ECE 2026 Exam 2 Part I Answer Sheet
Summer 2025

Name ______________________________

General Instructions:

- Exam is closed book / closed notes other than the allowed handwritten notes.
- Choose the best possible answer available in all cases.
- The only graded answers are those placed on the lines below, and would be the identified element (e.g. a, b, c, d, e, f).
- Blank scratch paper is allowed

The first part (Objective Questions) of the exam is to be completed and submitted first. When you have submitted the first part of the exam, you will be handed the second part (Open Response Question) part of the exam. Each question has equal weight (4 points each).

_______________ Question 1

_______________ Question 2

_______________ Question 3

_______________ Question 4

_______________ Question 5

_______________ Question 6

_______________ Question 7

_______________ Question 8

_______________ Question 9

_______________ Question 10

_______________ Question 11

_______________ Question 12

_______________ Question 13

_______________ Question 14

_______________ Question 15

_______________ Question 16

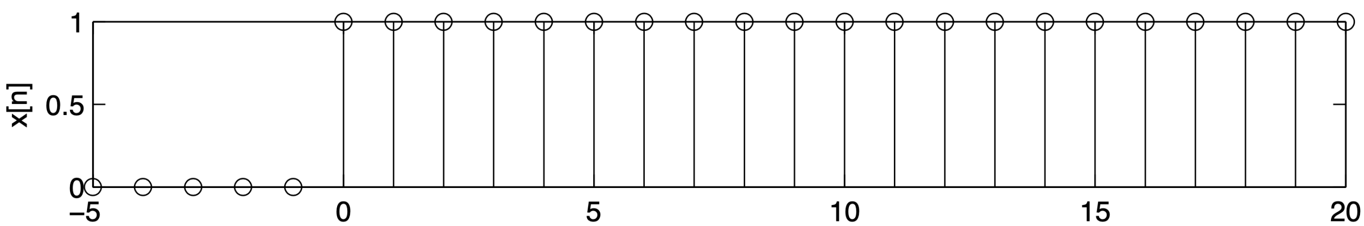
_______________ Question 17

_______________ Question 18

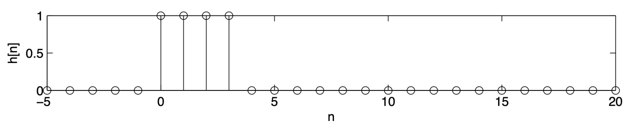
Part I: Objective Questions

These questions have straight-forward answers. Make sure to put your answer in the line required as that is the part that will be graded for the answer given. Only the final answers, as indicated by the question, will be considered correct for each question. Each question is worth 4 points (total of 72 points)

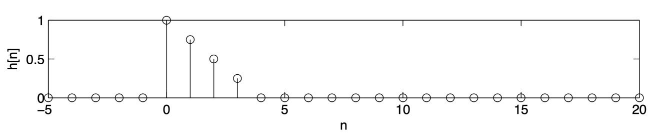
Match the h[n] and output response for the following input



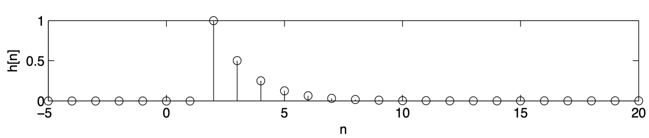
__________ 1.



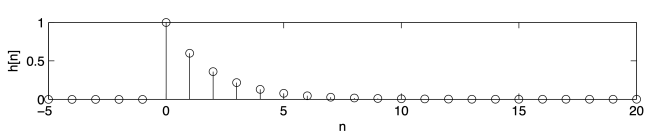
__________ 2.



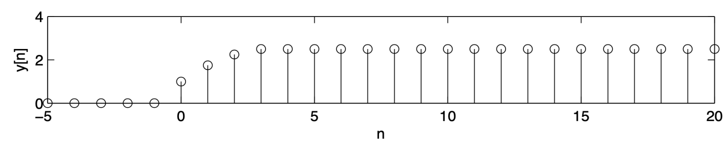
__________ 3.



