tau} = 5.66 \times 10^{-3} \hat{a}_z$

04. Ans : (b)

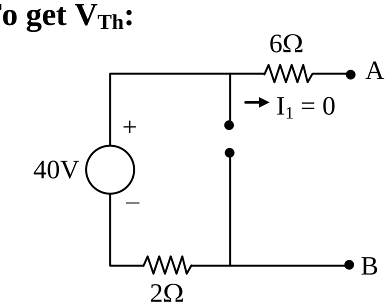
Sol: Capacitance of an isolated sphere $= 4\pi\varepsilon a$

Where 'a' is the radius of the sphere

$$C = 4\pi\varepsilon_0 \frac{1}{2\pi\varepsilon_0} = 2 \text{ F}$$

05. Ans: (d)

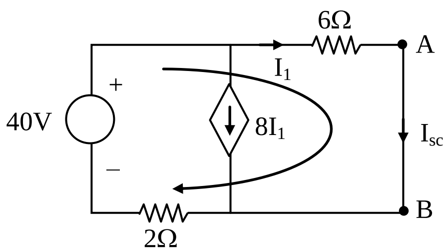
Sol: To get V_{Th}:



$V_{th} = 40V$ As $I_1=0$

To get R_{th} :

$$R_{th} = \frac{V_{th}}{I_{st}}$$



$I_1 = I_{sc}$

Apply KVL to the loop

$$-40 + 6I_{sc} + 2(I_{sc} + 8I_{sc}) = 0$$

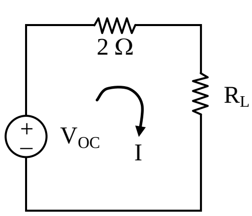
$$24I_{sc} = 40$$

$$I_{sc} = \frac{5}{3}$$

$$R_{th} = \frac{V_{th}}{I_{sc}} = \frac{40}{\frac{5}{3}} = 24\Omega$$

06. Ans: (c)

Sol: Given data, V_{OC} = 20 V, I_{SC} = 10 A and R_L = 3 Ω.



$$R_{th} = \frac{V_{OC}}{I_{SC}} = \frac{20}{10} = 2\ \Omega$$

$$I = \frac{20}{2+3} = 4\ A$$

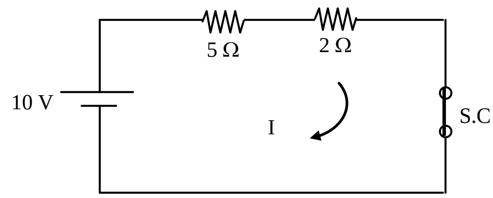
07. Ans: (d)

Sol: $R_{Total} = \frac{\Delta V}{\Delta I} = 24\ \Omega$

$R_{int} = 24 - 10 = 14\ \Omega$

08. Ans: (c)

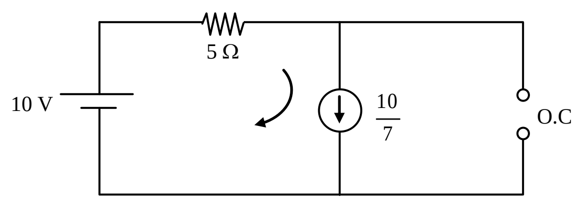
Sol: t < 0



$$I = \frac{10}{7} A$$

$I_L(0^-) = I_L(0^+)$

at t = 0, Inductor acts as open circuit



Now, current in the circuit is

$$I = \frac{10}{7} A$$

09. Ans: (a)

Sol: For an RL- circuit

$$\tau = \frac{L}{R} = \frac{1}{1} = 1 sec$$

The condition for the transient free response

$$\omega t_0 + \phi = \tan^{-1}\omega\tau + \frac{\pi}{2}$$

$$\Rightarrow 1.t_0 + \frac{\pi}{3} = \tan^{-1}(1.1) + \frac{\pi}{2}$$

$\Rightarrow t_0 + \frac{\pi}{3} = \frac{\pi}{4} + \frac{\pi}{2}$

$\Rightarrow t_0 = \frac{5\pi}{12}$

10. Ans: (a)

Sol: $X_C = \frac{1}{\omega C} = 8$

$X_{Leq} = 8$ for series resonance

$X_{L_1} = \omega L_1 = 2$

$X_{L_2} = \omega L_2 = 4$

$\rightarrow X_{L_1} + X_{L_2} = 6 < X_{L_{eq}} = 8$

So coils must be connected in the aiding manner

$\Rightarrow L_{eq} = L_1 + L_2 + 2M$

$\omega L_{eq} = \omega L_1 + \omega L_2 + 2K\sqrt{\omega L_1 . \omega L_2 .}$

$X_{L_{eq}} = X_{L_1} + X_{L_2} + 2K\sqrt{X_{L_1} . X_{L_2}}$

$\Rightarrow 8 = 2+4+2K\sqrt{2.4}$

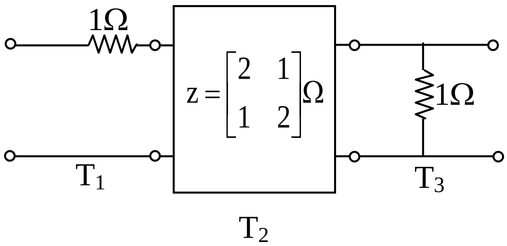
$\Rightarrow 8 = 6+4K\sqrt{2}$

$\Rightarrow 4K\sqrt{2} = 2$

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

11. Ans: (b)

Sol:



T_1: $Z_1 = 1\Omega$

$Z_2 = \infty\Omega$

$$T_1 = \begin{pmatrix} 1+\frac{Z_1}{Z_2} & Z_1 \\ \frac{1}{Z_2} & 1 \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$$

T_2 :

$V_1 = 2I_1 + I_2$ ------(1)

$V_2 = I_1 + 2I_2$ -----(2)

(2) $\Rightarrow I_1 = V_2 - 2I_2$ -----(3)

(3) in (1)

$V_1 = 2V_2 - 3I_2$ -------(4)

$$T_2 = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$$

T_3: $Z_1 = 0\Omega$

$Z_2 = 1\Omega$

$$T_3 = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$$

In cascade connection

$T = (T_1).(T_2).(T_3)$

$$= \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 2 & 3 \\ 1 & 2 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 8 & 5 \\ 3 & 2 \end{pmatrix}$$

Check: Here AD – BC = 1

Since passive and hence must be reciprocal.

