

**LINEAR SYSTEMS AND SIGNALS — Ph.D. Qualifying Exam
Spring 2009**

(i) (6 pts.)

Consider a continuous-time system whose input $x(t)$ and output $y(t)$ are related by

$$y(t) = \sin(2t)x(t)$$

Determine (with justification) whether the system is:

- memoryless
- invertible
- causal
- stable
- time-varying
- linear

(ii) (7 pts.)

Find the impulse response of the causal system whose input $x(t)$ and output $y(t)$ are related by the differential equation

$$\frac{d^2}{dt^2} y(t) + 3\frac{d}{dt} y(t) + 2y(t) = 2\frac{d}{dt} x(t) + x(t)$$

Does the system have a well-defined frequency response $H(j\omega)$? If so, give an equation for it.

(iii) (7 pts.)

Determine the region of convergence (ROC) of the transfer function

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

such that the corresponding continuous-time system is stable. Is that system also causal? Determine its impulse response $h(t)$.