

科目：訊號與系統 適用：電機所系統組

編號：442

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

本 試 題  
共 2 頁  
第 1 頁

1. (20%) The systems that follow have input  $x(t)$  or  $x[n]$  and output  $y(t)$  or  $y[n]$ . For each system, determine whether it is

(i) linear (ii) time invariant

(a) (4%)  $y[n] = \log_{10}(|x[n]|)$

(b) (4%)  $y(t) = dx(t)/dt$

(c) (4%)  $y[n] = \cos(2\pi x[n+1]) + x[n]$

(d) (4%)  $y(t) = \frac{d}{dt}(e^{-t}x(t))$

(e) (4%)  $y[n] = 2x[2^n]$

2. (20%) Evaluate the step response for the LTI systems represented by the following impulse responses:

(a) (10%)  $h[n] = nu[n]$

(b) (10%)  $h(t) = e^{-|t|}$

3. (20%) Find the continuous-time Fourier transforms of the following signals:

(a) (10%)  $x(t) = \left[ \frac{\sin(3\pi t)}{\pi t} \right] \left[ \frac{2\sin(2\pi t)}{\pi t} \right]$

(b) (10%)  $x(t) = e^{-t+3}u(t-3)$

4. (10%) You are given  $x[n] = n\left(\frac{3}{5}\right)^{|n|} \xleftrightarrow{DTFT} X(e^{j\omega})$ . Without evaluating  $X(e^{j\omega})$ , find  $y[n]$  if

(a) (5%)  $Y(e^{j\omega}) = e^{-j3\omega}X(e^{j\omega})$

(b) (5%)  $Y(e^{j\omega}) = X(e^{j\omega}) * X(e^{j(\omega-\pi/2)})$ ,

where "\*" is the linear convolution operation.

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共 2 頁  
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5. (10%) For each of the following signals, sampled with sampling interval  $T_s$ , determine the bounds on  $T_s$ , which guarantee that there will be no aliasing:

(a) (5%)  $x(t) = \frac{\sin(3\pi t)}{t} + \cos(2\pi t)$

(b) (5%)  $x(t) = e^{-6t}u(t) * \frac{\sin(10\pi t)}{t}$ ,

where "\*" is the linear convolution operation.

6. (10%) A system has the indicated transfer function  $H(s)$  as follows:

$$H(s) = e^{-5s} + \frac{1}{s-2}$$

Determine the impulse response, assuming that the system is causal and stable.

7. (10%) Determine the time domain signal corresponding to the following  $z$ -transform:

$$X(z) = \frac{1}{1 - \frac{1}{9}z^{-2}}, \quad |z| < \frac{1}{3}$$

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