ACE Engineering Academy

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ESE- 2019 (Prelims) - Offline Test Series Test-3

ELECTRONICS & TELECOMMUNICATION ENGINEERING

SUBJECT: SIGNALS & SYSTEMS AND BASIC ELECTICAL ENGINEERING SOLUTIONS

01. Ans: (d)

Sol: Given $y(n) = \sum_{k=-\infty}^{|2n|} x(k)$

$$y(-1) = \sum_{k=-\infty}^{2} x(k)$$

Present output depends on future input. So, system is non-causal.

For a bounded input u(n) system produces unbounded output(ramp). So, system is unstable.

02. Ans: (d)

Sol: $x(n) \leftrightarrow X(z)$, ROC: R

From time reversal property

$x(-n) \leftrightarrow X(z^{-1})$, ROC: $\frac{1}{R}$

So, ROC's are reciprocal to each other.

03. Ans: (c)

Sol: A. $Re\{x(n)\} \leftrightarrow X_e(e^{j\omega})$

B. $jImg\{x(n)\} \leftrightarrow X_0(e^{j\omega})$

C. $x_e(n) \leftrightarrow Re\{X(e^{j\omega})\}$

D. $x_0(n) \leftrightarrow jImg\{X(e^{j\omega})\}$

04. Ans: (b)

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

But from definition

$$H(z) = \sum_{n=-\infty}^{\infty} h(n)z^{-n}.$$

By comparing $h(0) = \frac{1}{2}, h(1) = \frac{1}{2}$

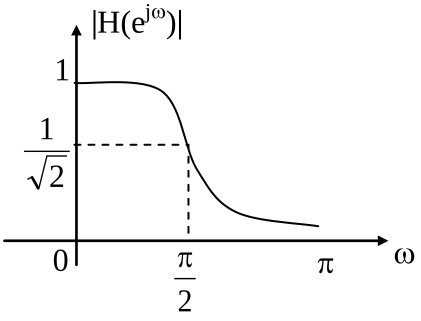
$$h(n) = \left\{\frac{1}{2}, \frac{1}{2}\right\}$$

It is having finite length impulse response. So, it is FIR filter.

Frequency response of above filter is

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

ω	$H(e^{j\omega})$	$\lvert H(e^{j\omega})\rvert$
0	1	1
$\frac{\pi}{2}$	$\frac{1}{2} - \frac{j}{2}$	$\frac{1}{\sqrt{2}}$
π	0	0



So, it is a low pass filter.

So, it is a FIR low pass filter.

05. Ans: (a)

Sol: A. $x(n) = \{1, 2, \underset{\uparrow}{2}, 1\}$. It is a finite duration both sided sequence. So, ROC is $0 < |z| < \infty$.

B. It is a finite duration right sided sequence, So, ROC is $|z| > 0$.

C. It is a finite duration left sided sequence, So, ROC is $|z| < \infty$.

D. The sequence is $x(n) = \delta(n)$ and the z-transform equal to 1 and ROC is entire z-plane.

06. Ans: (a)

Sol: (1) Number of stages in flow graph are $\log_2 N$.
So, statement (1) is wrong

(2) Number of butterflies in each stage are $\frac{N}{2}$.

(3) Number of complex multiplications are $\frac{N}{2}\log_2 N$.

(4) Number of complex additions are $N\log_2 N$.

(5) Inputs are bit reversal order, outputs are normal order.
So, statement (5) is false

07. Ans: (a)

Sol: Pole of analog filter is $s = -2$

Pole of digital filter is $z = e^{sT} = e^{-2(1)} = e^{-2}$

So, the transfer function of digital filter $H(z) = \dfrac{1}{1 - z^{-1}e^{-2}}$

08. Ans: (b)

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

$y(-1) = x(-2)$

$y(0) = x(-1)$

$y(1) = x(0)$

In all cases present output depends on past inputs, so causal system.

(b) $y(n) = 3x(n) + 2$

$y_1(n) = 3x_1(n) + 2$

$y_2(n) = 3x_2(n) + 2$

$y_3(n) = 3[\alpha x_1(n) + \beta x_2(n)] + 2$

$\alpha y_1(n) + \beta y_2(n) \neq y_3(n)$

So, Non-linear.

(c) $y(n) = 2x(n) + 5x(n-1)$

For a bounded input, system producing bounded output, so stable system.

