

ES 1

Rappresentare lo spettro dei seguenti segnali

1) $y = 3 \cdot \cos(2 \cdot \pi \cdot 10 \cdot t)$

2) $y = \cos\left(12.56 \cdot t + \frac{\pi}{3}\right)$

3) $y = \cos\left(12.56 \cdot t + \frac{7}{3}\pi\right)$

4) $y = \sin\left(2 \cdot \pi \cdot 9 \cdot t + \frac{\pi}{3}\right)$

5) $y = 5 \cdot \cos\left(2 \cdot \pi \cdot 6 \cdot t - \frac{\pi}{3}\right) + 5$

6) $y = 5 \cdot \cos\left(2 \cdot \pi \cdot 6 \cdot t - \frac{\pi}{3}\right) - 5$

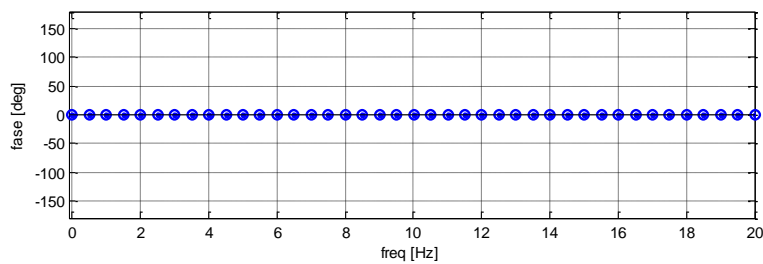
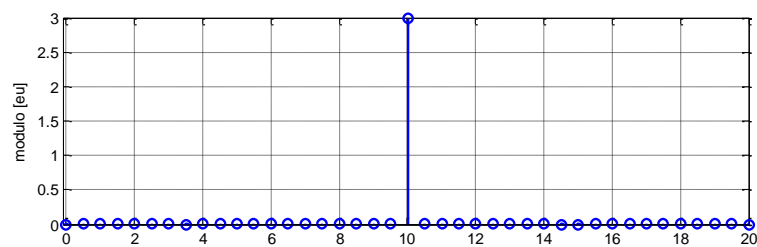
7) $y = -5 \cdot \cos\left(2 \cdot \pi \cdot 6 \cdot t - \frac{\pi}{3}\right) - 5$

8) $y = 3 \cdot \cos\left(2 \cdot \pi \cdot 5 \cdot t + \frac{\pi}{6}\right) + \cos\left(2 \cdot \pi \cdot 14 \cdot t - \frac{\pi}{3}\right) + 2$

9) $y = 2 \cdot \cos\left(2 \cdot \pi \cdot 10 \cdot t + \frac{\pi}{3}\right) - \sin(2 \cdot \pi \cdot 14 \cdot t) + 8$

SOLUZIONI ES 1

1)

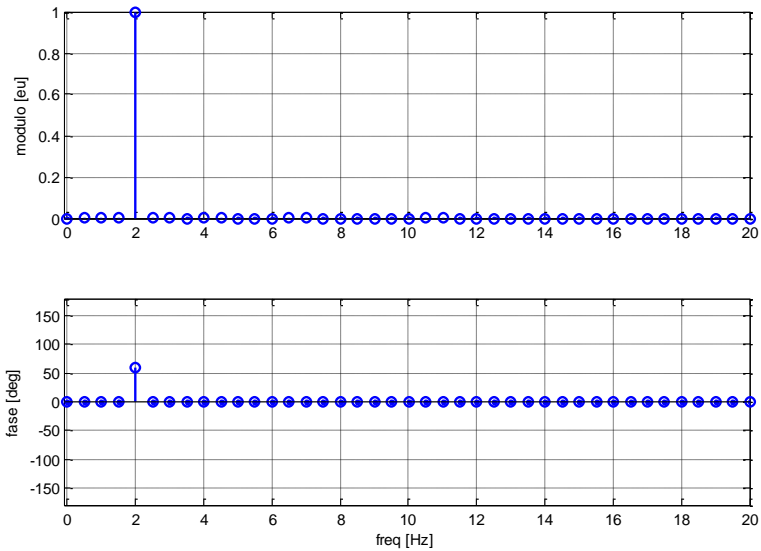


2)

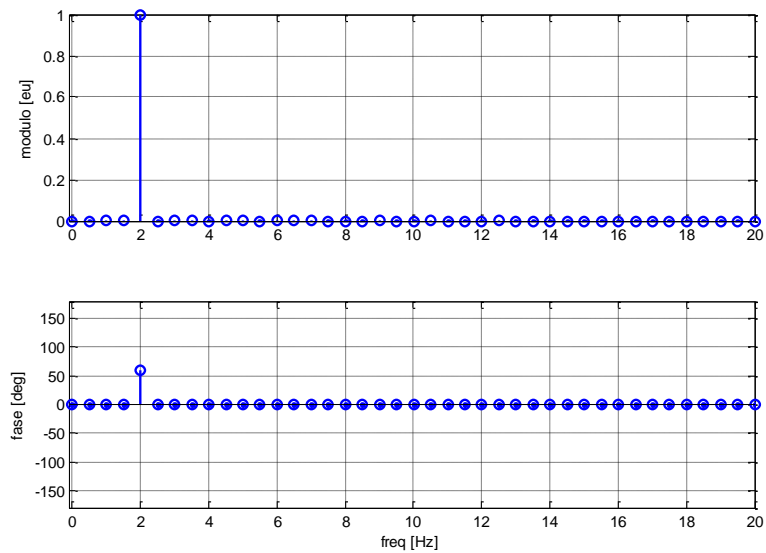
$$\omega = 12.56 \text{ rad/s}$$

$$\omega = 2\pi f$$

$$f = \frac{\omega}{2\pi} = 2 \text{ Hz}$$



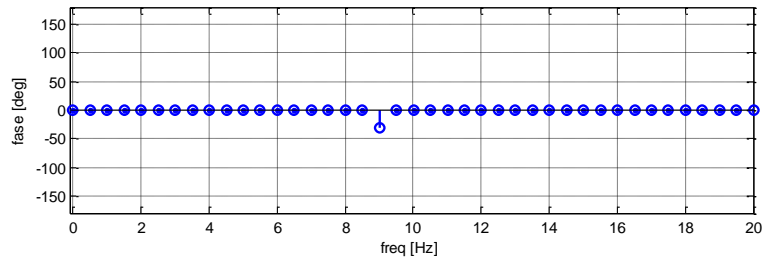
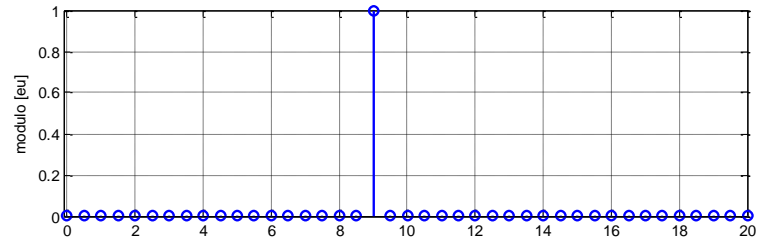
3)



