Signali i sustavi

Prvi međuispit (grupa A) – 24. ožujka 2011.

1. Totalna snaga vremenski kontinuiranog signala $x(t) = 2 + 4\sin(t)$ je:

a) 2 **b)** 4 **c)** 6 **d)** 12 **e)** 20

2. Energija vremenski diskretnog signala $x(n) = \left(\frac{1}{5}\right)^{2n}\mu(n)$ je:

a) $\frac{24}{25}$ **b)** $\frac{624}{625}$ **c)** $\frac{25}{24}$ **d)** $\frac{625}{624}$ **e)** $+\infty$

3. Totalna snaga vremenski diskretnog signala $x(n) = 4 + 2\sin\left(\frac{\pi}{3}n\right)$ je:

a) 4 **b)** 6 **c)** 16 **d)** 18 **e)** 20

4. Koji od zadanih signala NIJE periodičan?

a) $\cos(\pi t)$ **b)** $\cos(3\pi t) + \sin(5\pi t)$ **c)** $\cos(3\pi t) + \sin(3t)$ **d)** $\cos(3t) + \cos(5t)$ **e)** $\mathrm{tg}\left(\frac{\pi}{5}t\right)$

5. Samo jedna od navednih tvrdnji NE VRIJEDI za Diracovu distribuciju $\delta(t)$. Koja?

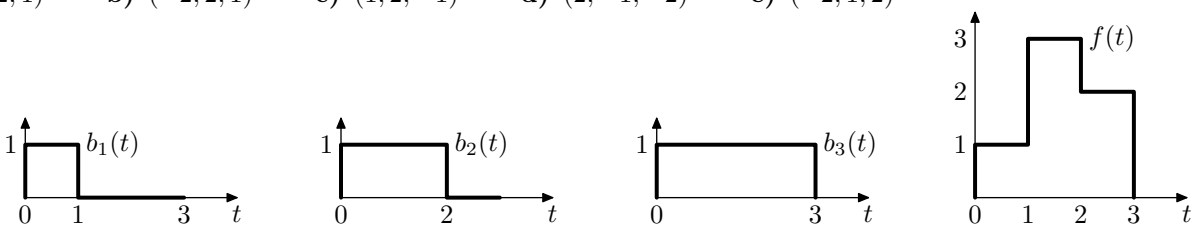
a) Za glatku $f(t) : \mathbb{R} \to \mathbb{R}$ vrijedi $\int_{-\infty}^{+\infty} f(t)\,\delta(t)\,dt = f(0)$.
b) Diracova distribucija je parna distribucija.
c) Za glatku $f(t) : \mathbb{R} \to \mathbb{R}$ vrijedi $\int_{-\infty}^{+\infty} f(t)\,\delta'(t)\,dt = -f'(0)$.
d) Generalizirana derivacija Heavisideove step funkcije je Diracova distribucija, odnosno $\mu'(t) = \delta(t)$.
e) Za glatku $f(t) : \mathbb{R} \to \mathbb{R}$ vrijedi $f(t)\,\delta(t - t_0) = f(t_0)$.

6. Generalizirana derivacija signala $f(t) = \mu(4 - t) + \mu(t) + (t-2)^2\big(\mu(t-2) - \mu(t-4)\big)$ je:

a) $-\delta(t-4) + \delta(t) + 2(t-2)\big(\mu(t-2) - \mu(t-4)\big) - 4$ **b)** $-5\,\delta(t-4) + \delta(t) + 2(t-2)\big(\mu(t-2) - \mu(t-4)\big)$
c) $-3\,\delta(t-4) + \delta(t) + 2(t-2)\big(\mu(t-2) - \mu(t-4)\big)$ **d)** $2(t-2)\big(\mu(t-2) - \mu(t-4)\big)$ **e)** $2(t-2)\big(\mu(t-2) - \mu(t-4)\big) - 4$

7. Signal $f(t) : [0,3] \to \mathbb{R}$ prikazujemo kao linearnu kombinaciju tri osnovna signala $b_1(t) : [0,3] \to \mathbb{R}$, $b_2(t) : [0,3] \to \mathbb{R}$ i $b_3(t) : [0,3] \to \mathbb{R}$. Kako glasi linearni rastav signala $f(t)$ po osnovnim signalima?

a) $(-1, 2, 1)$ **b)** $(-2, 2, 1)$ **c)** $(1, 2, -1)$ **d)** $(2, -1, -2)$ **e)** $(-2, 1, 2)$



8. Promatramo signal $x(t) = \sin(20\pi t) + \cos(40\pi t) + \sin(60\pi t)$. Kojim periodom očitanja T_S moramo očitati taj signal da ne dođe do preklapanja spektra?

