24. $\begin{cases} x' = -x - y + z + x^3 \\ y' = x - 2y + 2z + xz \\ z' = x + 2y + z + xy \end{cases}$

INDEED $(0,0,0)$ IS AN EQUILIBRIUM. LET $V = -x^2 - y^2 + 2z^2$
THEN

$$\dot{V} = -2x(-x - y + z + x^3) - 2y(x - 2y + 2z + xz) + 4z(x + 2y + z + xy)$$
$$= 2x^2 + 2y^2 + 2z^2 .$$

SO, V IS (IS) AND $\dot{V}$ IS (+D). THEREFORE $(0,0,0)$ IS (NS).

26 (1) $u'' - (|u| + |u'| - 1)u' + u|u| = 0$

SOL

LET $x = u$ AND $y = u'$ THEN (2) $\begin{cases} x' = y \\ y' = y|x| + y|y| - y - x|u| \end{cases}$

HERE WE USE THE ENERGY FUNCTION

$$V = \frac{y^2}{2} + \int_0^x g(s)\,ds$$

WHERE $g(s) = s|s|$. NOTICE $sg(s) = s^2|s| > 0 \quad \forall s$
$\Longrightarrow \int_0^x g(s)\,ds > 0$ FOR SMALL x. SO, V IS (+D).
NOW CONSIDER

$$\dot{V} = V_x f_1 + V_y f_2 = g(x)y + y(y|x| + y|y| - y - x|x|)$$
$$= yx|x| + y^2|x| + y^2|y| - y^2 - yx|x|$$
$$= y^2(|x| + |y| - 1)$$

LET $z = |x| + |y|$. THEN z IS ALWAYS POSITIVE. FURTHER
AS z GETS SUFFICIENTLY SMALL ENOUGH SAY $z < 1$ WE
HAVE $z - 1 < 0$. SINCE $y^2 \geq 0 \ \forall y$, AND $z - 1 \leq 0$
FOR z IN ANY NHBD OF ZERO WE HAVE $\dot{V}$ IS (-D).
THEREFORE, BY THM $u = 0$ OF (1) IS (US) AND (AS).