بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

Department of Electrical Engineering
EE 207 Signals and Systems
Second Semester (142)

Exam I
Tuesday, 10 March 2015
7:00 pm – 8:30 pm

SER	Name	ID	Sec

Problem	Score	Out of
1		40
2		30
3		30
Total		100

KEY

Q1 Select one answer only **(40 points)**

$\delta(t)$ – delta function $\quad$ $u(t)$ – step function

$r(t)$ – ramp function $\quad$ NV – None of the above

(1) Evaluate the integral $\int_{-\infty}^{\infty} (t-2)\delta(t-4)dt$

(a) 2 $\quad$ (b) −2 $\quad$ (c) −6 $\quad$ (d) 6 $\quad$ (e) NV

(2) Evaluate the convolution $\sin(3(t+2)) * \delta(t-4)$

(a) $\sin(3(t+4))$ $\quad$ (b) $\sin(3(t+2))$ $\quad$ (c) $\sin(3(t-4))$ $\quad$ (d) $\sin(18)$

(e) NV

(3) The system described by input $x(t)$ and output $y(t)$ as $y(t) = \cos(t)x(t)$

(a) Linear and Time-Invariant $\quad$ (b) Linear and Time-Variant

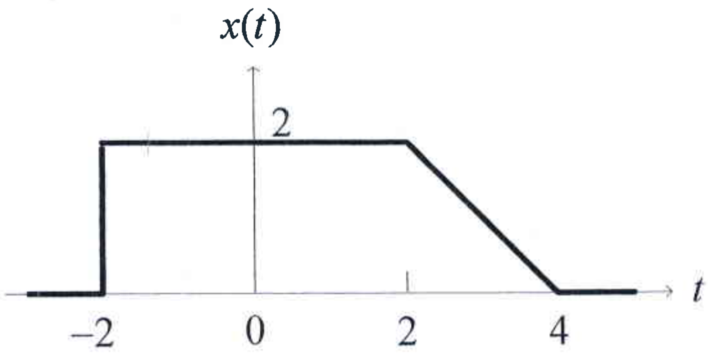
(c) Nonlinear and Time-Invariant $\quad$ (d) Nonlinear and Time-Variant

(4) Let $h(t)=\cos(\pi t)u(t)$ be the impulse response for a Linear Time-Invariant (LTI) system . Then the system :

(a) Has memory and BIBO stable $\quad$ (b) Memoryless and not BIBO stable

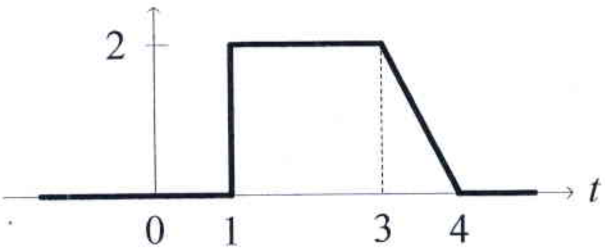
(c) Memoryless and BIBO stable $\quad$ (d) Has memory and not BIBO stable

(5) Let $x(t)$ be a signal as shown

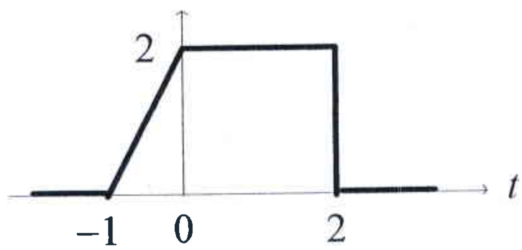


Then $x(4-2t)$ is

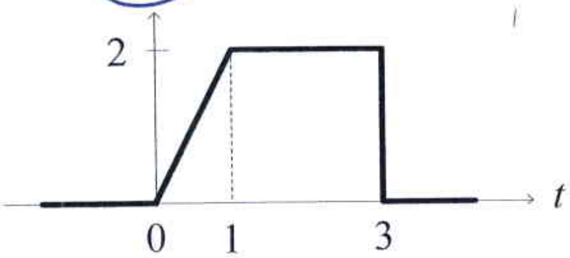
(a)



