Time: 90 Min.   M.M.: 25

Instructions to students: _All questions are compulsory. Do the questions in order and all parts of the questions should be at the same place._

1. a) Plot the waveform of $x(t) = \frac{d}{dt}[-u(t+1) + r(t+1) - r(t-1) - u(t-1)]$.

   b) Find odd and even component of $x(t) = \begin{cases} Ae^{-at}, & t > 0 \\ 0, & t < 0 \end{cases}$.

   c) Find the autocorrelation function $R_{xx}(\tau)$ of $x(t) = A\sin(wt + \Phi)$. Utilizing $R_{xx}(\tau)$ expression, find the power of signal $x(t)$. [_Hint: use $\tau = 0$ in second part_]

   d) State the Parseval's theorem mathematically.   [1+1+2+1]

2. Consider two systems are connected in cascade. One have the impulse response $h_1(t) = e^{-t}u(-t)$ and the other system is shown in Fig. 1. Calculate the overall impulse response of the cascaded system.   [5]

Fig. 1
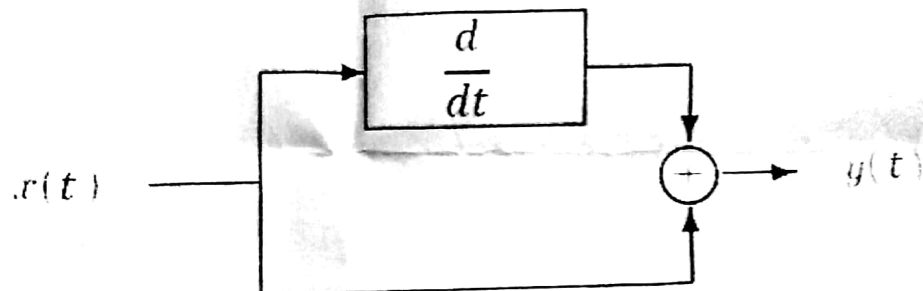
3. A binary signal $x(t)$ with $x(t) = 0$, $t < 0$ is shown in Fig. 2 For positive time, $x(t)$ toggles between one and zero as follows: one for 1 second, zero for 1 second, one for 1 second, zero for 2 seconds, one for 1 second, zero for 3 seconds, and so forth. That is, the "on" time is always one second but the "off" time increases by one second between each toggle. Determine the energy and power of $x(t)$.   [2 + 3]

Fig. 2