LAB CODE AND NAME - 19 (LE284 SOFTWARE DEFINED RADIO LAB EXPERIMENT NUMBER - 5 DATE - 30/05/2022

## DESIGN AND ANALYZE FILTERS FOR GIVEN SPECIFICATIONS

# AIM &

Given the order, cutoff frequency, and filter type, analyze the filter nesponse and magnitude nesponse. Also, include finite word length effects in the analysis.

\* SOFTWARE REQUIRED :

Spyder 10t - Bython 3.9

CODE

impart matplotlib. pyplot as plt # Phondos an implicit may of platting impart numpy as up # support for large, multi-dimensional arrays and matrices

import time # Handle time-related tasks

# Compute DFT coefficients using linear thansformation method: - def DFT 12, plat-name, wound-off):

start = time . time ()

# Compute N(N) 1D Ahray: -

Wn=[]

for i in range (x1);
for f in range (ii);

wn append (np. enp (-2; + np.pi +; +; / len(a)))

# mumpy. neshape () is used to give a new shape to an array without changing its data.

Wh- multidim = np. hoshage (wn, (Al, (1)) # An N+N W(N) materia Als unly; alsi 8- multidins - Ap. Leshape (2/12/04) # An N+1 x(N) matrix

# compute xln) = wln) \* xln), an N\*/ mathin faurier thansform\_multidim = [To] + c2] + at # NULL Multidimensional Array Declaration

faurier\_ towarsform-l-t = [] # Convert Multidimensional Array

for i in range (A1): fer j in range (02) 3 fourier\_transform\_multidins [i][j] = 0
for k in range (ci):

faurier - transform - multidim [][] += mn-multidim [][k]+ float [r\_multidin [k][j])

feurier - transform-l-t. append (hound Cabs (fourier-transform multidin [i][j], hound\_ off ))

plt. Alabel ("Frequency in Herte") plt ylabel (" AG) in voelts")

pet title ("" + str (plet\_name) + " in Frequency Demain") pet plat (np arange (o, een (fæurier - transform - l-t)).

fourier\_transform-l-t)

pet gred (True) plt show ()

end = time . time ()

phint I'm The time taken for execution of + str(plet-name) + Design (in seconds) is ; , enq-start)

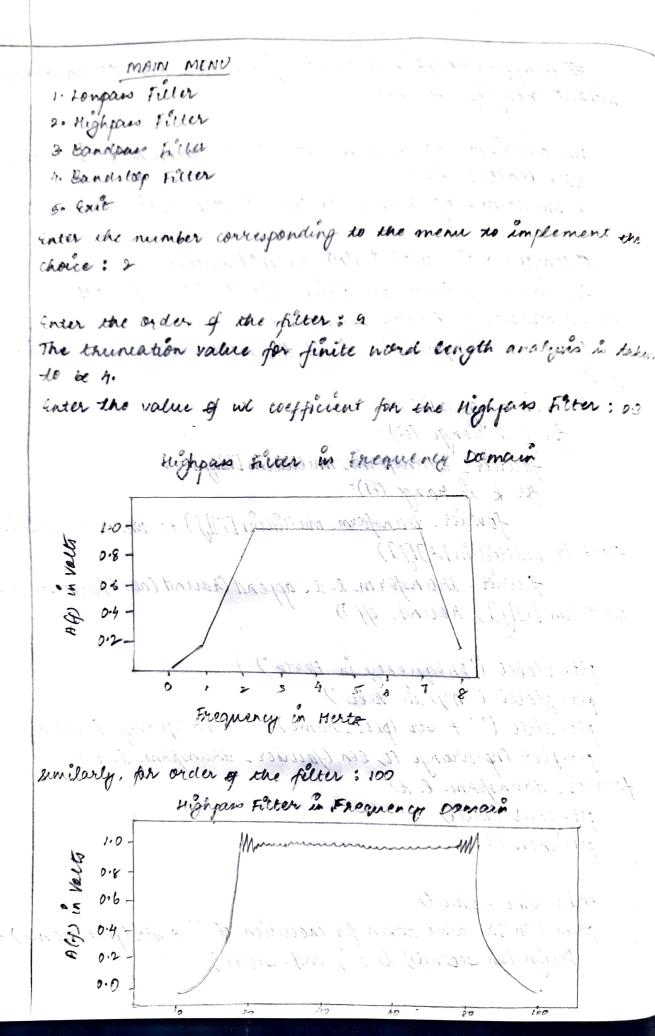
MAIN MENU E. PEFTAGENIT MEANER - S 1. Lowpass Fieter 2001/30/18 - 2100 2. Highpan Filler 3. Bandpass Filter EESTAN IND FARELLY IT ONE PL 4. Bandstop Fitter 5. Gait the choice of alle noperal and anegoliation neg The bruncation value for finite word unilysis is taken to be anter the value of we coefficient for the conspans Filter: 0.3 Lowpan ficter in Frequency Danain inject maight with place as pla it provides as The second of son the souther the distance to be Chart Time the Mill the second to the il sapale NT league have some leaves the hope onthe in the transfer proper Frequency in parts 1 8 The time taken for energition of fourpass Fifter Design (in second) 10: 0.10024905204772949 similarly, for order of the fitter 5,102 to War street Mrs. +0-1 a windy of the 3 0%-0-4-0.2-000 -

det plat-desired-impula-nespanse (Ad-n, plat-name); pet xlabel ("Frequency in Hertz") plt. ylabel ("A/J) in Volls") plt title ("Desired Impulse Response of "+ str (plat-name)) plt. stem (np. arange (o, een (nd-n)), hd-n) pet gold (True) pet show () def lengass-filter (N, round-off): title = "Langas Filter" mc = float linput l'anter the value of ul coefficient son une t oth (title) t ": MC = M-C # No. DI hd\_n = [] # Desired Frequency Response - NULL Array Declaration for n in range (-N/2+1, N/2+1, 1): hd-n. append ((W-c + np. sinc (w-c + n)) I np. pi) # Geometric Interpretation else: hd n. append (np. sin ( w c + n) / (np. pi + n)) # computation Purposes. plot-desired-impulse-response (hd-n, title) DFT (hd-n, title, round-off def highpass filter (N, round-off): totle = "Highpass Filter"