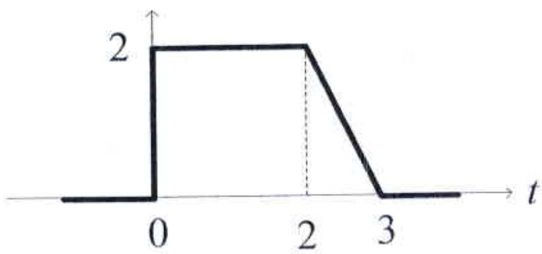
(b)



(c)

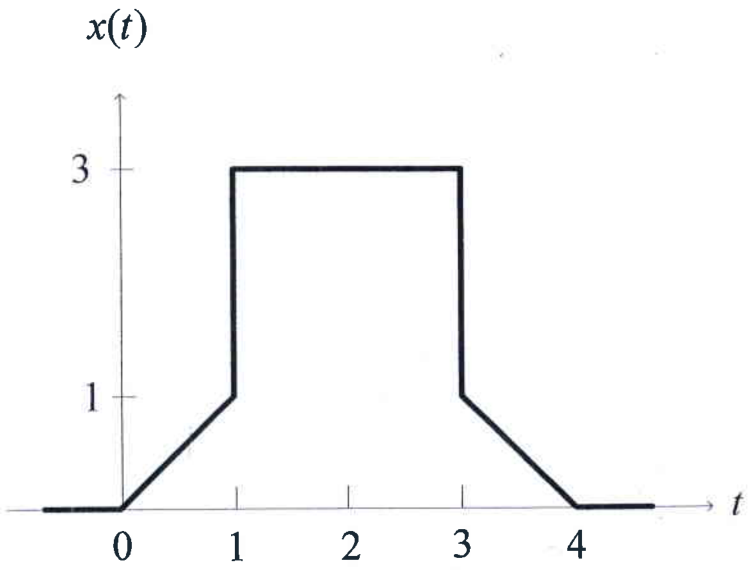


(d)



(e) NV

(6) Let $x(t)$ be a signal as shown



Then $x(t)$ can be expressed in terms of singularity functions (unite step, ramp,…)

(a) $x(t) = r(t) - r(t-1) - r(t-3) + r(t-4)$

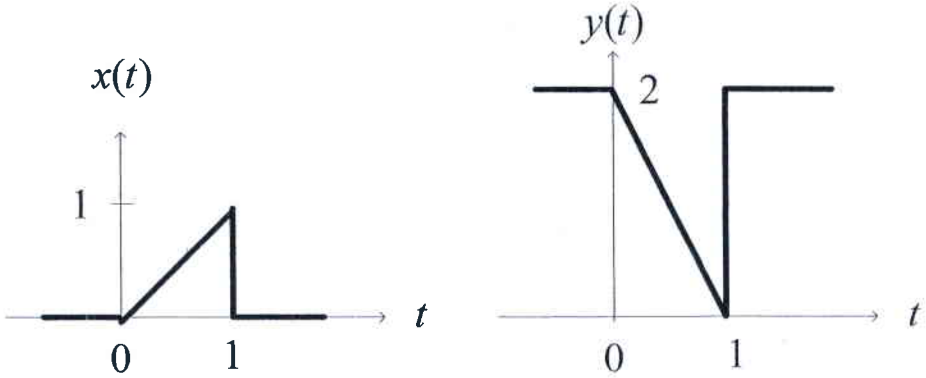
(b) $x(t) = r(t) - 2r(t-1) - 2r(t-3) + r(t-4)$