(d) $y(n) = [x(n-1)]^2$

$y_1(n) = [x(n - 1 - n_0)]^2$

$y(n - n_0) = [x(n - n_0 - 1)]^2$

$y_1(n) = y(n - n_0)$, so time invariant

09. Ans: (b)

Sol: **A.** $te^{-at}u(t) \leftrightarrow \dfrac{1}{(s+a)^2}$

B. $x(at) \leftrightarrow \dfrac{1}{|a|}X\left(\dfrac{s}{a}\right)$

C. $\int x(t)y(t-z)dz = x(t) * y(t) \leftrightarrow X(s)Y(s)$

D. $\dfrac{dx(t)}{dt} \leftrightarrow sX(s)$

A → 3; B → 5; C → 2; D → 1

10. Ans: (b)

Sol: $x(n-n_0) \xleftrightarrow{DFT} W_N^{kn_0}X(k)$

$x(-n) \xleftrightarrow{DFT} X(N-k)$

$x((n+3))_4 \leftrightarrow W_4^{-3k}X(k)$

$x((-n+3))_4 \leftrightarrow W_4^{3k}X((-k))_4 = W_4^{3k}X(4-k)$

11. Ans: (c)

Sol: The larger side lobes of $W(e^{j\omega})$ results in the undesirable ringing effects in the FIR filter frequency response $H(e^{j\omega})$, and also in relatively large side lobes in $H(e^{j\omega})$.

12. Ans: (b)

Sol: There is a non-linear relation ship between analog and digital frequency in bilinear transformation method.

So, statement (2) is false, remaining all are true.

13. Ans: (d)

Sol: In CD playback system Bessel filter is used to pass frequencies below 20 kHz, while blocking frequencies above 88.2 kHz.

14. Ans: (a)

Sol: Given $C_n = \frac{1-\cos n\pi}{(n\pi)^2}$.

$$C_{-n} = \frac{1-\cos n\pi}{(n\pi)^2} = C_n$$

$C_{-n} = C_n$. So, $x(-t) = x(t)$.

So, x(t) is even signal.

15. Ans: (a)

Sol: Consider option (a)

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

$$x(t) = \frac{dy(t)}{dt} = 2e^{-t}\delta(t) - 2e^{-t}u(t)$$

From product property

$x(t)\,\delta(t - t_0) = x(t_0)\delta(t - t_0)$

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

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

16. Ans: (b)

Sol: $\delta(at+b) = \frac{1}{|a|}\delta\left(t+\frac{b}{a}\right)$

$$\int_{-4}^{2}\cos(2\pi t)\delta(2t+1)dt = \frac{1}{2}\int_{-4}^{2}\cos(2\pi t)\delta\left(t+\frac{1}{2}\right)dt$$

From SIFTING property

$$\int_{t_1}^{t_2} x(t)\delta(t-t_0)dt = x(t_0)\ ; \quad t_1 \le t_0 \le t_2$$

$$= 0 \qquad \text{otherwise}$$

$$\int_{-4}^{2}\cos(2\pi t)\delta(2t+1)dt = \frac{1}{2}\cos(2\pi t)\Big|_{t=-\frac{1}{2}}$$

$$= \frac{1}{2}\cos(\pi)$$

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

17. Ans: (b)

Sol: Even part of x(t) is $x_e(t) = \frac{x(t)+x(-t)}{2}$

$$x_e(t) = \frac{e^{-t}u(t) + e^{t}u(-t)}{2}$$

$$x_e(t) = \frac{1}{2}e^{-|t|}$$

18. Ans: (a)

Sol: Fourier transform pair is

$$e^{-\alpha|t|} \leftrightarrow \frac{2\alpha}{\alpha^2+\omega^2}$$

Inverse Fourier transform is

$$x(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(\omega)e^{j\omega t}d\omega$$

$$x(0) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(\omega)d\omega$$

Assume $X(\omega) = \frac{2\alpha}{\alpha^2+\omega^2}$, $x(t) = e^{-\alpha|t|}$

$$\int_{-\infty}^{\infty}\frac{2\alpha}{\omega^2+\alpha^2}d\omega = 2\pi x(0)$$

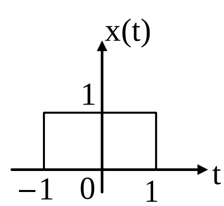
$$\int_{-\infty}^{\infty}\frac{1}{\omega^2+\alpha^2}d\omega = \frac{\pi}{\alpha}e^{-\alpha|0|} = \frac{\pi}{\alpha}$$

19. Ans: (c)

Sol: Assume $x(t) = u[1-|t|] = 1$; $1-|t| > 0$

$\Rightarrow |t| < 1$

$= 0$ otherwise



So, $x(t) = \text{rect}\left(\frac{t}{2}\right)$

$$A\text{rect}\left(\frac{t}{T}\right) \leftrightarrow AT\text{Sinc}(fT)$$

$$\text{rect}\left(\frac{t}{2}\right) \leftrightarrow 2\text{Sinc}(2f)$$

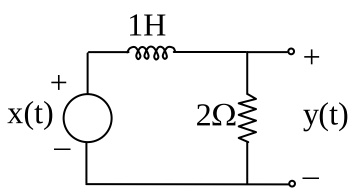
$$X(f) = 2\text{Sinc}(2f)$$

20. Ans: (c)

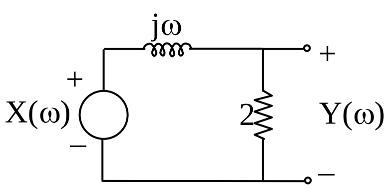
Sol: A signal is called energy signal if energy is finite and power is zero.
A signal is called power signal if power is finite and energy is infinite.
In the given statement 1, 2 and 3 are true.
But statement (4) is false. Because $u(t+2)u(2-t) = \text{rect}\left(\frac{t}{4}\right)$ is an energy signal.