W-c-float (input ("Enter the value of all coofficient for the 't

(title) + ":"))

sta (title) +



W-C= Wc \* Ap.pi

Adno 1) # Desired Frequency Response - NULL Array

for n in range 1- N/12+1, N/12+1, 1):

M. sine (m. c + n)) / (np. pi°))) # Geometrie Interpretation else:

I ((np.pi) + n)) # computation purposes

plat\_desired\_impulse\_nesponse (hd-n, title) DFT (hd-n, title, neunol-off)

def bandpass - filter (N, round - off):

title = "Barbas Filter"

who float (input ("Enter the value of wh coefficient for the + str (title) + "; "))

Wet = Wet + np. pi

w. 1= float (input ("anter the value of we coefficient for the + str (title) + " i ")) w. 1= w. 1 + np. pi

hel-n: [] # Desired Frequency Response - NVII Array Declaration

par n in range (-N/12+1, N/12+1, Vi y n==0:

hd-n. append ((w-l \* np. sinc (w-l \* n) Inp. pi) - (w-l + np. ninc (w-l \* n) Inp. pi)) # Geænnettic Interpretation else:

MAIN MENU 1. Hongan Fitter so Highpan Ficter 3. Bandpass Filer 4 Bandatop felter s frit Exter the number corresponding to the menu to implement the choice: 3 Enter the order of the fetter 29 hands in 1993 and colding The truncation value for finite word length analysis is taken to be Enter the value of we coefficient for the Bandpain Filter: 0.6 Enter the value of we coefficient for the Bandpain Filter: 0.3 Sandpass filter in Entervency Dontain (711/2) ds # (18 + Ng & 120+90 works (2) 181715 Frequency in Hertz 1.0 8.0 0.6.

( np. pi + n)) # computation Purposes plat\_desired\_impulse-response (Ad-n, title) DFT (hd-n, title, nound-off)

def bundstop filter (N, round - off):

title - Bandstop Filter"

who = fleat ( input ( " Enter the value of wh coefficient por the "+ str(title)+":

Who wil to pit ("anter the value of we coefficient for

The "+ str (title) + "; ")) w.l= wel + np. pi

hd-n = [] # Desired Frequency Response - NVII Array Declaration

for n in range (-N/2+1, N/2+1, 1):

ng. sinc (w. 1 + n) 1 np. pi) - (w. n + np. sinc (w. n + n) 1 np. pi)) A geometric Interpretation

nd-n. append (((np. sin (np. pi+n)) + (np. sin (w.s + n)) - (np. sin (w. n + n))) / (np. pi+n)) # computation Purposes

plot-desired\_impulse\_response (hd-n, title) PFT (hd-n, title, round-off)

# Priver Cade: main (); Execution starts here.

## MAN MINU

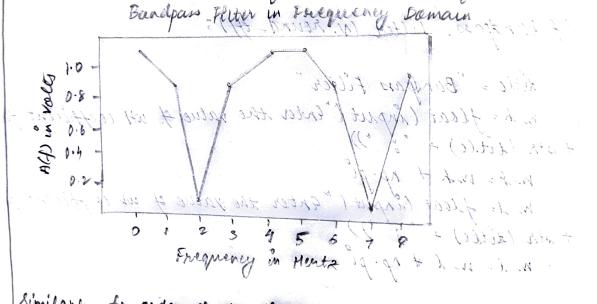
- 1. Longan Filter
- o. Highpan hiller
- 3. Bandpass Filter
- 4. Bandslep Recen
- 5. Exit

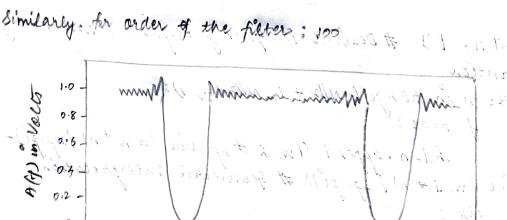
anter the number corresponding to the menu to implement the choice: 4

Be Colone & Prope

the truncation value for finite word length analysis is taken to be to

Enter the value of wir coefficient for the Bandstop Filter: 0.6 when the value of wir coefficient for the canaster Filter: 0.3





while Thue: # This simulates a Do Loop

Choice = input |

1. Lowpass Filter |n 2. Highpass Filter |n 3.

Bandpass Filter |n 4. Bandstop Filter |n 5. 4xit |n anter the
number corresponding to the menu to implement the choice: ")

# Menu Driven Implementation

# str () neturns the string version of the variable 'choice"

If (Choice == str()) or choice == str() or choice == str() or

choice == str (4)):

N: intlingut ("In Enter the order of the filter: ")

print ("The truncation value for finite word sength analysis is taken to be 4.")

round. off = 4

if choice == sta(1) :

Lowepass = filter (N, hound-off)

elif choice == sta (2):

highpass = filter (N, nound-off)

elif choice == sta(3):

bandpass = filter (N, nound-off)

elif choice == sta(4):

bandstop = filter (N, nound-off)

elif ehore = = stx l5) i

sreak # Erit loop

else :

print ["Gorror: Invalid Input! Please try again.")

\* RESULT:

For the given order, cutoff frequency, and filter type, analyzed the filter response and magnitude response. Also, included finite word length effects in the analysis. All the simulation results were verified successfully.