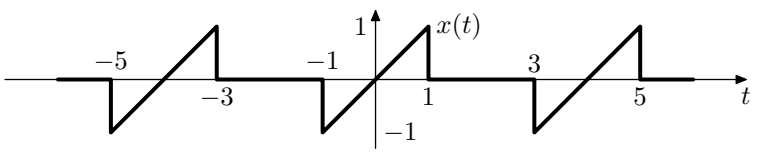
a) $T_S > 20$ **b)** $T_S > 60$ **c)** $T_S < 1/20$ **d)** $T_S < 1/60$ **e)** Ne postoji takav period T_S!

9. Zadan je signal $x(t) = 3\sin(2t) + 2\cos\left(3t + \frac{\pi}{3}\right)$. Amplitudni i fazni spektar za $k = 2$ i $k = -3$ su:

a) $A_2 = \frac{3}{2}$, $\phi_2 = \frac{\pi}{2}$, $A_{-3} = 1$, $\phi_{-3} = \frac{\pi}{3}$ **b)** $A_2 = \frac{3}{2}$, $\phi_2 = -\frac{\pi}{2}$, $A_{-3} = 1$, $\phi_{-3} = -\frac{\pi}{3}$
c) $A_2 = \frac{3}{2}$, $\phi_2 = -\frac{\pi}{2}$, $A_{-3} = 1$, $\phi_{-3} = \frac{\pi}{3}$ **d)** $A_2 = 3$, $\phi_2 = \frac{\pi}{2}$, $A_{-3} = 2$, $\phi_{-3} = \frac{\pi}{3}$
e) $A_2 = 3$, $\phi_2 = 0$, $A_{-3} = 2$, $\phi_{-3} = \frac{\pi}{3}$

10. Za vremenski kontinuirani i periodčan signal $x(t)$ perioda 4 zadan slikom izračunaj NULTI i DRUGI član rastava u Fourierov red.

a) $(X_0, X_2) = (1, -\frac{2j}{\pi^2})$ **b)** $(X_0, X_2) = (0, -\frac{1}{2\pi})$ **c)** $(X_0, X_2) = (0, -\frac{j}{2\pi})$ **d)** $(X_0, X_2) = (0, -\frac{j}{\pi^2})$
e) $(X_0, X_2) = (1, \frac{2}{\pi^2})$



11. Snaga signala iz prethodnog zadatka je:

a) 0 **b)** $\frac{1}{9}$ **c)** $\frac{1}{6}$ **d)** $\frac{2}{3}$ **e)** 1

12. Izračunaj vremenski kontinuiranu Fourierovu transformaciju (CTFT) signala $f(t) = e^{-2t}\,\mu(t) + e^{3t}\,\mu(-t)$.

a) $F(j\omega) = \dfrac{-5}{6+\omega^2+j\omega}$ **b)** $F(j\omega) = \dfrac{5}{6+\omega^2-j\omega}$ **c)** $F(j\omega) = \dfrac{5}{6+\omega^2+j\omega}$ **d)** $F(j\omega) = \dfrac{5}{\sqrt{(6+\omega)^2+\omega^2}}$
e) $F(j\omega) = \dfrac{1}{2+j\omega}$

13. Zadan je spektar $X(j\omega) = 4\big(\mu(\omega+2\pi) - \mu(\omega-2\pi)\big)$. Signal čiji je to spektar je:

a) $x(t) = \frac{8}{t}\sin(2\pi t)$ **b)** $x(t) = -\frac{4}{\pi t}\sin(2\pi t)$ **c)** $x(t) = \frac{4}{\pi t}\sin(2\pi t)$ **d)** $x(t) = \frac{4}{\pi t}\cos(2\pi t)$
e) $x(t) = 4\,\delta(t) - \frac{4}{j\pi t}\cos(2\pi t)$