21. Ans: (a)

Sol: Given circuit is



Apply Fourier transform to above circuit. Then



$$Y(\omega) = \frac{2X(\omega)}{2+j\omega}$$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = \frac{2}{2+j\omega}$$

Given $x(t) = t\,e^{-2t}\,u(t)$

$$X(\omega) = \frac{1}{(2+j\omega)^2}$$

$$Y(\omega) = X(\omega)H(\omega) = \frac{2}{(2+j\omega)^3}$$

$$t^n e^{-at}u(t) \leftrightarrow \frac{n!}{(j\omega+a)^{n+1}}$$

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

22. Ans: (b)

Sol: Given $y(n) = ay(n-1) + bx(n)$
Apply Z transform to above equation
$Y(z) = az^{-1}Y(z) + bX(z)$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{b}{1-az^{-1}}$$

$$H(z) = \sum_{n=-\infty}^{\infty} h(n)z^{-n}$$

$$H(1) = \sum_{n=-\infty}^{\infty} h(n)$$

But given $\sum_{n=-\infty}^{\infty} h(n) = 1$,

So, H(1) = 1

$$H(1) = \frac{b}{1-a} = 1$$

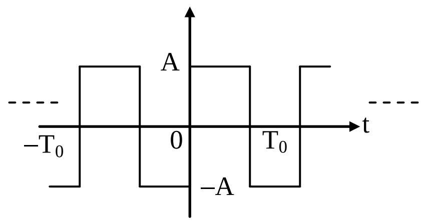
b = 1 – a

23. Ans: (a)

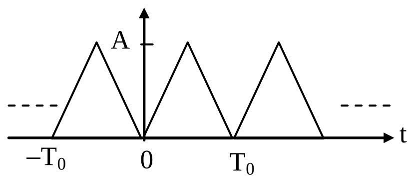
Sol: Fourier transform of impulse signal is Constant.
Fourier transform of rectangular function is Sinc function
Fourier transform of constant is impulse function.
Fourier transform of Gaussian pulse is also Gaussian pulse.

24. Ans: (c)

Sol: The convergence rate of Fourier series indicates how rapidly the reconstruction approaches the signal. So, statement 1 is correct.
The Gibbs effect is present for the signals with jumps. So, one of such function is square function.



Whose exponential Fourier series coefficient is $C_n \alpha \frac{1}{n}$. So, statement 2 is true.
The Gibbs effect is absent for the signals with no jumps. So, one of such function is triangular function.



Whose exponential fourier series coefficient is $C_n \alpha \frac{1}{n^2}$. So, statement 3 is true.

25. Ans: (b)

Sol: $H(z) = \frac{z^{-1} - \alpha^*}{1 - z^{-1}\alpha}$

$$H(e^{j\omega}) = \frac{e^{-j\omega} - \alpha^*}{1 - \alpha e^{-j\omega}}$$

$$H(e^{j\omega}) = e^{-j\omega}\left[\frac{1 - \alpha^* e^{j\omega}}{1 - \alpha e^{-j\omega}}\right]$$

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

$|H(e^{j\omega})| = 1$

So, magnitude response is constant.

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

So, $\angle H(e^{j\omega})$ is non linear function of frequency.

26. Ans: (c)

Sol: S_1: $e^{jn\frac{\pi}{2}} \rightarrow e^{jn\frac{\pi}{2}}u(n)$

For an LTI system if input is $Ae^{j\omega_0 n}$ then output is of the form $AH(e^{j\omega_0})e^{j\omega_0 n}$.

So,

S_1 is not LTI system

S_2: $e^{j\frac{n\pi}{2}} \rightarrow e^{j\frac{3\pi}{2}n}$, input and output frequencies are not same, so it is not LTI system.

S_3: $e^{j\frac{n\pi}{2}} \rightarrow 2e^{j\frac{5\pi}{2}n} = 2e^{j\frac{\pi}{2}n}$, input and output frequencies are same, so it is an LTI system.

27. Ans: (a)

Sol: $y(t) = x(t)\sin(50\pi t)$

Linear: Superposition principle

$y_1(t) = x_1(t)\sin(50\pi t)$

$y_2(t) = x_2(t)\sin(50\pi t)$

$y_3(t) = [x_1(t) + x_2(t)]\sin(50\pi t)$

$y_3(t) = y_1(t) + y_2(t)$

Superposition principle is satisfied

Scaling: $y_1(t) = [kx(t)]\sin(50\pi t)$

$= ky(t)$

Scaling property is satisfied

System is linear

Time invariance:

$y_1(t) = x(t - t_0)\sin(50\pi t)$

$y(t - t_0) = x(t - t_0)\sin(50\pi(t - t_0))$

$y_1(t) \neq y(t - t_0)$

Time variant

Causal: Present output depends on present input so, system is causal.