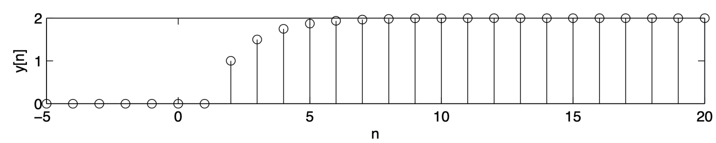
__________ 4.



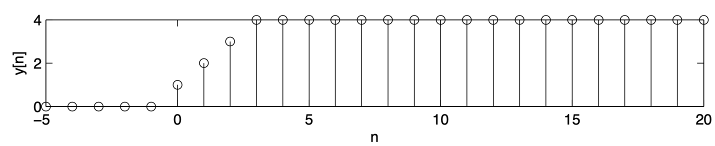
a.



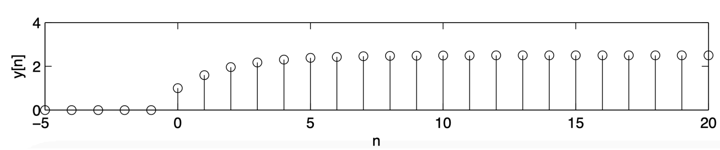
b.



c.



d.



What Magnitude Response corresponds to the given h[n]?

__________ 5.
$\delta[n] - \sqrt{2}\delta[n-1] + \delta[n-2]$

__________ 6.
$\delta[n] + \sqrt{2}\delta[n-1] + \delta[n-2]$

__________ 7.
$\delta[n] - \delta[n-1] + \delta[n-2] - \delta[n-3]$

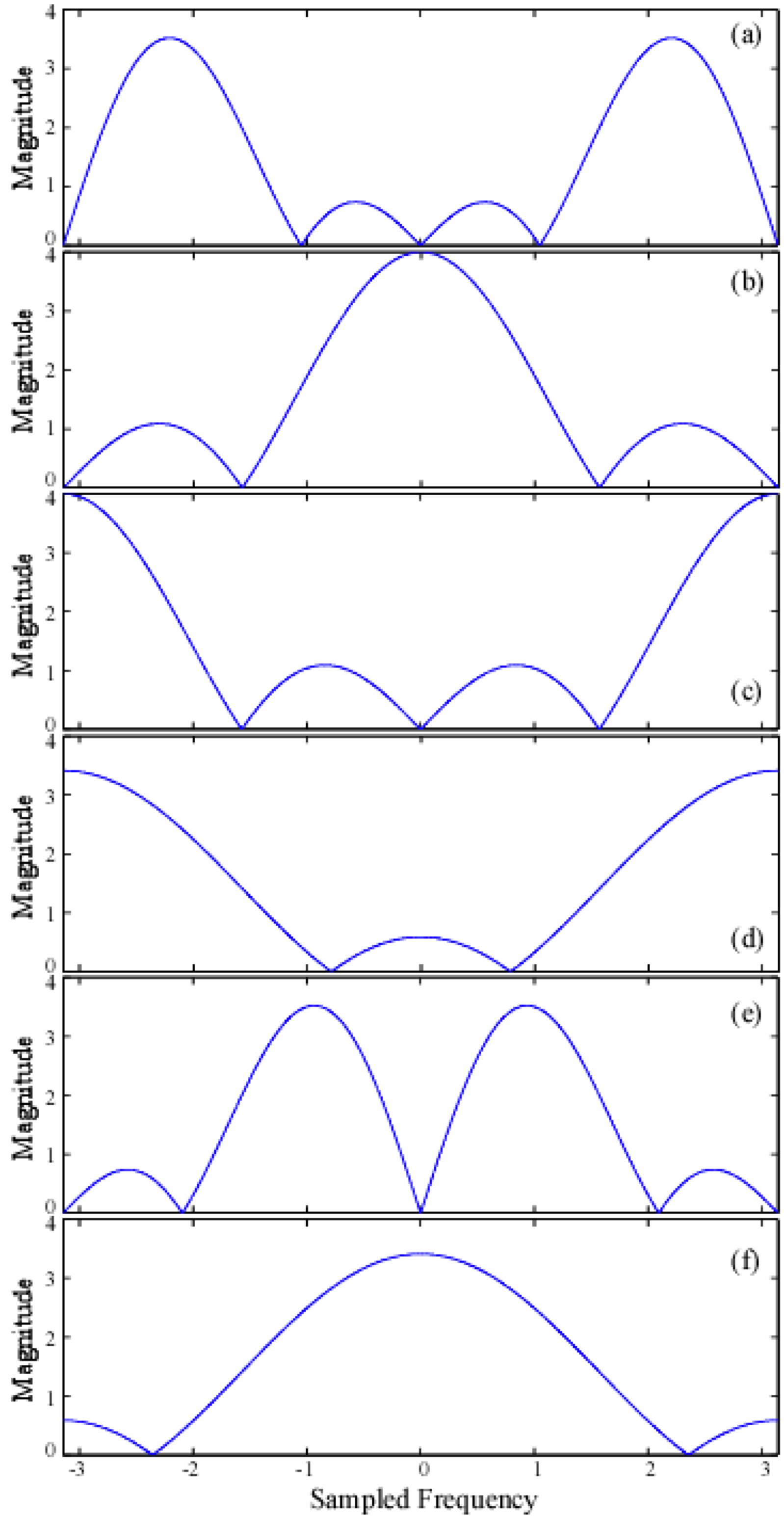
__________ 8.
$\delta[n] + \delta[n-1] + \delta[n-2] + \delta[n-3]$