12. Ans: (a)

Sol: Here, $V = 10\sqrt{2}\sin(314t) = 10\sqrt{2}\angle 0^o$

$R = 1\Omega$

$X_L = 314\times3.18\times10^{-3} \approx 1\Omega$

$\therefore\ Z = (1+j1)\Omega$

$\therefore\ I = \dfrac{V}{Z} = \dfrac{10\sqrt{2}\angle 0}{\sqrt{2}\angle 45} = 10\angle -45^o$

$\therefore\ I = 10\sin(314t - 45^o)$

$P_{avg} = \dfrac{V_m I_m}{2}\cos\phi$

$= \dfrac{10\sqrt{2}\times10}{2}\cos(45^o) = \dfrac{100\sqrt{2}}{2}\times\dfrac{1}{\sqrt{2}}$

= 50 Watts

13. Ans: (d)

14. Ans: (d)

Sol: Here, $V_c(0) = 4$ volts

$V_c(\infty) = 1$ Volts

$\tau = R_{eq}C = 2\times\frac{1}{4} = \frac{1}{2} = 0.5\,\text{sec}$

$V_c(t) = V_c(\infty) + [V_c(0) - V_c(\infty)]\, e^{-t/\tau}$

$= 1 + (4-1)e^{-2t} = 1 + 3e^{-2t}$ Volts

15. Ans: (c)

Sol: The Voltage across resistor 'R' is

$V_R(s) = I(s)\times 2$

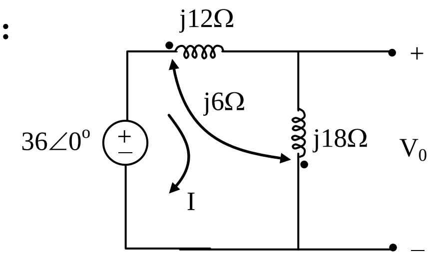
$\Rightarrow V_R(s) = \dfrac{2}{s^2+2s+2}$

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

$\Rightarrow V_R(t) = 2e^{-t}\sin t\ u(t)$ Volts

16. Ans: (a)

Sol:



By KVL, $-36\angle0^o + j12I - j12I + j\,18I = 0$

$\Rightarrow -36\angle0^o + j18I = 0$

$\Rightarrow I = \dfrac{36\angle0^o}{18\angle90^o} = 2\angle{-90^o} = -j2$ Ampere

Again by KVL, $-V_0 + j18I - j6I = 0$

$\Rightarrow V_0 = j12I$

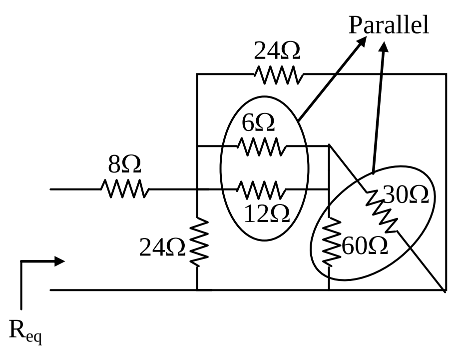
$\Rightarrow V_0 = j12\times(-j2)$

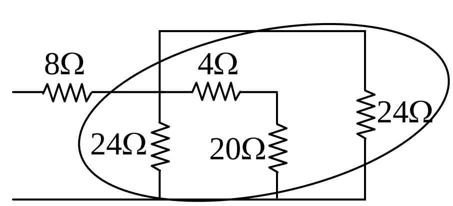
$\Rightarrow V_0 = 24\angle0^o$

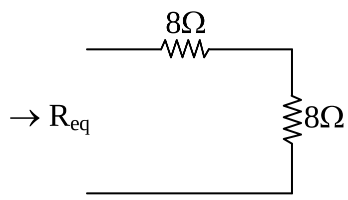
$\Rightarrow V_0(t) = 24\sin 2t$ Volts

17. Ans: (a)

Sol:







$R_{eq} = 16\Omega$

18. Ans: (b)

Sol: Rotor speed = $\frac{120 \times \text{supply frequency}}{\text{Rotor poles}}$

$= \frac{120 \times 50}{10}$

= 600 rpm

19. Ans: (b)

Sol: **Shaded pole motor:** These motors employ salient pole stator construction and cage type rotor with skewed slots.

Hysteresis motor: The stator winding is of the permanent split capacitor type or of the shaded pole type for very small sizes.

The periphery of the rotor is without any slots and therefore without any winding.

Reluctance motor: Stator is similar to the stator of any of the single phase induction motors. The rotor construction is completed just like squirrel cage rotor.

Repulsion motor: Stator of this motor carries a single phase exciting winding, similar to the main winging of a single phase induction motor. The rotor carries an ordinary distributed dc type winding connected to the commutation at one end.

20. Ans: (b)

Sol: Given data:

$B_{mA} = 1.2$ wb/m^2

$B_{mB} = 1.4$ wb /m^2

So transformer with more flux densities will require less core area for given kVA.

$A = \frac{\phi}{B_m}$

So weight of transformer 'A' per kVA is more than that B.

21. Ans: (b)

Sol: With an air-gap introduced in the core, the reluctance of the core flux path increases appreciably. Hence magnetizing inductance decreases by a large amount, and the corresponding magnetizing reactance also becomes small. At rated voltage operation, the no-load current will become much larger. Option (b) is correct. Other options are obviously wrong.

22. Ans: (a)

Sol: With V and f variable but V/f constant, maximum core flux density B_{max} remains unchanged irrespective of values of V and f.

Hysteresis loss = $K_h f\ B_{max}^x$, thus changes as f changes.

Eddy current loss = $K_e f^2 B^2_{max}$, also changes as f changes.

23. Ans; (b)

Sol: $S_{new} = S_{old} - \dfrac{E_j}{E_{20}}$

If E_j and E_{20} are in the same phase, then E_j and E_{20} have the same sign, there S_{new} decrease and the speed increase. If S_{old} is less than $\dfrac{E_j}{E_{20}}$, S_{new} became negative, the rotor speed will be more than synchronous, super synchronous speed.

24. Ans: (a)

25. Ans: (b)

Sol: With constant excitation, the maximum flux density B_m in the armature core is constant. (It is only here that core losses occur).

Hysteresis loss = $W_h = K_h f B^n_m$ where k_h & n are constants.

Eddy current loss = $W_e = K_e f^2 B^2_m$ where k_e is constant.

As speed is doubled, frequency of flux reversals in armature core is doubled. Hence W_h is doubled while W_e increase by 4 times.

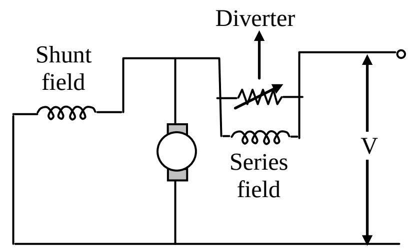
26. Ans: (a)

Sol: Based on the "Degree of compounding" the "cumulative compound machine" are classified has

(i) Over compound machine ⇒ V > E

(ii) Under compound machine ⇒ V < E

(i) Flat compound machine⇒ V = E



The degree of compounding can be controlled (obtained) by connecting a suitable low resistance across series field winding called "diverter".

27. Ans: (b)

Sol: (i) O.C voltage:

If the excitation is kept constant, induced emf which is equal to the O.C voltage is directly proportional to speed.

At rated speed, for an excitation I_f let the induced voltage = E volts. Then at 110% rated speed, for the same excitation, induced voltage = (110/100)E = 1.1 E volts.

Induced voltage increases by 10%.

(ii) S.C current:

Let synchronous inductance per phase be L_s H. Let resistance (which will anyway be small) be neglected. Consider an excitation I_f

At rated speed: open-circuit voltage = E. Let the frequency be f Hz. Synchronous reactance = $2\pi fL_s$. Short-circuit current $(E/2\pi fL_s)$.

At 110% rated speed: open-circuit voltage = 1.1 E and synchronous reactance = $2\pi(1.1f)L_s$.

Short-circuit current = $(1.1E)/2\pi(1.1f)L_s$

$= E/2\pi fL_s$.

The short-circuit current is unaltered.

28. Ans: (a)

Sol: When only the winding on the salient pole rotor is excited:

What ever be the position of the salient pole rotor, the path for the field flux is always one of least reluctance. Since reluctance torque tends to bring the rotor into a position where the reluctance of the flux path is minimum. Since the rotor is always in that position, no reluctance torque will be produced. **Statement 1 is wrong.**

When only the winding on the stator is excited:

Reluctance torque will be produced tending to align the rotor along the minimum reluctance position, that is, the stator axis.

Statement 2 is correct.

