FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY

School of Electrical & Electronics Engineering

Bachelor of Engineering (Electrical & Electronics)

EEE787 – Fundamentals of Digital Signal Processing

RESIT EXAMINATION

Penster 4, 2017

Date: As per Exam Time Table

Time: As per Exam Time Table (3 hours)

Venue: As per Exam Timetable

Instructions to Students

1. You are allowed an extra ten (10) minutes of reading time during which you are NOT allowed to write.
2. Attempt ALL questions in this examination booklet
3. Write your answers in the answer booklet provided.
4. Write your Student ID number on each page used.
5. Begin each Section on a fresh page and use both sides of the answer sheet.
6. You may use calculators provided they are non-programmable.
7. Clearly number the questions in your answer paper in their correct sequence and write legibly. Show all working.
8. Attach any extra sheets used to your answer booklet securely with the string provided.

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Question 1 **[9 marks]**

Using block diagram, briefly explain a digital signal processing system. Also state and explain all the processes involved in analog to digital conversion.

Question 2 **[6 marks]**

A digital communication link carries binary-coded words representing samples of an input signal $x_a(t) = 1.7\cos 1100\pi t + 4.2\sin 820\pi t$. The link is operated at 9, 840 bits/s and each input sample is quantized into 4096 different voltage levels. Determine the:

a) sampling frequency. [2 marks]

b) highest frequency that can be represented uniquely at this sampling rate? [1 mark]

c) resulting discrete-time signal? [3 marks]

Question 3 **[9 marks]**

Given the following input signal:

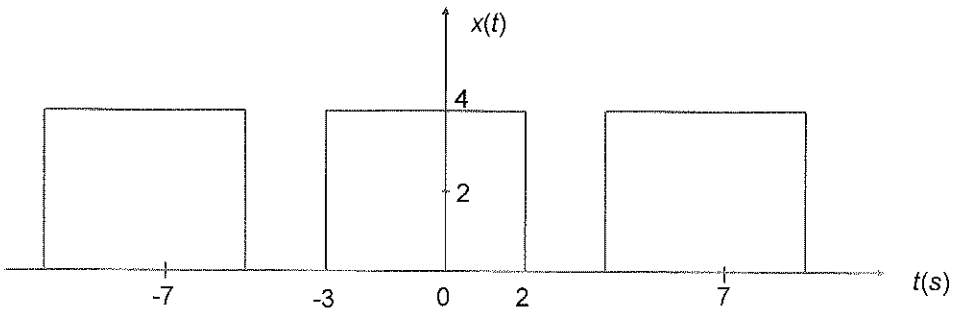
$$x(n) = \left(\frac{1}{3}\right)^n u(n)$$

a) Represent the signal using sequence representation. [2 marks]

b) Determine the response to the system: $h(n) = \left(\frac{1}{5}\right)^n u(n)$ [7 marks]

Question 4 **[10 marks]**

Determine the power density spectrum of the rectangular pulse train shown below.



Please Turn Over

Question 5 **[12 marks]**

Refer to the difference equation given below to answer the following questions:

$1.31y(n) = y(n+1) + 2.15y(n) - x(n-1) - 3.89x(n)$

a) Using the basic building blocks, sketch the block diagram representation of this discrete-time system, where $x(n)$ is the input and $y(n)$ is the output of the system. [4 marks]

b) Determine the system function and the unit sample response of the system. [8 marks]

Question 6 **[10 marks]**

Convolution in time domain is the same as multiplication in frequency domain. Using the sequences $x(n) = \{2, \underset{\uparrow}{0}, -1\}$ and $h(n) = \{1, \underset{\uparrow}{-5}, 4\}$, show that the statement holds to be true.

