Department of Electrical Engineering
Final Exam Assignment
Date: 28/09/2020

Course Details

Course Title: Digital Signal Processing **Module:** 6th
Instructor: ______________ **Total Marks:** 50

Student Details

Name: ______________ **Student ID:** ______________

Q1.	(a)	Determine the response y(n), n ≥ 0, of the system described by the second order difference equation $$y(n) - 4y(n-1) + 4y(n-2) = x(n) - x(n-1)$$ To the input $x(n) = (-1)^n u(n)$. And the initial conditions are y (-1) = y (-2) = 0.	**Marks 8** **CLO 2**
	(b)	Determine the impulse response and unit step response of the systems described by the difference equation. $$y(n) - 0.7y(n-1) + 0.1y(n-2) = 2x(n) - x(n-2)$$	**Marks 7** **CLO 2**
Q2.	(a)	Determine the causal signal x(n) having the z-transform $$x(z) = \frac{1}{(1-2z^{-1})(1-z^{-1})^2}$$ (Hint: Take inverse z-transform using partial fraction method)	**Marks 8** **CLO 2**
	(b)	Perform the circular convolution of the following two sequences. Solve the problem step by step $$x_1(n) = \left\{\underset{\uparrow}{2}, 1, 2, 1\right\}$$ $$x_2(n) = \{\underset{\uparrow}{1}, 2, 3, 4\}$$	**Marks 7** **CLO 2**
Q.3	(a)	A two- pole low pass filter has the system response	**Marks 12**

<table>
<tr><td></td><td></td><td>$$H(z) = \frac{b_o}{(1 - pz^{-1})^2}$$
Determine the values of b_o and p such that the frequency response H(ω) satisfies the condition H(0) = 1 and $\left|H(\frac{\pi}{4})\right|^2 = \frac{1}{2}$.</td><td>CLO 3</td></tr>
<tr><td></td><td>(b)</td><td>Design a two-pole bandpass filter that has the center of its passband at ω = π/2, zero in its frequency response characteristics at ω = 0 and ω = π and its magnitude response in $\frac{1}{\sqrt{2}}$ at ω = 4π/9.</td><td>Marks 8
CLO 3</td></tr>
<tr><td rowspan="2">Q 4</td><td>(a)</td><td>A finite duration sequence of Length L is given as
$$x(n) = \begin{cases} 1, & 0 \le n \le L-1 \\ 0, & otherwise \end{cases}$$
Determine the N- point DFT of this sequence for N ≥ L</td><td>Marks 8
CLO 2</td></tr>
<tr><td>(b)</td><td>Evaluate the inverse z- transform using the complex inversion integral
$$X(z) = \frac{1}{1 - az^{-1}} \qquad |z| > |a|$$</td><td>Marks 6
CLO 2</td></tr>
<tr><td rowspan="2">Q5</td><td>(a)</td><td>Consider the following analog signal
$$x_a(t) = 3cos100\pi t + 4sin200\pi t$$
i. Determine the minimum sampling rate required to avoid aliasing.
ii. Suppose that the signal is sampled at the rate $F_s = 100Hz$. What is the discrete-time signal obtained after sampling? Also explain the effect of this sampling rate on the newly generated discrete time signal.
iii. What is the analog signal $y_a(t)$ we can reconstruct from the samples if we use ideal interpolation?</td><td>Marks 8
CLO 1</td></tr>
<tr><td>(b)</td><td>Consider a discrete time signal which is given by
$$x(n) = \begin{cases} 0.5^n, & n \ge 0 \\ 0, & n < 0 \end{cases}$$
This is signal is sampled at the rate $F_s = 2Hz$.
i. Draw the sampled signal.
ii. The samples of the signals are intended to carry 3 bits per sample. Determine the quantization level and quantization resolution to quantized the sampled signal achieved in part i .
iii. Perform the process of truncation and rounding off on all the values of the sampled signal and find the quantization error for each of the sampled data. Express your answer in tabular form.</td><td>Marks 8
CLO 1</td></tr>
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