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Magnitude and Phase Response Analysis of Low Pass Fir Filter Using Blackman And Blackman Harris Window Techniques

Dipti Rathore[1], Anjali Gupta[2], Sumit Chakravorty[3], Pranay Kumar Rahi[4]
[1, 2, 3] B.E. Scholar, [4]Assistant Professor, Department of Electrical and Electronics Engineering Institute of Technology, Korba, Chhattisgarh, India.

Abstract: A digital signal processing is a main branch of electronics. It is concerned with the representation by sequence of number or symbol and the processing of these signals. Dsp have many more applications which are useful in our life i.e. Telecommunication, image processing, speech processing, medical diagnostic instrumentation and signal filtering etc. Signal filtering is the most important application of dsp. In this process we can remove all the unwanted background noise and interference. In this paper we are concentrating on low pass fir filter design by using blackman and blackman harris window techniques. By the comparative analysis of both the window technique we conclude that, the blackman window design having better result in pass band region and show more attenuation in stop band region with compare to blackman harris window technique.
Key words: dsp, digital filter, fir filter, low pass filter, blackman window, blackman harris window techniques, matlab.

I. INTRODUCTION

Signals play a major role in our life. In general, a signal can be function of time, distance, position, temperature, pressure, etc, and it represents some variable of interest associated with a system. For example, in an electrical system the associated signals are electric current and voltage. In a mechanical system, the associated signal may be force, speed, torque etc. In addition to these, some examples of signals that we encounter in our daily life are speech, music, pictures and video signals. A signal can be represented in a number of ways. Most of the signals that we come across are generated naturally. However, there are some signals that are generated synthetically. In general, a signal carries information, and the objective processing is to extract this information.
Signal processing is a method of extracting information from the signal which in turn depends on the type of signal and the nature of information it carries. Thus signal processing is concerned with signals in mathematical terms and extracting the information by carrying out the algorithmic operations in the signal. Mathematically, a signal can be represented in terms of basic function in the domain of the original independent variable or it can be represented in terms of basic functions in a transform domain. Similarly, the information contained in the signal can also be extracted either in the original domain or in the transform domain [5].
Most signals we encounter are generated by natural means. However, a signal can also be generated synthetically or computer simulation. A signal carries information, and the objective of signal processing is to extract useful information carried by the signal. The method of information extractions depends on the type of signal and the nature of the information being carried by the signal. Thus, roughly speaking signal processing is concerned with the mathematical representation of the signal and the algorithmic carried out on it to extract the information present. The representation of the signal can be in terms of basic functions in the domain of the original independent variable(s), or it can be in terms of basis function in a transform domain. Likewise, the information extraction process may be carried out in the original domain of the signal or in transform domain [2].

A. There are two major types of digital filters are

1) Infinite Impulse response (IIR) filters
2) Finite Impulse response (FIR) filters.

Infinite Impulse Response (IIR) digital filter has the problems of phase non-linearity. Therefore it is a low order.
Filter which becomes highly unstable. Due to these factors, the FIR filter can be used to design a linear phase digital.
Filter which is convenient for image processing and data transmission applications. The FIR filters are broadly used in various fields, such as long distance communication, image processing applications etc [6]. The system function of FIR filter is given

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below:

$$H(z) = \sum_{n=0}^{L-1} h(n) z^{-n}$$

where, L is the length of the filter, and h[n] is the impulse response.

II. WINDOW TECHNIQUE

Most digital signals are infinite, or sufficiently large that the data set cannot be manipulated as a whole. Sufficiently large signals are also difficult to analyze statically, because statistical calculation require all points to be available for analysis. In order to avoid these problems, engineers typically analyze small subsets of the total data, through a process called windowing. The window design method does not produce filters that are optimal (in the sense of meeting the design specifications in the most computationally efficient fashion), but the method is easy to understand and does produces filters that are reasonably good. Off all the hand design methods the window method is the most popular and effective [2].

A. Blackman Window

Blackman windows are defined as:

By common convention, the unqualified term *Blackman window* refers to $\alpha = 0.16$, as this most closely approximates the "exact Blackman", with $a_0 = 7938/18608 \approx 0.42659$, $a_1 = 9240/18608 \approx 0.49656$, and $a_2 = 1430/18608 \approx 0.076849$.These exact values place zeros at the third and fourth side lobes [4].

$$W(n) = a_0 - a_1 \cos\left(\frac{2n\pi}{N-1}\right) + a_2 \cos\left(\frac{4n\pi}{N-1}\right) \text{ .... } (1)$$

Where;

$a_0 = \frac{1-\alpha}{2}$

$a_1 = \frac{1}{2}$

$a_2 = \frac{\alpha}{2}$

B. Blackman Harris Window

A generalization of the Hamming family, produced by adding more shifted sinc functions, meant to minimize side-lobe levels.