Static: Present output depends on present input, so system is static (Memory less).

Stable: For a bounded input, bounded output results, so system is stable.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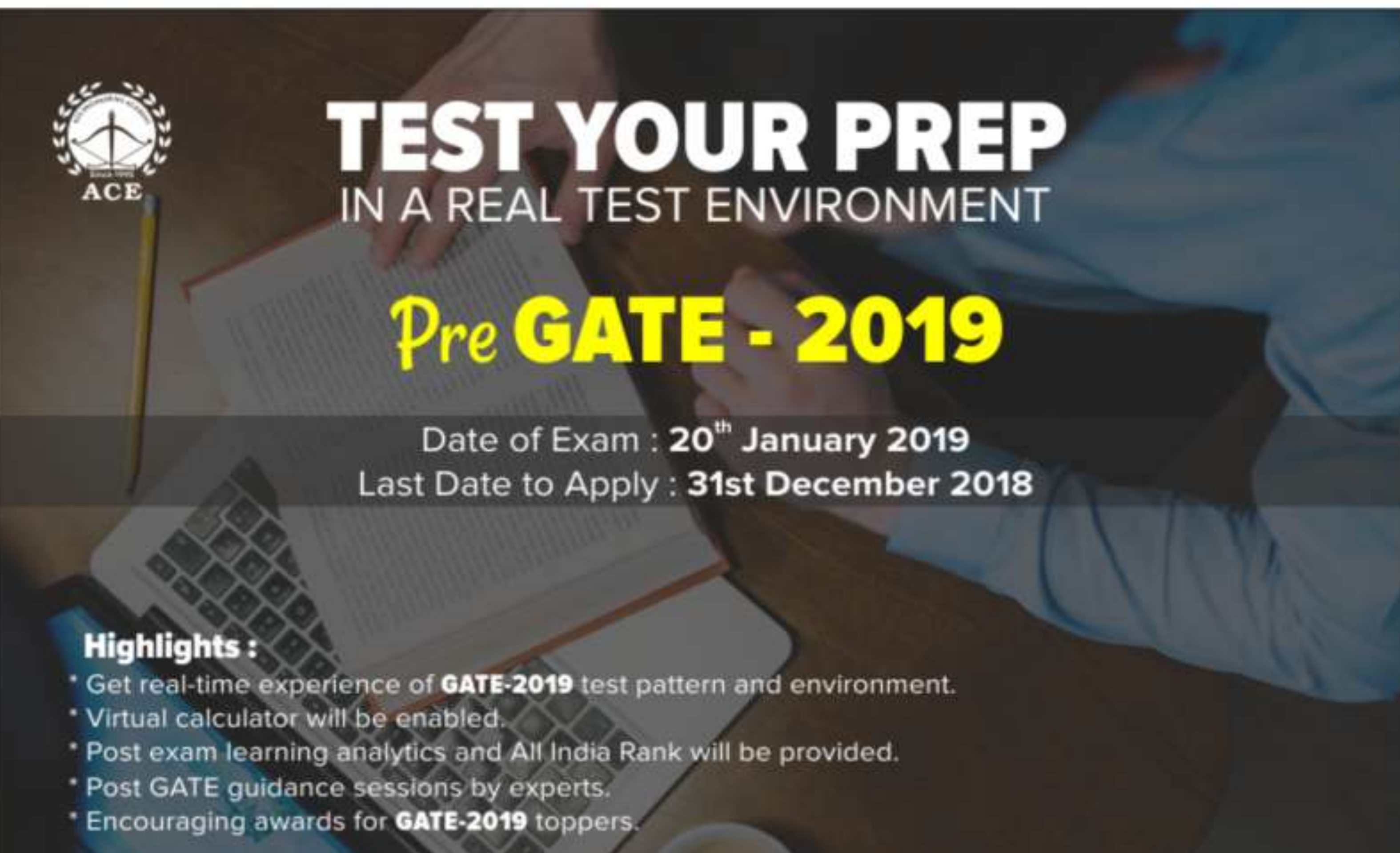
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28. Ans: (c)

Sol: A system is called minimum phase system, if all poles and zeros are lies on the left side of s-plane. A system is called stable if all poles lies on the left side of s-plane. So, Minimum phase systems are always stable and have smallest group delay. So, statement 1 is true.

A system is called mixed phase system, if one or more zeros lies on the right side of s-plane. So, statement 2 is false.

A system is called maximum phase system, if all zeros are lies on the right side of s-plane.

So, statement 3 is true

For system to be both causal & stable, all poles have negative real parts in the s-plane.