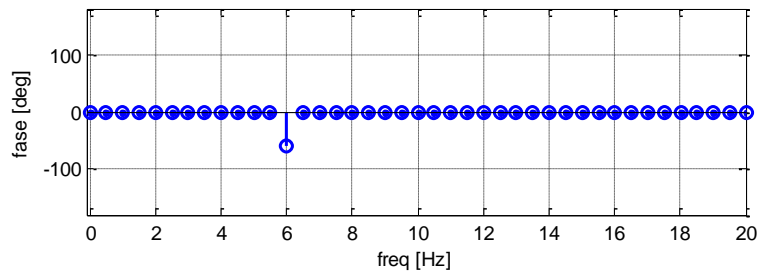
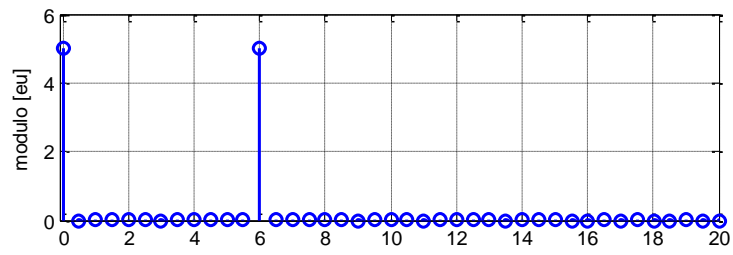
4)

$$\sin(\alpha) = \cos\left(\frac{\pi}{2} - \alpha\right) \quad \text{e} \quad \cos(-\alpha) = \cos(\alpha)$$

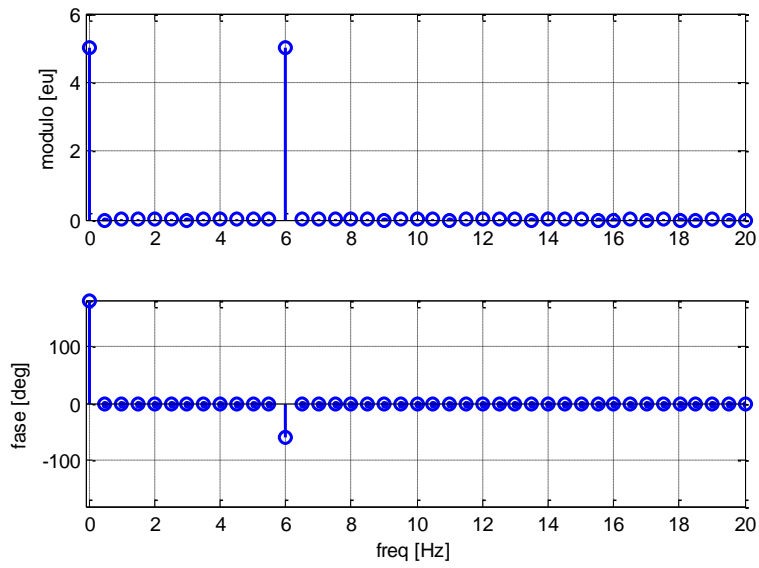
$$\begin{aligned} \sin\left(2\pi 9t + \frac{\pi}{3}\right) &= \cos\left(\frac{\pi}{2} - \left(2\pi 9t + \frac{\pi}{3}\right)\right) = \cos\left(-2\pi 9t + \frac{\pi}{6}\right) = \cos\left(-\left(2\pi 9t - \frac{\pi}{6}\right)\right) = \\ &= \cos\left(2\pi 9t - \frac{\pi}{6}\right) \end{aligned}$$



5)



6)

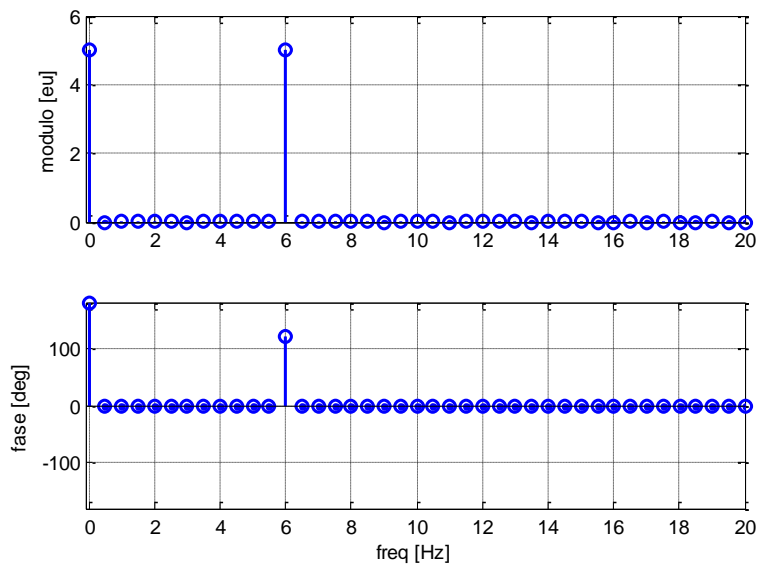


7)

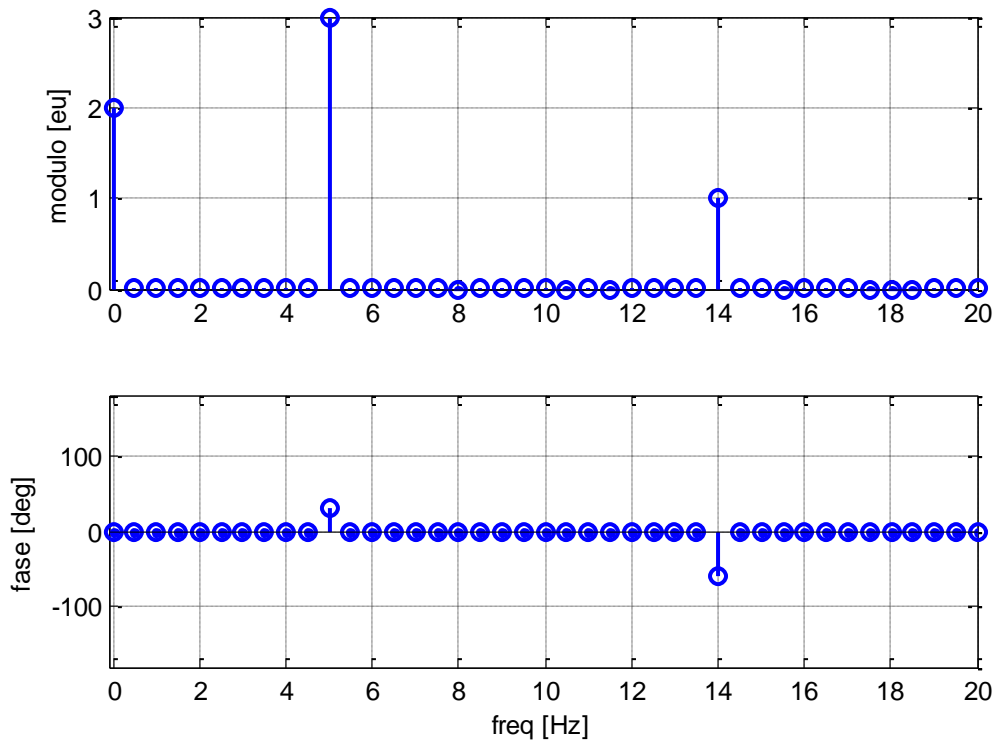
$$-\cos(\alpha) = \cos(\pi - \alpha) \quad \text{e} \quad \cos(-\alpha) = \cos(\alpha)$$

$$-5 \cos\left(2\pi 6t - \frac{\pi}{3}\right) - 5 = 5 \cos\left(\pi - \left(2\pi 6t - \frac{\pi}{3}\right)\right) - 5 = 5 \cos\left(\frac{4}{3}\pi - 2\pi 6t\right) - 5 =$$

$$5 \cos\left(-\left(2\pi 6t - \frac{4}{3}\pi\right)\right) - 5 = 5 \cos\left(2\pi 6t - \frac{4}{3}\pi\right) - 5 = 5 \cos\left(2\pi 6t + \frac{2}{3}\pi\right) - 5$$



