ACE Engineering Academy

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ESE- 2020 (Prelims) - Offline Test Series Test - 19
ELECTRICAL ENGINEERING

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

01. 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.

02. Ans: (b)

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

03. Ans: (c)

04. Ans: (a)

Sol: Strcat function concatenates str1, str2 and resultant string is stored in <u>str1</u>

05. Ans: (a)

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

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

$= 2^{35}$ Bytes

= 32 GB

06. Ans: (b)

Sol: Pointers are used to manipulate array and to return more than one value from a function

07. Ans: (a)

Sol: i range is from –128 to +127

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

08. Ans: (b)

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

09. Ans: (c)

Sol: $T_t \geq 2T_p$

Minimum Frame size = $(2T_p) \times$ DTR

$= (2\times 50 \text{ ms})\times 100$ kbps

$= 10^4$ bits

= 1250 bytes

10. Ans: (b)

Sol: Size of IP(V_4) Header = (HLEN *4) Bytes

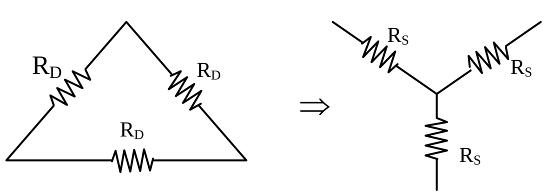
= 40 Bytes.

11. Ans: (b)

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

12. Ans: (a)

Sol:

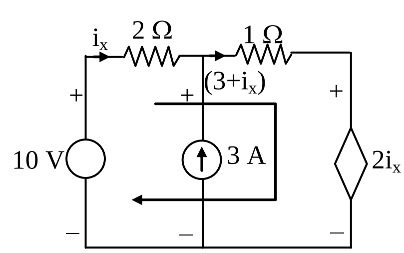


$Z \rightarrow Z/3$

$$R_{DELTA} \rightarrow \frac{R_{DELTA}}{3} = R_{STAR}$$

13. Ans: (d)

Sol: The given circuit can be redrawn as



By KVL,

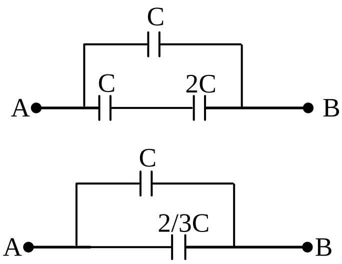
$-10 + 2i_x + 1(3 + i_x) + 2i_x = 0$

$\Rightarrow 5i_x = 7$

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

14. Ans: (d)

Sol:

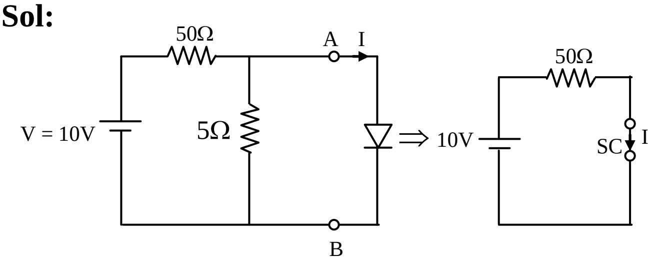


Effective capacitance between A and B is

$$C_{eff} = \frac{2C}{3} + C = \frac{5C}{3} = 5\mu F\ ;\ (\text{given } C = 3\mu F)$$

15. Ans: (c)

Sol:



Diode current I

When diode (FB) → Short circuit

$$I = \frac{V}{50} = \frac{10}{50} = 0.2\text{Amps}$$

$I = 200\times10^{-3} = 200\text{mA}$

16. Ans: (d)

Sol: Here R_L = 30 Ω 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.

17. Ans: (b)

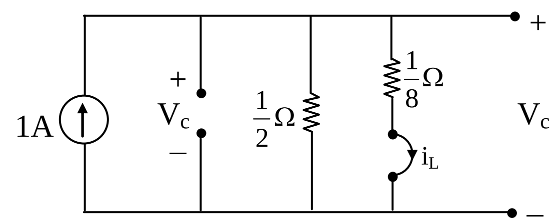
18. Ans: (a)

Sol: $\tau = RC,\ R = 2 \parallel 3 = \frac{6}{5}\ \Omega,\ C = 5\times10^{-6}$ F

$$\tau = \frac{6}{5}\times 5\times10^{-6} = 6\ \mu\text{sec}$$

19. 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

20. Ans: (d)

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

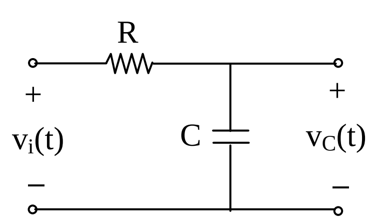


Fig.

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

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

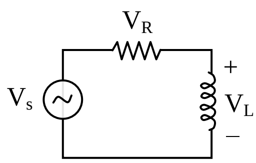
$$RC\frac{dv_C(t)}{dt} = v_i(t)$$

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

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

21. Ans: (c)

Sol:



$V_R = V_L$

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

$\Rightarrow R = \omega L$

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

$\Rightarrow V_L > V_R$

22. Ans: (a)

Sol:

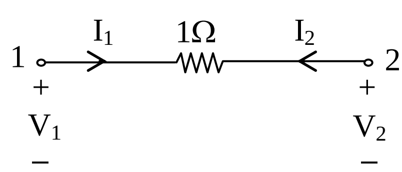


Fig.