__________ 9.
$\delta[n] - \delta[n-1] + \delta[n-3] - \delta[n-4]$

__________ 10.
$\delta[n] + \delta[n-1] - \delta[n-3] - \delta[n-4]$

__________ 11. How many zeros are in (b)?

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5



What Phase Response corresponds to the given h[n]?

__________ 12.
$\delta[n] - \sqrt{2}\delta[n-1] + \delta[n-2]$

__________ 13.
$\delta[n] + \sqrt{2}\delta[n-1] + \delta[n-2]$

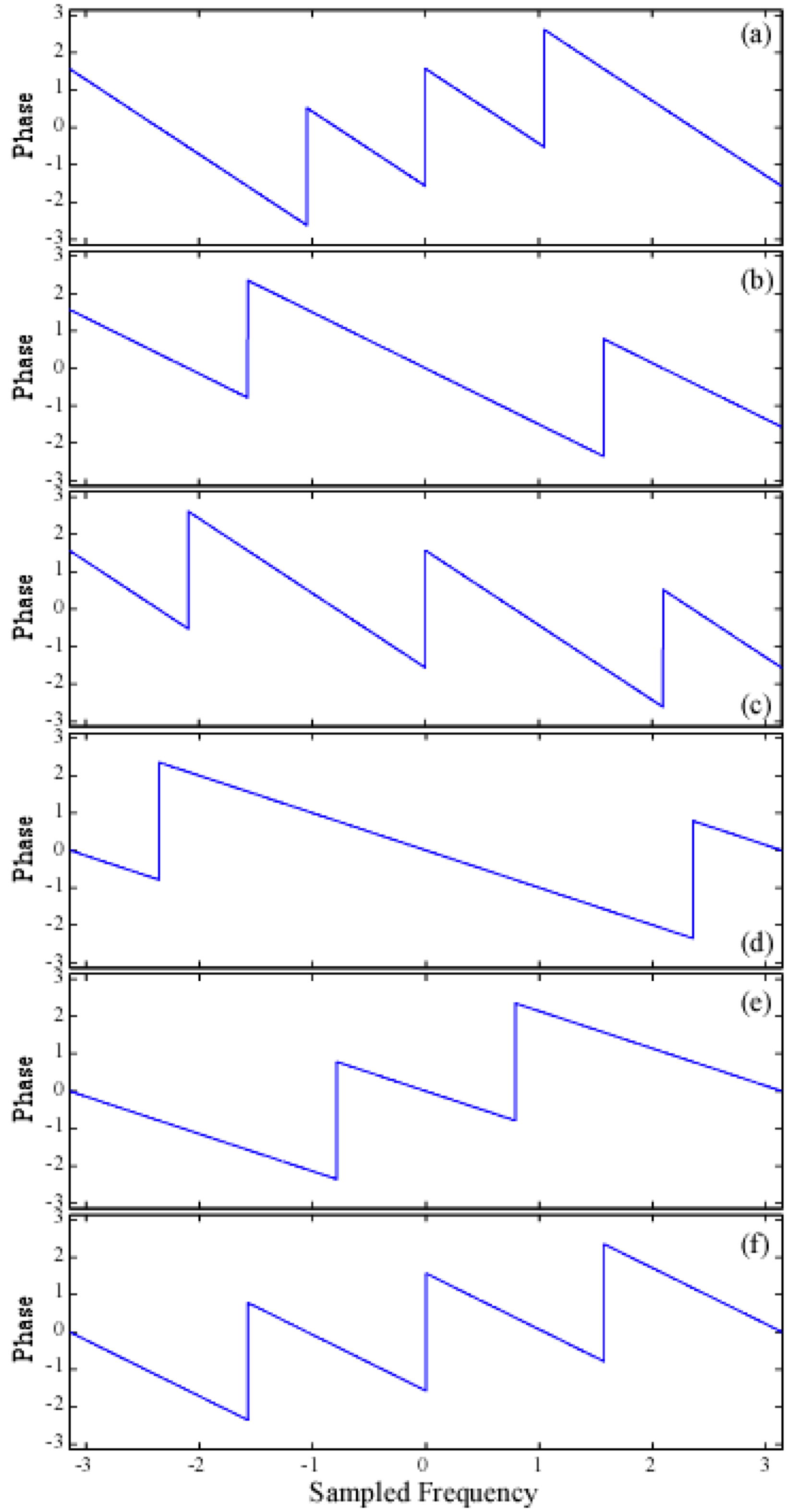
__________ 14.
$\delta[n] - \delta[n-1] + \delta[n-2] - \delta[n-3]$

