ACE
Engineering Academy

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ESE- 2018 (Prelims) - Offline Test Series **Test-3**

ELECTRICAL ENGINEERING

SUBJECT: SYSTEMS & SIGNAL PROCESSING + ELECTRICAL MACHINES

SOLUTIONS

01. Ans: (b)

Sol: $x(t) \leftrightarrow X(f)$

$e^{-j4\pi t}x(t) \leftrightarrow X(f+2)$ [from frequency domain shifting property]

$e^{-j\frac{4\pi t}{3}}x\left(\frac{t}{3}\right) \leftrightarrow \frac{1}{1/3}X\left(\frac{f}{1/3}+2\right)$ [From Time-scaling property]

$e^{-j\frac{4\pi t}{3}}x\left(\frac{t}{3}\right) \leftrightarrow 3X(3f+2)$

$\frac{1}{3}e^{-j\frac{4\pi t}{3}}x\left(\frac{t}{3}\right) \leftrightarrow X(3f+2)$

02. Ans: (a)

Sol: $x(t) = 4\left[\frac{1-\cos 6t}{2}\right] = 2 - 2\cos 6t$

$X(\omega) = 2[2\pi\delta(\omega)] - 2[\pi\delta(\omega+6) + \pi\delta(\omega-6)]$

$X(\omega) = 4\pi\delta(\omega) - 2\pi\delta(\omega-6) - 2\pi\delta(\omega+6)$

03. Ans: (c)

Sol: The area of e^{-at^2} is $\int_{-\infty}^{\infty} e^{-at^2}dt = \sqrt{\frac{\pi}{a}}$

Area of $e^{-\pi t^2} = 1$

Area of $e^{-\pi\frac{t^2}{2}} = \sqrt{2}$

Apply area property of convolution to

$e^{-\pi t^2} * e^{-\pi t^2} = Ae^{\frac{-\pi t^2}{2}}$

Then (1)(1) $= A\sqrt{2} \Rightarrow A = \frac{1}{\sqrt{2}}$

04. Ans: (c)

Sol: Auto correlation function must be non-negative, even symmetric & maximum at origin. All these conditions are satisfied by 'c' option

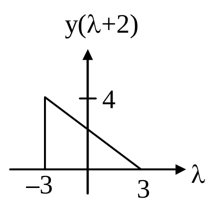
05. Ans: (c)

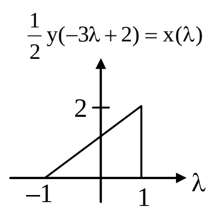
Sol: $y(t) = 2x\left(\frac{-t}{3} + \frac{2}{3}\right)$

$$\frac{-t}{3} + \frac{2}{3} = \lambda \Rightarrow \frac{-t}{3} = \lambda - \frac{2}{3}$$

$$-t = 3\lambda - 2 \Rightarrow t = -3\lambda + 2$$

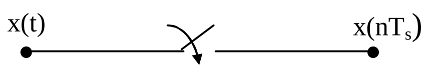
$$x(\lambda) = \frac{1}{2}y(-3\lambda + 2)$$





06. Ans: (c)

Sol:



$$t = nT_s = \frac{n}{100}$$

$$x(nT_s) = \cos\left[\frac{320\pi n}{100} + \frac{\pi}{4}\right]$$

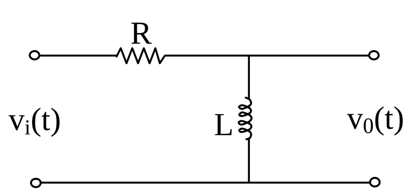
$$= \cos\left[\frac{16\pi n}{5} + \frac{\pi}{4}\right]$$

$$\frac{\omega_0}{2\pi} = \frac{16\frac{\pi}{5}}{2\pi} = \frac{8}{5} = \frac{m}{N}$$

8 full periods of x(t) generate one period of x(n)

