中山大学本科生期末考试

考试科目：《信号与系统》（A 卷）

学年学期：**2014** 学年第 **3** 学期　　姓　　名：_____

学 院/系：理工学院　　学　　号：_____

考试方式：闭卷　　年级专业：_____

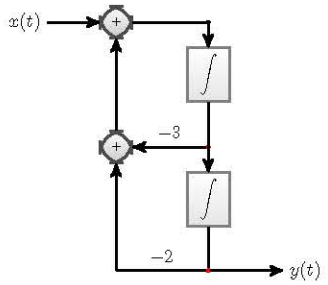
考试时长：120 分钟　　班　　别：_____

任课老师：陈晖

警示 《中山大学授予学士学位工作细则》第八条："考试作弊者，不授予学士学位。"

----------以下为试题区域，共 5 道大题，总分 100 分，考生请在答题纸上作答----------

1. Consider the system structure shown in Figure



   (a) (5 points) Find the differential equation relating $x(t)$ and $y(t)$.

   (b) (5 points) Find the impulse response $h(t)$ of this system.

   (c) (5 points) What is $y(t)$ if $x(t) = e^{-2t}u(t)$? List two methods and use one of them answer.

   (d) (5 points) If this system is cascaded with another one with $H_2(j\omega) = (a - j\omega)/(a + j\omega)$, what would be steady state response of the whole system upon input of $3u(t)$?

2. A discrete-time system has input $x[n]$ and output $y[n]$. The Fourier transforms of these signals are related by equation

$$Y(e^{j\omega}) = \frac{1}{1 - \frac{1}{3}e^{-j\omega}} X(e^{j\omega})$$

   (a) (5 points) Determine the difference equation describing this system.

   (b) (5 points) Determine the output $y[n]$ upon an input $x[n] = \left(\frac{1}{2}\right)^n u[n]$.

   (c) (3 points) Is this system linear? Justify your answer.

   (d) (4 points) If the system is a filter, what type of filter is it? Sketch the filter response.

   (e) (3 points) What is the phase at its maximum transfer?

3. Consider a continuous-time LTI system for which the input $x(t)$ and output $y(t)$ are related by the differential equation

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

   Let $X(s)$ and $Y(s)$ denote Laplace transforms of $x(t)$ and $y(t)$, respectively, and let $H(s)$ detnote the Laplace transform of $h(t)$, the system impulse response.

   (a) (5 points) Determine $H(s)$ as a ratio of two polynomials in s.

   (b) (5 points) Sketch the pole-zero pattern of $H(s)$.

   (c) (5 points) Sketch the LTI system spectral response.

   (d) (3 points) Determine $h(t)$ for the case that the sytem is stable.

4. Consider the digital filter structure shown in Figure

   (a) (10 points) Find $H(z)$ for this causual filter.

   (b) (5 points) Plot the pole-zero pattern and indicate the region of convergence.

   (c) (5 points) For what values of teh k is the system stable

   (d) (5 points) Determine $y[k]$ if $k = 1$ and $x[n] = (2/3)^n$ for all n.