For the series element

2 port NW shown,

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

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

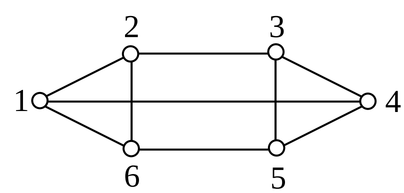
$$Y_B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$[Y] = [Y_A] + [Y_B] = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

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

23. Ans: (d)

Sol:



It is a regular & connected graph

It is not complete graph

$\because\ b \neq n_{C_2}$

24. Ans: (c)

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

The limiting errors of voltage and current add up

% limiting error of resistance = 2% + 2% = 4%

Resistance (R) = $\frac{V}{I} = \frac{50V}{50mA}$ = 1000 Ω

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

25. 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.

26. Ans: (c)

27. 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.

28. Ans: (c)

Sol: Dual slope integrating DVM integrates input voltage for a fixed time period & gives average value of input

29. 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:

$T_d = T_C$

$\Rightarrow K_1\theta = KI$

$\Rightarrow \theta = \left(\frac{K}{K_1}\right)I \Rightarrow \text{linear scale}$

For gravity:

$T_d = T_C$

$\Rightarrow K_s\sin\theta = KI$

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

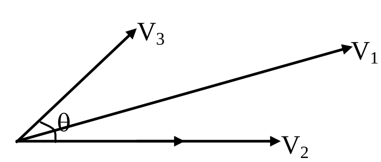
$\Rightarrow \theta = \text{Sin}^{-1}\left(\frac{KI}{K_2}\right) \Rightarrow \text{non linear}$

(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.

30. Ans: (a)

Sol: The phasor diagram for the given circuit is



$\therefore$ Power consumed in the load is

$P = V_3I\cos\theta$

But $V_2 = RI$

And

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

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

$$= 2R(V_3I\cos\theta)$$

$$= 2\ RP$$

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

31. 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

32. 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 = $\frac{\text{charge}}{\text{Force}}$ = C/N

33. Ans: (a)

34. 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.

35. Ans: (a)

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

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

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

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

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

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

= Positional error constant

$$e_{ss} = \frac{R}{1+K_p} = 0$$

Lowest value of $K_i = 0$

i.e., $e_{ss} = 0$, even if integral control is not applied.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36. Ans: (a)

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

$= \dfrac{\angle K\angle 0\angle j2}{\angle(-1+j1)\angle(j1)} = \dfrac{0°+0°+90°}{135°+90°} = -135°$

$\phi_A = 180° - \angle GH = 180° + 135° = -45°$

37. Ans: (d)

Sol: Slope from 1 to ω_1 = 40 dB/dec

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

$\omega_1 = 4$ rad/sec

Slope from 20 to $\omega_3 = -6$ dB/oct

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

$\omega_3 = 320$ rad/sec

38. 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

39. Ans: (c)

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

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

40. Ans: (d)

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

41. 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	$\dfrac{5-K}{5}$	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

$\omega = 2\pi f$

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

42. Ans: (b)

Sol: $\xrightarrow{CE}$ $(s+2)^2\,(s+5)\,(s+6) + k\,(s^2+4) = 0$

$$G(s)H(s) = \frac{K(s^2+4)}{(s+2)^2(s+5)(s+6)}$$

Asymptotes meet at centroid

$$\sigma = \frac{(-2-2-5-6)}{4-2} = \frac{-15}{2} = -7.5$$

$= (-7.5, 0)$

43. Ans: (b)

Sol: Given response is under damped system response. Hence damping ratio $0 < \zeta < 1$.

44. Ans: (b)

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

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

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

45. 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)

$e^{-\infty} = 0$

$c(t) = 1 - 0$

$c(t) = 1$

46. Ans: (a)

Sol: Soft magnetic materials have high eddy current losses.

47. Ans: (a)

Sol: $A = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}$

$\text{STM} = L^{-1}\,[(SI-A)^{-1}]$

$$(SI-A) = \begin{bmatrix} s & -2 \\ 2 & s \end{bmatrix}$$

$$(SI-A)^{-1} = \frac{1}{s^2+4}\begin{bmatrix} s & 2 \\ -2 & s \end{bmatrix}$$

$$L^{-1}[(SI-A)^{-1}] = \begin{bmatrix} \cos 2t & \sin 2t \\ -\sin 2t & \cos 2t \end{bmatrix}$$

48. Ans: (a)

Sol: TF the SSR is in CCF

TF =

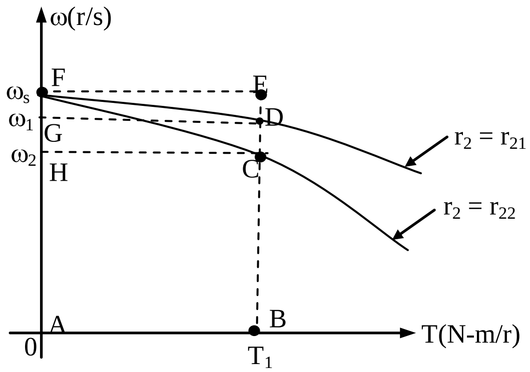
$$\frac{8(2)}{s^2+5s+4} = \frac{C(s)}{R(s)} \qquad R(s) = \frac{1}{s}$$

$$C(\infty) = \underset{s\to 0}{\text{Lt}}\, SC(s) = \frac{8\times 2}{4} = 4$$

$C(\infty) = 4$

49. 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.

