# Glasgow College, UESTC

## Signals and Systems—Semester 2, 2017 - 2018

## Quiz 3

**June, 2018**

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**Notice:** **Please make sure that both your UESTC and UoG Student IDs are written on the top of every sheet. This examination is closed-book and the use of a cell phone is not permitted. All scratch paper must be adequately labeled. Unless indicated otherwise, answers must be derived or explained clearly. Please write within the space given below on the answer sheets.**

**All questions are compulsory. There are 5 questions and a maximum of 100 marks in total.**

**The following table is for grader only:**

| Question | 1 | 2 | 3 | 4 | 5 | Total | Grader |
|---|---|---|---|---|---|---|---|
| Score | | | | | | | |

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**Question1 (10 points)** Each of the following questions may have only one right answers, justify your answers and write it in the blank.

(1) The Laplace transform of $f(t) = tu(t-1)$ is ( ).

A. $\frac{1}{s^2}(1+e^{-s}), \mathrm{Re}[s] > 0$　　B. $\frac{e^{-s}}{s^2}(1+s), \mathrm{Re}[s] > 0$

C. $\frac{1}{s^2}(1-e^{-s}), \mathrm{Re}[s] > 0$　　D. $\frac{e^{-s}}{s^2}(1-s), \mathrm{Re}[s] > 0$

(2) A continuous-time LTI system has system function $H(s) = \frac{s}{s^2+2s-3}$. Which of following statement is true( )?

A. If it is causal, then it is stable.　　B. If it is not stable, then it is causal.

C. If it is not causal, then it is stable.　　D. If it is stable, then it is not causal.

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**Question2 (30 points)** Fill in the blanks.

(1) A causal signal $x(t)$ with given Laplace transform $X(s) = \frac{2s+1}{s^3+3s^2+2s}$, $\mathrm{Re}\{s\} > 0$, then $x(0^+)$ is ( ), and $x(\infty)$ is ( ).

(2)The system function of a causal LTI system is $H(s) = \frac{1}{s^2+5s+6}$, $\mathrm{Re}\{s\} > -2$. When its system input is $x(t) = e^{2t}, -\infty < t < +\infty$, the system output is ( ). Is the system stable? (Yes/No) ( ).

(3) The relation between the input $x(t)$ and the output $y(t)$ of a causal LTI system is $\frac{dy(t)}{dt} + 5y(t) = \int_{-\infty}^{+\infty} x(\tau)z(t-\tau)d\tau - x(t)$, where $z(t) = 3e^{-t}u(t) + 2\delta(t)$. The frequency response of the system is $H(jw) = ($ $)$. The unit impulse response of the system is $h(t) = ($ $)$.

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**Question3 (15 points)** We are given the following five facts about a real signal x(t) with Laplace transform X(s).

(1) X(s) has exactly two poles.

(2) X(s) has no zeros in the finite s-plane.

(3) X(s) has a pole at s= -1+j.

(4) $e^{2t}x(t)$ is not absolutely integrable.

(5) X(0)=8.

Determine X(s) and specify its region of convergence; sketch the pole-zero plot and mark the ROC on the plot.

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**Question4 (25 points)** Consider a causal LTI system for which the system function $H(s)$ has the pole-zero pattern shown in Figure1. The impulse response of this system is $h(t)$, and $\lim_{t\to 0^+} h(t) = 3$.

(a) Determine the system function $H(s)$.

(b) Determine the unit impulse response $h(t)$ of this system, is this system stable?

(c) If the input is $x(t) = e^{t}, -\infty < t < +\infty$, determine the output $y(t)$.

(d) Determine the differential equation of this system.

(e) Draw a block diagram representation of this system.

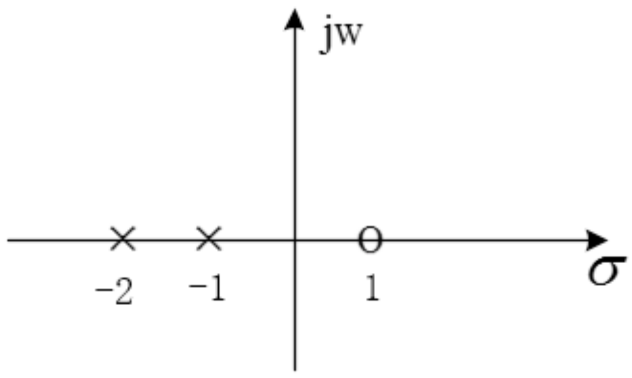


Figure 1

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**Question5** (**20 points**) The input x(t) and output y(t) of a stable system are related through the block-diagram representation shown in Figure2.

(a) Determine the system function H(s) of the system and the sketch the pole-zero pattern, then indicate the ROC of H(s).

(b) Determine the unit impulse response h(t) of this system, is this system causal?

(c) If the input $x(t) = e^{-t}, -\infty < t < +\infty$,determine the output y(t).

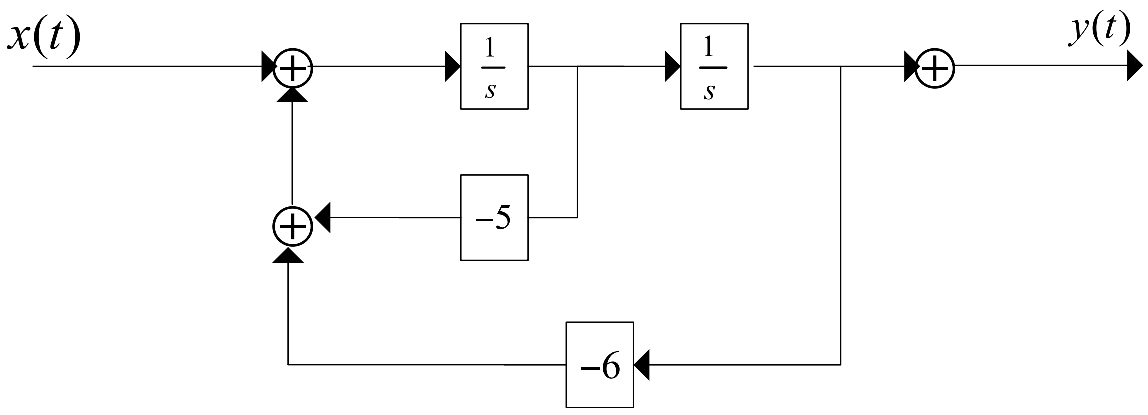


Figure 2