So, statement 4 is true

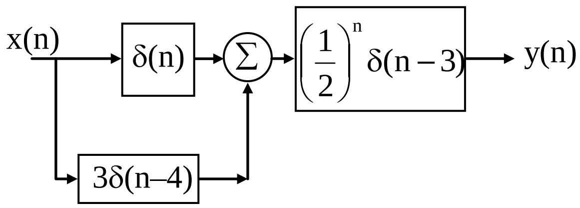
29. Ans: (a)

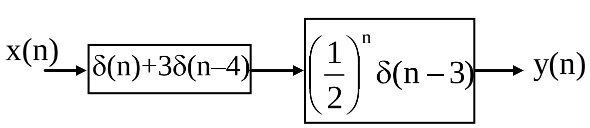
Sol:
1. All the finite poles of an FIR filter must lie at z = 0 .So, Statement (1) is true.
2. An FIR filter is always stable, because all poles lies inside the unit circle. So, Statement (2) is true.
3. A causal IIR filter can never display linear phase. So, Statement (3) is true.
4. Consider a causal filter whose impulse response is $h(n) = \delta(n-3)$.The impulse response of inverse filter is $h(n) = \delta(n+3)$,it is non-causal.

So, Statement (4) is false.

30. Ans: (d)

Sol:





$$h(n) = [\delta(n) + 3\delta(n-4)] * \left[\left(\frac{1}{2}\right)^n \delta(n-3)\right]$$

$$h(n) = \left[\left(\frac{1}{2}\right)^n \delta(n-3) + 3\left(\frac{1}{2}\right)^{n-4} \delta(n-7)\right]$$

$$h(3) = \left(\frac{1}{2}\right)^3 \delta(0) + 3\left(\frac{1}{2}\right)^{-1} \delta(-4)$$

$$h(3) = \frac{1}{8}$$

31. Ans: (b)

Sol: From multiplication of exponential in time domain property.

$$x(n) \leftrightarrow X(z)$$

$$(a)^n x(n) \leftrightarrow X(z/a)$$

$$(j)^n x(n) \leftrightarrow X(z/j)$$

From the given data

$$X(z) = \frac{k}{\left(z - \frac{3j}{2}\right)\left(z + \frac{3j}{2}\right)} = \frac{k}{z^2 + \frac{9}{4}}$$

$$X\left(\frac{z}{j}\right) = \frac{k}{\left(\frac{z}{j}\right)^2 + \frac{9}{4}} = \frac{k}{-z^2 + \frac{9}{4}} = \frac{-k}{z^2 - \frac{9}{4}}$$

Poles of $X\left(\frac{z}{j}\right)$ are $z^2 - \frac{9}{4} = 0$, $z = \pm\frac{3}{2}$

32. Ans: (b)

Sol: Assume $Y(k) = X^2(k)$

Apply IDFT

$y(n) = x(n)$ circular convolution $x(n)$

$$y(n) = \begin{bmatrix} 1 & 1 & -1 & 0 \\ 0 & 1 & 1 & -1 \\ -1 & 0 & 1 & 1 \\ 1 & -1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ -1 \\ 1 \end{bmatrix}$$

$y(n) = \{2, -2, -1, 2\}$

33. Ans: (c)

Sol: Using parseval's theorem

$$\int_{-\infty}^{\infty}|X(\omega)|^2 d\omega = 2\pi\int_{-\infty}^{\infty} x^2(t)dt$$

$$= 2\pi\left[\frac{2}{3}+\frac{2}{3}\right] = \frac{8\pi}{3}$$

34. Ans: (b)

Sol: % V.R = (%R) cos ϕ_2 ± (%x) sin ϕ_2

% V.R at 0.8 lagging p.f
= (1) (0.8) + (4) (0.6)
= 3.2 %

% V.R at 0.8 leading p.f
= (1) (0.8) –(4) (0.6) = –1.6 %

35. Ans: (d)

Sol: The approximate expression for regulation is given by $\frac{I}{V}(r_{eq}\cos\phi + x_{eq}\sin\phi)$

(Lagging loads only are considered since they cause more regulation). Differentiate w.r.t ϕ and equate to zero.

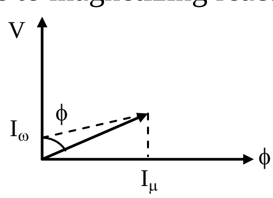
36. Ans: (b)

Sol: At maximum efficiency $P_{iron} = P_{cu}$

Total losses = $2P_{iron}$ = 2 × 3000 = 6000 W

37. Ans: (a)

Sol: At no load, power factor of transformer is poor due to magnetizing reactance.



So power factor angle is high, power factor is low

38. Ans: (d)

Sol: The power factor under no load condition is ≅ 0.2.

The power factor under S.C Test is ≅ 0.5 to 0.6.

39. Ans: (d)

Sol: $W_0 = V_1 I_0 \cos\phi_0$
= 230 × 5 × 0.25 = 287.5 watt

40. Ans: (b)

Sol: $B \propto \frac{V}{f}$

$\Rightarrow B\text{ (new)} = \frac{2.25V}{0.75f}$

$= \frac{225}{75} = 3$ Times

41. Ans: (c)

Sol: **The open - circuit test in a transformer can be used to obtain**

1. Core losses
2. Magnitude of exciting current
3. Equivalent shunt branch impedance

The short – circuit test in a transformer can be used to obtain

1. Copper losses
2. Equivalent series impedance

42. Ans: (b)

Sol: Speed of DC shunt motor, $N \propto \frac{E_b}{\phi}$ but both $E_b \propto V$ and $\phi \propto V$.