When windings on the rotor as well as the stator are excited:

There will be reluctance torque as well as electromagnetic torque. **Statement 4 is correct. Statement 3,** which implies that only electromagnetic torque is produced when both stator windings are excited but no reluctance torque, **is wrong.**

29. Ans: (d)

Sol: Power in watts $P=\sqrt{3}V_L I_L \cos\varphi$

Given P = 500 MW,

V_L = 12.5 kV, $\cos\phi$ = 0.8 Pf

$\therefore$ Full load current

$$(I_L)=\frac{P}{\sqrt{3}\,V_L\cos\phi}=\frac{500\times10^6}{\sqrt{3}\times12.5\times10^3\times0.8}$$

= 28.86 kA

30. Ans: (d)

Sol: In the system AX = 0, if $|A| \neq 0$ then the system has only zero solution.

31. Ans: (b)

Sol:
$$f(x)=\frac{xe^{\frac{1}{x}}}{1+e^{\frac{1}{x}}} \quad , x \neq 0$$
$$= 0 \quad , x = 0$$

$$\underset{x\to 0-}{Lt} f(x) = \underset{x\to 0-}{Lt}\left(\frac{x e^{\frac{1}{x}}}{1+e^{\frac{1}{x}}}\right) = \frac{0}{1} = 0$$

$$\underset{x\to 0+}{Lt} f(x) = \underset{x\to 0+}{Lt}\left(\frac{x e^{\frac{1}{x}}}{1+e^{\frac{1}{x}}}\right) = \underset{x\to 0+}{Lt}\left[\frac{x}{e^{\frac{-1}{x}}+1}\right] = 0$$

f(0) = 0

∴ f(x) is continuous at x = 0

32. Ans: (a)

Sol: If $\left(-1+\sqrt{3}\right)$ is an eigen value of a matrix, then $\left(-1-\sqrt{3}\right)$ is also an eigen value of A.

Let λ be the third eigen value of A. Sum of the eigen values=Trace of A.

$$\Rightarrow \left(-1+\sqrt{3}\right)+\left(-1-\sqrt{3}\right)+\lambda = 0$$

$$\Rightarrow \lambda = 2$$

33. Ans: (c)

Sol: Let I = $\int_{-\pi}^{\pi} \sin^4 x \, dx$,

Let $f(x) = \sin^4 x$

$$f(-x) = \sin^4(\pi - x) = \sin^4 x$$

$$= f(x)$$

∴ f(x) is even function

$$I = 2\int_0^{\pi} \sin^4 x \, dx$$

$$= 2\times 2\int_0^{\pi/2} \sin^4 x = 4.\frac{3}{4}\frac{1}{2}\frac{\pi}{2} = \frac{3\pi}{4}$$

34. Ans: (a)

Sol: Let u = x^2 y

$$\frac{du}{dx} = \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}\left(\frac{dy}{dx}\right)$$

$$= 2xy + x^2\left(\frac{dy}{dx}\right) \text{...... (1)}$$

Given, $x^2 + xy + y^2 = 1$

Differentiating with respect to x, we have

$$2x + x\frac{dy}{dx} + y + 2y\frac{dy}{dx} = 0$$

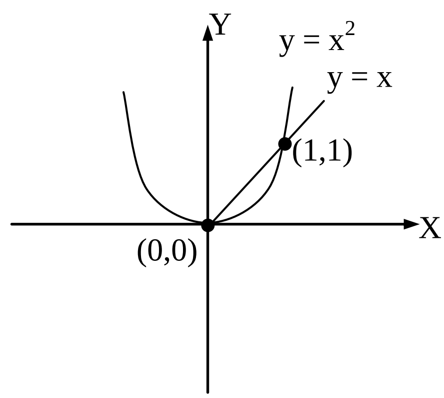
$$\frac{dy}{dx} = -\left(\frac{2x+y}{x+2y}\right)$$

Substituting in (1), we have

$$\frac{du}{dx} = 2xy - x^2\left(\frac{2x+y}{x+2y}\right)$$

35. Ans: (a)

Sol:



Green's theorem is

$$\oint_C (M\,dx + N\,dy) = \iint_R \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dx\,dy$$

$$\Rightarrow \oint_C \left[\left(xy + y^2\right)dx + x^2 dy\right] = \iint_R \left[2x - (x+2y)\right] dxdy$$

$$\Rightarrow \int_{x=0}^{1}\int_{y=x^2}^{x} (x - 2y)\,dxdy$$

$$= \int_{x=0}^{1} \left\{xy - y^2\right\}_{y=x^2}^{x} dx$$

$$= \int_{x=0}^{1} \left\{\left(x^2 - x^2\right) - \left(x^3 - x^4\right)\right\} dx$$

$$= \int_0^1 \left(x^4 - x^3\right) dx = \left(\frac{x^5}{5} - \frac{x^4}{4}\right)_0^1$$

$$= \frac{1}{5} - \frac{1}{4} = \frac{-1}{20}$$

36. Ans: (d)

Sol: A pair of fair dice is tossed 2 times.

Probability of not getting 7 or 11

$$= 1 - \left(\frac{6+2}{36}\right) = \frac{28}{36} = \frac{7}{9}$$

Required probability = $\frac{7}{9} \times \frac{7}{9} = \frac{49}{81}$

37. Ans: (b)

Sol: Given $\frac{dy}{dx} = e^{x+y}$, y(1) = 1

$$\frac{dy}{dx} = e^x e^y$$

$$\Rightarrow \int e^{-y} dy = \int e^x dx$$

$$\Rightarrow -e^{-y} dy = e^x + C$$

$$\Rightarrow e^x + e^{-y} = k$$

……… (1)

y(1) = 1, (1) $\Rightarrow e + e^{-1} = k$

$$\Rightarrow \frac{e^2 + 1}{e} = k$$

$$(1) \Rightarrow e^x + e^{-y} = \frac{e^2 + 1}{e}$$

when x = – 1

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

$$\Rightarrow e^{-y} = \frac{e^2 + 1}{e} - \frac{1}{e} = \frac{e^2 + 1 - 1}{e} = e$$

$$\Rightarrow -y = 1$$

$$\therefore y = -1$$

38. Ans: (b)

Sol: $f(z) = \frac{9z + i}{1 - \cos z}$

$$= \frac{9z + i}{1 - \left[1 - \frac{z^2}{2!} + \frac{z^4}{4!} - \frac{z^6}{6!} + ...\right]}$$

$$= \frac{9z + i}{\left(\frac{z^2}{2!} - \frac{z^4}{4!} + \frac{z^6}{6!} - ....\right)}$$

$$= \frac{(9z + i)}{z^2\left[\frac{1}{2!} - \frac{z^2}{4!} + \frac{z^4}{6!} - ....\right]}$$

Let $\phi(z) = 9z + i$

$\phi(0) = i = \sqrt{-1} \neq 0$

$\therefore$ z = 0 is a double pole (or) pole of order 2

39. Ans: (c)

Sol: Given $f(z) = \frac{2z}{(z-1)^2 (z-2)}$

F(z) has singular points at z = 1 and z =2

$\Rightarrow$ z = 1 is a pole of order two and z = 2 is a pole of order one.

