Signal system Objective Solution (ESE-2015 Test Series Dated 10.04.2015)

1. (C) $j = e^{j\pi/2}$

$x[n] = e^{j\frac{\pi}{2}\cdot\frac{n}{2}} = e^{jn\pi/4}$

$\omega_0 = \frac{\pi}{4} = \frac{2\pi}{N_0} \qquad N_0 = 8$

2. (C) $P\{X = x\} = \frac{e^{-\lambda}\cdot\lambda^x}{x!}$ where $\lambda \rightarrow$ mean = np

$P(x=1) = \frac{e^{-\lambda}\cdot\lambda}{1!} = e^{-\lambda}\cdot\lambda$

$P(x=2) = \frac{e^{-\lambda}\cdot\lambda^2}{2!}$

But $\frac{2e^{-\lambda}\cdot\lambda^2}{2!} = 2e^{-\lambda}\cdot\lambda$

$\lambda = 4 = \text{mean} = \text{variance}$

Standard deviation $= \sqrt{\text{variance}} = 2$

3. (B) $y[n] - \alpha y[n-1] = x[n] \qquad H(z) = \frac{1}{1-\alpha z^{-1}}$

Since it is anti causal signal;

ROC $\Rightarrow |z| < \alpha$ So $h[n] = -\alpha^n u[-n-1]$

4. (B) $y[n] = x[n+1] + x[n-1] - x[n-2]$

$Y[z] = zX(z) + z^{-1}X(z) - z^{-2}X(z)$

$H(z) = z + z^{-1} - z^{-2} \qquad \sum_{n=-\infty}^{\infty} h[n] \rightarrow$ finite

Finite sequence

$\therefore$ Stable and Non-causal

5. (A) Energy signal $\therefore$ Power = 0.

6. (C) DTFS – finite series and no convergence issue is there.

7. (A) $H(z) = 5 - 4z^{-1} + 3z^{-2} + 2z^{-3}$

Put $z = 1;$ $H(z) =$ finite (non-zero) = 6

$z = \infty;$ $H(z) = 5$

$\therefore$ Band stop filter

8. (A) For odd signal $X(0) = 0$ $X[-1] = -X[15] = -j$

9. (C) $X(s) = \frac{a\beta}{s+4} - \frac{\beta}{s-4} = \frac{a\beta s - 4a\beta - \beta s - 4\beta}{s^2-16} = \frac{16}{s^2-16}$

$= \frac{(a\beta-\beta)s - 4\beta(a+1)}{s^2-16}$

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$a-1=0 \qquad -4\beta(2)=16$

$a=1 \qquad \beta=-2$

10. (C)

11. (C) $H(z)=\dfrac{b_1+a_1z^{-1}}{a_1+b_1z^{-1}}$ for $a_0=b_1$ and $a_1=b_0$.

$|H(z)|=1.$

12. (B) $E=\dfrac{1}{5}\left[1^2+2^2+3^2+4^2+5^2\right]=\dfrac{55}{5}=11.$

13. (A) $x(t)=\sum_{k=-\infty}^{\infty} C_k\, e^{+jk\omega_0 t}$

$C_2=2e^{-j\pi}=-2 \qquad C_3=3e^{-j\pi}=-3$

$C_{-2}=2e^{-j\pi}=-2 \qquad C_{-3}=3e^{-j\pi}=-3$

$x(t)=\left(C_2e^{j\omega_0 t}+C_{-2}e^{-j\omega_0 t}\right)+\left(C_3e^{j\omega_0 t}+C_{-3}e^{-j\omega_0 t}\right)$

$x(t)=-2\cos\omega_0 t-3\cos\omega_0 t$

$x(t)\in \text{Real}$

14. (D)

15. (A) $x[n]=2\left(3^n\right)u[-n]=2\left(\dfrac{1}{3}\right)^{-n}u[-n]$

$X(\omega)=\dfrac{2}{1-\dfrac{1}{3}e^{j\Omega}}$

16. (A) $x(t)\longrightarrow e^{j\frac{2\pi t\alpha}{\beta}}$

$1\longrightarrow\delta(f)$

$e^{j\frac{2\pi\alpha t}{\beta}}\longrightarrow\delta\left(f-\dfrac{\alpha}{\beta}\right)$

17. (B) $x[n]=\cos\left(\dfrac{\pi n}{3}\right)u[n]=\dfrac{e^{j\pi n/3}+e^{-j\pi n/3}}{2}$