07. Ans: (b)

Sol:



$$\frac{V_0(s)}{V_i(s)} = \frac{sL}{R + sL} = \frac{s}{s + \frac{R}{L}}$$

$$\Rightarrow H(s) = \frac{s}{s + \frac{R}{L}} = \frac{s + \frac{R}{L} - \frac{R}{L}}{s + \frac{R}{L}} = 1 - \frac{\frac{R}{L}}{s + \frac{R}{L}}$$

$$h(t) = \delta(t) - \frac{R}{L}e^{\frac{-Rt}{L}}u(t)$$

$$\therefore \text{ for stability } \int_{-\infty}^{\infty}|h(t)|\,dt < \infty$$

$$= \int_{-\infty}^{\infty}\left|\delta(t) - \frac{R}{L}e^{\frac{-Rt}{L}}\,u(t)\right|dt$$

$$= \int_{-\infty}^{\infty}\delta(t)dt - \frac{R}{L}\int_{0}^{\infty}e^{\frac{-Rt}{L}}dt$$

$$= 1 - \frac{R}{L}\left[-\frac{L}{R}e^{\frac{-Rt}{L}}\right]_0^{\infty}$$

$$= 1 + (e^{-\infty} - e^{0})$$

$$= 1 + (0 - 1)$$

$$= 1 - 1 \Rightarrow 0$$

$\therefore \int_{0}^{\infty}|h(t)|dt < \infty \Rightarrow$ System is BIBO stable and stability not depends on R and L

08. Ans: (d)

Sol: $x(t) = e^{-2t}u(t)$ and $y(t) = e^{-t}u(t)$

$x(t)\,\delta(t-1) = x(1)\,\delta(t-1) = e^{-2}\delta(t-1)$

$y(t)\,\delta(t-2) = y(2)\,\delta(t-2) = e^{-2}\delta(t-2)$

$x(t)\,\delta(t-1) * y(t)\,\delta(t-2) = e^{-4}[\delta(t-1)*\delta(t-2)]$

$= e^{-4}\delta(t-3)$

09. Ans: (d)

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

$$y(n) = [2\delta(n)+\delta(n-3)] * \left(\frac{1}{2}\right)^n u(n)$$

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

$$y(1) = \left(2\times\frac{1}{2}\right) + \left(\frac{1}{2}\right)^{-2} u(-2) = 1$$

$$y(4) = 2\left(\frac{1}{2}\right)^4 + \left(\frac{1}{2}\right)u(1) = \frac{1}{8}+\frac{1}{2} = \frac{5}{8}$$

$$y(1)+y(4) = 1+\frac{5}{8} = \frac{13}{8}$$

10. Ans: (a)

Sol: $h_1(t) = \delta(t) - e^{-t}u(t)$

Transfer function of RC low pass filter is

$$H_2(s) = \frac{1}{1+s\tau} = \frac{1}{1+s} \text{ [given } \tau = 1\text{sec]}$$

$h_2(t) = e^{-t}u(t)$

the impulse response of parallel combination is

$$h_p(t) = h_1(t) + h_2(t) = \delta(t) - e^{-t}u(t) + e^{-t}u(t)$$

$h_p(t) = \delta(t)$

11. Ans: (c)

12. Ans: (a)

Sol: The signal y(t) can be represented in terms of x(t) as

y(t) = x(t) –x(t–1)

Given $x(t) \xleftrightarrow{F.S} C_n$

$$x(t-1) \xleftrightarrow{F.S} e^{-j\omega_0 n}C_n$$

$$= e^{-j\frac{2\pi}{2}n}C_n = e^{-j\pi n}C_n = (-1)^n C_n$$

$$\therefore y(t) \xleftrightarrow{F.S} C_n - (-1)^n C_n$$

13. Ans: (a)

Sol: $x_1(t) = \sum_{\ell=-\infty}^{\infty} a_\ell e^{j\ell\omega_0 t}$

Fourier series coefficient of

$$x_1(t)x_2(t) = \frac{1}{T_0}\int_{t=0}^{T_0} x_2(t)\left[\sum_{\ell=-\infty}^{+\infty} a_\ell e^{j\ell\omega_0 t}\right] e^{-jn\omega_0 t}dt$$

$$= \sum_{\ell=-\infty}^{\infty} a_\ell \frac{1}{T_0}\int_0^{T_0} x_2(t)e^{-j(n-\ell)\omega_0 t}dt$$

$$= \sum_{\ell=-\infty}^{\infty} a_\ell b_{n-\ell}$$

14. Ans: (b)

Sol: $x(t) = \cos(\omega_0 t)$ $\omega_0 = 10\pi$

$y(t) = 10\cos(\omega_0 t) + 2\cos(3\omega_0 t) + \cos(5\omega_0 t)$

III harmonic distortion in the output is $= \frac{C_3}{C_1}$

$C_1 = 10, C_3 = 2$

$$\frac{C_3}{C_1} = \frac{2}{10} = 0.2 = 20\%$$

15. Ans: (a)

Sol: x(3t) is compressed by 3, so T = 2. Its power doesn't change so P = 4 watts.

