EEE2035F EXAM
SIGNALS AND SYSTEMS I

HINTS: June 2008

1. *Fundamental. Don't forget the dirac delta in* $y_7(t)$*, and note that* $y_6(t) = 2$ *for large* t*.*

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2. *We have* $y_1(t) = u(t)$ *and* $y_2(t) = u(t-2)$*, so the system is not time invariant. Also not causal, since we need to know* $x(-1)$ *to find* $y(-2)$*. Linear because response to* $ax_1(t) + bx_2(t)$ *is* $ax_1(t/2) + bx_2(t/2) = ay_1(t) + by_2(t)$*.*

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3. *Convolve* $h(t)$ *with* $u(t)$ *in the time domain to get result* $y(t) = 3/10(1 - e^{-10t})u(t)$*.*

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4. *Coefficients are* $c_0 = 1/2(e - 1/e)$ *and* $c_k = 1/(2(1 - jk\pi))(e^{(1-jk\pi)} - e^{-(1-jk\pi)})$ *for* $k \neq 0$*. The second harmonic corresponds to the terms with coefficients* $c_2 = (e^1 - e^{-1})/(2\sqrt{4\pi^2+1})e^{j\arctan(2\pi)}$ *and* $c_{-2} = c_2^*$*.*

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5. *The signal can be decomposed as* $x(t) = e^{-t}u(t) + e^t u(-t)$*, and the required answer follows from the time reversal property. Using the modulation property gives* $Y(\omega) = 1/[(\omega+10)^2 + 1] + 1/[(\omega-10)^2 + 1]$*.*

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6. *Answers are* $x_1(t) = 5te^{-3t}u(t)$ *and* $x_2(t) = 10/(4j)[e^{2t}u(-t) - e^{-2t}u(t)]$*.*

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7. *Taking the transform of the expression given and rearranging gives the frequency response* $H(\omega) = 1/(j2\omega + 1)$*. Since* $X(\omega) = j\pi[\delta(\omega + 2\pi) - \delta(\omega - 2\pi)]$ *the response is* $Y(\omega) = H(\omega)X(\omega) = j\pi H(-2\pi)\delta(\omega + 2\pi) - j\pi H(2\pi)\delta(\omega - 2\pi)$*. Now take the inverse transform and simplify back into the form of a sinusoid.*

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8. *Taking the Fourier tranform of the differential equation and rearranging gives the required frequency response. The impulse response is the time-domain description of this signal. Using the derivative property gives* $h(t) = \delta(t) - e^{-2t}u(t)$.