$x_1[n]=\dfrac{1}{2}\left(e^{j\pi/3}\right)^n u[n]$

$X_1(z)=\dfrac{1}{2}\left(\dfrac{1}{1-e^{j\pi/3}z^{-1}}\right) \qquad X_2(z)=\dfrac{1}{2}\left(\dfrac{1}{1-e^{-j\pi/3}z^{-1}}\right)$

$X(z)=\dfrac{1}{2}\left[\dfrac{1-e^{-j\pi/3}z^{-1}+1-e^{j\pi/3}z^{-1}}{\left(1-e^{-j\pi/3}z^{-1}\right)\left(1-e^{j\pi/3}z^{-1}\right)}\right]$

Causal signal $\therefore$ ROC greater than greater pole. $\therefore \qquad |z|>1$

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18. (A)

19. (D) $x(t)=e^{-at^2}$ put a=π

$e^{-\pi t^2} \longrightarrow e^{-\pi f^2}$

Put $e^{-\pi t^2} \longrightarrow e^{-\pi f^2}$

20. (B) $x[7]=x^*[1]=1+j3 \quad x[8]=x^*[0]=5$

21. (B) Here b/a=-2 and signal is shifted in right hand side so b=-6

22. (A) Random variable always map on real line not on complex line.

23. (C) $X(z)=\dfrac{5-7z}{1+3z-2z^2}$

$$1+3z-2z^2 \;\overline{)\;5-7z}$$
$$\underline{5+15z-2z^2}$$
$$-22z+2z^2$$

$$X(z)=5-\left(\frac{22z-10z^2}{1+3z-2z^2}\right)$$

$z=\dfrac{3\pm\sqrt{9+8}}{4}$ One pole on right and one on left.

24. (A) $I=\int_{-\infty}^{\infty}\delta'(t)dt$ If $x(t)=1 \quad \Rightarrow \quad -\int_{-\infty}^{\infty}\delta'(t)dt=0$

25. (D)

26. (C) In a continuous Random variable, probability of event any particular point is always zero.

27. (C) It is non periodic

28. (A) Sum of all values of y[n] = Sum of all values of $h[n]X$ Sum of all values of $x[n]$

29. (A)

30. (D)

$x[n]=2^{|n|}=2^n u[n]+2^{-n}u[-n-1]$

No common ROC

31. (B) $H(z)=\left(\dfrac{2z^{-6}}{z-1}\right) \qquad H_1(z)=\dfrac{2-1}{2z^{-6}}$

$h_1[n]=\dfrac{1}{2}[\delta(n+7)-\delta(n+6)]$

32. (B)

33. (C)

34. (D)

35. (C) $x_{odd}=\dfrac{1}{2}[x[n]-x[-n]]$

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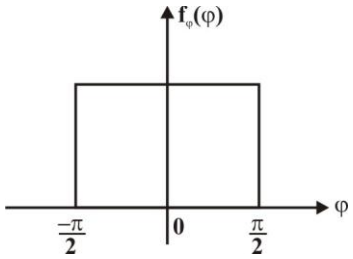
36. (A)

37. (A) $\phi \propto \omega \Rightarrow \phi = k\omega \qquad t_p = k \qquad t_g = k$

38. (B) $\int_{-\infty}^{\infty} \left(x_1(t)+x_2(t)\right)^2 dt = \int_{-\infty}^{\infty} x_1^2(t)dt + \int_{-\infty}^{\infty} x_2^2(t)dt + 2\int_{-\infty}^{\infty} x_1(t)x_2(t)dt = 8+4+2 = 14$

39. (B)



$$f_\varphi(\varphi) = \frac{1}{\pi};\ \ \frac{-\pi}{2} < \varphi < \frac{\pi}{2}$$

$$E\left[g(x)\right] = \int_{-\infty}^{\infty} g(x) f_X(x)dx$$

$$E\left[\sin(\omega t+\varphi)\right] = \int_{-\pi/2}^{\pi/2} \frac{\sin(\omega t+\varphi)}{\pi} d\varphi$$

$$= -\frac{1}{\pi}\left[\cos\left(\omega t+\frac{\pi}{2}\right) - \cos\left(\omega t-\frac{\pi}{2}\right)\right]$$

$$= \frac{1}{\pi}\left[-\sin\omega t - \sin\omega t\right] = \frac{2}{\pi}\sin\omega t$$

40. (C)

41. (B) Value is defined but final value theorem is not applicable.

