3. $Y(\omega) = 2X(\omega) + e^{-j\omega}X(\omega) - \frac{dX(\omega)}{d\omega}$

Inverse fourier transform

$\Rightarrow y[n] = 2x[n] + x[n-1] - nx[n]$

let

$y_1[n] = 2x_1[n] + x_1[n-1] - nx_1[n]$

& $y_2[n] = 2x_2[n] + x_2[n-1] - nx_2[n]$

Now

$y_3[n] = 2[\alpha x_1[n] + \beta x_2[n]] + [\alpha x_1[n-1] + \beta x_2[n-1]]$
$- n[\alpha x_1[n] + \beta x_2[n]]$

$= \alpha y_1[n] + \alpha y_2[n]$

$\Rightarrow$ Linear

(b) if we put

$x_1[n] = x[n-\tau]$

$\Rightarrow y_1[n] = 2x[n-\tau] + x[n-\tau-1] - [n]x[n-\tau]$

$\neq y[n-\tau]$

$(\because y[n-\tau] = 2x[n-\tau] + x[n-\tau-1] - [n-\tau]x[n-\tau])$

Not time-invariant

(c) $x[n] = \delta[n]$

$\Rightarrow y[n] = 2\delta[n] + \delta[n-1] - n\,\delta[n]$

$y[0] = 2$

$y[1] = 1$

$y[n] = 0 \quad \forall\ n \neq 1, 2$