$r_1 = \text{res}(f(z) : z = 2)$

$$= \underset{z\to 2}{\text{Lt}}\left[(z-2).\frac{2z}{(z-1)^2(z-2)}\right] = 4$$

$$R_2 = \text{Res}(f(z) : z = 1)$$

$$= \frac{1}{(m-1)!}\ \underset{z\to z_0}{\text{Lt}}\left[\frac{d^{m-1}}{dz^{m-1}}\left\{(z-z_0)^m f(z)\right\}\right]$$

$$= \frac{1}{(2-1)!}\ \underset{z\to 1}{\text{Lt}}\left[\frac{d}{dz}\left\{(z-1)^2.\frac{2z}{(z-1)^2(z-2)}\right\}\right]$$

$$= \underset{z\to 1}{\text{Lt}}\left[\frac{(z-2)(2)-(2z)(1)}{(z-2)^2}\right] = -4$$

$\therefore$ Sum of residues of f(z) = $R_1 + R_2$

= 4 – 4 = 0

40. Ans: (c)

Sol: $\frac{dy}{dx} = \frac{1+2\cos^2 y - 1}{1-(1-2\sin^2 x)} = \frac{\cos^2 y}{\sin^2 x}$

$\Rightarrow \int \sec^2 y\,dy = \int \text{cosec}^2 x\,dx$

$\Rightarrow$ tan y = – cot x + C

$\therefore$ The solution is tan y + cot x = C

41. Ans: (a)

Sol: $V(x, y, z) = -(x\cos xy + y)\bar{i} + (y\cos xy)\bar{j} + [\sin z^2 + x^2 + y^2]\,\bar{k}$

div $\bar{V}$ =

$$\frac{\partial}{\partial x}[-(x\cos xy + y)] + \frac{\partial}{\partial y}[y\cos xy] + \frac{\partial}{\partial z}\left[\sin z^2 + x^2 + y^2\right] = 2z\cos z^2$$

42. Ans: (B)

Sol: The brake magnet of an error free electro mechanical induction type energy meter is shifted from its position and moved a small distances towards the edge of the disc then the meter will continue to work, but register a lower kwh

43. Ans: (C)

Sol: % error $= \left[\frac{1.11}{1.57} - 1\right] \times 100\%$

= –29.29%

44. Ans: (c)

Sol: Power factor of the load,

$$\text{p.f} = \cos\left[\frac{2.5}{\sqrt{(2.5)^2 + 10^2}}\right] = 0.24 \text{ lag}$$

Two wattmeter method of 3-ϕ power measurement:

$W_1 = V_L I_L \cos[30 - \phi]$

$W_2 = V_L I_L \cos[30 + \phi]$

The relation between two meter readings for different power factors is shown in below table.

ϕ	Power factor	W_1 & W_2
0	1	$W_1 = W_2$
30	0.866	$W_1 = 2W_2$
60	0.5	$W_1 \times W_2 = 0$
90	0	$W_1 = -W_2$

Power factor, p.f < 0.5

$\therefore$ One of the wattmeter will indicate negative value.

45. Ans: (b)

Sol: →Parallel- comparator type ADC is fastest among the above given.

→Dual slope integrating type ADC's more accurate but slower

46. Ans: (c)

Sol: $Q = \omega C_4 R_4$

$= 2\pi \times 1000 \times 0.5 \times 10^{-6} \times 1000$

$= 3.14$

47. Ans: (c)

Sol: The main sources of error that introduce error into Q-indication in direct connection of Q-meter are insertion resistance in Q-meter & self capacitance of test coil

48. Ans: (a)

Sol: We know that, $T_1 = nT_s$

Where, T_1 = horizontal sweep speed

T_s = Vertical input time period

$\therefore$ Here T_1 = 0.4 millisecond

$$T_s = \frac{1}{5\times10^3} = 0.2\,\text{milliseconds}$$

$$\therefore n = \frac{T_1}{T_s} = \frac{0.4}{0.2} = 2$$

49. Ans: (c)

Sol: The average value for the set of measurements is given by

$$\overline{X}_n = \frac{\sum X_n}{10} = \frac{1005}{10} = 100.5$$

$$\text{Precision} = 1 - \left|\frac{X_n - \overline{X}_n}{\overline{X}_n}\right|$$

For the 6th reading, Precision

$$= 1 - \left|\frac{100 - 100.5}{100.5}\right| = 1 - \frac{0.5}{100.5} = \frac{100}{100.5} = 0.995$$

50. Ans: (a)

Sol: A piezoelectric transducer cannot be used to measure static variable

51. Ans: (d)

Sol: 1. Venture tube ....Flow

2. Optical tachometer...Velocity

3. LVDT.............. Displacement

4. Pirani gauge..............Pressure

52. Ans: (c)

Sol: G = 1+2v

$$G = \frac{\left(\frac{\Delta R}{R}\right)}{\in}$$

$$= \frac{(1009 - 1000)/1000}{0.0015} = 6$$

6 = 1+2v

$\Rightarrow$ v = 2.5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53. Ans: (d)

Sol: Error at CF $=|-20\log 2\zeta| = |-20\log 2(0.4)| = 2$dB

54. Ans: (c)

Sol: Transfer function of given plot is

$$T.F = \frac{K(s+a)}{s(s-b)}$$

$$M = \frac{K\sqrt{\frac{\omega^2}{a^2}+1}}{\omega\sqrt{\frac{\omega^2}{b^2}+1}}$$

$$\phi = -90° + \tan^{-1}\left(\frac{\omega}{a}\right) - \left[180° - \tan^{-1}\left(\frac{\omega}{b}\right)\right]$$

	M	**ϕ**
$\omega = 0$	∞	$-270°$
$\omega = \infty$	0	$-90°$

It is type-1 system

K_V = finite

For type-1 system steady state error due to ramp input is finite.

For type-1 system steady state error due to parabolic input is infinite.

55. Ans: (a)

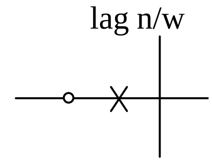
Sol: $$T(s) = \frac{R_2 + \frac{1}{Cs}}{R_1 + R_2 + \frac{1}{Cs}} = \frac{R_2Cs+1}{(R_1+R_2)Cs+1}$$

$$T(s) = \frac{0.001s+1}{0.003s+1}$$

$\tau = 0.001$

$\alpha\tau = 0.003$

$\alpha = 3$



$$\phi_m = \sin^{-1}\left[\frac{1-\alpha}{1+\alpha}\right]$$

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

$\phi_m = -30°$

56. Ans: (a)

Sol: Angle of asymptotes $\phi = \frac{(2\ell+1)\pi}{P-Z}$ $\ell = 0, 1, 2 \ldots\ldots |P-Z| - 1$

Number of poles P = 3

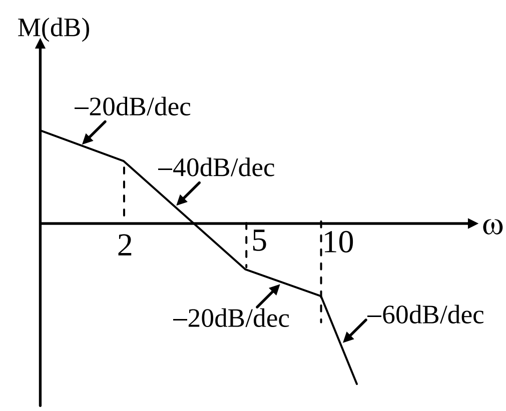
Number of zeros Z = 0

$$\phi_0 = \frac{\pi}{4},\ \phi_1 = \frac{3\pi}{4},\ \phi_2 = \frac{5\pi}{4},\ \phi_3 = \frac{7\pi}{4}$$

57. Ans: (c)

Sol: $$G(s) = \frac{10(1+s/5)}{s\left(1+\frac{s}{2}\right)\left(1+\frac{s}{20}+\frac{s^2}{100}\right)}$$

Magnitude plot



At ω=0 rad/sec change sin slope

$\Rightarrow$ –20 dB/dec to – 60dB/dec

58. Ans: (d)

Sol: Number of poles P = 2

Number of zero Z = 2

Number of asymptotes = |P – Z| = 0

$\therefore$ asymptotes does not exist.