50. 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.

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

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

51. Ans: (a)

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

52. Ans: (c)

Sol: during parallel operation, an overexcited synchronous machine demagnetizes and an under excited synchronous machine magnetizes.

53. 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.

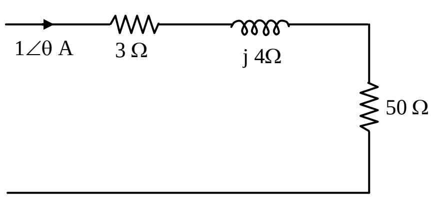
There does exist a conducting path between supply and load (unlike the 2-winding transformer where supply and load are electrically isolated). (3) is correct.

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.

54. 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

55. 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.

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

[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

56. Ans: (c)

Sol: The fictitious secondary has

1. same number of turns as primary (say N_1). (1) is correct.
2. copper losses same as those of actual secondary (not primary) (2) is wrong.
3. reactive power loss same as that of actual secondary (not primary). (3) is wrong.

4. The fictitious secondary has N_1 turns and so will carry (N_2/N_1) (current in actual secondary). However it must have the same copper loss as the actual secondary. So it must have $(N_1/N_2)^2$ times the resistance of the actual secondary. To achieve this, it can be shown that its conductor cross section must be (N_1/N_2) (conductor cross – section of the actual secondary)

(4) is correct.

57. Ans: (b)

Sol: $\frac{120\times 50}{6} = 1000$ RPM = synchronous speed

= speed at which stator mmf rotates ref stator

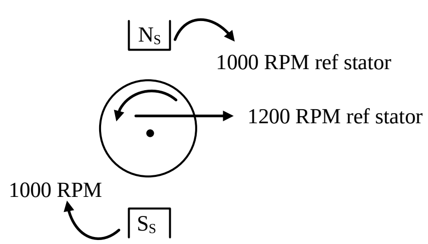


Fig .1

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.

58. Ans: (c)

Sol: Additional mmf required at full load

$= 500 \times (3.2 - 2)$

$= 500 \times 1.2$

$= 600$ AT

This mmf is obtained by using series field mmf

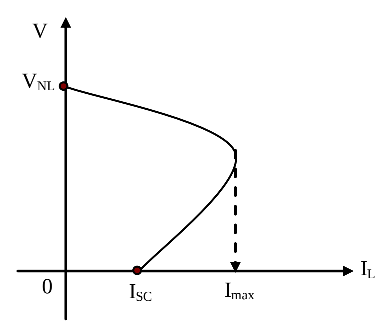
$\therefore$ Series filed turns × Armature current = 600 AT

Armature current $I_a = \frac{36\times 10^3}{240}$ A

$\therefore T_{se} \times \frac{36\times 10^3}{240} = 600 \Rightarrow T_{se} = 4$

59. Ans: (a)

Sol: External characteristic of DC shunt generator.



During short circuit, main field flux = residual flux.

60. Ans: (b)

Sol: $T_L \propto N^2$ $\quad N_2 \propto \frac{1}{2} N_1$

$T_{lm} = I_a^2$

In series motor, $\phi \propto I_a$

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

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

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

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

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

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

61. Ans: (b)

Sol: The given equation can be written as

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

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

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

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

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

62. Ans: (b)

Sol: Given $\sin(x)\frac{dy}{dx} + 2y = \tan^3\left(\frac{x}{2}\right)$

$$\Rightarrow \frac{dy}{dx} + \left(\frac{2}{\sin(x)}\right) y = \frac{\tan^3\left(\frac{x}{2}\right)}{\sin(x)}$$

The above differential equation is a linear D.E

Now the integrating factor is given by

$$I.F = e^{\int \frac{2}{\sin(x)} dx}$$

$$\Rightarrow I.F = e^{\int 2.\operatorname{cosec}(x) dx = e^{2\log\left(\tan\left(\frac{x}{2}\right)\right)}}$$

$$\Rightarrow I.F = e^{\log\left(\tan^2\left(\frac{x}{2}\right)\right)}$$

$$\therefore I.F = \tan^2\left(\frac{x}{2}\right)$$

63. Ans: (b)

Sol: Let p be probability of getting '3' on a die

$$\Rightarrow p = \frac{1}{6} \ \&\ q = \frac{5}{6}$$

$\therefore$ p{first time 3 occurs at the even throw}

$= qp + qqqp + qqqqqp + \ldots\ldots..$

$= qp\{1 + q^2 + q^4 + \ldots\ldots\ldots.\}$

$$= qp\left\{\frac{1}{1 - q^2}\right\}$$

$$= \frac{5}{6} \times \frac{1}{6}\left\{\frac{1}{1 - \frac{25}{36}}\right\}$$

$$= \frac{5}{36} \times \frac{36}{11}$$

$$= \frac{5}{11}$$

64. Ans: (d)

Sol: $f(z)=\dfrac{(z^2-2z)}{(z+1)^2(z+2i)(z-2i)}$

z = –2i is a simple pole

The residue of f(z) at z = –2i is

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

$$=\frac{-4+4i}{(-4+1-4i)(-4i)}$$

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

$$=\frac{(i-1)(3i+4)}{(3i+4)(3i-4)}=\frac{-7+i}{-25}$$

$$=\frac{7-i}{25}$$

65. Ans: (d)

Sol: Given $I=\int_C \frac{1}{z^2+4}\,dz$ where C is $|z-j|=2$

The integrand function $\frac{1}{z^2+4}$ has singular points at z = ± 2i.