16. Ans: (b)

Sol: $X(s) = \dfrac{s^2(s+2)}{s^2+9} = \dfrac{s^3+2s^2}{s^2+9} = s+2-\dfrac{9(s+2)}{s^2+9}$

$$X(s) = s+2-\frac{9s}{s^2+9}-\frac{18}{s^2+9}$$

$$x(t) = \dot{\delta}(t) + 2\delta(t) - 9\cos(3t)u(t) - 6\sin(3t)u(t)$$

$$\therefore\ y(t)+z(t) = \dot{\delta}(t) + 2\delta(t)$$

17. Ans: (d)

Sol: $H(s) = \dfrac{s+1}{(s+2)(s-3)}$

$$H(s) = \frac{1/5}{s+2}+\frac{4/5}{s-3}$$

For a stable system, ROC includes imaginary axis. So, ROC = $-2<\sigma<3$

$$h(t) = \frac{1}{5}e^{-2t}u(t) - \frac{4}{5}e^{3t}u(-t)$$

18. Ans: (b)

Sol: Given $G(s) = \dfrac{10}{s(s+5)}$

The relation between z- transform & Laplace transform is $z = e^{ST}$

Poles of G(s) are $s = 0$, $s = -5$

Poles of G(z) or $z = 1$, $z = e^{-5T}$

The denominator of G(z) is

$(z-1)(z-e^{-5T})$

The final value of G(s) is

$$= \underset{s\to0}{Lt}\, s.G(s) = \underset{s\to0}{Lt}\frac{10}{s+5} = 2$$

Consider 'b' option

$$g(\infty) = \underset{z\to1}{Lt}(z-1)\frac{2(1-e^{-5T})z}{(z-1)(z-e^{-5T})}$$

$$= \frac{2(1-e^{-5T})}{(1-e^{-5T})} = 2$$

19. Ans: (c)

Sol: $r_{xx}(n) = x(n)*x(-n)$

$ZT[r_{xx}(n)] = X(z).X(z^{-1})$

20. Ans: (a)

Sol: $H(z) = \frac{Y(z)}{X(z)} = \frac{1-\beta z^{-1}}{1-\alpha z^{-1}}$ for stability | pole | <1 i.e., $|\alpha| < 1$

21. Ans: (a)

Sol: $H(Z) = \frac{Y(Z)}{X(Z)} = \frac{1-\alpha}{1-\alpha Z^{-1}}$

$$H_{inv}(Z) = \frac{1}{H(Z)} = \frac{1-\alpha Z^{-1}}{1-\alpha} = \frac{Y(Z)}{X(Z)}$$

$$(1-\alpha z^{-1})X(Z) = (1-\alpha)Y(Z)$$

Take Inverse Z-Transform on both sides

$$x(n) - \alpha x(n-1) = (1-\alpha)y(n)$$

22. Ans: (d)

Sol: Here, $y(n) = x(n) + x(n-5)$

$\Rightarrow Y(e^{j\omega}) = X(e^{j\omega}) + e^{-j5\omega}X(e^{j\omega})$

$\Rightarrow Y(e^{j\omega}) = X(e^{j\omega})(1+e^{-j5\omega})$

$\therefore a = 5$

23. Ans: (b)

Sol: $x(n) + x(n-1) = y(n)$

$$X(e^{j\omega}) + e^{-j\omega}X(e^{j\omega}) = Y(e^{j\omega})$$

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

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

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

$$|H(e^{j\omega})|_{\omega=\omega_c} = \frac{1}{\sqrt{2}}|H(e^{j\omega})|_{max}$$

$$|H(e^{j\omega})|_{max} = 2$$

$$|H(e^{j\omega_c})| = \sqrt{2+2\cos\omega_c} = 2\times\frac{1}{\sqrt{2}}$$

$$\sqrt{2}\left(\sqrt{2\cos^2\left(\frac{\omega_c}{2}\right)}\right) = \sqrt{2}$$