42. (C) $x_1[n] = \alpha(0.5)^n u(n)$

$$E_1 = \sum_{n=0}^{\infty} \alpha^2 \cdot (0.5)^{2n} = \sum_{n=0}^{\infty} \alpha^2 (0.25)^n \qquad E_2 = 1.5+1.5 = 3$$

$$= \frac{\alpha^2}{1-0.25} = \frac{4}{3}\alpha^2$$

$$\frac{4\alpha^2}{3} = 3 \qquad \alpha = 1.5$$

43. (B) Just take common are

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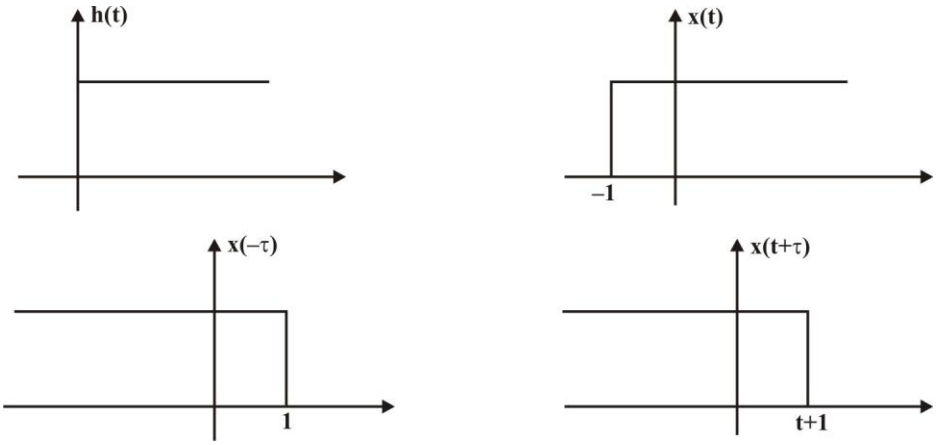
44. (D)



Common portion from 0 to (t + 1).

45. (B) $H_2(s)=\dfrac{s^2-as+b}{s^2+as+b}\rightarrow$ 2nd order all pass filter

46. (B)

47. (C)

48. (C) Absolutely Summable – Stable ROC will contain unit circle Non – causal.

49. (B) In Ist system $x[k+2]$ is not present.

50. (D)

51. (C) Not low pass Time limited not band limited

52. (A)

53. (D) $x(t)=e^{-at}u(t)$

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

$$X(\omega)=\frac{1}{a-j\omega}=X(-\omega)\rightarrow \text{Conjugate symmetric}$$

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

$$X_R=\frac{a}{a^2+\omega^2} \qquad X_I=-\frac{\omega}{\omega^2+a^2}$$

$$X_I(\omega)=\frac{-j\omega}{\omega^2+a^2}$$

54. (C)

55. (C) Discontinuities will be finite only

56. (D) $P=C_0^{\,2}+2C_1^{\,2}=1+2=3.$

57. (A) SNR ↑, probability of error ↓

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58. (C)

$$H(j\omega) = \underset{\downarrow}{H_1(j\omega)} + j\underset{\downarrow}{H_2(j\omega)}$$

Im and odd Real

Overall Purely Imaginary

59. (D) $\left(\frac{1}{2}\right)^n \rightarrow \frac{1}{1-\frac{1}{2}z^{-1}} = \frac{2z}{2z-1}$

$$x\left(\frac{1}{2}\right)^n = -\frac{d}{dz}\left(\frac{2z}{2z-1}\right)$$

$$X(0) = 2$$

60. (B) $x(t) = e^{-jt}$

$$1 \rightarrow 2\pi\delta(\omega)$$

$$e^{-jt} \rightarrow 2\pi\delta(\omega+1) \qquad H(j\omega) = -j2\omega$$

$$Y(\omega) = 2\pi\delta(\omega+1)X - j2\omega$$

$$Y(\omega) = -4\pi j\omega\,\delta[\omega+1]$$

$$Y(\omega) = j\omega\left[-4\pi\delta(\omega+1)\right]$$

$$y(t) = \frac{d}{dt}\left(-2e^{-jt}\right) = 2je^{-jt}$$

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