59. Ans: (c)

Sol: $G(s)H(s) = \dfrac{K}{s-2}$

$K|_{s=0} = |s-2|_{s=0} = 2$

60. Ans: (b)

Sol: Closed loop gain = $\dfrac{8}{1-\dfrac{8}{4}} = -8$

61. Ans: (b)

Sol: Using dominant pole approximation

$T.F = \dfrac{150}{(s+2)\times 150} \Rightarrow \dfrac{1}{s+2}$

Time constant $\tau = \dfrac{1}{2}$ sec

For 5% criterion, $3\tau \Rightarrow 3/2$ sec

62. Ans: (a)

Sol: Given system is unstable if $\dfrac{32-K}{8} < 0$

32 < K

K > 32

63. Ans: (a)

Sol: Number of loops = 0

Number of forward paths = 9

Number of two non touching loops = 0

64. Ans: (b)

Sol: $G(s) = \dfrac{K\times 100}{s^2+10s+100}$

$s^2 + 10s + 100 \Rightarrow s^2 + 2s\xi\omega_n + \omega_n^2$

$\omega_n = 10$

$\xi = \dfrac{1}{2}$

$M = \dfrac{K}{2\xi\sqrt{1-\xi^2}} = \dfrac{10}{\sqrt{3}}$

$= \dfrac{K}{2(0.5)\sqrt{1-(0.5)^2}} = \dfrac{10}{\sqrt{3}}$

K = 5

65. Ans: (a)

Sol: C.E = det [sI –A] =0

$$\left|\begin{bmatrix} s & 0 & 0 \\ 0 & s & 0 \\ 0 & 0 & s \end{bmatrix} - \begin{bmatrix} 0 & 0 & -20 \\ 1 & 0 & -24 \\ 0 & 1 & -9 \end{bmatrix}\right| = 0$$

$$\begin{vmatrix} s & 0 & +20 \\ -1 & s & +24 \\ 0 & -1 & s+9 \end{vmatrix} = 0$$

$s[s(s+9)+24]-0+20(1)=0$

$s^3+9s^2+24s+20=0$

s^3	1	24
s^2	9	20
s^1	$\frac{9(24)-20}{9}$	0
s^0	20	

All coefficient of 1st row are positive. So, system is stable

66. Ans: (c)

Sol: The common alloying elements added to steel for improving its oxidation resistance are chromium, aluminum and nickel.

67. Ans: (d)

Sol:

- The most common copper alloys are the brasses, for which zinc, as a substitutional impurity, is the predominant alloying element.
- Some of the common uses for brass alloys include costume jewelry, cartridge casings, automotive radiators, musical instruments, electronic packaging and coins. Hence, given statement is incorrect.
- The bronzes are alloys of copper and several other elements, including tin, aluminum, silicon and nickel. These alloys are somewhat stronger than the brasses, yet they still have a high degree of corrosion resistance.
- Applications include jet aircraft landing gear bearings and bushings, springs and surgical and dental instruments.

68. And: (a)

Sol:

Dominant Characteristics	Crystal structure
High strength	BCC
High ductility	FCC
Tend to be brittle	HCP

69. Ans: (c)

Sol: Poles of the system are at $z = \pm j$

Since ROC is exterior of a circle hence system is causal.

But ROC is not including unit circle. So, system is unstable

Now $H(z) = \frac{z}{z^2+1}, |z| > 1$

$\text{Sin}(\omega_0 n)\, u(n) \leftrightarrow \frac{z \sin \omega_0}{z^2 - 2z\cos\omega_0 + 1}, |z| > 1$

$z^2 + 1 = z^2 - 2z\cos\omega_0 + 1$

$\therefore 2z\cos\omega_0 = 0$

$\therefore \omega_0 = \frac{\pi}{2}$

$$\therefore \sin\left(\frac{\pi}{2}n\right)u(n) = \frac{z\sin\left(\frac{\pi}{2}\right)}{z^2 - 2z\cos\left(\frac{\pi}{2}\right)+1} = \frac{z}{z^2+1}$$

$$h(n) = \sin\left(\frac{\pi}{2}n\right)u(n)$$

70. Ans: (a)

Sol: In super conducting state, resistivity and the magnetic flux density is zero and since the super conductor is almost a perfect diamagnet, its susceptibility is negative and equal to units, shows $\mu_x = 1 + \chi$ is almost zero. However, the transition between superconducting and normal states is reversible.

71. Ans: (b)

Sol: The soft magnetic materials have low hysteresis.

72. Ans: (d)

Sol: The values of dielectric strength are given as

Materials	**Dielectric strength (kV/inch)**
Rubber	450 to 550
Teflon	1500
Bakelite	300 to 550
Glass	2000 to 3000

73. Ans: (c)

Sol: Aluminum is a metal its resistivity is the lowest, where as mica is an insulator with highest resistivity. As pure silicon is an intrinsic semiconductor whose resistivity is slightly higher than the doped extrinsic silicon which has more charge carrier in it.

74. Ans: (c)

Sol: All the statements are correct. In fact soft superconductors also follow Meissner effect.

75. Ans: (b)

Sol: In Anti-ferromagnetic materials, above a specific Neel temperature the anti parallel arrangement breakdown and the material becomes paramagnetic, temperature dependence of susceptibility, i.e. When T > T_N (Neel Temperature) $\chi = \frac{C}{T+\theta}$.

76. Ans: (a)

Sol: Lead zirconate, {Pb[zrxTil-x]O_3}, (0≤x≤1), an inter metallic, inorganic compound is the most common piezo electric ceramic use

77. Ans: (c)

Sol: Turn ON delay time can be reduced by increasing gate current magnitude. Current rise time can be decreased by increasing rate of rise of gate current that is $\frac{di_g}{dt}$.

78. Ans: (a)

Sol: For turning ON of a N-MOS $V_{GS} > V_{th}$ .So, during turn ON delay time gate to source voltage rises from zero to threshold value.

79. Ans: (d)

Sol: $V_{th} \propto \phi_{ms}$;

$\phi_{ms} = \phi_m - \phi_s$

ϕ_m = work function of metal

ϕ_s = work function of semiconductor

$\phi_s \propto V_T \propto T$ (temperature)

So, V_{TH} decreases with increase in junction temperature.

As MOSFET is majority carrier device R_{DS} (resistance) increases with increase in temperature.

80. Ans: (c)

Sol: Blocking voltage of a layer is always determined by both thickness and doping level of the layer.

81. Ans: (b)

Sol: As IGBT acts as positive temperature coefficient device in conduction mode it can be inferred that most of the current flows through MOSFET.

82. Ans: (b)

Sol: In a three phase full converter each thyristor conducts for 120°.