(c) $x(t) = r(t) + 2u(t-1) - r(t-1) - 2u(t-3) - r(t-3) + r(t-4)$

(d) $x(t) = r(t) + 2u(t-1) - 2u(t-3) - r(t-3) + r(t-4)$

(e) NV

(7) Let $x(t)$ and $y(t)$ be the two signals as shown



Then $y(t)$ in terms of $x(t)$ is

(a) $y(t) = 2x(t) + 2$ (b) $y(t) = -2x(t) - 2$

(c) $y(t) = 2x(t) - 2$ (d) $y(t) = -2x(t) + 2$

(e) NV

(8) For a Linear Time-Invariant system (LTI), if the step response of the system is

$$s(t) = \left(1 - e^{-2t}\right)u(t)$$

Then, the output due to the input $x(t) = 6\delta(t-1)$ is

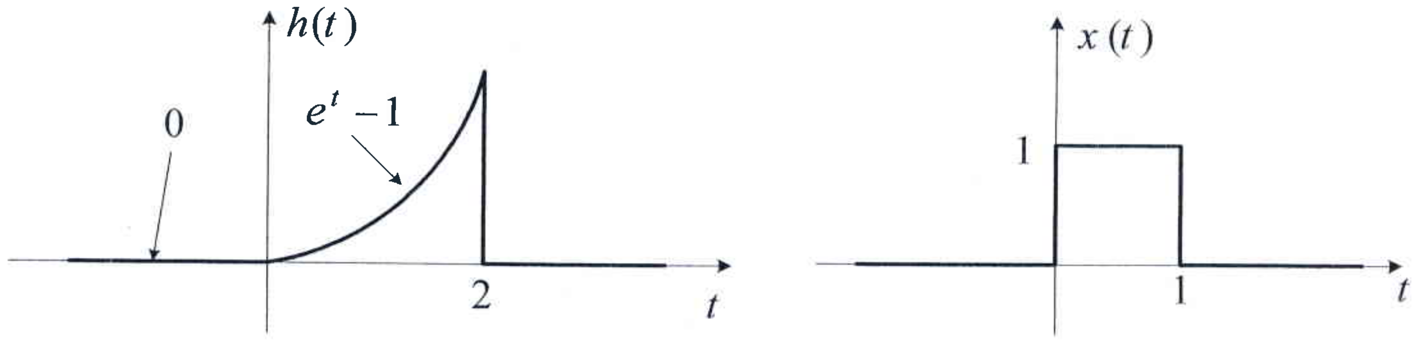
(a) $y(t) = 12\left(1 - e^{-2t}\right)u(t-1)$ (b) $y(t) = 6e^{-2t}u(t-1)$

(c) $y(t) = 12e^{-2(t-1)}u(t-1)$ (d) $y(t) = 12\left(1 - e^{-2(t-1)}\right)u(t-1)$

(e) NV

Q2 (30 points)

For the functions $x(t)$ and $h(t)$ shown below, perform the convolution $y(t) = \int_{-\infty}^{\infty} h(\tau)\, x(t-\tau)\, d\tau$ [i.e., Do not use $y(t) = \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau$] Give the expression for $y(t)$ and the corresponding time intervals for all t.



$y = 0 \quad , \quad t < 0$

$y = \int_0^t (e^\tau - 1)\, d\tau = e^t - t - 1 \quad , 0 < t < 1$

$y(t) = \int_{t-1}^{t} (e^\tau - 1)\, d\tau = e^t - e^{t-1} - 1 \quad , 1 < t < 2$