$$2\cos\left(\frac{\omega_c}{2}\right) = \sqrt{2}$$

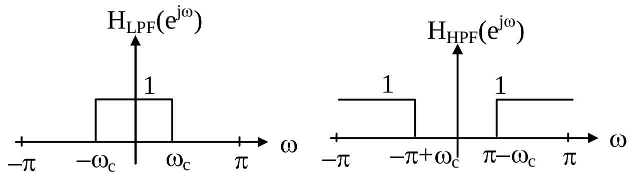
$$\cos\left(\frac{\omega_c}{2}\right) = \frac{1}{\sqrt{2}}$$

$$\frac{\omega_c}{2} = \frac{\pi}{4}$$

$$\omega_c = \frac{\pi}{2}$$

24. Ans: (a)

Sol:



$$H_{HPF}\left(e^{j\omega}\right) = H_{LPF}\left(e^{j(\omega-\pi)}\right)$$

$$h_{HPF}(n) = e^{j\pi n} h_{LPF}(n)$$

$$h_{HPF}(n) = (-1)^n h_{LPF}(n)$$

25. Ans: (a)

Sol: $x(n)e^{j\omega_0 n} \leftrightarrow X\left[e^{j(\omega-\omega_0)}\right]$

$$y(n) = e^{j\pi n} x(n)$$

$$\Rightarrow Y(e^{j\omega}) = X\left(e^{j(\omega-\pi)}\right)$$

$$= \frac{2}{1-\frac{1}{2}e^{-j(\omega-\pi)}}$$

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

26. Ans: (c)

27. Ans: (a)

28. Ans: (a)

Sol: Consider option(a)

$$H(z)=\frac{1-z^{-1}}{3+z^{-1}}$$

At low frequency $H(z)\big|_{z=1}=\frac{1-1}{3+1}=0$

At high frequency, $H(z)\big|_{z=-1}=\frac{1+1}{3-1}=\frac{2}{2}=1$

$$\therefore H(z)=\frac{1-z^{-1}}{3+z^{-1}}\Rightarrow \text{high pass filter}$$

Consider option (b)

$$H(z)=\frac{1+z^{-1}}{3+z^{-1}}\Rightarrow \text{low pass filter}$$

$$H(z)\big|_{z=1}=\frac{2}{4}=\frac{1}{2}$$

$$H(z)\big|_{z=-1}=\frac{1-1}{3-1}=0$$

$$H(z)=\frac{2+z^{-1}}{1+2z^{-1}}\Rightarrow \text{all pass filter}$$

29. Ans: (d)

Sol: For a stable system

1. $\int_0^\infty e^{-\alpha t}\,dt$ is finite
2. $\int |h(t)|\,dt$ is finite
3. Eigen values of the system are not positive and real
4. Roots of the characteristic equation lie in the left half of the s-plane.

30. Ans: (b)

Sol: 1. If the system is causal, h(t) = 0 for t < 0

2. If the system is time-variable, then the response of the system to an input of $\delta(t-T)$ is not $h(t-T)$ for all values of the constant T.
3. If the system is static or non-dynamic, then h(t) is of the form A $\delta(t)$, where the constant A depends on the system.

$\therefore$ Options (1) and (3) are correct.

31. Ans: (b)

Sol: (a) y(n) = x(n) Linear and causal → (3)

(b) y(n) = x(n2) Linear because y α x Non-causal y(−1) = x(1) → (2)

(c) y(n) = x2(−n) Nonlinear (squared x term) Non-causal y(−1) = x2(1) → (1)

(d) y(n) = x2(n) Non-linear (squared x term) Causal because y(n) depends on x(n) → (4)

32. 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.

33. Ans: (c)

Sol: A. Reconstruction

To convert the discrete time sequence back to a continuous time signal. → (2)

B. Over-sampling

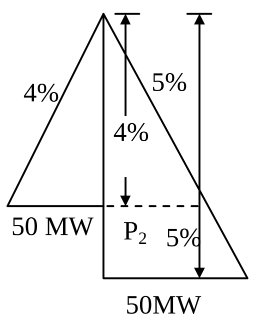
fs > > Nyquist rate → (1)

C. Interpolation

Assign values between samples → (3)