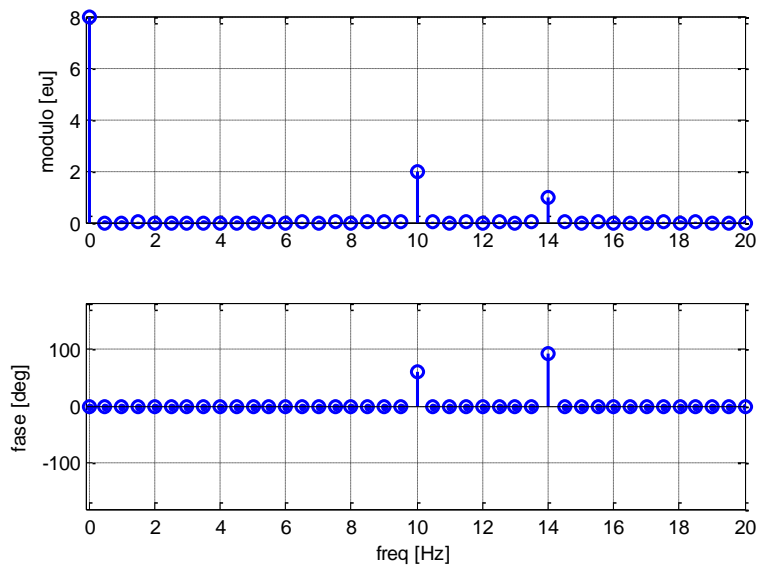
8)



9)

$$\sin(\alpha) = \cos\left(\frac{\pi}{2} - \alpha\right) \quad \text{e} \quad -\cos(\alpha) = \cos(\pi - \alpha)$$

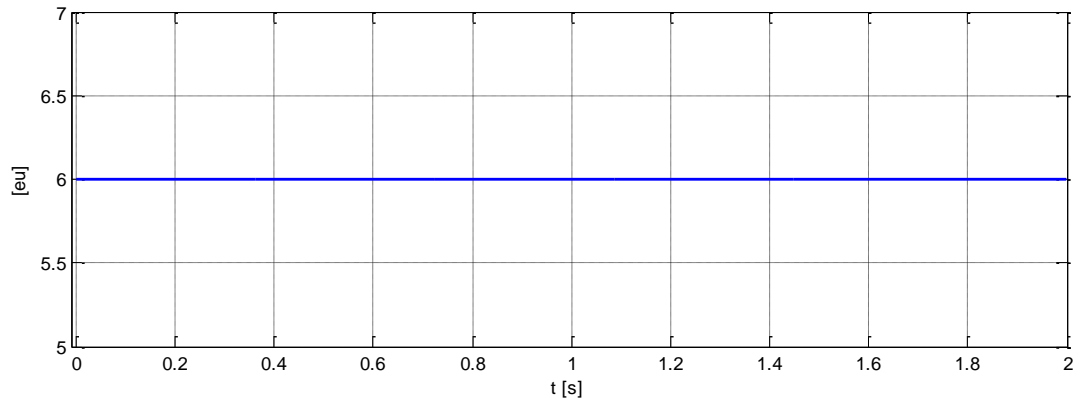
$$-\sin(2\pi 14t) = -\cos\left(\frac{\pi}{2} - 2\pi 14t\right) = \cos\left(\pi + 2\pi 14t - \frac{\pi}{2}\right) = \cos\left(2\pi 14t + \frac{\pi}{2}\right)$$



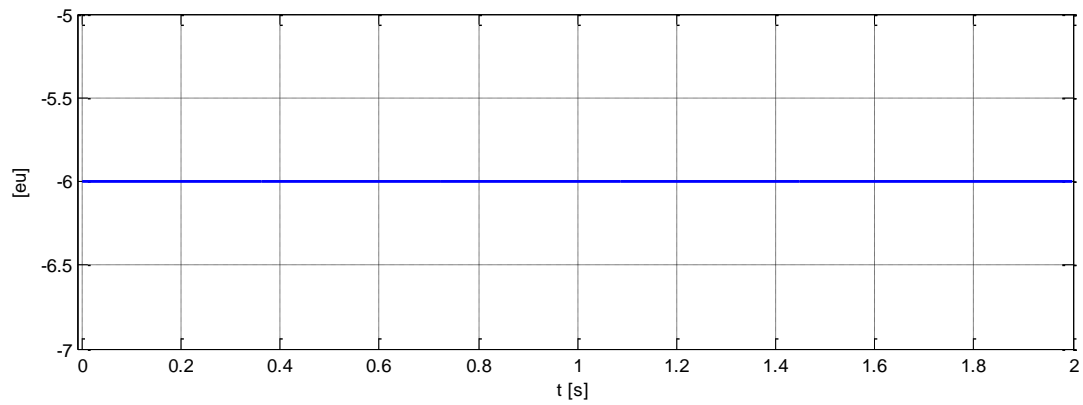
ES 2

Rappresentare lo spettro dei seguenti segnali

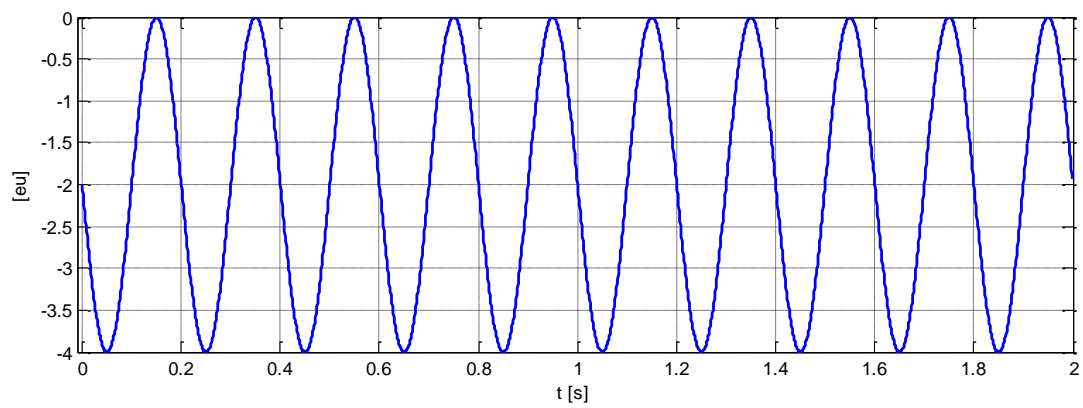
1)



