中山大学理工学院 2012 学年 2 学期期末
信号与系统 试卷（A）

11 年级 微电子（2+2）专业 姓名：_____ 学号：_____

共一页，四道大题。 教师姓名:陈晖 考试成绩:_____

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1. The input and the output of a stable and causual LTI system are related by the differential equation

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

   (a) (9 points) Find the impulse response $h(t)$ of this system.

   (b) (9 points) What is the response $y(t)$ of this system if $x(t) = te^{-2t}u(t)$?

   (c) (7 points) If this system is cascaded with another filter with $H_2(j\omega) = (a - j\omega)/(a + j\omega)$, what would be steady state response of the whole system upon input of a unit step function?

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) (8 points) Determine the difference equation describing this system.

   (b) (9 points) Determine the output $y[n]$ upon an input $x[n] = \left(\frac{1}{2}\right)^n u[n]$.

   (c) (4 points) Is this system linear? Justify your answer.

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

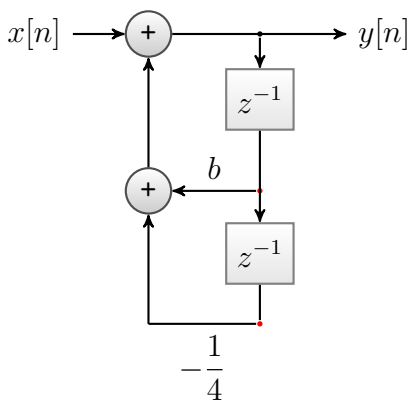
   (a) (8 points) Determine $H(s)$ as a ratio of two polynomials in s.

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

   (c) (6 points) Determine $h(t)$ for the case that the sytem is stable.

   (d) (6 points) Determine $h(t)$ for the case that the sytem is causual.

4. Consider the digital filter structure shown in Figure



   (a) (5 points) Find the difference equation relating the input $x[n]$ and output $y[n]$.

   (b) (9 points) If $b = \frac{5}{2}$, find $H(z)$ for this **causual** filter. Remember to include ROC.

   (c) (6 points) Draw the pole-zero parttern for your $H(z)$ obtained, indicate ROC.

   (d) (5 points) For what values of the b is the system stable?