1) \( e^{-5t+1} \) is an energy signal

\[
E = \int_{-\infty}^{\infty} (e^{-5t+1})^2 \, dt = \int_{-\infty}^{0} e^{10t} \, dt + \int_{0}^{\infty} e^{-10t} \, dt
\]

\[
= \left. \frac{e^{10t}}{10} \right|_{-\infty}^{0} + \left. \frac{-e^{-10t}}{10} \right|_{0}^{\infty} = \frac{1}{5}
\]

2) \( b(t) = 3 + e^{-5t+1} \) is a power signal

\[
p = \lim_{T \to \infty} \frac{1}{T} \int_{-\frac{T}{2}}^{\frac{T}{2}} b(t)^2 \, dt = \lim_{T \to \infty} \frac{1}{T} \int_{-\frac{T}{2}}^{\frac{T}{2}} 9 + 6e^{-5t+1} \, dt
\]

\[
= \frac{9}{2} \text{ since } 6e^{-5t+1} \text{ and } e^{-10t+1} \text{ have finite integrals}
\]

3) \( c(t) \) is a power signal (periodic)

\[
p = \lim_{T \to \infty} \frac{1}{T} \int_{-\frac{T}{2}}^{\frac{T}{2}} c(t)^2 \, dt
\]

\[
= \frac{1}{4} \int_{0}^{1} c(t)^2 \, dt = \frac{1}{4} \int_{0}^{1} t^2 \, dt = \frac{1}{12}
\]

4) \( \cos^2(t) = \frac{1 + \cos(2t)}{2} \) periodic \( \omega_0 = 2 \quad T = \pi \)

5) \( \cos(t^2) \) not periodic

6) \( \cos(4\pi t) + \sin(10\pi t) \) periodic \( \omega_0 = 2\pi \quad T = 1 \)
The given function $x(t)$ can be simplified as

$$x(t) = u(t+3) - 2r(t+2) + \frac{5}{2}r(t+1) - \frac{1}{2}r(t-1) - u(t-2) + u(t-3)$$

The solution from $-2$ to $3$ can be written as

$$g(t) = g(t+2) - 2r(t+1) + 2r(t-1) - r(t-2)$$

for $T = 5$. The solution can be expressed as

$$g(t) = \sum_{k=-\infty}^{\infty} g(t-5k)$$

0.5 + x(4-a-t) = 0.5 + x(-2(t-2))

Flippe + new origin

$2y(1/2 + t) = 2y(1/2(t+2))$

New origin

$y_e = 0$

$y_0 = y$

($y$ is purely odd)
\( \tan (x(t)) \) & \( N \) & \( Y \) & \( Y \) & \( Y \) & \( Y \) \\
\( \sin (t+1) \cdot x(t+1) \) & \( Y \) & \( N \) & \( Y \) & \( N \) & \( Y \) \\
\( 5 \cdot x(t/2) \) & \( Y \) & \( N \) & \( Y \) & \( N \) & \( Y \) \\
\( (t+1) \cdot x(t) \) & \( N \) & \( N \) & \( N \) & \( Y \) & \( Y \) \\
\( \int_{a}^{t+1} x(t) \, dt \) & \( Y \) & \( Y \) & \( N \) & \( N \) & \( Y \) \\
\( h(t) = e^{-t} u(t) \) & \( S \) & \( N \) & \( N \) & \( Y \) \\
\( h_2(t) = \cos(4) \cdot u(t+1/2) \) & \( N \) & \( N \) & \( N \) & \( Y \) \\
\( s_2(t) = s_1(t) \cdot s_0 \) & \( Y \) & \( Y \) & \( Y \) \\
\( h_3(t) = 5 \delta(t) \) & & & & & \\
\( s(t) = r(t-1) - r(t-2) \cdot s_0 \) & \( Y \) & \( N \) & \( Y \) \\
\( h_4(t) = u(t-1) - u(t-2) \) & & & & & \\

Stability based on \( \int_{-\infty}^{\infty} |h(t)| \, dt < \infty \)

