填准考證號碼

注意事項：

1. 本試題共【5】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

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1. Consider the following two memoryless systems with input $u(t)$ and output $y(t)$, related by
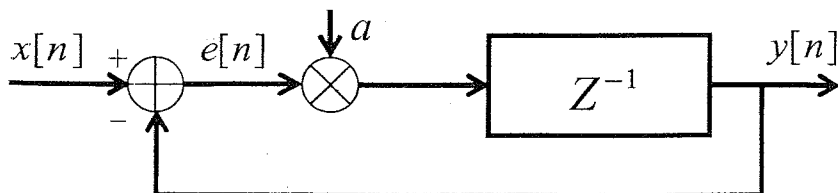
　　System1: $y(t) = \cos(u(t))$

　　System2: $y(t) = (\cos(30t))u(t)$

(10%) (a) Which system is linear?

(10%) (b) Is the System1 time invariant?

Justify your answers in details.

2. Consider the following negative feedback system

(10%) (a) Derive the difference equation of this system.

(10%) (b) Derive the impulse response of this system.

Show your derivation in details.

3. Determine the Fourier transform of the following functions

(10%) (a) $x(t) = \begin{cases} e^{2t}, & for\ t \geq 0 \\ 0, & for\ t < 0 \end{cases}$

(10%) (b) $x(t) = \begin{cases} 1, & for\ |t| \leq a \\ 0, & for\ |t| > a \end{cases}$

Show your derivation in details

4. Let $X(w)$ and $Y(w)$ denote the Fourier transform of $x(t)$ and $y(t)$, respectively.
   Prove in details that:

(10%) (a) $\int_{-\infty}^{\infty} |x(t)|^2\ dt = \dfrac{1}{2\pi} \int_{-\infty}^{\infty} |X(w)|^2\ dw$

(10%) (b) $x(t) * y(t) = X(w)Y(w)$, where $*$ represents the convolution operation.

5. Consider a system with transfer function

$$H(s) = \frac{3s^2 - 2}{s^2 + 3s + 2}$$

(10%) (a) Is the system boundary-input boundary-output (BIBO) stable?

(10%) (b) Compute the step response of this system.

Justify your answers in details.