__________ 15.
$\delta[n] + \delta[n-1] + \delta[n-2] + \delta[n-3]$

__________ 16.
$\delta[n] - \delta[n-1] + \delta[n-3] - \delta[n-4]$

__________ 17.
$\delta[n] + \delta[n-1] - \delta[n-3] - \delta[n-4]$

__________ 18. How many zeros are in (c)?
a. 0
b. 1
c. 2
d. 3
e. 4
f. 5



ECE 2026 Exam 2 & Part II Open Response Question
Summer 2025

Name ______________________________

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_____/72_ Part I: Objective Questions

_____/28_ Part II: Open Response Question

____/100_ Final Score

A. Derive the following discrete-time—z-transform pair for a fixed $\hat{\omega}_1$.

$$a^n \cos(\hat{\omega}_1 n + \theta) u[n] \quad \longleftrightarrow \quad \frac{\cos(\theta) - a\cos(\hat{\omega}_1 - \theta) z^{-1}}{1 - 2a\cos(\hat{\omega}_1) z^{-1} + a^2 z^{-2}}$$

B. What is the condition for the numerator to not have a delay term?
What is the transforms for $\hat{\omega}_1$ equal to $\pi/6$ and $\pi/4$ for this case?

C. Consider the following differential equation that is typical of a circuit with an inductor (L), capacitor (C), and resistor (R):

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

Remember the definitions of first- and second-order derivatives:

$$\frac{dy}{dt} = \lim_{\Delta \to 0} \frac{y(t+\Delta) - y(t)}{\Delta}$$

$$\frac{d^2y}{dt^2} = \lim_{\Delta \to 0} \frac{y(t+\Delta) - 2y(t) + y(t-\Delta)}{\Delta^2} = \lim_{\Delta \to 0} \frac{y(t) - 2y(t-\Delta) + y(t-2\Delta)}{\Delta^2}$$

We want to sample the differential equation at a regular sample time (T_s):

$$t = nT_s$$

Formulate the difference equation for this differential equation. Write the equation in terms of parameters Q and the ratio, $a = \tau/T_s$. Formulate this differential equation for the specific parameters Q = 1, a = 1. What is the impulse response for this system? How would you set up and see the flow for the step response for this system (e.g. setting up partial fraction expansion)? Extra credit (4 points): what is the continuous-time solution for τ = 1ms, and Q = 1.