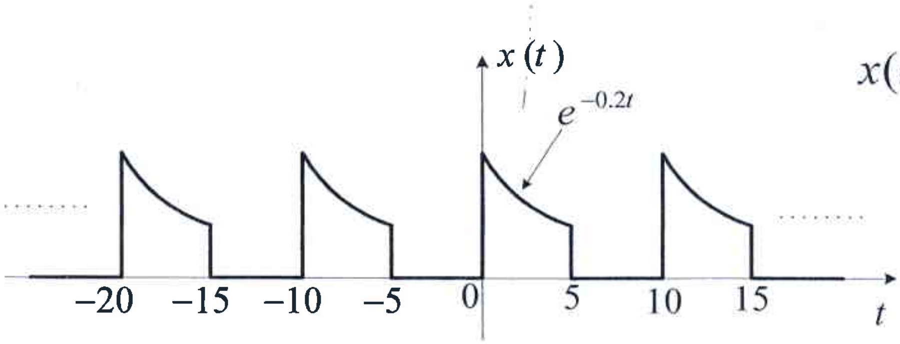
$y(t) = \int_{t-1}^{2} (e^\tau - 1)\, d\tau = e^2 - 3 + t - e^{t-1} \quad , 2 < t < 3$

$y(t) = 0 \quad , t > 3$

Q3 (30 points)

Part I

Consider the periodic signal $x(t)$ as shown in the figure:



$$x(t) = \begin{cases} e^{-0.2t} & 0 < t < 5 \\ 0 & 5 < t < 10 \end{cases}$$

(a) Calculate the average value of the signal (C_0)

(b) Calculate the Complex Fourier Series Coefficient C_3.

(c) Use the result for C_3 above to find C_{-3}.

a) $C_0 = \frac{1}{10}\int_0^5 e^{-0.2t}\,dt = \frac{1}{10}\,\frac{e^{-0.2t}}{-0.2}\Big|_0^5 = 0.316$

b) $C_3 = \frac{1}{10}\int_0^5 e^{-0.2t}\,e^{-j3(0.2\pi)t}\,dt$

$= \frac{1}{10}\,\frac{e^{-0.2t-j0.6\pi t}}{(-0.2-j0.6\pi)}\Big|_0^5 = \frac{e^{-1-j3\pi}-1}{-2-j6\pi}$

$= \frac{-e^{-1}-1}{-2-j6\pi} = \frac{1+e^{-1}}{2+j6\pi} = 0.0722\angle -83.94^\circ$

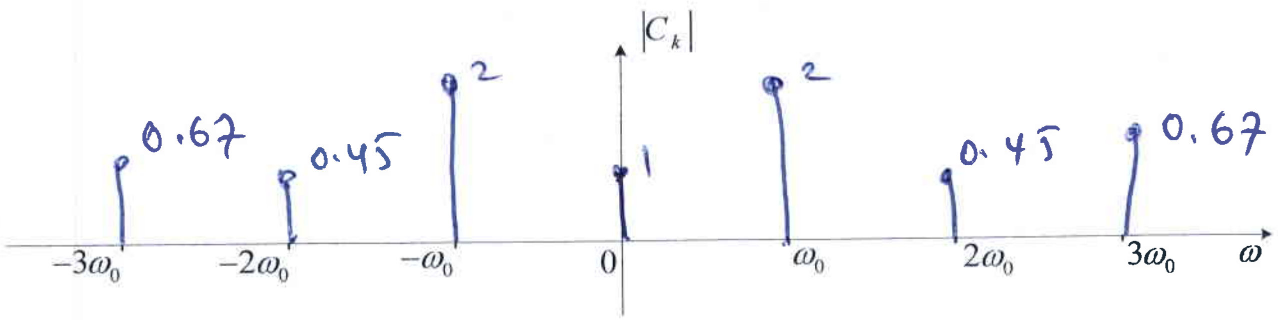
$= 0.0076 - j0.072$

Part II

A certain periodic signal $x(t)$ has the following Complex Fourier Series Coefficients:

$$C_k = \begin{cases} \dfrac{2}{jk}, & k\,(odd) \\[2ex] \dfrac{1}{(1+jk)}, & k\,(even) \end{cases}$$

(a) Plot and label the two-sided magnitude $|C_k|$ in the frequency range $-3\omega_0 \le \omega \le 3\omega_0$.



(b) Plot and label the two-sided phase spectrum θ_k in the frequency range $-3\omega_0 \le \omega \le 3\omega_0$.