Since, during unsaturated condition

$\phi \neq$ constant

∴ As applied voltage 'V' is half

⇒ both E_b & ϕ becomes half, hence new speed of motor is doesn't change (i.e. 1000 rpm only).

43. Ans: (a)

Sol: $\phi_2 = \frac{\phi_1}{2}$, $N_2 = 2N_1$

$$E_g = \frac{z\phi N}{60}\times\frac{P}{A}$$

$E_g \propto \phi N$

$E_{g1} = \phi_1 N_1$

$$E_{g2} = \frac{\phi_1}{2} \times 2N_1$$

$E_{g2} = E_{g1}$

44. Ans: (a)

Sol: Compensating winding & Inter pole winding connected in series with the armature winding. Compensating flux is used to nullify the cross magnetization effect under polar axis i.e d-axis only but commutating poles flux used to compensate cross magnetization effect under inter polar region i.e. q-axis and also limits reactance voltage.

45. Ans: (c)

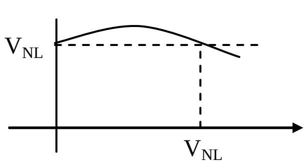
Sol: In cumulative compound dc motor,
$\phi = \phi_{sh} + \phi_{se}$, as field is short circuited 'ϕ' decreases, Then its speed increases.

46. Ans: (d)

Sol: (i) The graph drawn between induced voltage [E_g] and armature current (I_a) is called as internal characteristics.
(ii) The graph drawn between terminal voltage [V] and load current (I_L) is called as external characteristics.

47. Ans: (d)

Sol: A DC generator will be flat compounded if, its terminal voltage remains constant irrespective of the load current supplied by the generator.



48. Ans: (b)

Sol: **Lap winding** high current and low voltage rating.
Wave winding low current and high voltage rating.

49. Ans: (c)

Sol: For series motor, $\phi \propto I_a$

$T = \phi I_a \Rightarrow T \propto I_a^2$

Neglecting resistance drop, V = E constant

$$E = \frac{\phi ZNP}{60\,A}$$

$$N \propto \frac{1}{\phi} \propto \frac{1}{I_a}$$

$$T \propto \frac{1}{N^2}$$

50. Ans: (b)

Sol: A. Cumulatively compounded motor
---- Definite no-load speed
B. Differentially compounded motor
---- It may start in reverse direction
C. Series Motor
---- Never started without load
D. Shunt Motor
---- Fairly constant speed irrespective of the load

51. Ans: (b)

Sol: Given gross mechanical power developed
$P_{gmd} = 10$ kW
$P_{gmd} = P_{ro}$
Where P_{ro} is the rotor output power
Given slip (s) = 3% = 0.03
Air-gap power/Rotor input = ?
We have,
$P_{ri} : P_{rc} : P_{ro} = 1 : s : (1 - s)$

$$\Rightarrow \frac{P_{ro}}{P_{ri}} = (1-s)$$

$$\Rightarrow P_{ri} = \frac{1}{(1-s)} P_{ro}$$

$$= \frac{P_{gmd}}{(1-s)} = \frac{10}{1-0.03}$$

$$= \frac{10}{0.97}\text{ kW}$$

52. Ans: (c)

Sol: $\tau_{max} = \frac{180}{2\pi N_s}\frac{E_{20}^2}{2X_{20}}$

τ_{max} is independent of rotor winding resistance.

53. Ans: (c)

Sol: Rotor frequency (f_r) = $\frac{120}{60}$

= 2Hz (oscillations/sec).

As, $f_r = s.f$

$2 = (s).50 \Rightarrow s = 0.04 = 4\%$

54. Ans: (b)

Sol: $\frac{\text{Starting current drawn with star/delta starter}}{\text{Starting current with direct on line}} = \frac{1}{3}$

Therefore Starting Current of the motor by means of a star/delta = $\frac{1}{3}$ times the current with direct on line starting

55. Ans: (c)

Sol: Speed = Constant

$\therefore$ slip = constant and frequency = constant.

As we know torque T_e

$$= \frac{3}{\omega_s}\frac{V^2}{\left(\frac{r_2}{s}\right)^2 + x_2^2}\frac{r_2}{s}$$

$T_e \propto V^2$

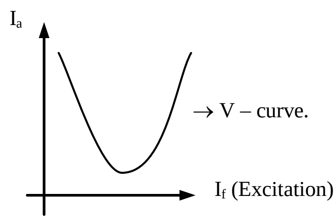
As slip (s) and frequency (f) are constants,

Impedance = constant

$\therefore I = \frac{V}{z} \Rightarrow I \propto V$

56. Ans: (a)

Sol:



57. Ans: (a)

Sol:

1. The armature mmf and field mmf rotate with same speed. The two mmf, i.e. armature mmf and field mmf must be stationary with respect to each other.
2. For zpf lag current, the armature mmf demagnetizes the main field mmf.
3. For zpf lead current, the nature of armature mmf is demagnetizing in motor.
4. For salient pole machine $X_d > X_q$.