Question 7: **[6 marks]**

A linear time-invariant system is characterized by the system function $H(z) = \frac{5}{1-2.23z^{-1}} - \frac{3.4}{1+1.08z^{-1}}$. Specify the ROC of $H(z)$ and determine $h(n)$ for the following conditions:

a) The system is stable. Is this system causal, non-causal or anticausal? [3 marks]

b) The system is causal. Is this system stable? [3 marks]

Question 8: **[13 marks]**

A two-pole lowpass filter has the system function $H(z) = \frac{b_0}{(1-pz^{-1})^2}$. Determine the values of center of b_0 and p such that the frequency response $H(w)$ satisfies the conditions $H(\pi) = 1$ and $\left|H\left(\frac{\pi}{5}\right)\right|^2 = \frac{1}{3}$.

Question 9: **[25 marks]**

Consider the FIR filter $y(n) = -0.73y(n-1) + 0.97x(n)$.

a) Compute and sketch its magnitude and phase response for $-2\pi \le w \le 2\pi$. (*Note: Plot the responses in the solution sheet provided*). [9 marks]

Please Turn Over

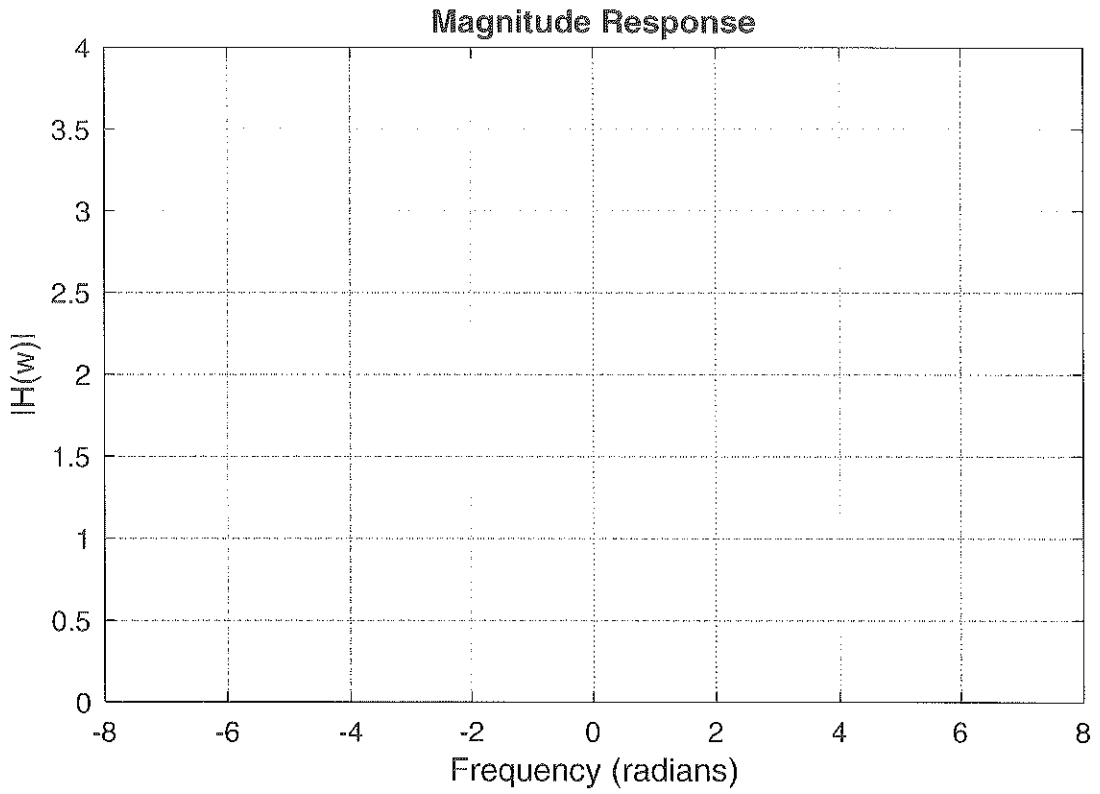
b) Determine the transient and steady state response of the system when the input signal is $x(n) = \sin(2\pi n/5)\,u(n)$ [16 marks]