But only z = 2i lies inside C.

∴ By Cauchy's Integral Formula, we have

$$I=\int_C \frac{1}{z^2+4}dz$$

$$=\int_C \frac{1}{(z+2i)(z-2i)}dz$$

$$\Rightarrow I=\int_C \frac{\left(\frac{1}{z+2i}\right)}{z-2i}\,dz$$

$$=2\pi i\left(\frac{1}{z+2i}\right)_{z=2i}$$

$$\therefore\ I=2\pi i\left(\frac{1}{2i+2i}\right)=\frac{\pi}{2}$$

66. Ans: (b)

Sol: For total number of cases, first person can born in any 12 months and second person can born in any 12 months

Total cases = 12 × 12

For favorable number of cases, Two friends share same birth month means both should have same birth month i.e.,

(J, J), (F, F), (M, M), (A, A) …., (D, D)

i.e., favorable cases = 12

$$p=\frac{12}{12\times 12}=\frac{1}{12}$$

67. Ans: (b)

Sol: $$\lim_{x\to 0}\frac{e^x-\left(1+x+\frac{x^2}{2}\right)}{x^3}=\lim_{x\to 0}\frac{\left(\frac{x^3}{3!}+\frac{x^4}{4!}+........\infty\right)}{x^3}$$

$$=\frac{1}{6}$$

Hint: Use expansion of e^x and apply L-hospital's rule

68. Ans: (b)

Sol: Let x – 1 = t

Then x = t + 1

As x : 0 → 2 ⇒ t : –1→1

$$\therefore \int_0^2 \frac{(x-1)^2 \sin(x-1)}{(x-1)^2+\cos(x-1)}dx = \int_{-1}^{1}\left(\frac{t^2 \sin t}{t^2+\cos t}\right)dt$$

$$= 0$$

[$\because$ Integrand is an odd function]

(or)

Use the property

$$\int_0^{2a} f(x)dx = 0 \quad \text{if } f(2a-x) = -f(x)$$

69. Ans: (d)

Sol: we have the vector identity

Curl (Curl P) = $\nabla\times(\nabla\times P)$

$$= \text{grad}(\text{div}\, P) - \nabla^2 P$$

$$= \nabla(\nabla.P) - \nabla^2 P$$

70. Ans: (d)

Sol: $\frac{dy}{dx} = -2xy^2 = f(x,y)$

f (0, 1) = 0

$y_1^p = y_0 + hf(x_0, y_0)$

$= 1 + 0.2(0) = 1$

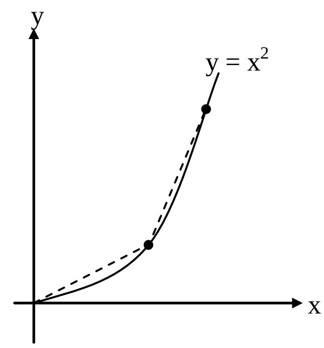
$y_1^c = y_0 + \frac{h}{2}\left[f(x_0,y_0) + f(x_1, y_1^p)\right]$

$= 1 + \frac{0.2}{2}(0-0.4) = 0.96$

71. Ans: (c)

Sol: In Trapezoidal rule, to evaluate $\int_a^b x^2 dx$ we have to approximate the curve by straight line segments and we have to evaluate the areas of corresponding trapeziums. For the curve y = x^2, if we join any two points on the curve, the straight line joining the two points lies above the curve, therefore the value of the integral is greater than or equal to exact value. But Simpson's rule gives the exact value of the integral if f(x) is a polynomial function of degree ≤ 3 .

$\therefore$ Option (c) is correct



72. Ans: (a)

Sol: S_1 is true

Ex: A = $\begin{bmatrix}1 & 0\\0 & 0\end{bmatrix}$ B = $\begin{bmatrix}0 & 1\\0 & 0\end{bmatrix}$

where |A| = 0, |B| = 0

$\Rightarrow$ A + B = $\begin{bmatrix}1 & 1\\0 & 0\end{bmatrix}$

$\Rightarrow$ |A + B| = 0

S_2 is true

Ex: A = $\begin{bmatrix}1 & 2\\0 & 3\end{bmatrix}$ B = $\begin{bmatrix}1 & 1\\2 & 3\end{bmatrix}$

Where, $|A| \ne 0$, $|B| \ne 0$

$$\Rightarrow \quad A + B = \begin{bmatrix} 2 & 3 \\ 2 & 6 \end{bmatrix}$$

$$\Rightarrow |A + B| \neq 0$$

73. Ans: (b)

Sol: Given $X^2 - X + I = O$

$$\Rightarrow X^{-1}(X^2 - X + I) = O$$

$$\Rightarrow \quad X - I + X^{-1} = O$$

$$\Rightarrow \quad X^{-1} = I - X$$

$$\Rightarrow X^{-1} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} a & 1 \\ -a^2 + a - 1 & 1 - a \end{bmatrix}$$

$$\therefore \; X^{-1} = \begin{bmatrix} 1 - a & -1 \\ a^2 - a + 1 & a \end{bmatrix}$$

74. Ans: (c)

Sol: Since $(x - x^2)$ is neither even nor odd function in the interval $[-\pi, \pi]$, the fourier series expansion of $x - x^2$ in the interval $(-\pi, \pi)$ contains both sine and cosine terms.

