**Department of Electrical Engineering**

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| **Faculty Member:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Dated: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
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| **Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Semester: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
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**EE-232 : Signals and Systems**

**Lab 3 : Signal Transformations**

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|  |  | **PLO4 –CLO3** | | **PLO5-CLO3** | **PLO8-CLO4** | **PLO9-CLO4** |
| **Name** | **Reg. No** | **Viva / Quiz / Lab Performance** | **Analysis of data in Lab Report** | **Modern Tool Usage** | **Ethics and Safety** | **Individual and Team Work** |
|  |  | **5 Marks** | **5 Marks** | **5 Marks** | **5 Marks** | **5 Marks** |
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**Lab3: Signal Transformations**

**Objectives**

This Lab experiment has been designed to introduce students to signal transformations using MATLAB

* How to perform time shifting
* How to perform time compression/expansion
* Even and Odd Signals

**Lab Instructions**

* The students should perform and demonstrate each lab task separately for step-wise evaluation(please ensure that course instructor/lab engineer hasverified each step after ascertaining its functional verification)
* Only those tasks that completed during the allocated lab time will be credited to the students. Students are however encouraged to practice on their own in spare time for enhancing their skills.

**Lab Report Instructions**

All questions should be answered precisely to get maximum credit. Lab report must ensure following items:

* MATLAB codes
* Results (graphs/tables) duly commented and discussed
* Discussion on answers

## 3.0 Pre-Lab Tasks

**Use of Matlabto Flip, compress and expand an audio sequence in time:**

**i)** Load the audio file titled “song.wav” using MATLAB. Play the audio file.

**ii)** Flip the audio sequence and play it back again. (Hint: The operation is time reversal).

**iii)** Next perform time compression on the flipped signal by a factor of 2. What does the audio sequence sound like?

**iv)** Perform time expansion by a factor of 2. What does the flipped audio sequence sound like?

Hints: You may use the commands ‘fliplr’ ‘flipud’ for flipping the signal. Also the same can be achieved using a for loop.

## 3.1 Basic trasformation of signals

**a) Transformations of the Time Index for Discrete time signals:**

**i)** Define a Matlab vector ***n,***such that -3 ≤n < 7, representing time/sample indices of a Discrete Time Signal **x[n]** such that :



*Enter the Matlab command(s) through which you defined this vector*

**ii)**  Make a generalized **function** that can shift the signal **x[n]**by delaying or advancing it by a specified amount.

\*HINT (You can make use of ‘find’ command in Matlab).

The inputs to the function should be the data and shift while output should be the shifted signal. Please make sure that the indices accompanying the shifted signal are correct.

**b) Use of Matlab command zeros and ones:**

**iii)** Implement the following function in Matlab. Your function should take ***k*** and ***n*** as input from user.

*Attach a screenshot of the figure generated by your function for the input values of* ***n*** *= 4. Also copy the function to your report.*

**c) Even and odd part of a signal:**

**iv)** Every signal ***x[n]*** is sum of its even part and odd part. Given the signal ***x[n]*** find its even and odd part.



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*Write a function that will produce three figures. The first figure shall show the signal* ***x[n]*** *given above. The second figure shall show the signal* ***xe[n]****. The third figure shall show the signal* ***xo[n]****.*

*You should copy the contents of the function into this report and also copy the figures into this report.*

**d) Image Transformation:**

**v)** Load the file ‘image.jpg’ in Matlab. See the image. You should see a fighter throwing a punch. Assuming that each row is a separate signal perform time reversal of each row. Now see the image. The fighter is now throwing a punch with which hand?

**Use the following commands:**

**For loading the image: img=imread(‘filename.extension’);**

**For seeing the image: imagesc(img);**

**For finding the dimensions of the image: [height width channels]=size(img);**

**To acess each channel separately try this output(:,:,1)=input(:,:,1). This means that we are copying rows, columns of the Blue Channel to be copied from input to output.**

## 3.2 Additional Tasks for Fun: Audio Signal based tasks:

**i)** Given an audio file and the functions developed above perform a mathematical operation that will introduce echo in the song.

**ii)** Assume that you want to develop a system that loads a song and gives you control to forward or rewind the song. For this you should load the song. The total time of the song can be calculated by dividing the Total No of Samples / Sampling Frequency. Next for each second, load the duration of song, play it, check if the user wants to forward or rewind the song by pressing ‘r’ or ‘f’ (getkeywait(seconds)) and modify the samples being used to play the song.