2)

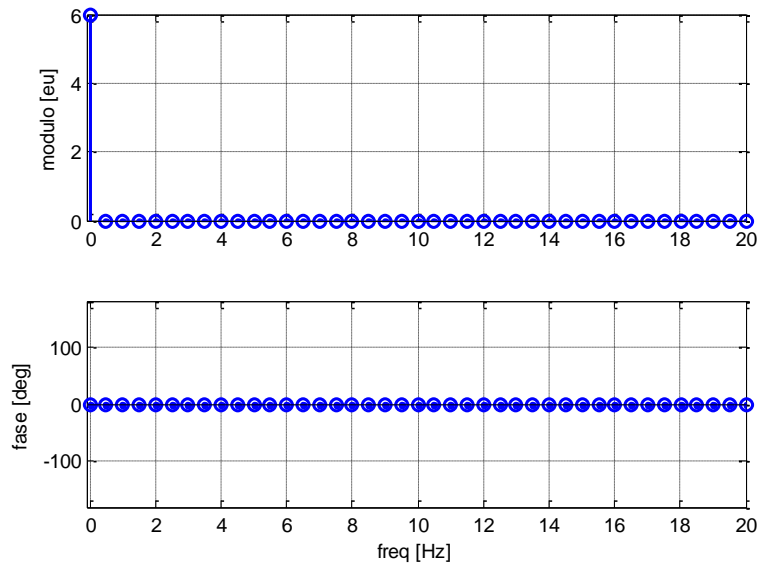


3)

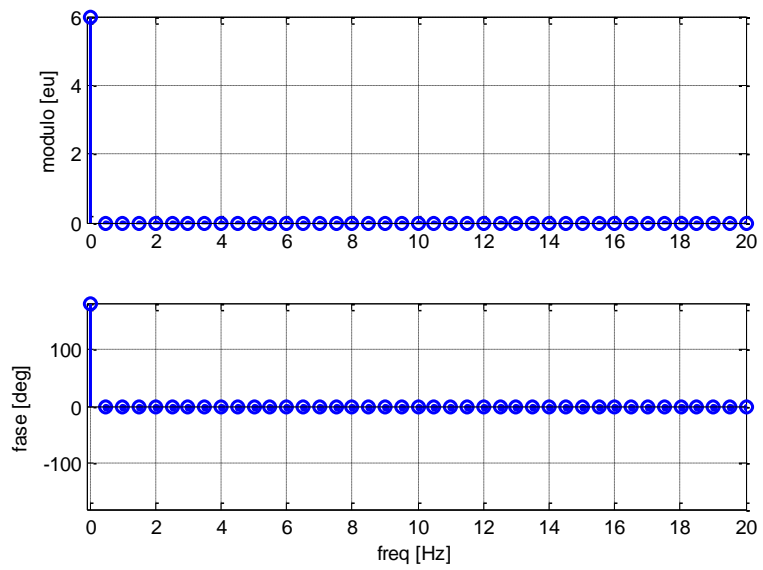


SOLUZIONI ES 2

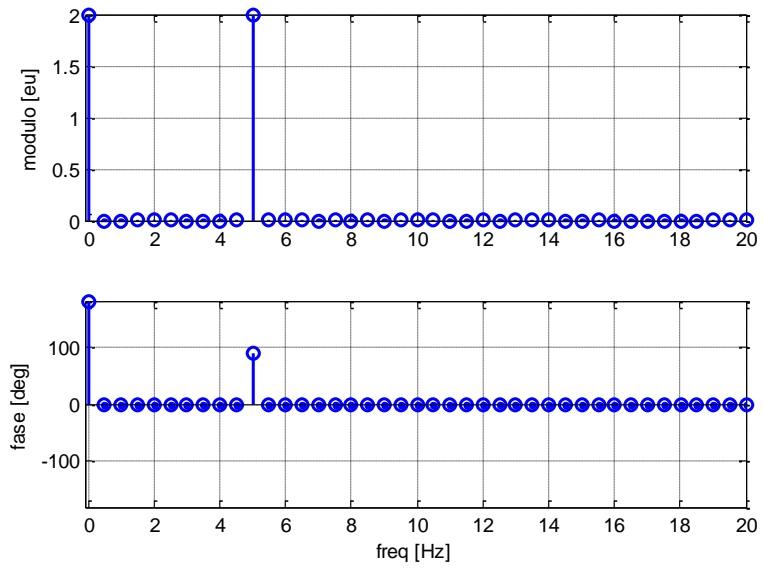
1)



2)



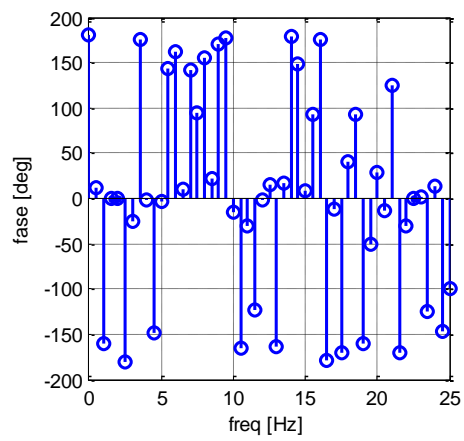
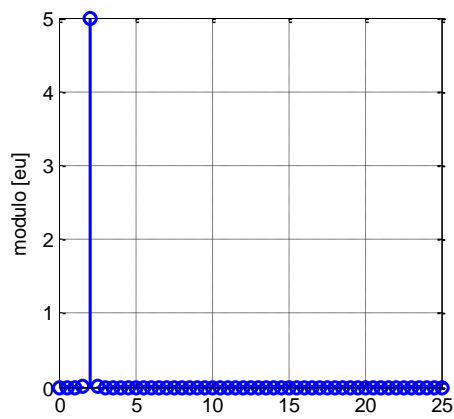
3)



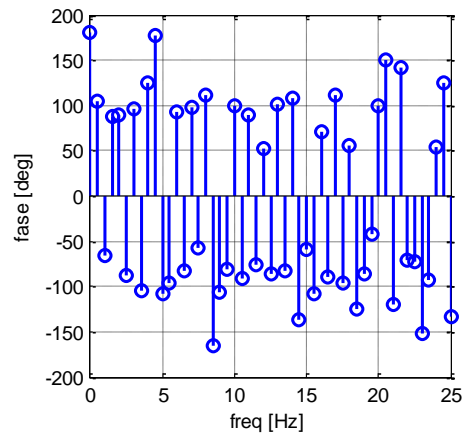
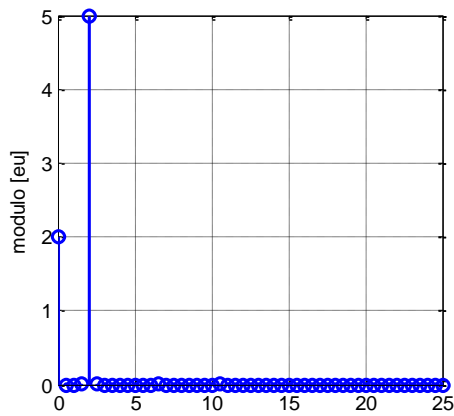
ES 3

Rappresentare i seguenti segnali nel dominio del tempo

1)



