**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 9 : Fourier Transform**

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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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**Lab 9: Fourier Transform**

**Objectives**

This Lab experiment has been designed to familiarize students with the concepts of Fourier Transform in MATLAB.

**Lab Instructions**

* This lab activity comprises of three parts: Pre-lab, Lab Exercises, and Post-Lab Viva session.
* The lab report shall be uploaded on LMS before next scheduled lab. The Pre-lab tasks should be completed before coming to the lab and soft copy of Pre-lab session should be deposited on LMS prior to start of the lab for necessary evaluation. The lab report should be submitted on LMS separately.
* The students should perform and demonstrate each lab task separately for step-wise evaluation (please ensure that course instructor/lab engineer has ascertained the functional verification of implemented algorithm).
* 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:

* Lab objectives
* MATLAB codes
* Results (graphs/tables) duly commented and discussed
* Conclusion

**Pre-Lab Tasks:**

If x(n) is absolutely summable:



Then, discrete-time Fourier transform (DTFT) is defined in the following way:



Inverse discrete-time Fourier transform (IDTFT) of X(ejw):



**Periodicity**

The DTFT X(ejw) is periodic in w with period 2π:

Implication:

We need only one period of X(ejw)

i.e. w∈[0,2π], or [- π, π], ect.

**The Properties of DTFT**

Let, X(ejw) be the discrete time Fourier Transform of x(n), Then:

1. Linearity



2. Time shifting



3. Frequency shifting



4. Conjugation



5. Folding



6. Symmetries in real sequences



For real-valued x(n), X(ejw) is conjugate symmetric

X(ejw) = X\*(ejw) or

- Re[X(e-jw)] = Re[X(ejw)] (even symmetry)

- Im[X(e-jw)] = Im[X(ejw)] (odd symmetry)

-|X(e-jw)| = |X(ejw)| (even symmetry)

- phase(X(e-jw)) = phase(X(ejw)) (odd symmetry)

**Implication:**

We need only half period of X(ejw) i.e. w∈[0,π]

**7**. Convolution



8. Multiplication

**In-Lab Tasks:**

**Lab Task 1:**

Generate a signal as sum of two sinusoidal of frequency Hz and Hz.

Use **fft()** function to find the Fourier transform. Show your results. You have to make two plots of the coefficients against frequency axis. One plot should be against frequency in radians. Other plot should be against frequency in Hz. You also need to use function **fftshift().** See MATLAB help for details.

**Lab Task 2:**

Calculate Fourier transform of .Plot the original signal, magnitude and phase of its Fourier transform. You have to make two plots of the coefficients against frequency axis. One plot should be against frequency in radians. Other plot should be against frequency in Hz. You also need to use function **fftshift().** See MATLAB help for details.

**Lab Task 3:**

Convolve the signals and for 100 samples. Verify that “convolution in time domain equals multiplication in frequency domain.”