34. Ans: (c)

Sol:



$$\frac{P_2}{50} = \frac{4}{5} \Rightarrow P_2 = 40 \text{ MW}$$

∴ The maximum load the set can supply without over loading = 50 + 40 = 90 MW

35. Ans: (c)

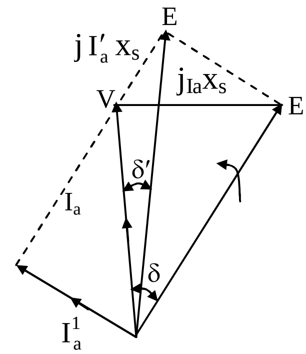
Sol: $P = \frac{EV}{X_s}\sin\delta \Rightarrow P \propto \sin\delta$

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

$$\Rightarrow \frac{2}{1} = \frac{\sin\delta_2}{\sin 30^0} \Rightarrow \delta_2 = 90°$$

36. Ans: (a)

Sol:



At UPF, $E\cos\delta = V$

If load decreases, $\delta\downarrow$, $\cos\delta\uparrow$

∴ $E\cos\delta > V \Rightarrow$ over excitation

$\Rightarrow$ Leading PF

$I_a\downarrow$, $\delta\downarrow$, PF → leading

37. Ans: (d)

38. Ans: (c)

Sol: Given p =6, slots =54

$$\therefore \text{ Pole pitch} = \frac{\text{slots(s)}}{\text{pole(p)}} = \frac{54}{6} = 9\,\text{slots}$$

Coil span = 6 slots

$$\text{Slot angular pitch } (\delta) = \frac{180^0}{(s/p)} = \frac{180^0}{9} = 20^0$$

Chording angle (ε) = 3 slots pitches

$$= 3 \times 20^0 = 60^0$$

$$\text{Pitch factor} = \cos\frac{\varepsilon}{2} = \cos\frac{60^0}{2}$$

$$= \cos 30^0 = \frac{\sqrt{3}}{2} = 0.866$$

39. Ans: (b)

40. Ans: (a)

Sol: $T_m/T_f = (a^2 + s^2)/2as$

Where s = Full load slip = 0.04

$a = R_2/X_2 = 0.01/0.1 = 0.1$

$T_m/T_f = ((0.1)^2 + (0.04)^2)/(2 \times 0.1 \times 0.04)$

$= 1.45$

41. Ans: (d)

42. Ans :(c)

Sol: I. Transformer core is made of cold rolled grain oriented steel

II. for parallel operation of transformers

Essential conditions

1. The same polarity
2. The same phase sequence
3. The relative phase displacement

Desirable conditions

1. The same voltage ratio
2. The same per unit impedance

III. As leakage flux is more, coefficient of coupling of transformer will decrease and also the inductive reactance drop will be increased

43. Ans: (b)

Sol: Due to the airgap, reluctance will be increased. So to maintain same flux the magnetizing current drawn from the source will be increased.

44. Ans: (b)

Sol: As airgap length is increased, reluctance and leakage flux will be increased.

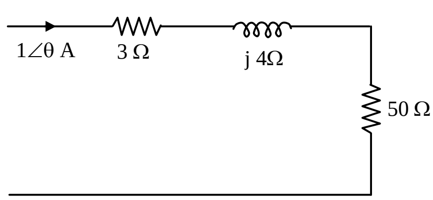
From this,

1. No load current drawn will be increased.
2. No load and full load power factors will be decreased

45. Ans: (c)

46. 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)

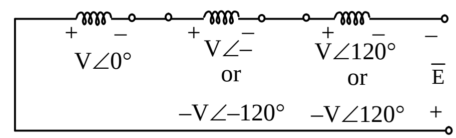
For 50 W; error is 3 W

Percentage error = 6

47. Ans: (d)

48. Ans: (c)

Sol:



Secondary open loop.

Fig.

From fig;

$$\bar{E} = V\angle 0 \pm V\angle 120° \pm V\angle 120°$$

We have 4 alternatives:

1) $\bar{E} = V\angle 0 + V\angle -120° + V\angle 120° = 0$

2) $\bar{E} = V\angle 0 + V\angle -120° - V\angle 120° = 2V\angle -60°$

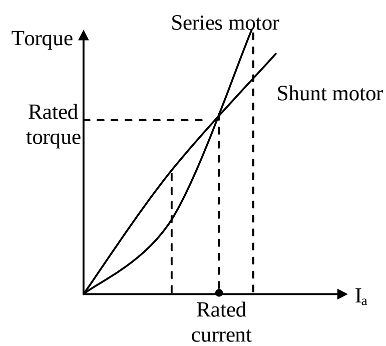
3) $\bar{E} = V\angle 0 - V\angle -120° + V\angle 120° = 2V\angle 60°$

4) $\bar{E} = V\angle 0 - V\angle -120° - V\angle 120° = 2V\angle 0°$

Thus, possible values of the voltage between the open terminals = 0 or 2 V.