2)



ES4

Rappresentare il modulo dello spettro del seguente segnale:

$$y = 3 \cdot \cos\left(2 \cdot \pi \cdot t + \frac{\pi}{6}\right) + 6 \cdot \cos\left(2 \cdot \pi \cdot 30 \cdot t + \frac{\pi}{3}\right) + 2$$

- 1) Nell'ipotesi in cui la frequenza di campionamento è pari a 1000 Hz
- 2) Nell'ipotesi in cui la frequenza di campionamento è pari a 22 Hz

ES5

Rappresentare il modulo dello spettro del seguente segnale:

$$y = \cos(2 \cdot \pi \cdot 6 \cdot t) + 2 \cdot \cos(2 \cdot \pi \cdot 16 \cdot t)$$

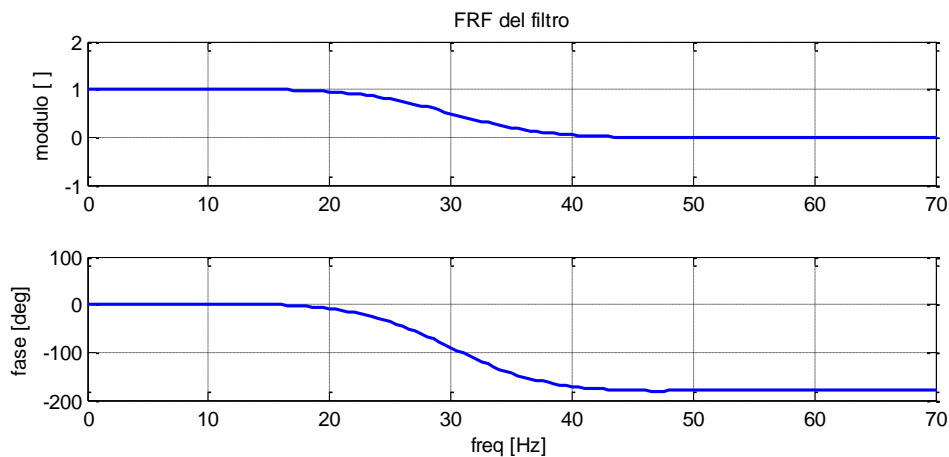
- 3) Nell'ipotesi in cui la frequenza di campionamento è pari a 1000 Hz
- 4) Nell'ipotesi in cui la frequenza di campionamento è pari a 22 Hz

ES6

Rappresentare lo spettro del segnale:

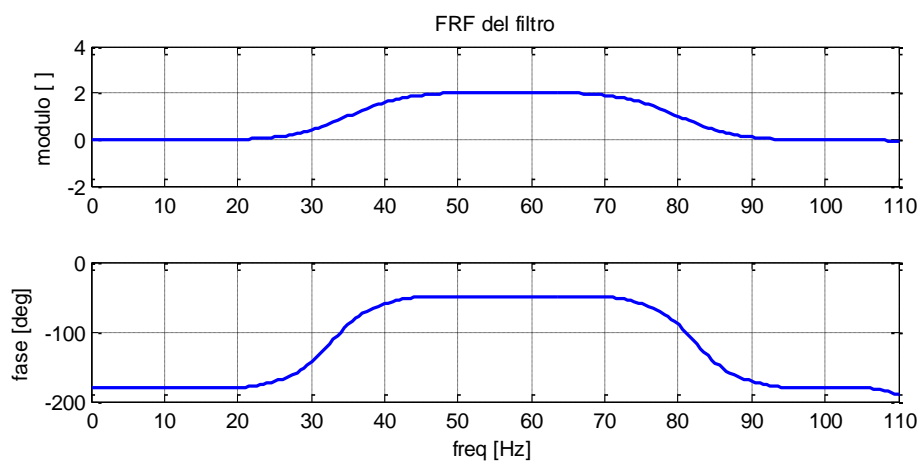
$$y = 12 \cdot \cos\left(2 \cdot \pi \cdot 10 \cdot t + \frac{\pi}{6}\right) + 1.5 \cdot \cos\left(2 \cdot \pi \cdot 50 \cdot t + \frac{\pi}{3}\right) + 2$$

a monte e a valle di un filtro la cui funzione di trasferimento è:

**Es 7**

Rappresentare lo spettro del segnale:

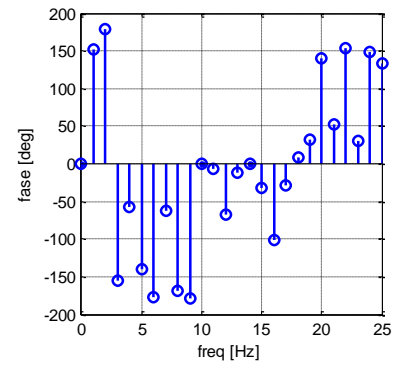
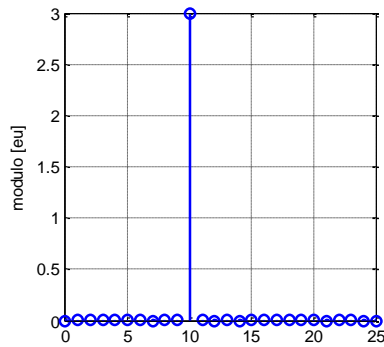
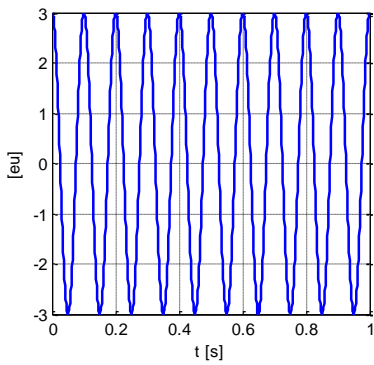
$$y = 12 \cdot \cos\left(2 \cdot \pi \cdot 10 \cdot t + \frac{\pi}{6}\right) + 1.5 \cdot \cos\left(2 \cdot \pi \cdot 50 \cdot t + \frac{\pi}{3}\right) + 2$$



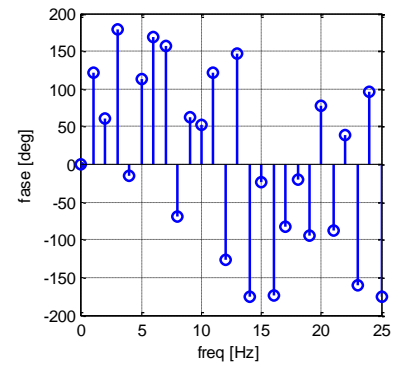
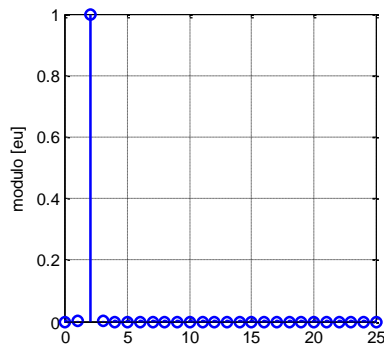
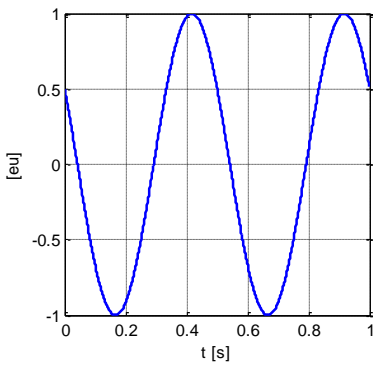
SOLUZIONI

