NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCE
COMPUTER SCIENCE DEPARTMENT
DECEMBER EXAMINATIONS 2001

SUBJECT: DIGITAL SIGNALS PROCESSING
CODE: SCS 6101

INSTRUCTION TO CANDIDATES

Answer any four (4) questions.
Each question carries 25 marks

Time: 3 hours

QUESTION ONE

a) What are the classification of Discrete-time systems and distinguish between them. [8]

b) Test whether the following Discrete-time signals are periodic, if it is periodic find its fundamental period. [5]

$x(n) = 5\sin(2n)$

c) Find whether the system $y(n)\ A\ x(n) + B$ is

i) Linear
ii) Time invariant
iii) Casual
iv) Stable [12]

QUESTION TWO

a) Write the expressions for

i) An arbitrary discrete time signal $x(n)$ resolued into Impulses.[1]
ii) Linear convolution. [1]
iii) Graphical representation of the following discrete time signal.
$x(n) = (-2)^n u(n)$ [2]

Convolve the sequences given

$h(n) = 5(3)^n u(n)$

$x(n) = 4(-2)^n \; u(n)$ [11]

Find the DFT of the sequence

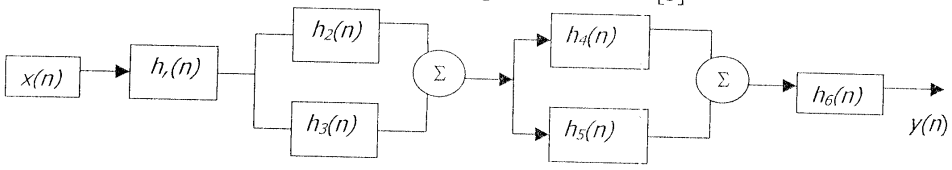
$x(n) = \{1, \; 2, \; 2, \; 1\}$ [10]

QUESTION THREE

i) An LTI system has the Impulse response $h(n) = \left(\frac{3}{4}\right)^n u(n)$. Determine the output of the system at times $n = -5, \quad n = +5 \quad and \quad n = 10$ when input $x(n) = u(n)$

[10]

ii) Find the expression for impulse response relating to input $x(n)$ *or* $x(t)$ to the output $y(n)$ *or* $y(t)$ in terms of the impulse response of each subsystem for the LTI system depicted in fig. Below. [3]



b) Let $h_1(t), \; h_2(t), \; h_3(t) \; and \; h_4(t)$ be the impulse responses of LTI system construct a system with impulse response $h(t)$ using $h_1(t), \; h_2(t), \; h_3(t) \; and \; h_4(t)$ as sub system. Draw the interconnection of systems required to obtain

$h(t) = h_1(t) \; x \; h_2(t) + h_3(t) \; x \; h_4(t)$ [3]

c) Define the elementary signals $\delta(t), \quad u(t) \; and \; r(t)$ and bring out the relation between them. [6]

Define stability of a system. [3]

QUESTION FOUR

a) i) What are FIR and IIR systems. Give examples.
ii) Bring out the advantages of FIR filter compared to IIR filters. [5]

b) A discrete time system has a unit sample response h(n) given by

$$h(n) = \frac{1}{2}\delta(n) + \delta(n-1) + \frac{1}{2}\delta(n-2)$$ [15]

Find the frequency response $H(e^{j\omega})$. Plot its magnitudes phase.

c) Find the convolution of the below finite sequence:

$$x(k) = \{\frac{1}{2},\ 2,\ 1,\ -1\}$$

$$h(k) = \{2,\ 1,\ \frac{1}{2}\}$$ [5]

QUESTION FIVE

a) Briefly explain

i) aliasing
ii) FFT
iii) Determine the sampling frequency for the following signals

$$x(t) = Sin200\Pi t + Cos300\Pi t + Sin400\Pi t$$ [6]

b) Find the circular convolution of the following two sec uences

$$x(n) = \{0,\ 1,\ 2,\ 3\}$$
$$\uparrow$$
$$h(n) = \{2,\ 1,\ 1,\ 2\}$$ [7]
$$\uparrow$$

Realize the following transfer function as Direct form I and II structure

$$H(z) = \frac{8z^3 - 4z^2 + 4z - 2}{(z - \frac{1}{4})(z^2 - z + \frac{1}{2})}$$ [12]

QUESTION SIX

With the help of block diagrams, explain how DSP techniques can be used for any one application. [25]

END OF QUESTION PAPER

GOOD LUCK!