

國立中央大學 105 學年度碩士班考試入學試題

所別： 電機工程學系 碩士班 系統與生醫組(一般生)

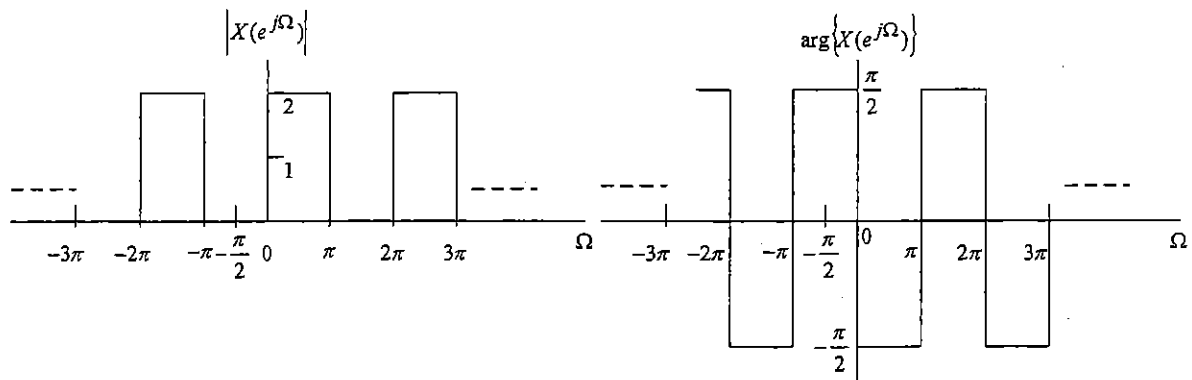
共 2 頁 第 1 頁

科目： 信號與系統

本科考試禁用計算器

*請在答案卷(卡)內作答

- How many signals have a Laplace transform that may be expressed as $\frac{(s-2)}{(s+5)(s^2+s-6)}$ in its region of convergence? (10%)
- Find the frequency-domain representation for signal $x(t) = (e^{-3t}u(5t)) \times e^{-j2t} * \frac{d}{dt} \left\{ e^{-2t}u(t-4) \right\}$. (20%)
- For a system $h(t)$, the input $x(t) = e^{-3t}u(t)$ and the output $y(t) = e^{-t}u(2t)$. Determine the impulse response of its inverse system $h^{inv}(t)$. (10%)
- Find the time-domain signal for the following frequency-domain representation. (10%)



- For a discrete-time Fourier transform $X(e^{j\Omega}) = \frac{5e^{-j\Omega} + 3}{(1 + \frac{1}{4}e^{-j\Omega})(1 - \frac{1}{3}e^{-j\Omega})}$, where Ω represents the frequency of discrete-time signal, please use inverse Fourier transform to find the discrete-time signal $x[n]$. (10%)
- Considering a continuous-time signal $x_c(t) = \cos(15000\pi t)$, the signal is sampled by an analog-to-digital (A/D converter) with sampling interval $T = 1/4500$. Please answer the following questions:
 - Is aliasing happened in the sampled signal? (2%)
 - What is the sampled discrete-time signal $x[n]$? (8%)

注意：背面有試題

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7. For a linear-time invariant (LTI) system $h[n]$, the relation between discrete-time input signal $x[n]$ and output signal $y[n]$ is represented as follows:

$$y[n] = -3x[n] + 10x[n-1] + 3x[n-2].$$

Please answer the following question:

- (a) Please find the impulse response $h[n]$ of the system. (5%)
- (b) For input signal $x[n] = 2\delta[n+1] - 4\delta[n] + 5\delta[n-2]$, please find the output signal $y[n]$ of the input signal. (5%)
- (c) Please find the Fourier transform $H(e^{j\Omega})$ of the impulse response $h[n]$. (5%)
- (d) Is the LTI system causal? (2%)
- (e) Is the LTI system stable? (3%)

8. Please prove the following discrete-time Fourier transform (DTFT) properties:

(a) $nx[n] \xrightarrow{DTFT} j \frac{dX(e^{j\Omega})}{d\Omega}$. (5%) (b) $\sum_{n=-\infty}^{\infty} |x[n]|^2 \xrightarrow{DTFT} \frac{1}{2\pi} \int_{-\pi}^{\pi} |X(e^{j\Omega})|^2 d\Omega$. (5%)

***Remark:** n is the discrete-time index, Ω is the radial frequency, $*$ is discrete-time convolution operator, and $X(e^{j\Omega})$ is the discrete-time Fourier transform of discrete-time sequences $x[n]$, respectively.

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