75. Ans: (b)

Sol: Series resistance reduces the short circuit current density. Series resistance:

1. Due to contact resistance between metal contact and the silicon
2. The movement of I through emitter & base of solar cell.

Effects:

(i) Doesn't effect open circuit voltage.

(ii) Reduce I_{SC}

(iii) Reduce fill factor.

(iv) Reduce efficiency

76. Ans: (d)

Sol: **%**voltage regulation =%R cosϕ±%Xsinϕ

('+' for lag, '–' for lead p.f)

77. Ans(c)

Sol: In a static over-current relay, inverse time characteristics can be obtained by using a transistor switch

78. Ans: (c)

Sol: $\because \nu = f\lambda \Rightarrow \lambda = \dfrac{\nu}{f}$

where, $\nu = 3 \times 10^5$ km/sec, f = 50Hz

then, $\lambda = \dfrac{3 \times 10^5}{50} = 6000\,\text{km}$

Now, wave number/phase constant

$$\beta = \frac{2\pi}{\lambda} = \frac{2 \times 3.14}{6000} = 1.046 \times 10^{-3}\,\text{rad/km}$$

Then, electrical length of the line

$$\beta.\ell = 1.046 \times 10^{-3} \times 800 = 0.836\,\text{rad} = 0.84\,\text{rad}$$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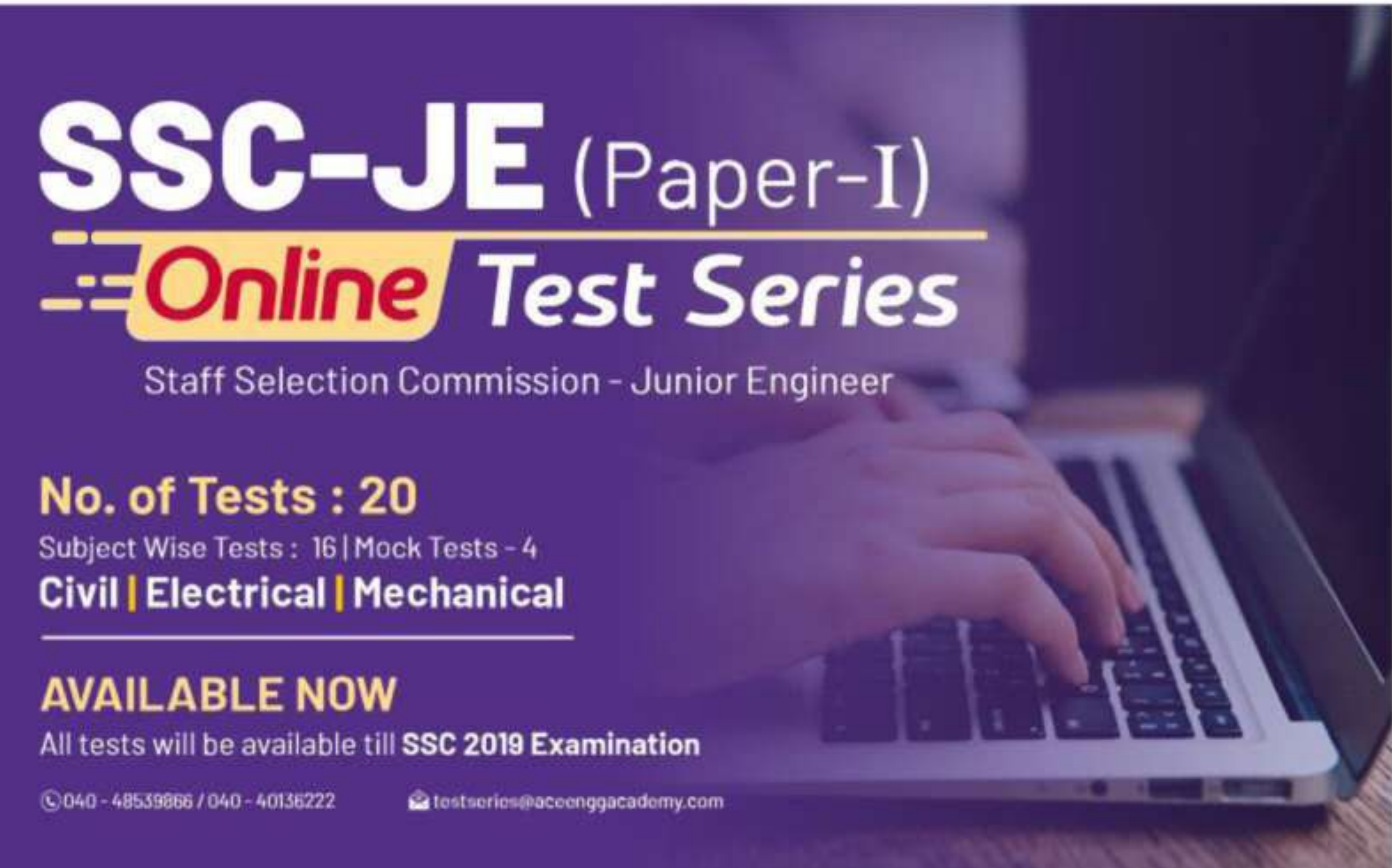
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79. Ans: (a)

Sol: High moment of inertia (M)

Swing equation

$$M\frac{d^2\delta}{dt^2} = P_a$$

$$\Rightarrow \frac{d^2\delta}{dt^2} = \frac{P_a}{M} \Rightarrow \frac{d^2\delta}{dt^2} \propto \frac{1}{M}$$

Therefore high M gives slow changes in δ so that longer time for breaker operation is available to isolate the fault before the critical clearing angle.

