

Signal Processing
İÜC - Computer Engineering Department

Final Exam
January 3rd, 2019

School Number	
First Name	
Last Name	
Signature	

Bu sınavda, kapak sayfası dahil olmak üzere, 2 sayfa ve 18 soru vardır. Sınavda toplam 125 puanlık soru vardır. Bu sınavın süresi 70 dakikadır. Lütfen test sorularını kağıdın üzerinde işaretleyiniz. Klavik sorular için cevaplarınız verilen cevap kağıtlarına yapınız. Lütfen soruları İNGİLİZCE ksa ve anlaşılır olarak cevaplayınız. Anlaşılmasın, yanlışlık ifadeler kullanmak, kötü yazı yazmak notunuza negatif olarak etki edecektir. Sınavda üsere içinde soru ve çözümleri olmayan notlarınızı yazdığınız 1 adet A4 kağıdı kullanabilirsiniz. Ayrıca, kitabın arkasındaki APPENDIX A'nın fotokopisini getirebilirsiniz ve bunun üzerinde ek olarak notlarınızı yazabilirsiniz. Sınavda 1 adet hesap makinesi kullanabilirsiniz. Fotoğraf veya bilgisayar çıktısı olabilir. Her türlü defter, kitap, notlar, sözlük ve elektronik sözlük yasaktır. Materyalin paylaşılması yasaktır. **SINAVDA KOPYA ÇEKENLER, KOPYA VERENLER VE BUNLARA TEŞEBBÜS EDENLER SINAVDAN "0" ALACAKTIR VE DEKANLIĞA ŞİKAYET EDİLECEKLERDİR!** Başarılar. (Mustafa Dağlıoğlu)

Q1: [5 Points] For a discrete non-periodic time-domain signal, $x[n]$, assuming it satisfies the Dirichlet conditions, the frequency representation can be found using DTFT. Which of the following statements is true?

- A. The frequency domain representation, $X(\Omega)$ is periodic and its period is π .
- B. The frequency domain representation, $X(\Omega)$ is non-periodic.
- C. The frequency domain representation, $X(\Omega)$ is continuous.
- D. The frequency domain representation, $X(\Omega)$ is discrete.

Q2: [5 Points] For a discrete periodic time-domain signal, $x[n]$ that is absolutely summable, which one of the following transformations is used to obtain the frequency domain representation?

- A. DTFS B. DTFT C. FT D. FS

Q3: [5 Points] Consider an absolutely summable discrete non-periodic time-domain signal, $x[n]$. Which one of the following transformations is used to obtain the frequency domain representation of this signal?

- A. DTFS B. DTFT C. FT D. FS

Q4: [5 Points] Consider the signal $x(t) = 1$. Which one of the following is true?

A. $x(t)$ is not absolutely summable, so no FT representation exists for this signal.

B. Although this signal is not absolutely summable, an FT can be nevertheless calculated and it is useful for analysis.

C. This signal is squarely summable.

D. The FT of $x(t)$ is $X(\omega) = 1$

Q5: [5 Points] Consider the LTI system $y(t) = H\{x(t)\} = x(t) - x(t - 2)$. Which one of the following is the impulse response of H ?

- A. The impulse response of H does not exist.
- B. $h(t) = 1$
- C. $h(t) = u(t) - u(t - 2)$
- D. $h(t) = \delta(t) - \delta(t - 2)$

Q6: [5 Points] Consider the LTI system $y[n] = H\{x[n]\} = x[n] - x[n - 2]$. Which one of the following is the step response of H ?

- A. The step response of H does not exist.
- B. $h[n] = 1$
- C. $h[n] = u[n] - u[n - 2]$
- D. $h(t) = \delta[n] - \delta[n - 2]$

Q7: [5 Points] Which one of the following equations are true? ($*$ is the convolution operator)

- A. $x(t) * h(t) \neq h(t) * x(t)$
- B. $x(t) * [h_1(t) + h_2(t)] = [x(t) * h_1(t)] + [x(t) * h_2(t)]$
- C. $x(t) * [h_1(t) * h_2(t)] = [x(t) * h_1(t)] * [x(t) * h_2(t)]$
- D. $\delta(t) * x(t - 2) = \delta(t - 2)$

Q8: [5 Points] Which one of statements must always be true for a discrete LTI system that has an "absolutely summable" impulse response?

- A. This system is not linear.
- B. This system has a zero frequency response.
- C. The system is non-invertible.
- D. The system is BIBO stable.

Q9: [5 Points] Which one of the following is the definition of a "sinc" function?

- A. $\text{sinc}(u) = \sin(u)/u$
 B. $\text{sinc}(u) = \sin(u)/\pi$
 C. $\text{sinc}(u) = \sin(\pi u)/(\pi \sin(u))$
 D. $\text{sinc}(u) = \sin(\pi u)/(\pi u)$

Q10: [5 Points] What is $\text{sinc}(0)$?
 A. π B. 1 C. 0.5 D. 0.5π

Q11: [5 Points] Which one of the following is equivalent to $\cos(0.7\pi t + 0.2\pi)$

- A. $\frac{1}{2} [e^{j0.7\pi t} + e^{-j0.7\pi t} - 0.2\pi]$
 B. $\frac{1}{2} [e^{j(0.7\pi t + 0.2\pi)} + e^{-j(0.7\pi t + 0.2\pi)}]$
 C. $\frac{1}{2} [e^{j(0.7\pi t + 0.2\pi)} + e^{-j(0.7\pi t + 0.2\pi)}]$
 D. $\frac{1}{2j} [e^{j(0.7\pi t + 0.2\pi)} - e^{-j(0.7\pi t + 0.2\pi)}]$

Q12: [5 Points] Which one of the following is equivalent to $\frac{1}{2j} [e^{j\pi t} - e^{-j\pi t}]$

- A. $\sin(1.5\pi t)$ B. $\sin(0.5\pi t)$ C. $\cos(1.5\pi t)$
 D. $\cos(0.5\pi t)$

Q13: [5 Points] Consider this statement: "If an LTI system is memoryless then its impulse response must be the unit impulse function multiplied by a constant". Please print either TRUE or FALSE inside the box.

Q14: [5 Points] Consider this statement: "The CT periodic signal $x(t) = \cos(0.2\pi t)$ cannot be represented in the frequency domain". Please print either TRUE or FALSE inside the box.

Q15: [5 Points] What is $\delta(t-4) * x(t)$? Write it in the box. (* is the convolution operator)

Q16: [15 Points] Find the DTFT representation of $x[n] = 3^n u[-n]$.

Q17: [15 Points] Find the time domain signal corresponding to the DTFS coefficients $X[k] = j \sin(k3\pi/7)$. You must also determine whether the time domain signal is periodic or not. If it is, what is the period?

Q18: A continuous time LTI system, \mathcal{H} , is given as: $y(t) = \int_{-\infty}^t x(\tau - 5) d\tau$, where $y(t)$ is the output of this system when $x(t)$ is its input. Answer the following questions.

- (a) [5 Points] Please find and sketch the impulse response of \mathcal{H} .
 (b) [10 Points] If the input signal of this system is given as $x(t) = e^{-t} u(t-1)$, find the output of this system.
 (c) [5 Points] Find the step response of this system.