49. Ans: (b)

Sol:



50. Ans: (b)

Sol: $x_2 \propto (N_{ph})^2 \Rightarrow x_2^1 = 4x_2$

$$T_{max} = \frac{3V^2}{\omega_s}\frac{1}{2x_2}$$

$$T_{max} \propto \frac{1}{x_2}$$

$$T_{max\ new} = \frac{1}{4}\ T_{max\ old}$$

51. Ans: (b)

Sol: Bushings are used to insulate winding terminals with transformer body.

52. Ans: (d)

Sol: In a dc compound machine, the series field usually has only a small number of turns with a large cross-section. Hence its resistance will be very small. Let us approximate it with a value of zero. Let the shunt and series field windings be interchanged. Then, with short shunt connection, the series field winding is directly across the armature, and it short-circuits the armature. The armature receives no voltage, it carries no current, and it will not run.

53. Ans: (d)

Sol: A pole pitch = 180° electrical

$\theta_m = ?$

we know that $\theta_e = \frac{P}{2}\theta_m$

$$\theta_m = \frac{2\times{}^{-}{}_{e}}{P} = \frac{2\times 180}{6} = 60^o$$

54. Ans: (c)

Sol: Torque Equation: $T_{em} = \frac{60}{2\pi N_s}\times 3I_r^2\frac{R_2}{S}$

$$T_{em} \propto \frac{I_r^2}{S}$$

Given starting torque (at S= 1) is equal to the full load torque (at S = 4%)

$$I_{st}^2 = \frac{I_{fl}^2}{S}$$

$$\Rightarrow \left(\frac{I_{st}}{I_{fl}}\right)^2 = \frac{1}{S}$$

$$\Rightarrow \left(\frac{I_{st}}{I_{fl}}\right)^2 = \frac{1}{0.04} \Rightarrow I_{st} = 5I_{fl}$$

55. Ans: (b)

Sol: Given magnetizing current at the same level

$\Rightarrow B = \text{Constant}$

$$\Rightarrow \frac{V}{f} = \text{Constant}$$

$$\Rightarrow \frac{V_1}{f_1} = \frac{V_2}{f_2}$$

$$\Rightarrow \frac{440}{50} = \frac{V_2}{25} \Rightarrow V_2 = 220V$$

56. Ans: (d)

Sol: Skewing of rotor slots in 3-phase induction motor makes the flux distribution uniform, hence reduces the slot harmonics. But by skewing the rotor slots, the stator slots will not be parallel; therefore, there will be additional leakage reactance.

57. Ans: (c)

58. Ans: (c)

Sol: At this slip machine is working as induction generator i.e, mechanical input energy is converted as electrical output energy.

59. Ans: (a)

60. Ans: (d)

Sol:

P ì 4: Even if field current is true, the salient pole synchronous machine will develop the reluctance torque by taking reluctance power from bus bar.

Q ì **6:** The effect of reactance voltage is neutralized by using commutating poles.

R ì 7: The motor cannot accelerate to its full speed but continues to run at a speed a little lower then the $1/7^{th}$ synchronous speed. The motor is now said to be crawling.

S ì 3: In plugging mode, armature terminals are reversed so that motor tends to run in the opposite direction speed gradually decreased.

T ì 5: Zero power factor method (or) potier method is used for alternator to find voltage regulation.

61. Ans: (d)

Sol: As frequency is reduced, the synchronous speed (speed of the rotating magnetic fields, 120f/P) decreases.

But for the induction motor as load is increased actual speed of the rotor must remain near to the synchronous speed (especially if V/f ratio's kept constant while frequency is reduced.

In the problem the actual speed of the rotor is given as 700 RPM. The synchronous speed must be the nearest higher value to this figure. For a 4 pole motor, for a frequency of 25 Hz; Synchronous speed is 750 RPM, which satisfies the above criterion.