But high M means heavier rotor i.e, high SCR (short circuit ratio).

$$\because \text{SCR} \propto \frac{1}{X_d}$$

Therefore, short circuit current increases as $X_d \downarrow$. Therefore high M method is uneconomical.

80. Ans: (c)

Sol: Given: Power = constant, Power loss is constant

Power in 3-ϕ circuit, P = $\sqrt{3}VI\cos\phi$

$$I = \left(\frac{P}{\sqrt{3}V\cos\phi}\right) A$$

Power loss, $W = 3I^2R$

$$W = 3\left(\frac{P}{\sqrt{3}V\cos\phi}\right)^2 \times \rho\frac{\ell}{A}$$

$$A = 3\left(\frac{P}{\sqrt{3}V\cos\phi}\right)^2 \times \frac{\rho\ell}{W}$$

Weight of conductor $\propto$ volume

Weight = $(3A \times \ell)$

$$= 3\left[3\left(\frac{P}{\sqrt{3}V\cos\phi}\right)^2 \times \frac{\rho\ell}{W}\right]$$

$$\text{Weight} \propto \frac{1}{(V\cos\phi)^2}$$

81. Ans: (b)

Sol: positive or negative sequence impedance of the transmission line is $Z_s - Z_m$.

zero sequence impedance of the transmission line is $Z_s + 2Z_m$.

82. Ans: (c)

Sol: Load duration curve is a rectangular curve hence plant load factor is unity.

$\therefore$ P.L.F = 1

$\therefore$ Average load = Maximum load $\neq$ installed capacity

$\Rightarrow$Plant capacity factor = Plant load factor $\times$ Plant utilization factor

$\Rightarrow$Reserve capacity = installed capacity – maximum load

$\Rightarrow$Reserve capacity $\neq$ 0

83. Ans: (b)

Sol: In a power flow study, real and reactive powers can not be defined at all the buses because the loss in the lines is unknown till the study is complete. So it is necessary to choose one bus as a slack bus at which the complex power is unspecified. The power at slack bus is such that, it supplies the difference in the total system load plus losses and the sum of complex powers specified at the remaining buses. This is the reason that slack bus must be a generator.

84. Ans: (b)

Sol: Wind is free and renewable form of energy. Wind is created when the sun unevenly heats the earth surface.

85. 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

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

86. Ans: (b)

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

87. 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.

$$\frac{I_{DS_1}}{I_{DS_2}} = \left(\frac{V_{GS_1} - V_{TH}}{V_{GS2} - V_{TH}}\right)^2$$

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

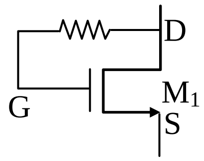
$$I_{DS_2} = 0.2\text{ mA}$$

88. 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.

89. Ans: (c)

Sol: → 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

90. Ans: (b)

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

91. 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

92. Ans: (b)

Sol: Using the law of the junction

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

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

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

$= 4.5 \times 10^3 \times 1.5 \times 10^9 / cm^3$

$= 6.75 \times 10^{12} cm^{-3}$

93. Ans: (d)

Sol: $\rho_v = \nabla.\overline{D} = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho \times D_\rho) = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho \times 5\rho^3)$

$$= \frac{1}{\rho} \times 5 \times 4\rho^3 = 20\rho^2$$

Hence, $\rho_v\big|_{\rho=3m} = 20(3)^2 = 180 C/m^3$

94. Ans: (b)

Sol: $V = \frac{\overline{p}.(\overline{r}_2 - \overline{r}_1)}{4\pi\varepsilon_0 |\overline{r}_2 - \overline{r}_1|^3}$, where $\overline{p} = 80\pi\varepsilon_0 \hat{a}_z C.m$

point 1 is that point at which dipole is located= (0,0,0)

point 2 is that point at which potential is desired = (x,y,z)

$$\overline{r}_2 - \overline{r}_1 = (x\hat{a}_x + y\hat{a}_y + z\hat{a}_z) - (0\hat{a}_x + 0\hat{a}_y + 0\hat{a}_z)$$

$$= x\hat{a}_x + y\hat{a}_y + z\hat{a}_z$$

$$\overline{p}.(\overline{r}_2 - \overline{r}_1) = 80\pi\varepsilon_0 z$$

$$|\overline{r}_2 - \overline{r}_1| = \sqrt{x^2 + y^2 + z^2}$$

$$\therefore V = \frac{80\pi\varepsilon_0 z}{4\pi\varepsilon_0 (x^2+y^2+z^2)^{\frac{3}{2}}} = \frac{20z}{(x^2+y^2+z^2)^{\frac{3}{2}}}$$

95. Ans: (d)

Sol: $\nabla.\overline{J} = -\frac{\partial \rho_v}{\partial t}$

$$\nabla.\overline{J} = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \times \frac{5}{\rho}\right) + \frac{\partial}{\partial z}\left(\frac{10}{\rho^2 + 1}\right) = 0$$

So, $\frac{\partial \rho_v}{\partial t} = 0$

96. Ans: (d)

Sol: For irrotational vector field, $\nabla\times\vec{A} = 0$

$$\begin{vmatrix} \hat{a}_x & \hat{a}_y & \hat{a}_z \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ (x+2y+pz) & (qx-3y-z) & (4x+ry+2z) \end{vmatrix} = 0$$

$r + 1 = 0 \Rightarrow r = -1$

$-(4 - p) = 0 \Rightarrow p = 4$

$(q - 2) = 0 \Rightarrow q = 2$

$\therefore$ values of p, q and r respectively 4, 2, –1

97. Ans: (d)

Sol: All the given statements are correct.