Note: true for \( h_2 \); all others are finite.
\[ X(t) \ast y(t) = \int_{-\infty}^{\infty} X(\tau) y(t-\tau) \, d\tau \]

(a) \[ X(t) \ast X(t) = (u(t) - u(t-2)) \ast (u(t) - u(t-3)) \]
\[ = r(t) - r(t-2) + r(t-1) \]

(b) \[ X(t) \ast y(t) = (u(t) - u(t-2)) \ast (r(t+1)-r(t+3)-u(t-1)) \]
\[ = q(t)+q(t-1)-r(t+1)-q(t+i)+\theta(t-1)+q(t-2)+r(t-3)+r(t-2) \]

Note scale:

\[ X(t) \ast y(t) = (u(t) - u(t-2)) \ast (u(t-3)) = r(t-3) - r(t-5) \]

(d) \[ \phi_{X(t)}(t) = X(t) \ast X(-t) = (u(t) - u(t-2)) \ast (u(t+2) - u(t+1)) \]
\[ = r(t+2) - 2r(t) + r(t+1) \]

(e) \[ \phi_{Z(t)}(t) = X(t) \ast z(-t) = \]
\[ = (u(t) - u(t-2)) \ast (1 - u(t+3)) \]
\[ = 2 - r(t+3) + r(t+1) \]
(1) \[ h(t) = e^{-t} u(t) + e^{-(t-2)} u(t-2) \]

\[
\int_{-\infty}^{\infty} \left| e^{-t} u(t) + e^{-(t-2)} u(t-2) \right| dt \\
= \int_{0}^{\infty} e^{-t} dt + \int_{2}^{\infty} e^{-(t-2)} dt \\
= \left[ -e^{-t} \right]_{0}^{\infty} + \left[ -e^{-(t-2)} \right]_{2}^{\infty} = 2 < \infty
\]

Stable

(2) \[ h(t) = 0 \text{ for } t < 0 \] Causal

(3) \[ \int_{-\infty}^{\infty} x(t-\tau) h(\tau) d\tau \]

\[
u(t+1) \int_{0}^{t+1} e^{-\tau} d\tau + u(t-1) \int_{2}^{t+1} e^{-(\tau-2)} d\tau \\
u(t+1) \left[ -e^{-\tau} \right]_{0}^{t+1} + u(t-1) \left[ -e^{-(\tau-2)} \right]_{2}^{t+1} \\
y_{1}(t) = u(t+1) \left( 1 - e^{-(t+1)} \right) + u(t-1) \left( 1 - e^{-(t-1)} \right)
\]

(4) Easy way: \[ y_{1}(t) \] is response to \[ u(t+1) \], so

\[ y_{1}(t-1) \] is response to \[ u(t) \] i.e. the step resp.

So \[ s_{r}(t) = u(t) \left( 1 - e^{t} \right) + u(t-2) \left( 1 - e^{(t-2)} \right) \]

\[ y_{2}(t) = s_{r}(t-1) - s_{r}(t-4) \]

\[ = u(t-1) \left( 1 - e^{-(t+1)} \right) + u(t-3) \left( 1 - e^{-(t+3)} \right) \\
- u(t-4) \left( 1 - e^{-(t+4)} \right) - u(t-6) \left( 1 - e^{-(t+6)} \right) \]

(5) \[ \int_{-\infty}^{\infty} \left( e^{-2(t-\tau)} u(t-\tau) e^{\tau} u(\tau) + e^{2(t-\tau)} u(t-\tau) e^{-(\tau-2)} u(\tau-2) \right) d\tau \\
u(t) \int_{0}^{t} e^{2t+\tau} d\tau + u(t-2) \int_{2}^{t} e^{2t+\tau+2} d\tau \\
u(t) \left[ e^{2t+\tau} \right]_{0}^{t} + u(t-2) \left[ e^{2t+\tau+2} \right]_{2}^{t} \\
u(t) \left( e^{t} - e^{2t} \right) + u(t-2) \left( e^{t+2} - e^{2t+4} \right) \]