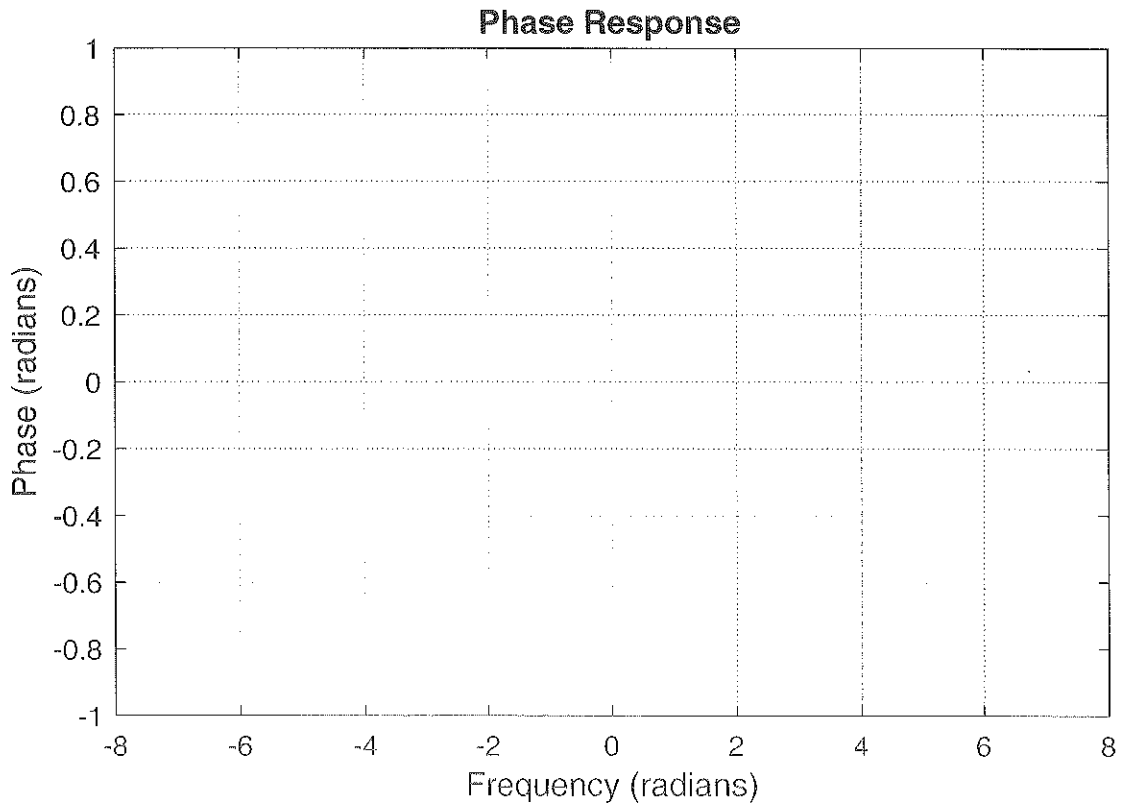
Given below is the z-transform table.

Signal, $x(n)$	z-Transform, $X(z)$	ROC
$\delta(n)$	1	All z
$u(n)$	$\frac{1}{1-z^{-1}}$	$\lvert z\rvert > 1$
$-a^n u(-n-1)$	$\frac{1}{1-az^{-1}}$	$\lvert z\rvert < \lvert a\rvert$
$-na^n u(-n-1)$	$\frac{az^{-1}}{(1-az^{-1})^2}$	$\lvert z\rvert < \lvert a\rvert$
$(\cos w_0 n)\,u(n)$	$\frac{1-z^{-1}\cos w_0}{1-2z^{-1}\cos w_0 + z^{-2}}$	$\lvert z\rvert > 1$
$(\sin w_0 n)\,u(n)$	$\frac{z^{-1}\sin w_0}{1-2z^{-1}\cos w_0 + z^{-2}}$	$\lvert z\rvert > 1$

THE END

ALL THE BEST FOR THE EXAMINATION





Please attach this sheet to your answer booklet