98. Ans: (d)

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

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

$= 10^{13}\Omega$

99. Ans: (b)

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

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

$= 511\ \mu s = 0.511 ms$

100. 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.

101. Ans: (d)

Sol: $\rightarrow$ (HL) = 1234H

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

$\rightarrow$ A – 1 = 00H – 01H = FFH

$\rightarrow$ Comparing with H

FFH ~ 12H

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

12H = 0001 0010

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

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

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

FF_H = 1111 1111
EE_H = 1110 1110
ED_H=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) = FF_H, (flag reg) = 10010101

= 95H

$\therefore$(PSW) = FF95H

102. Ans: (a)

103. Ans: (c)

Sol: $BW_{FM} = 2\Delta f + 2f_m = 2K_fA_m + 2f_m$

$BW_{PM} = 2\Delta f + 2f_m = 2K_pA_mf_m + 2f_m$

$= 2f_m\,(K_PA_m + 1)$

figure of merit for single tone modulation,

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

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

104. Ans: (a)

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

$+ 10\cos(4\pi \times 10^3 t)]$

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

$= |5\cos(2\pi\times10^3 t) + 10\cos(4\pi \times 10^3 t)|_{max}$

$= 15$

105. Ans: (d)

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

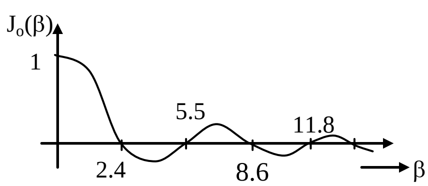
$$\omega = \frac{d\theta}{dt} = 24\pi t^2 + 12\pi t + 4\pi$$

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

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

106. Ans: (b)

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



107. Ans: (a)

Sol: Output SNR in DM system

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

$= 311.25 = 24.93\text{dB}$

108. Ans: (c)

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

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

Apply inverse Fourier transform

$\delta(t) \leftrightarrow 1$

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

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

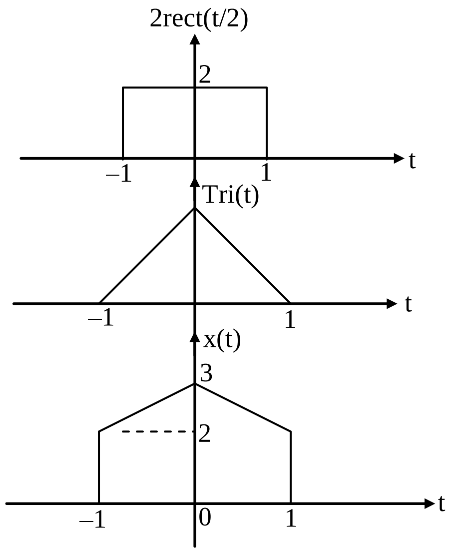
$$e^{-2t}u(t) \leftrightarrow \frac{1}{2}\frac{1}{1+j\pi f} \quad [u(2t) = u(t)]$$

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

109. Ans: (b)

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

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



110. Ans: (c)

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

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

So, $\omega_0 = \dfrac{\pi}{8}$

$\dfrac{\omega_0}{2\pi} = \dfrac{1}{16}$ is a rational number. ∴ Periodic signal

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

$N_0 = 16$

111. 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

$\delta(t) \leftrightarrow 1$

$\delta'(t) \leftrightarrow s$

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

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

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

112. 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, $(-1)^n * [\delta(n) + \delta(n-1)] = x(n)*[\delta(n) + \delta(n-1)]$

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

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

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

$= 0$

113. Ans: (c)

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

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

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

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)

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

$y(0) = 4a^2$

114. Ans: (c)

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

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,

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

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

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

115. Ans: (a)

116. Ans: (d)

117. 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

118. Ans: (c)

Sol: Losing or gaining electrons

→ Ionic bond. Sharing of electrons

→ Covalent bond.

119. 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.

120. Ans: (a)

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

121. 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.

122. Ans: (a)

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

123. Ans: (c)

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

124. Ans: (c)

Sol: $I_L = \dfrac{230}{46} = 5\text{ A}$

$$\therefore I_s \Rightarrow I_2 \times \frac{N_2}{N_1} = 5 \times \frac{230}{10} = 115\text{ A}$$

$$\therefore (I_{Tr}) = 115\sqrt{\frac{1}{2}} = 81.317\text{ A}$$

125. Ans: (c)

Sol: Synchronous speed

$$N_{s1} = \left(\frac{120f}{P}\right)$$

$$N_r = N_s(1 - s)$$

$$1425 = 1500(1 - s)$$

$$1 - s = \left(\frac{1425}{1500}\right)$$

$$s = \frac{1}{20}$$

For a frequency 40 Hz, corresponding synchronous speed is

$$N_{s2} = \frac{120 \times 40}{4} = 1200$$

$N_r = N_{s2}(1 - s)$

$= 1200\left(1-\frac{1}{40}\right)$

$= 1200 - 30$

$N_r = 1170$ rpm

126. Ans: (c)

Sol Lighting load:

The time constant for lighting load is very less that is the light glowing is responds very quickly with the changes in the supply voltage magnitude. So, for this types of loads phase controlled ac voltage controller are very suitable.