$\therefore$ Statements 1 & 2 are correct

58. Ans: (b)

Sol: **Damper winding:**

Function in Alternators:

(i) To eliminate hunting.

(ii) To suppress the negative sequence field.

- Damper winding is made with low resistance copper, Aluminium or Brass.
- They are inserted in the slots made under the pole shoes.
- With respect to damper winding, the rotor behaves as squirrel cage rotor of induction motor Therefore induction machine action will comes into picture when the rotor speed is other than synchronous speed.

When the rotor speed is less than synchronous speed induction motor torque in same direction as that of rotor rotation so that rotor accelerate. More than synchronous speed induction generator torque in opposite direction that of rotor rotation, so that rotor decelerate.

59. Ans: (b)

Sol: The advantage of hydro electric plant over thermal power station is that operating cost of hydro-electric power station is low because of minimal fuel cost

60. Ans: (d)

Sol:

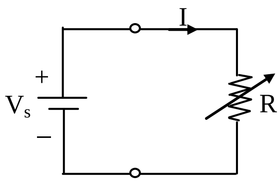


Fig.

$$I_1 = \frac{V_s}{R} = 0.5 \quad \text{or} \quad R = 2\,V_s$$

$$I_2 = \frac{V_s}{R+5} = 0.4 \;\; \text{or} \;\; \frac{V_s}{2V_s+5} = 0.4$$

$V_s = 0.8\,V_s + 2$

$$\Rightarrow V_s = \frac{2}{0.2} = 10\text{ V}$$

$\therefore$ R = 20 Ω

$$I_3 = \frac{V_s}{R+R_x} = 0.2$$

$$\frac{10}{20+R_x} = 0.2 \Rightarrow R_x = 30\,\Omega$$

61. Ans: (b)

Sol: Power Transmitted conductively

= K× Input power

= 0.8×3 kW

= 2.4 kW

62. Ans: (b)

Sol: If B_m = constant $\Rightarrow W_h \propto f$, $W_e \propto f^2$

Core loss = $Af + Bf^2$; A, B = constants

$50 = A(40) + B(40)^2$

$100 = A(60) + B(60)^2$

Solving A = 0.416, B = 0.0208

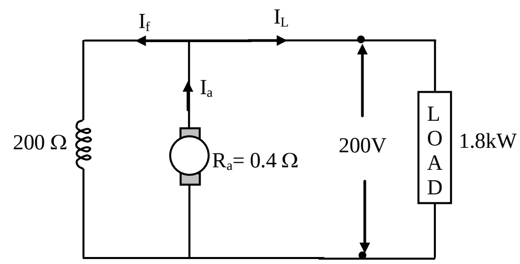
Now core loss at 50 Hz is

$W_e = (0.416)(50) + (0.0208)(50)^2$

W_e = 72.8 watts

63. Ans: (c)

Sol:



Generated EMF

$\Rightarrow E_g = V + I_a . R_a$ ……….. (1)

Electrical load, $P_L = V.I_L$ = 1.8 kW

$$\Rightarrow I_L = \frac{1800}{200} = 9A \quad I_f = \frac{V}{R_f} = \frac{200}{200} = 1A$$

For generator $\Rightarrow I_a = I_L + I_f$

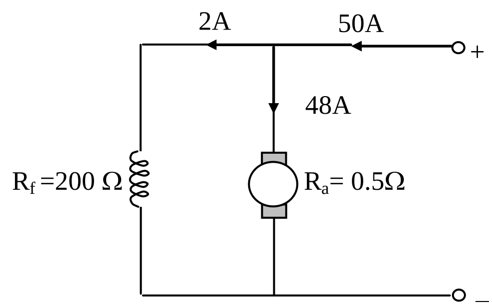
= 9A + 1A = 10A

From eq(1),

E_g = 200 + (10) (0.4) = 204 V

64. Ans: (a)

Sol:



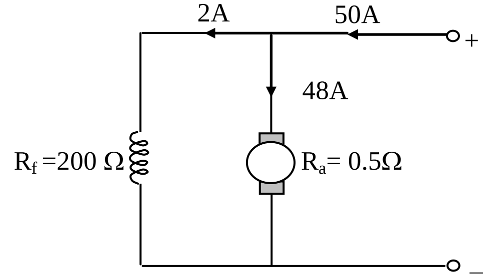
Shunt motor at no-load

$E_{b1} = V - I_{a1}.R_a$

$$I_{f1} = \frac{400}{200} = 2A \text{ For motor, } I_{a1} = I_L - I_{f1} = 3A$$

$\Rightarrow E_{b1}$ = 400– (3) (0.5)

= 398.5V



Shunt motor on Full load

$E_{b2} = V - I_{a2}.R_a$

$I_{f2} = \frac{400}{200} = 2A$

$I_{a2} = I_L - I_{f2} = 48$ A

$E_{b2} = 400 - (48)(0.5) = 376$ V

$$\frac{N(\text{Full Load})}{N(\text{No}-\text{Load})} = \frac{E_{b2}}{E_{b1}} \times \frac{\phi_2}{\phi_1}$$