14. Energija signala iz prethodnog zadatka je:

a) 8 **b)** 32 **c)** 16π **d)** 64π **e)** $+\infty$

15. Zadan je vremenski diskretan periodičan signal $x(n) = \sin\big(\frac{\pi}{55}n\big)$. Temeljni period signala N i temeljni period spektra K su:

a) $(N,K) = (55,55)$ **b)** $(N,K) = (55,110)$ **c)** $(N,K) = (110,110)$ **d)** $(N,K) = (220,110)$
e) $(N,K) = (110,220)$

16. Jedan period periodičnog signala perioda $N = 6$ je $x(n) = \begin{cases} 2\sqrt{3}n, & n \in \{-2,-1,0,1,2\} \\ 6, & n = 3 \end{cases}$. Prva dva člana spektra su:

a) $X_0 = 0,\ X_1 = 6$ **b)** $X_0 = 1,\ X_1 = -1-3j$ **c)** $X_0 = 1,\ X_1 = -1+3j$ **d)** $X_0 = 1,\ X_1 = -1+j$
e) $X_0 = 1,\ X_1 = -1-j$

17. Zadan je vremenski diskretan periodički signal $x(n) = \cos\big(\frac{\pi}{12}n\big) - \sin\big(\frac{3\pi}{4}n\big)$. Petnaesti član spektra je:

a) $X_{15} = \frac{1}{2}e^{-j\pi/2}$ **b)** $X_{15} = \frac{1}{2}e^{j\pi/2}$ **c)** $X_{15} = 0$ **d)** $X_{15} = e^{j\pi/2}$ **e)** $X_{15} = e^{-j\pi/2}$

18. Jedan period spektra vremenski diskretne Fourierove transformacije (DTFT) je $X(e^{j\Omega}) = \begin{cases} e^{-|\Omega|}, & \Omega \in [-a,a] \\ 0, & \Omega \in \langle -\pi,-a\rangle \cup \langle a,\pi] \end{cases}$.
Signal čiji je to spektar jest:

a) $x(n) = \frac{1}{\pi}\frac{1}{1+n^2}\Big(1 + e^{-a}\big(n\sin(an) - \cos(an)\big)\Big)$ **b)** $x(n) = \frac{1}{\pi}\frac{1}{1+n^2}\Big(1 + e^{-a}\big(\sin(an) - n\cos(an)\big)\Big)$
c) $x(n) = \frac{1}{\pi}\frac{1}{1+n^2}\Big(1 + e^{-a}\big(\sin(an) - \cos(an)\big)\Big)$ **d)** $x(n) = \frac{1}{\pi}\frac{1}{1+n^2}\Big(1 + e^{-a}\big(\cos(an) - \sin(an)\big)\Big)$
e) $x(n) = \frac{1}{\pi}\frac{1}{1+n^2}$

19. Promatramo vremenski diskretan signal čiji jedini uzorci različiti od nule su $\{1,3,\underline{4},3,1\}$ (podcrtani član je uzorak za korak $n = 0$). Vremenski diskretna Fourierova transformacija zadanog signala je:

a) $X(e^{j\Omega}) = \frac{2}{\pi} + \frac{3}{\pi}\cos(\Omega) + \frac{1}{\pi}\cos(2\Omega)$ **b)** $X(e^{j\Omega}) = 4 + 6\cos(\Omega) + 2\cos(2\Omega)$
c) $X(e^{j\Omega}) = 4 + 6j\sin(\Omega) + 2j\sin(2\Omega)$ **d)** $X(e^{j\Omega}) = \frac{2}{\pi} + \frac{3j}{\pi}\cos(\Omega) + \frac{j}{\pi}\cos(2\Omega)$
e) $X(e^{j\Omega}) = 4 + 3\cos(\Omega) + \cos(2\Omega)$

20. Zadan je vremenski diskretni signal $x(n) = 2^n\,\mu(-n)$. Vremenski diskretna Fourierova transformacija (DTFT) zadanog signala je:

a) $X(e^{j\Omega}) = \dfrac{1}{1+2e^{-j\Omega}}$ **b)** $X(e^{j\Omega}) = \dfrac{2}{2+e^{-j\Omega}}$ **c)** $X(e^{j\Omega}) = \dfrac{2}{1-e^{-j\Omega}}$ **d)** $X(e^{j\Omega}) = \dfrac{1}{1-2e^{j\Omega}}$
e) $X(e^{j\Omega}) = \dfrac{2}{2-e^{j\Omega}}$