So, $I_{T,\,rms} = \dfrac{I}{\sqrt{3}}$,

$I_{T,\,avg} = \dfrac{I}{3}$

83. Ans: (c)

Sol: In a 3 pulse converter for α = 60°, both SCR and FD conduct for 60° each.

$$I_{T,\,rms} = I_0\sqrt{\frac{60}{360}} = \frac{I_0}{\sqrt{6}}$$

As there are three SCR's, FD conducts for 3 × 60 = 180°.

$$I_{FD,\,rms} = I_0\sqrt{\frac{180}{360}} = \frac{I_0}{\sqrt{2}}$$

$$\therefore \text{Ratio} = 1 : \frac{1}{\sqrt{6}} : \frac{1}{\sqrt{2}}$$

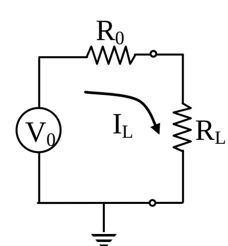
84. Ans: (d)

85. Ans: (a)

Sol: For low variations of voltage, control circuit required is minimum. So cost is less.

86. Ans: (c)

Sol:



Step (1): For maximum power transfer into the load

$R_L = R_0 = 4\Omega$ - - - - - (1)

$$\Rightarrow I_L = \frac{V_0}{R_0 + R_L} = \frac{6V}{8\Omega} = \frac{3}{4}A \text{ - - - - - - (2)}$$

Step (2): $P_{Lmax} = I_L^2 R_L$ - - - - - - (3)

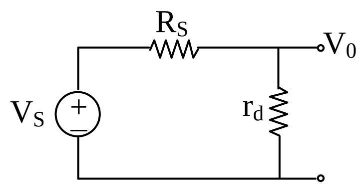
$$= \left(\frac{3}{4}\right)^2 \times 4W \text{ ------- } (4)$$

$$= \frac{3\times 3}{4\times 4}\times 4W \text{ ------- } (5)$$

$P_{Lmax} = 2.25$ W ------- (6)

87. Ans: (a)

Sol: The small signal equivalent circuit is as follows



For small signal response, open DC current source, short capacitors C_1 and C_2. Replace diode with its small signal resistance (r_d).

$$r_d = \frac{\eta V_T}{I}$$

$$V_0 = V_s\left[\frac{r_d}{r_d + R_s}\right] = V_s \frac{\frac{\eta V_T}{I}}{\frac{\eta V_T}{I} + R_s}$$

$$V_0 = V_s \frac{\eta V_T}{\eta V_T + IR_s}$$

88. Ans: (b)

Sol:

1. For CMRR to be high, common mode gain, $|A_C| = \frac{R_C}{2R_E}$ should be low. In a differential amplifier, when R_E is replaced with current mirror, as the current mirror is a constant current source, the common mode gain, A_C will be almost zero and hence CMRR becomes very high.
2. Level shifter in op-amps reduce/shifts the unwanted DC level to almost zero, during AC amplification.
3. Virtual ground in op-amps exist in case of open-loop gain of op-amp is very high (ideally infinite)
4. Mismatching of internal transistors & false grounding are the two main reasons beyond error/off set voltage in op-amps.

89. Ans: (d)

Sol: In CS amplifier, $A_V = \frac{V_0}{V_i} = -g_m(R_D // r_d) \Rightarrow$

V_0 is 180^0 out of phase with V_i

In source follower (CD amplifier), $R_0 = R_s // \frac{1}{g_m} \Rightarrow$ If R_s is large, $R_0 \approx \frac{1}{g_m}$

In common gate amplifier, $R_i = R_s // \frac{1}{g_m}$ and is low

90. Ans: (a)

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

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

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

$= 15$

91. Ans: (a)

Sol: For proper demodulation of m(t) [where $\mu < 1$] using envelope detection, the time constant 'RC' is $RC \le \frac{1}{\omega_m}\left[\frac{\sqrt{1-\mu^2}}{\mu}\right]$

$$\therefore RC_{MAX} = \frac{1}{\omega_m}\left[\frac{\sqrt{1-\mu^2}}{\mu}\right]$$

92. Ans: (b)

Sol: The bandwidth of IF amplifier in FM is 200kHz

93. Ans: (c)

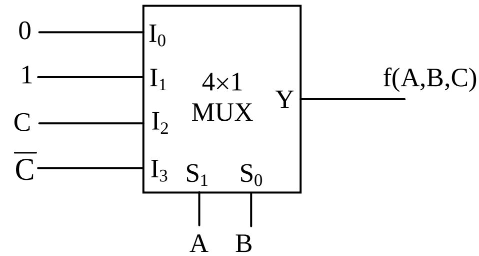
Sol: Bandwidth = $2(\beta+1)f_m$

The ratio of frequency deviation and message signal frequency is called modulation index.

Since both becoming doubled modulation index will not change but bandwidth is directly proportional to message signal frequency. Hence bandwidth becomes doubled.

94. Ans: (a)

Sol:



A B / $S_1 S_0$	I_0 / 0 0	I_1 / 0 1	I_2 / 1 0	I_3 / 1 1
$\overline{C}$ (0)	0	(2)	4	(6)
C (1)	1	(3)	(5)	7
	0	1	C	$\overline{C}$

f(A,B,C) = Σm (2, 3, 5, 6)

A \ BC	00	01	11	10
0			1	1
1		(1)		1

Minimized expression

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

95. Ans: (a)

Sol: A = 11110111 ⇒ –9

B = 00110111 ⇒ +55

A – B ⇒ –64

```
  11110111
+ 11001001
  11000000 ⇒ –64
```

96. Ans: (a)

Sol: For $Q_3Q_2Q_1Q_0$ = 1 0 0 1

⇒ Flip-Flops are cleared.

It counts from 0000, …… 1000, 0000,….

Its modulus = 9.

97. Ans: (c)

Sol: Analog output

$= V_0 = K[2^3 b_3 + 2^2 b_2 + 2^1 b_1 + 2^0 b_o]$

Given V_0 = 4.5V for Digital Input 1001= 9 input

$\therefore K = \frac{V_0}{V_{in}} = \frac{4.5}{9} = 0.5$

For digital Input = 0110 = 6

Output = K [6] = 0.5 × 6 = 3V

98. Ans: (c)

Sol: A. Involution theorem : $(x^1)^1 = x$

B. Absorption theorem : x + xy = x

Proof: x+xy

= x.1 + xy

= x(1+y)

= x.1

= x

C. Demorgan theorem : $(x+y)^1 = x^1y^1$

Dual : $(xy)^1 = x^1 + y^1$

D. Associative theorem : x+(y+z) = (x+y)+z

Dual : x(yz) = (xy)z

99. Ans: (c)

Sol: After push, pop instruction DE = HL = 8500_H

After DAD instruction , $HL + DE \rightarrow HL$

i.e., $8500_H + 8500_H \rightarrow HL = 0A00_H$

100. Ans: (c)

Sol: V_{BE} = 6V, V_{BC} = 3V. Both junctions are Forward–bias.

Hence saturation region.

101. Ans: (b)

Sol: We have collector current

$$i_c = i_s \exp\left(\frac{V_{BE}}{\eta V_T}\right), \quad i_c = \beta I_B$$

Trans conductance $(g_m) = \frac{\partial ic}{\partial V_{BE}}$

$$= \frac{i_s}{\eta V_T} \exp\left(\frac{V_{BE}}{\eta V_T}\right) = \frac{i_c}{\eta V_T}$$

$$r_\pi = \frac{\partial V_{BE}}{\partial i_B} = \frac{\partial V_{BE}}{\frac{1}{\beta}\partial i_c} = \frac{\beta}{g_m} = \frac{\eta\beta V_T}{i_c}$$

$$\therefore r_\pi = \frac{\eta\beta V_T}{i_c}$$

102. Ans: (b)

Sol: $C_{ox} = \frac{\varepsilon_{ox}}{t_{ox}} = \frac{3.9 \times 8.85 \times 10^{-14}}{50 \times 10^{-7}} = 69\,nF/cm^2$

103. Ans: (c)

Sol: From graph, it can be easily seen that

V_{th} = 1V.