ES 1

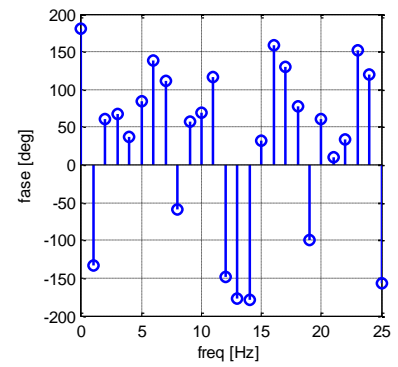
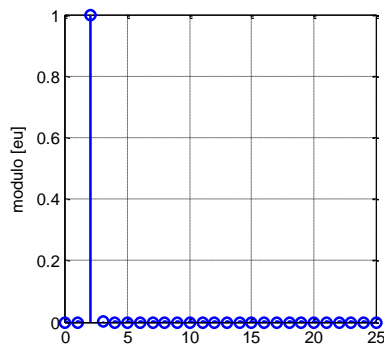
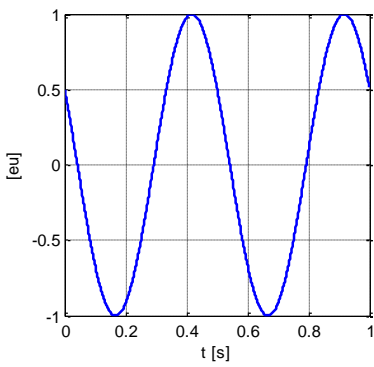
1)



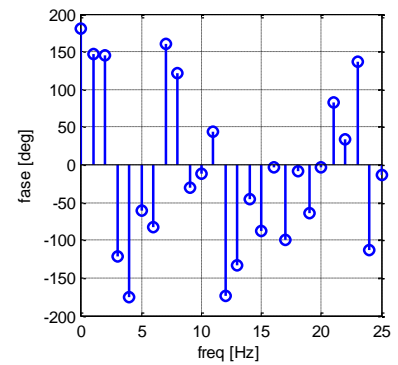
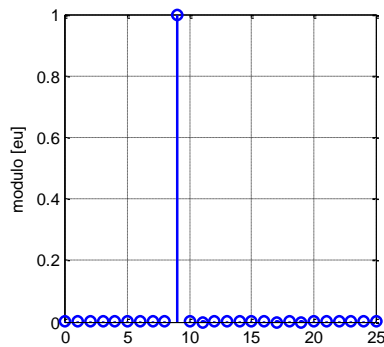
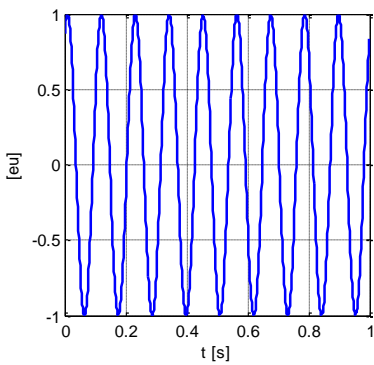
2)



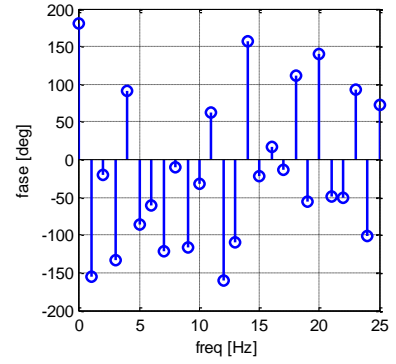
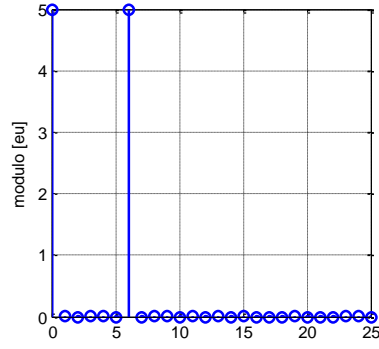
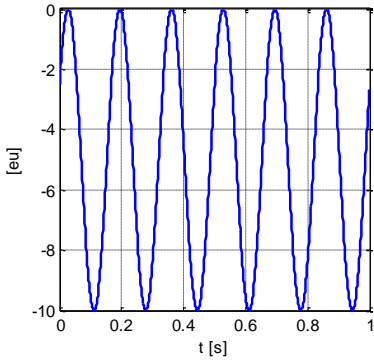
3)



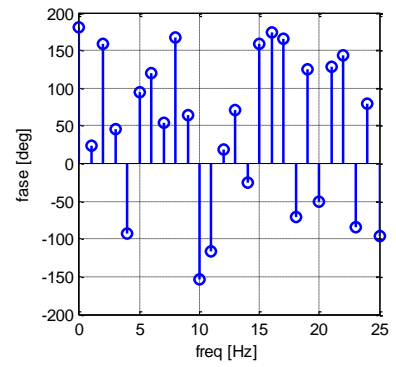
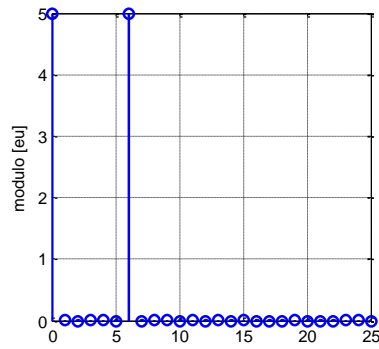
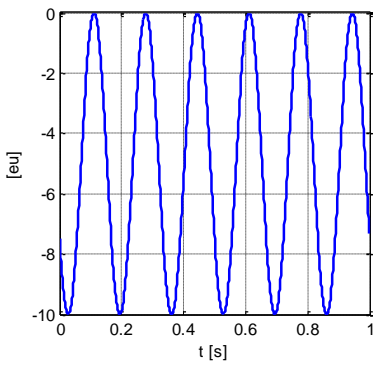
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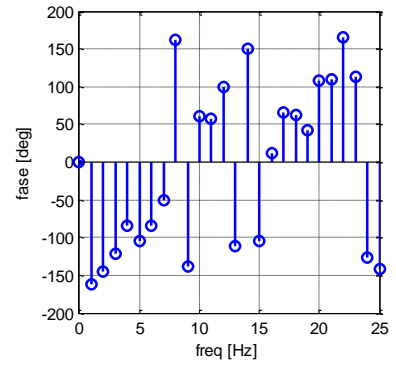
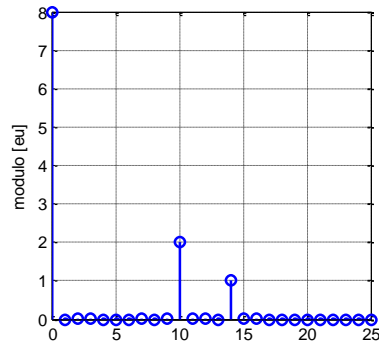
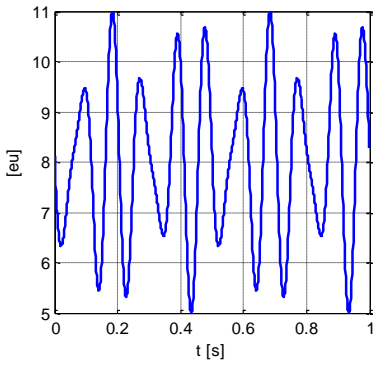
5)