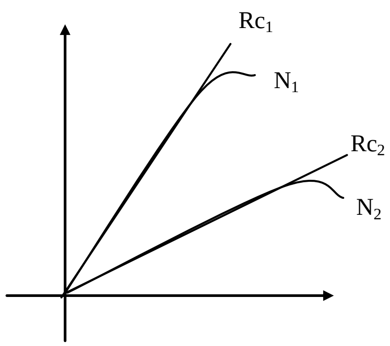
$$= \frac{376}{398.5} = 0.94$$

For shunt motor,

$\phi_2 = \phi_1 \quad [\because I_{f2} = I_{f1}]$

65. Ans: (c)

Sol:



$$\frac{R_{C2}}{R_{C1}} = \frac{N_2}{N_1}$$

Here R_c = Critical Resistance

N = Speed of the generator

$$\Rightarrow R_{c2} = \frac{1000}{800} \times 200 = 250\Omega$$

66. Ans: (d)

Sol: As the rotor resistance increase hence total circuit resistance increased, so stator current will decrease.

For constant torque load slip $\propto R_2 \Rightarrow$ as R_2 increases slip also increases.

67. Ans: (d)

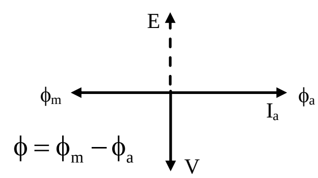
Sol: Synchronous motor under no-load operated at UPF $\Rightarrow$ E = V.

As field current is increased, 'E' is increased ($\because$ E $\propto I_f$)

$\therefore$ E > V called "overexcited synchronous motor".

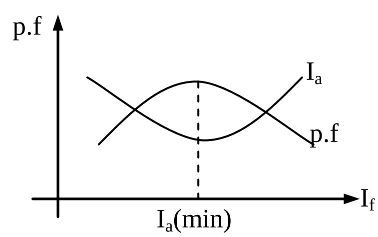
Over excited synchronous motor always de-magnetized and

operates at leading power factor.



(or)

From inverted 'V' curve we can choose answer directly.



68. Ans: (b)

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

69. Ans: (c)

Sol: FIR filters is always stable, because all poles lies inside the unit circle. So, Statement (I) is true.

FIR filters have linear phase only when it is symmetric/ anti symmetric. i.e, h(n) = h(N−1−n) or h(n) = −h(N−1−n), So, Statement (II) is false.

70. Ans: (b)

Sol: Sampling in one domain makes the signal to be periodic in the other domain. So, statement (I) is correct. According to multiplication in time domain property, multiplication in one domain is the convolution in the other domain. So, statement (II) is correct.

71. Ans: (c)

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

72. Ans: (c)

Sol: A 3-phase induction motor is basically a self starting motor. But the purpose of starters for 3-ϕ IM is not for starting torque, but starters are required to limit high starting currents.

One of the starter is star-delta starters, which reduces the starting current drawn from the supply to 1/3 value compared to delta.

73. Ans: (b)

Sol: Synchronous motor is a constant speed motor and always rotates at synchronous speed and Synchronous motor is not a self starting motor, because starting torque is zero. But develops good running torque.

This can be accomplished by three methods, namely

1. Auxiliary motor starting
2. Induction motor starting or damper winding starting
3. Synchronous-induction motor starting

Statement (I) and Statement (II) are individually correct and Statement (II) is not a reason to maintain motor speed constant

74. Ans: (c)

Sol: For a given kVA rating of transformer, more the design frequency, lesser the cross sectional area of the core and lesser will be the size and weight of transformer.

For a given kVA rating and designed frequency of transformer, superior the magnetic material used for transformer core, higher will be the flux density and lesser will be the size and weight of the transformer.

Copper loss is directly proportional to square of the current and resistance.

75. Ans: (c)

Sol: In general, a squirrel cage induction motor is preferred over a slip-ring induction motor due to following relative advantages.

i) A cage rotor requires considerably less conductor material than wound rotor consequently I^2R loss in cage rotor is less. Therefore, cage motor is a little more efficient than a wound rotor motor.

ii) Wound motor construction requires slip rings, brushes, short-circuiting devices etc., As a result of it, a wound rotor motor is costlier than a cage induction motor.

iii) A squirrel cage rotor has very small length of overhang there fore, it has low rotor overhang leakage flux. This has the effect of resulting in low leakage reactance X_2 for a cage rotor than for a wound rotor. So a cage motor has more pull-out torque, greater maximum power output and better operating power factor as compared to a wound rotor induction motor.

iv) Cage motor is more rugged and requires no slip rings, brushes etc., therefore, its maintenance charges are low.

v) cage rotor can be cooled better because of its bare end-rings.

But disadvantages are cage motor will have small starting torque for very large starting current and its poor starting power factor.

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