Heating load:

The thermal time constant is of the order of several seconds for heating loads. i.e., for heating loads time constant is usually quite high. For such applications, almost no variation in speed or temperature will be noticed if control is achieved by connecting the load to source for some on-cycles and then disconnecting the load for some off cycles. This form of power control is called integral cycle control.

127. Ans: (a)

Sol: A dc reactor is connected in series with each of a converter station in order to prevent commutation failure in the inverter

128. Ans: (d)

Sol: The size of transformer is reduced by operating at high frequencies.

129. Ans: (c)

Sol: $V_{S\,max} = 1.34 \times 0.5 \times (5 \times 10^6)(5 \times 10^{-6})$

$= 16.75$ V

130. Ans: (d)

Sol: Dual converter with circulating current:

Advantages:

1. Fast response, is desired in four quadrant operation of the dual converter.

Disadvantages:

1. A reactor is required to limit the circulating current.
2. Circulating converter gives rise to more losses in the converters, hence the efficiency and power factor are low.

131. Ans: (b)

Sol: For type – A chopper,

I_0 = constant,

$I_{D(avg)} = (1-D)I_0$

$= (1-D)\left(\frac{V_0 - E}{R}\right) = (1-D)\left[\frac{DV_{dc} - E}{R}\right]$

$(I_D)_{avg} = \frac{D(1-D)V_{dc} - (1-D)E}{R}$

$\frac{(dI_D)_{avg}}{dt} = 0$, for I_{Davg} = maximum

$\therefore -DV_{dc} + (1-D) V_{dc} + E = 0$

$$D = \frac{E}{2V_{dc}} + \frac{1}{2}.$$

132. Ans: (c)

Sol: Unipolar: $f_h = [j(2m_f) \pm k]f_1$

$\Rightarrow (2 \times 27 - 1) \times 53 = 2809$ Hz

133. Ans: (b)

Sol: A GTO is more versatile power semiconductor device. It is like a conventional thyristor but with added features in it. A GTO can easily be turned off by a negative gate pulse of appropriate amplitude. Thus a GTO is a pnpn device that can be turned on by a positive gate current and turned off by a negative gate current at its gate cathode terminals.

A chopper is a circuit that converts fixed dc input voltage to a variable dc output voltage directly

134. Ans: (b)

Sol: **Statement-I:** The process of SCR turn off by natural reversal of ac supply voltage is called line commutation can be operated both as rectifier and inverter with suitable dc source in load circuit. So Statement-I is true.

Statement-II: SCR has three states like forward blocking state during forward bias, reverse blocking state during reverse bias and forward conducting state. Forward blocking sate can be controlled by gate pulse. But it does not explain Statement-I.

135. Ans: (a)

Sol: After SCR T_1 is turned off, some minimum time t_{qmin} must elapse for T_1 to regain its forward blocking capability. Otherwise there is a chance to become T_1 and T_2 short circuit and

$$t_{qmin} = \frac{\pi}{\omega} - \frac{\pi}{\omega_r}$$

where,

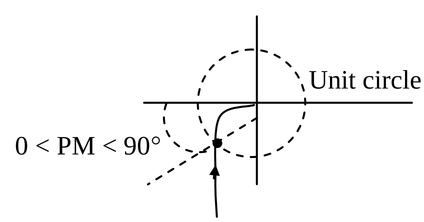
ω = output frequency in rad/sec

136. Ans: (b)

Sol: Only orientation polarisation depends on temperature. When the temperature increases orientation polarization decreases. So total polarization decreases.

137. Ans: (a)

Sol:



140. Ans: (b)

Sol: Both statements are correct, but Statement (II) is not reason for Statement (I).

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.

138. Ans: (c)

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

139. Ans: (a)

141. Ans: (b)

Sol: When the variable frequency of the source is set at $\omega_0 = \dfrac{1}{\sqrt{LC}}$, 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.

142. Ans: (b)

Sol: Complex power,

$$S = \overline{V}\,\overline{I}^* = (100 - j50)\,(6 + j8)$$

$$= 600 + 400 + j500 = 1000 + j\,500$$

True power $= \text{Re}[\overline{V}\,\overline{I}^*] = 1000\text{ W}$

Reactive power $= \text{Im}[\overline{V}\,\overline{I}^*] = 500\text{ W}$

So A is True, R is also true, but R is not the correct explanation.

143. 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.

144. 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).

145. Ans: (b)

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

146. Ans: (b)

Sol: Active power imbalance causes frequency unstability.

Reactive power imbalance causes voltage unstability.

147. Ans: (a)

Sol: In STATCOM, Reactive power $\propto V$

In SVC, Reactive power $\propto V^2$

So when voltage falls to let 0.8V then to raise the voltage reactive power has to be injected into the system. But since voltage is 0.8V, SVC can supply reactive power proportional to $0.64V^2$ ($\therefore Q \propto V^2$ in SVC), where as STATCOM can supply reactive power proportional to 0.8V ($\therefore Q \propto V$ in STATCOM). Hence STATCOM provides better reactive power support to system when it is needed the most.

148. 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).

149. Ans: (c)

Sol: In avalanche photo diodes current amplification occurs.

150. Ans: (c)

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