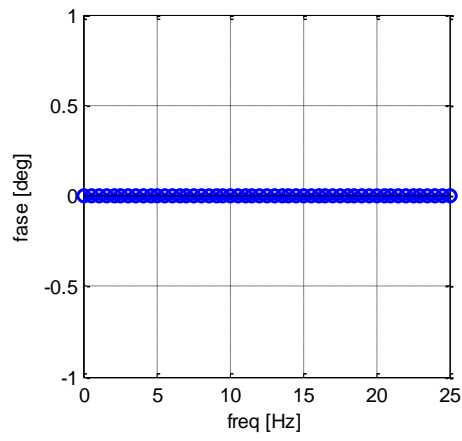
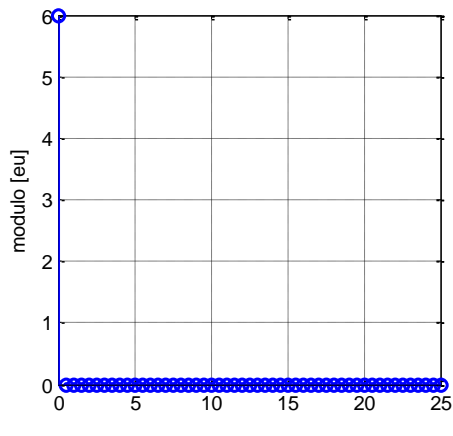
6)



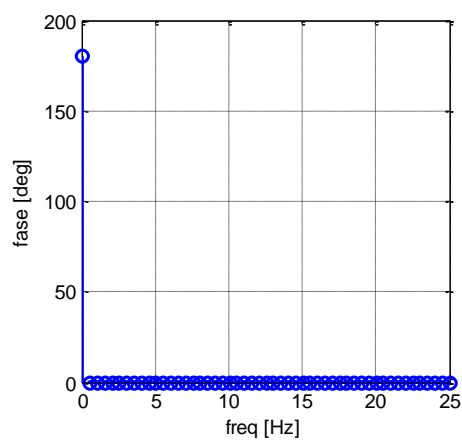
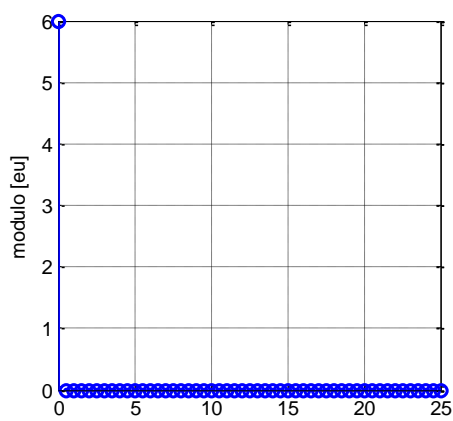
7)



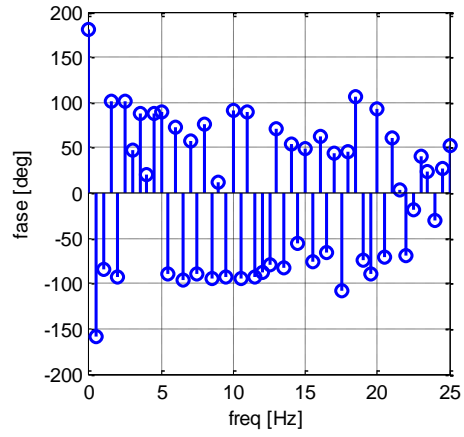
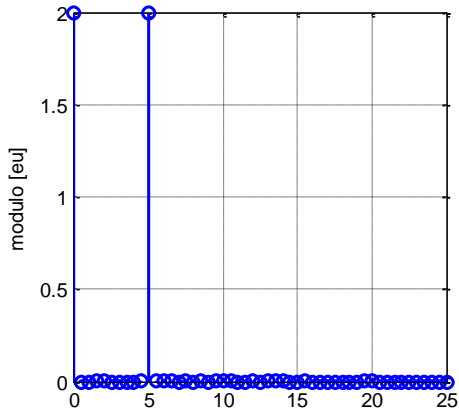
ES2
1)



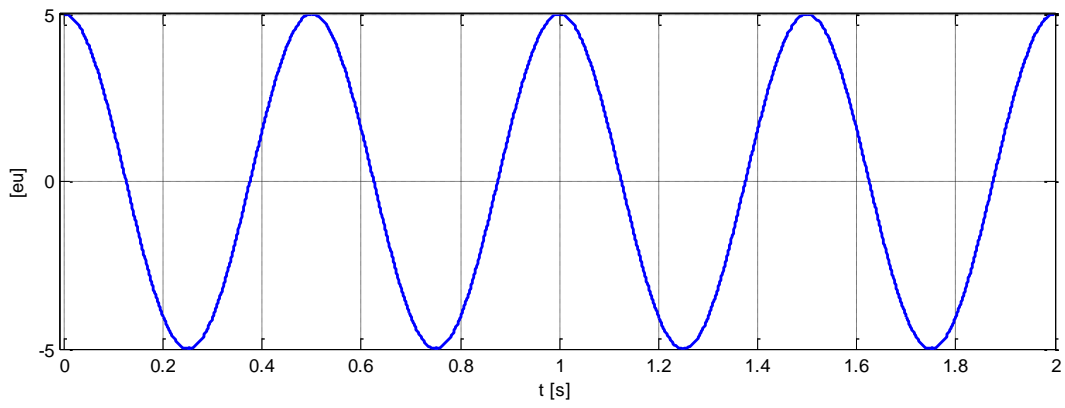
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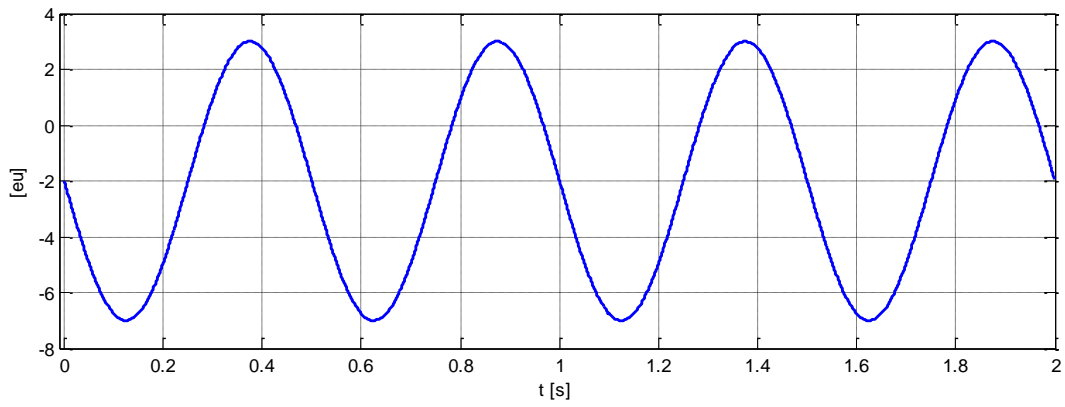
3)