(The number of pole P is not given, but the ratings specify 50 Hz and 1500 RPM, from which we can calculate P to be 4 and given that negligible series impedance which means motor is an ideal motor)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62. Ans: (b)

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

= synchronous speed

= speed at which stator mmf rotates ref stator

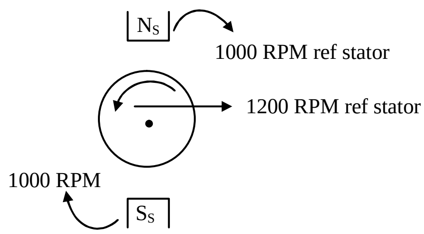

Fig .1

From fig.1 we see that the rotating field rotates relative to the rotor at (1000+ 1200) = 2200 rpm. Hence frequency of rotor emfs

= (PN/120) = (6 × 2200) /120 = 110 Hz.

63. Ans: (d)

Sol: A: Because of the nature of the hystersis loop of an iron core, iron cored transformer used in power systems draw a non-sinusoidal current (with harmonics) when given a sinusoidal voltage. (A-3)

B: In sumpner's test, full load conditions exist for both transformers (without using any actual load). Hence temperature rise can be studied. (B-4)

C: The secondary of a current transformer is always short-circuited. (C-1)

D: If an iron cored single-phase transformer (which is normally used in power applications) is switched on at an instant when the ac supply is going through zero, the core flux will be initially doubled. (This can be easily proved). (D-2)

64. Ans: (d)

65. Ans: (d)

Sol:
- Due to the usage of chamfered poles in salient-pole synchronous machine, the stator MMF wave is nearly sinusoidal.

õ In DC machine, stator MMF wave observed as "Trapezoidal" and armature MMF wave is "Triangular"

õ In squirrel-cage rotor of induction motor, due to the distributive & full pitch winding on rotor, air gap MMF wave becomes "sinusoidal"

66. Ans: (a)

Sol: Steady State stability limit is the maximum power that can be developed by synchronous machine without loosing its stability.

(a) The steady state stability is max for salient pole synchronous machine due to extra reluctance power

(b) The reluctance power is due to variable reluctance caused by non uniform airgap

(c) The airgap is minimum along d-axis, maximum along Q-axis.

$$P_{rel} = \frac{v^2}{2}\left(\frac{1}{x_q} - \frac{1}{x_d}\right) \qquad ; X_d > X_q$$

(d) Where as in non salient pole synchronous machine, air gap is uniform, $x_d = x_q$ and $P_{rel} = 0$

67. Ans: (b)

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

68. Ans: (c)

Sol: If it runs at synchronous speed, the motor will not get over loaded. Actually then there will be no relative speed, no rotor emfs, no rotor currents, and no developed torque, but there will be resisting torque opposing rotation (unless the motor is ideal and is on no load). For running at a steady speed, the developed torque must equal the resisting torque in magnitude. Hence the rotor slows down, until a torque is developed equal to the resisting torque.

69. Ans: (a)

70. Ans: (d)

Sol: The distribution transformers are designed for minimum core losses. because primary windings of distribution transformers are energized throughout the day.

71. Ans: (c)

Sol: VA rating of Δ/Δ bank = $3V_1I_1$ ……… (1)

VA rating of V/ V bank = $\sqrt{3}\ V_1\ I_1$ …… (2)

V_1 = phase voltage

I_1 = phase current

$$\frac{(kVA)_{V-V}}{(kVA)_{\Delta-\Delta}} = \frac{\sqrt{3}V_1I_1}{3V_1I_1} \Rightarrow 0.577$$

If 100% load is maintained on open delta bank, then each single transformer is overloaded by 73.2%.

72. Ans: (d)

73. Ans: (a)

Sol: A system is memory less if output, y(t) depends only on x(t) and not on past or future values of input, x(t). A system is causal if the output, y(t) at any time depends only on values of input, x(t) at that time and in the past.

Both **Statement–I** and **Statement–II** are true and **Statement–II** is the correct explanation of **Statement–I**.

74. Ans: (a)

Sol: $H(S)_{APF} = \frac{s-\alpha}{s+\alpha}$

75. Ans: (c)

Sol: FIR filters have linear phase only when it is symmetric/ anti symmetric.