Now, V_{GS} = 3–1 = 2 V.

and V_{DS} = 5–1 = 4V.

Since $V_{DS} > V_{GS} \rightarrow V_{DS} > V_{GS} - V_T$

Thus MOSFET is in saturation region.

104. Ans: (b)

Sol: Given $x(n) = \cos\left(\frac{n\pi}{4}\right)$

N = 4

So, $x(n) = \left\{1, \frac{1}{\sqrt{2}}, 0, -\frac{1}{\sqrt{2}}\right\}$

$$X(k) = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 1 \\ 1/\sqrt{2} \\ 0 \\ -1/\sqrt{2} \end{bmatrix}$$

X(k) = {1, 1 – j1.414, 1, 1 + j1.414}

105. Ans: (a)

Sol: y(n) = 0.2x(n) – 0.5x(n –2) + 0.4x(n – 3)

Apply z-transform

$Y(z) = 0.2X(z) - 0.5z^{-2}X(z) + 0.4z^{-3}X(z)$

$$H(z) = \frac{Y(z)}{X(z)} = 0.2 - 0.5z^{-2} + 0.4z^{-3}$$

Apply Inverse z-transform, then

h(n) = {0.2, 0, –0.5, 0.4}

Given input x(n) = {–1, 1, 0, 1}

$y(n) = x(n) * h(n)$

$$\begin{array}{c|cccc} & 0.2 & 0 & -0.5 & 0.4 \\ \hline -1 & -0.2 & 0 & 0.5 & -0.4 \\ 1 & 0.2 & 0 & -0.5 & 0.4 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0.2 & 0 & -0.5 & 0.4 \end{array}$$

y(n) = {–0.2, 0.2, 0.5, –0.7, 0.4, –0.5, 0.4}

y(2) = 0.5

106. Ans: (c)

Sol: To reduce the side lobes, it is desirable to optimize the frequency specification in the transition band of the filter. This optimization can be accomplished numerically on a digital computer by means of linear programming techniques.

107. Ans: (b)

Sol: Given $H(\omega) = -3e^{-j2\omega}$

So, $h(t) = -3\delta(t-2)$

Given $x(t) = u(t) + \delta(t-3)$

$y(t) = x(t) * h(t)$

$= [u(t) + \delta(t-3)] * [-3\delta(t-2)]$

$= -3[u(t)*\delta(t-2) + \delta(t-3)*\delta(t-2)]$

$= -3[u(t-2) + \delta(t-5)] = -3u(t-2) - 3\delta(t-5)$

108. Ans: (a)

Sol: x(3t) is compressed by 3, So T = 2secs.

$$p_{x(t)} = \frac{1}{T}\int_0^T |x(t)|^2 dt$$

$$p_{x(3t)} = \frac{1}{\left(\frac{T}{3}\right)}\int_0^{T/3} |x(3t)|^2 dt$$

$$P_{x(3t)} = p_{x(t)}$$

∴ Power does not change.

109. Ans: (c)

Sol: $\alpha^n x(n) \leftrightarrow X\left(\frac{Z}{\alpha}\right)$ with ROC = |α|R

$$ROC = \left(\frac{5}{4}\right)(0.8) = 1$$

110. Ans: (c)

Sol: $\left(\frac{1}{2}\right)^n u(n) \xrightarrow{\text{DTFT}} \frac{1}{1-\frac{1}{2}e^{-j\omega}}$

$$Y(k) = X(e^{j\omega})\Big|_{\omega=\frac{2\pi k}{10}} \quad ;0 \le k \le 9$$

$$Y(k) = \frac{1}{1-\frac{1}{2}e^{-\frac{j2\pi k}{10}}} \quad ;0 \le k \le 9$$

$$a^n \quad ;0 \le n \le N-1 \longleftrightarrow \frac{1-a^N}{1-ae^{-j\frac{2\pi}{N}k}}$$

$$\left(\frac{1}{2}\right)^n \; 0 \le n \le 9 \leftrightarrow \frac{1-\left(\frac{1}{2}\right)^{10}}{1-\left(\frac{1}{2}\right)e^{-j\frac{2\pi}{N}k}}$$

$$y(n) = \frac{\left(\frac{1}{2}\right)^n}{1-\left(\frac{1}{2}\right)^{10}} \quad ;0 \le n \le 9$$

111. Ans: (c)

Sol: Change in generation contributed by load is

$$\Delta P_g = \frac{-\Delta f}{R}$$

Drop on frequency, $\Delta f = -0.0015$

$$\Delta P_g = \frac{-(-0.0015\text{pu})}{0.01\text{pu}} = 0.15\text{pu}$$

112. Ans: (a)

Sol: Always steady state stability limit is greater than transient stability limit. Steady state stability is due to the small and gradual variation of load where as Transient stability limit is due to the sudden and large variation of load

113. Ans: (b)

Sol: SC MVA = $\frac{100}{0.2} = 500$

114. Ans: (a)

Sol: Given Data

V_1 = 110kV, V_2 = 110 kV, X= 100Ω

$$P = \frac{V_1V_2}{X}\sin\delta$$

(or) $P_{max} = \frac{V_1V_2}{X}$ { sinδ = 1}

$$\Rightarrow P_{max} = \frac{110\times 110}{100} = 121\text{MW}$$

115. Ans: (b)

Sol: Let radius of each sub conductor be 'r' and radius of single solid conductor be R then

$\pi R^2 = 4 \times \pi r^2$

$R^2 = 4r^2 \Rightarrow R = 2r$

$$r = \frac{R}{2} = \frac{40\text{mm}}{2} = 20\text{mm}$$

116. Ans: (c)

Sol: Generally lighting strikes on topmost conducting body on the earth surface, to protect power lines from lighting strokes a wire kept on top of tower through the length by directly connecting that to the tower which is known as ground wire (or) earth wire (or) lighting shield wire. This wire protects power lines only from direct lighting strokes, it won't carry neutral correct and it won't protect system from indirect lighting strokes.

117. Ans: (a)

Sol: Output impedance of the transmission is given by

Output impendence of the line $= \frac{V_r}{I_r}$

as $\begin{bmatrix} V_s \\ I_s \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_r \\ I_r \end{bmatrix}$

$$\begin{bmatrix} V_r \\ I_r \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}^{-1} \begin{bmatrix} V_S \\ I_S \end{bmatrix}$$

$$= \frac{1}{AD - BC} \begin{bmatrix} D & -B \\ -C & A \end{bmatrix} \begin{bmatrix} V_S \\ I_S \end{bmatrix}$$

AS AD–BC = 1

$$\begin{bmatrix} V_r \\ I_r \end{bmatrix} = \begin{bmatrix} D & -B \\ -C & A \end{bmatrix} \begin{bmatrix} V_s \\ I_s \end{bmatrix}$$

Now $\frac{V_r}{I_r} = \frac{DV_s - BI_s}{-CV_s + AI_S}$

$$\therefore z_0 = \frac{V_r}{I_r} = \frac{DV_s - BI_s}{-CV_s + AI_s}$$

118. Ans: (a)

Sol: In L-G fault, whenever the neutral of alternator is not connected to ground, the voltage in the healthy line will be $\sqrt{3}\,V$. It is called arc ground phenomena so damage of insulation may be occur by flash over in healthy phase.

