ECNG2011

PROBLEM SET 2

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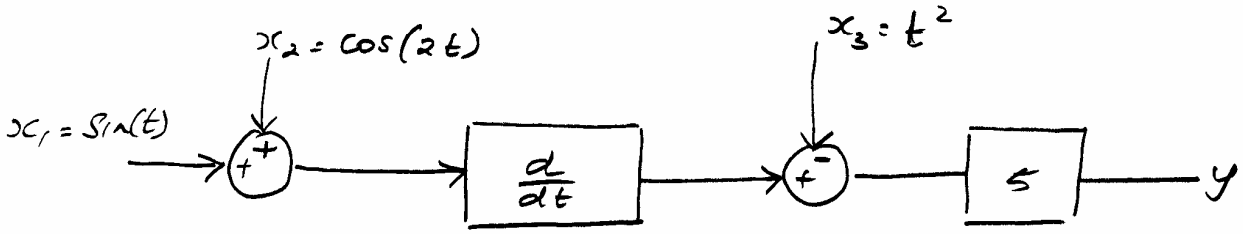
Q1 Use the Principle of Superposition to determine the output y of the following system



Q2 Determine the output transform $Y(s)$ for the following differential equation

$$\frac{d^3y}{dt^3} + 3\frac{d^2y}{dt^2} - \frac{dy}{dt} + 6y = \frac{d^2x}{dt^2} - x$$

Where y = output & x = input.

Initial conditions: $y(0^-) = \left.\frac{dy}{dt}\right|_{t=0^-} = 0$

$$\left.\frac{d^2y}{dt^2}\right|_{t=0^-} = 0$$

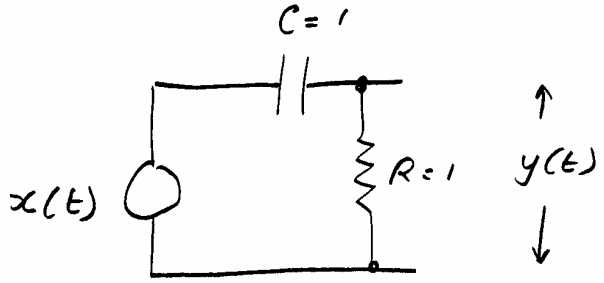
Q3 Express $Y(s)$ in partial fraction form

$$Y(s) = \frac{-(s^2+s-1)}{s^3+3s^2+2s}$$

Q4 For the RC network shown

(i) Find the DE relating y to x

(ii) If the initial voltage on C is 1V and $x(t) = 2e^{-t}$, Find $y(t)$ using the Laplace Transform.



Q5. $$Y(s) = \frac{2}{s^2+6s+8} X(s)$$

Find the unit step response $y(t)$. Sketch the answer.

Q6 $$\frac{d^2y}{dt^2} + \frac{dy}{dt} + y = x(t) + \frac{dx}{dt}.$$

Find $y(t)$ with no initial conditions for $x(t) = \delta(t)$. Sketch $y(t)$.

Q7. Examine the system shown in Fig Q7.

Determine if the system is (a) Causal, (b) Linear (c) time-invariant (d) BIBO stable.

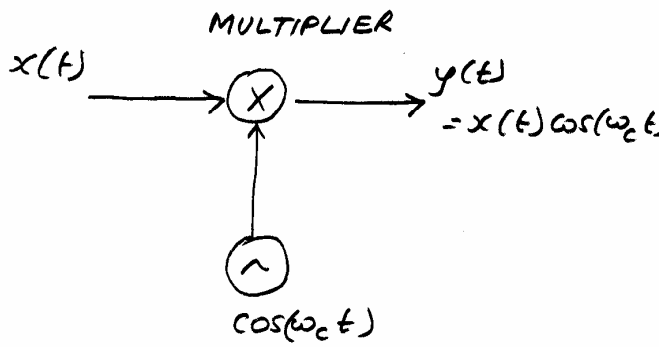


Fig Q7.

Q8 $x(t) = u(t)$

$h(t) = e^{-\alpha t} u(t) \quad \alpha > 0$

Find $y(t) = x(t) * h(t)$.

Q9. Examine Figure Q9.

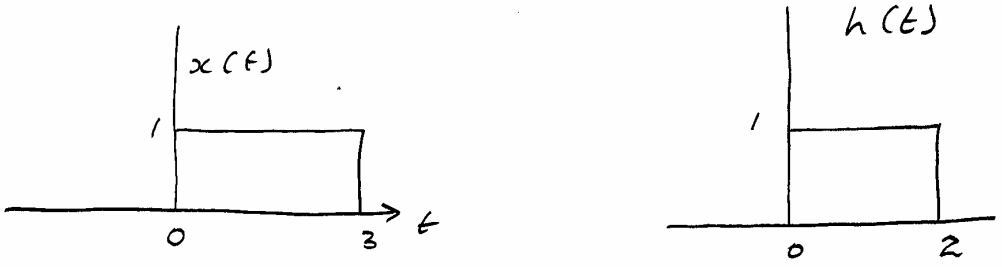


FIG Q9

a) Find $x(t) * h(t)$.

(b) Find $h(t) * x(t)$, i.e $\int_{-\infty}^{\infty} h(\tau) x(t-\tau) d\tau$.

Any comments?

Q10 Examine Fig Q10.

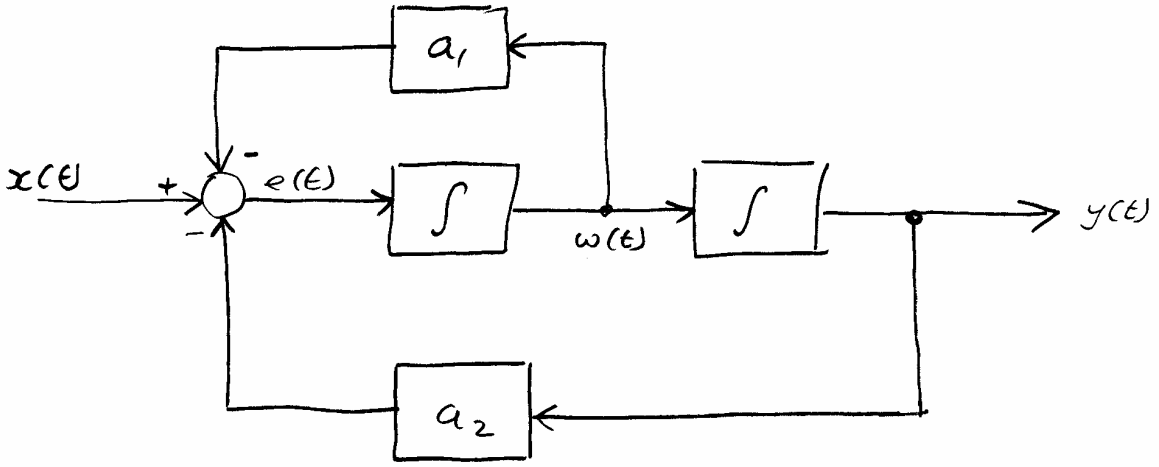


FIG Q10

Derive a DE relating $y(t)$ to $x(t)$.

Q11 Find $X(s)$ and sketch the pole-zero plot and ROC of the following.

(i) $x(t) = e^{-2t}u(t) + e^{-3t}u(t)$

(ii) $x(t) = e^{2t}u(t) + e^{-3t}u(-t)$

Any Comments?

Q12

Find the convolution of the two continuous-variable functions shown below: