

國立中山大學100學年度碩士班招生考試試題

科目：訊號與系統【電機系碩士班已組】

Fourier Transform formula:

$$F\{f(t)\} = F(\omega) = \int_{-\infty}^{\infty} f(t) \exp[-j\omega t] dt$$

1. (a) Draw the plot (繪圖) for $\cos(t)$ and $\cos(3t)$. (2%)
 (b) Compute and plot the spectrum (Fourier transformation) for $\cos(t)$ and $\cos(3t)$ by Euler Theorem: $e^{\pm ju} = \cos u \pm j \sin u$. The computation procedures must be provided. (8%)
 2. Prove Coordinate Scaling for Fourier Transform. (10%)
- $$F\{f(\alpha t)\} = \frac{1}{|\alpha|} F\left(\frac{\omega}{\alpha}\right)$$
3. By using the above theorem, Please draw the plots of the spectrum for $\cos(t)$ and $\cos(3t)$ again. (10%)
 4. Why the Hilbert transform defined by the following equation in the frequency domain for a real function must be a real function too? Please work on the frequency domain. $\hat{F}(\omega) = -j \operatorname{sgn}(\omega)$
 Where $\operatorname{sgn}(\)$ is the sign function to be 1 or -1 dependent upon positive or negative argument.
 (Please Do not use the inverse Fourier transform). (20%)
 5. Explain the two major procedures to transform analog signals to digital signals (data)? (10%)
 6. State and explain the Sampling Theorem. (10%)
 7. Prove the Sampling Theorem by plots. (15%)
 8. Plot the convolution result for the following problem and explain why you have the correct answer. $g(t) = f(t) \otimes h(t)$ (15%)