119. Ans: (c)

Sol: Given data,

$$Y_{12} = \frac{1}{j0.5}$$

$\Rightarrow Y_{12} = -j2$

$Y_{13} = -5j$

$\Rightarrow Y_{23} = -4j$

$Y_{11} = Y_{12} + Y_{13} = -7j$

$Y_{22} = Y_{23} + Y_{12} = -6j$

$Y_{33} = Y_{13} + Y_{23} = -9j$

120. Ans (a)

Sol: Due to the phenomena of correct chopping arc may restrike between the contacts of C.B, to reduce the rate of rise of restriking voltage a resistor is connected across the contacts of C.B

121. Ans (d)

Sol: Inrush correct has a large third harmonic component which is prevented by harmonic restraint.

122. Ans: (c)

123. Ans: (b)

124. Ans: (d)

125. Ans: (b)

126. Ans: (a)

Sol: * If exponent is e bits long then exponent is excess $(2^{(e-1)}-1)$ code

* For IEEE 754 Double precision (64 bits), exponent is 11 bits long.

127. Ans: (b)

Sol: Cache line size = 64KB = 2^{16} Bytes

Offset width ⇒ 16 bits

No. of cache lines

$$= \frac{4MB}{64KB} = \frac{2^{22}\text{Bytes}}{2^{16}\text{Bytes}} = 2^6 \text{lines}$$

No. of cache sets = $\frac{2^6}{2} = 2^5$ sets

Index width ⇒ 5 bits

Main memory size = 1 GB = 2^{30} Bytes

Physical address width ⇒30 bits

Tag entry width = 30–16–5 = 9 bits

Size of Tag memory= 9 bits * 2^6 = 72 Bytes

128. Ans: (d)

Sol: Use to high overheads of other strategies.

129. Ans: (a)

Sol: Since the program contain head recursion, so the output of the given program is reverse of the given input string so it is SAVINIRS.

130. Ans: (b)

Sol: In fully associative cache memory any MM block can be mapped to anywhere in the one of the cache blocks i.e. conflict miss doesn't occur.

131. Ans: (d)

Sol: Defragmentation is applied in disk and it done by either device manager part of Operating System or by any application software.

132. Ans: (b)

133. Ans: (a)

134. Ans: (c)

Sol: Over the length of transposition cycle, the total flux linkages and hence net voltage induced in a near by telephone line is zero

135. Ans: (a)

Sol: Both correct and statement - II is correct explanation of statement I

$$\therefore Z(x) = Z_o\left[\frac{Z_L \cos\beta\ x + jZ_o \sin\beta\ x}{Z_0 \cos\beta\ x + jZ_L \sin\beta\ x}\right]$$

$Z(x) = Z_{in}$; x=L

$$Z_{in} = Z(L) = to\left[\frac{Z_L \cos\beta L + jz_o \sin\beta L}{Z_o \cos\beta L + jZ_L \sin\beta L}\right]$$

But, $\beta L = \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2}$

$$\Rightarrow z_{in} = \frac{Z_o^{\ 2}}{Z_L}$$

Now, Open circuit line, $Z_L \to \propto$

$\therefore Z_{in} = 0$

Short circuit line, $Z_L = 0$

$\therefore Z_{in} = \propto$

136. Ans: (c)

Sol: In electrostatics, $\vec{E} = -\nabla V$

Similarly , $\vec{H} = -\nabla V_m$

Where V_m: magnetic scalar potential, is generally known as magneto motive force, expressed in (amp or AT).

From ampere's law: $\vec{J} = \nabla \times \vec{H}$

$$\vec{J} = \nabla \times (-\nabla V_m)$$

Curl of gradient of any scalar is always zero and hence $\vec{J} = 0.$

Therefore $\vec{H} = -\nabla V_m$ is defined if and only if $\vec{J} = 0.$

This indicates magnetic scalar potential is defined only in the current free $(\vec{J} = 0)$ (or) non-conducting region.

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

Magnetic flux density is always solenoidal.

$\nabla.\mu\vec{H} = 0$

If the medium is homogeneous, then

$\mu\nabla.\vec{H} = 0 \Rightarrow \nabla.\vec{H} = 0$

If the medium is non-homogeneous, then $\nabla.\mu\vec{H} = 0$ but $\nabla.\vec{H} \neq 0.$

Hence magnetic field intensity is not solenoidal always.

Therefore statement-I is true, but statement-II is false.

137. Ans: (b)

Sol: High frequency transformers are designed with thin laminations, therefore Stacking factor is low.

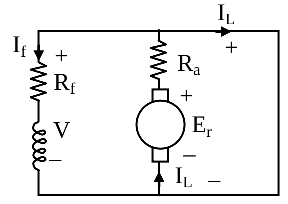
Eddy current loss is directly proportional to conductivity.

138. Ans: (d)

Sol: In figure, because of the short-circuit, V = 0.

Since V = 0, I_fR_f =0 and I_f is zero.

But residual magnetism will induce a voltage E_r in the armature, which circulates a current I_L in the armature and the short-circuit $\left(I_L = \frac{E_r}{R_a}\right)$



'Statement I' is false, but 'Statement II' is true.

139. Ans: (c)

Sol: The speed of dc series motor sharply falls as torque increases. Hence, the mechanical (and electrical) power developed remains nearly constant at various loads, and prevents overloading.

'Statement I' is correct, 'Statement II' is false.

140. Ans: (a)

Sol: An overexcited synchronous motor operated under no-load condition called Synchronous condenser which is used to deliver the reactive power only such that power factor can be corrected, for this purpose diameter of shaft need not be large.

141. Ans: (b)

Sol: Both statements - I and Statement-II are true but Statement - II is not correct explanation for Statement-I.

142. Ans: (b)

Sol: Both Statement-I and Statement-II are true but Statement-II is not correct explanation for Statement-I.

143. Ans: (a)

Sol: At full load, exact braking torque will not produce proportional driving torque.

144. Ans: (c)

Sol: Due to hysteresis loss, inductor cannot be used as a lag network. Capacitor network is used as a lag network

145. Ans: (b)

Sol:

- Carbon Nanotubes structure consists of a single sheet of graphite, rolled into a tube, both ends of which are capped with C60 fullerene hemispheres. The nano perefix denotes that tube diameters are of the order of a nanometer (i.e., 100 nm or less).
- These nanotubes are extremely strong and stiff and relatively ductile. For single-walled nanotubes, tensile strengths range between 50 and 200 GPa (approximately an order of magnitude greater than for carbon fibers); this is the strongest known material.

146. Ans: (b)

Sol: White iron has a characteristic white, crystalline fracture surface. Large amounts of Fe_3C are formed during casting, giving a hard, brittle material.

- Gray iron has a gray fracture surface with a finely faceted structure. A significant silicon content (2 to 3 wt%) promotes graphite (C) precipitation rather than cementite (Fe_3C). The sharp, pointed graphite flakes contribute to characteristic brittleness in gray iron.

147. Ans: (b)

Sol: In a collector to base bias amplifier circuit,

the stability factor, $S = \dfrac{1+\beta}{1+\beta\left[\dfrac{R_C}{R_C+R_B}\right]}$

i.e., by increasing R_C and decreasing R_B, the stability of Q-point can be improved.

The resistor R_B causes AC negative feedback in the amplifier and reduce the overall AC gain of the amplifier.

148. Ans: (c)

Sol: Statement-I is true & statement-II is false.

149. Ans: (c)

Sol: RIM instruction is used to read the status of hardware interrupts (RST 7.5, RST 6.5, RST 5.5). So statement (II) is incorrect.

150. Ans: (A)

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

From time shifting property

$x(n-n_0) \leftrightarrow z^{-n_0}X(z)$

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

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