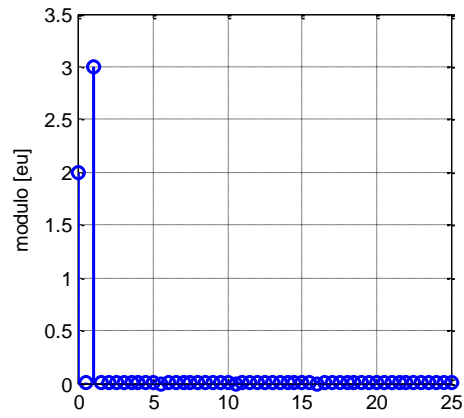
ES3
1)



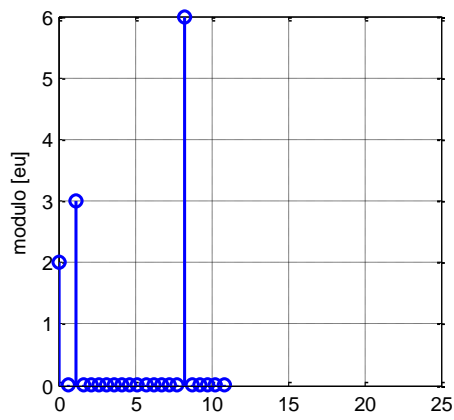
2)



ES4
1)

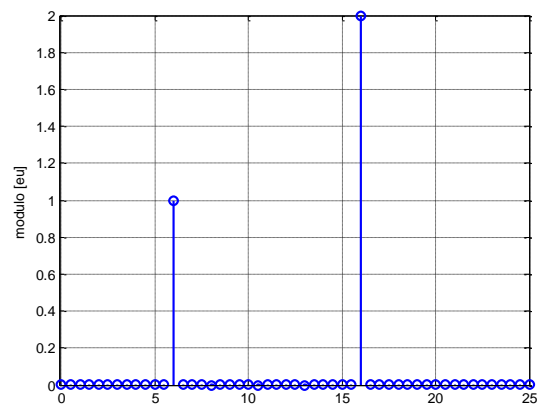


2)

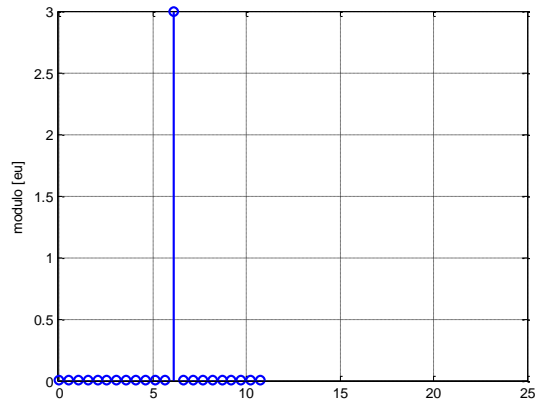


ES5

1)

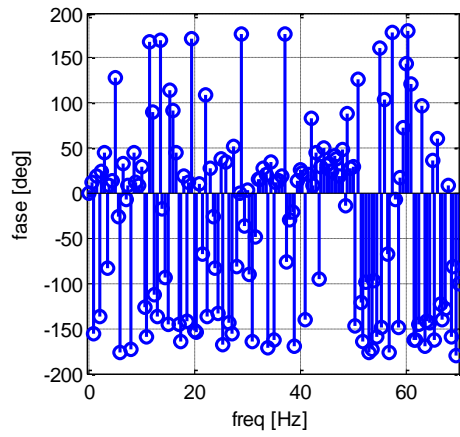
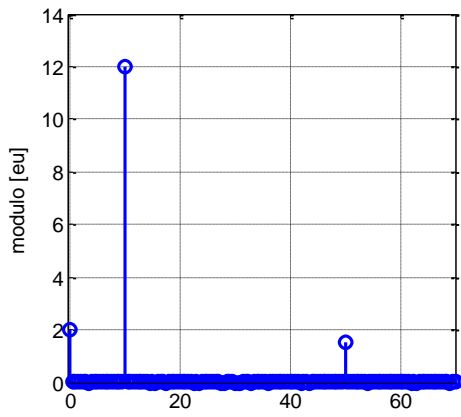


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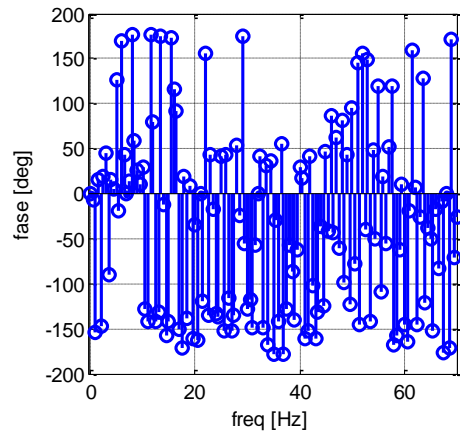
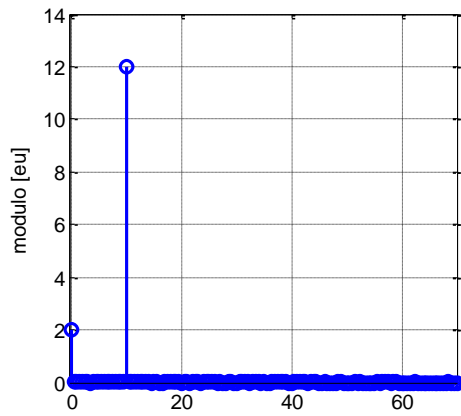


ES6

Prima del filtro:

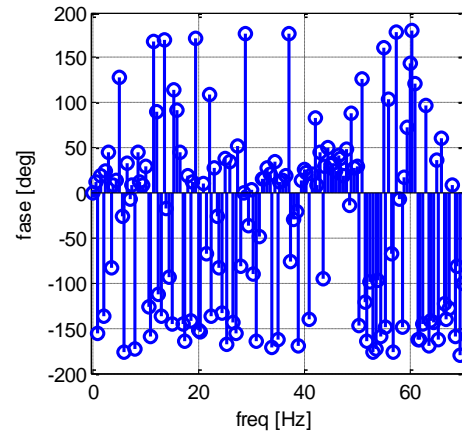
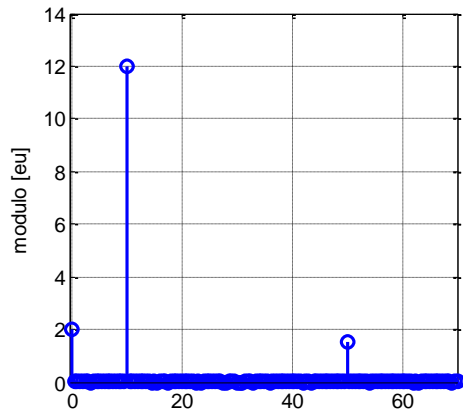


Dopo il filtro



ES7

Prima del filtro:



Dopo il filtro