$$W(n) = a_0 - a_1 \cos\left(\frac{2n\pi}{N-1}\right) + a_2 \cos\left(\frac{4n\pi}{N-1}\right) - a_3 \cos\left(\frac{6n\pi}{N-1}\right) \text{................} (2)$$

Where;

$a_0 = 0.35875$;

$a_1 = 0.48829$;

$a_2 = 0.14128$;

$a_3 = 0.01168$

III. DESIGN SIMULATION

Table 1.1 Filter parameters and value

PARAMETER	VALUE(Hz)
Sampling frequency(f_s)	48000
Cut off frequency(f_c)	10800

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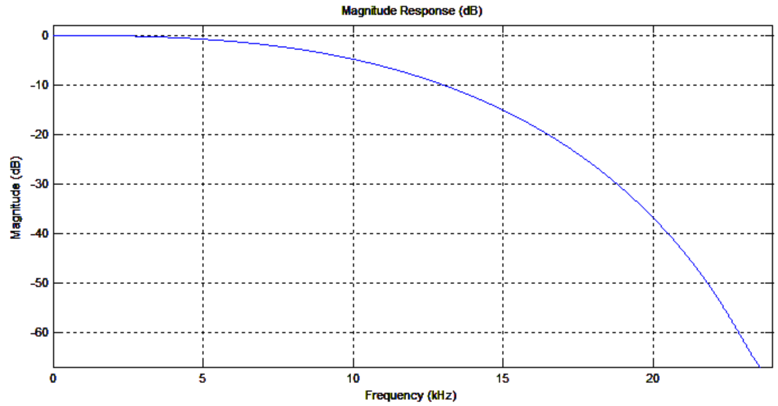

Fig 1.1 Magnitude Response of Blackman Window Technique.

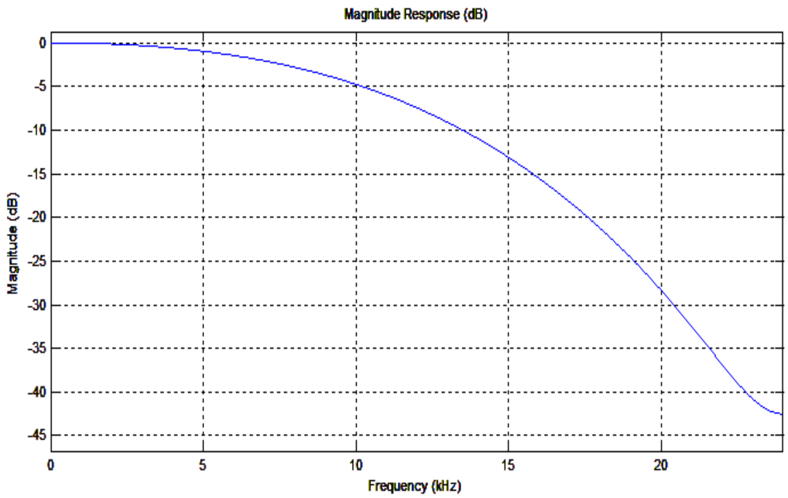

Fig 1.2 Magnitude Response of Blackman Harris Window Technique.

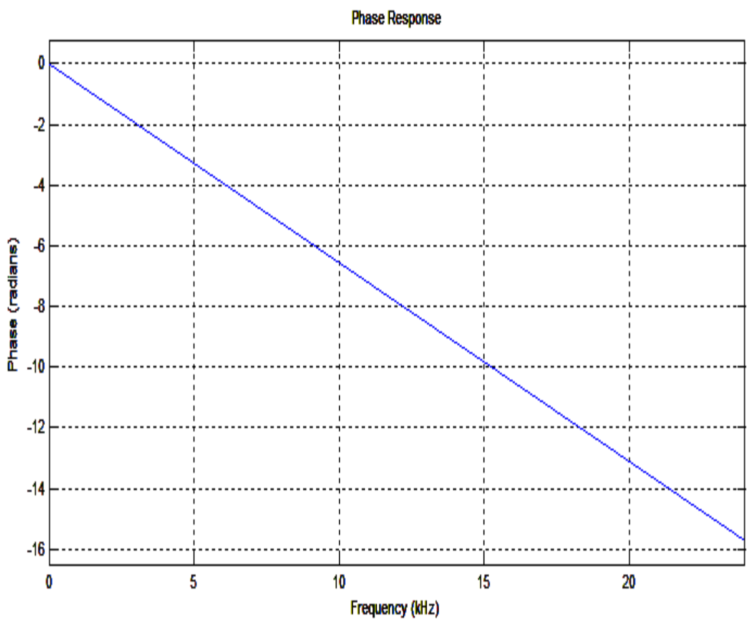

Fig1.3 Phase Response of Blackman Window Technique.

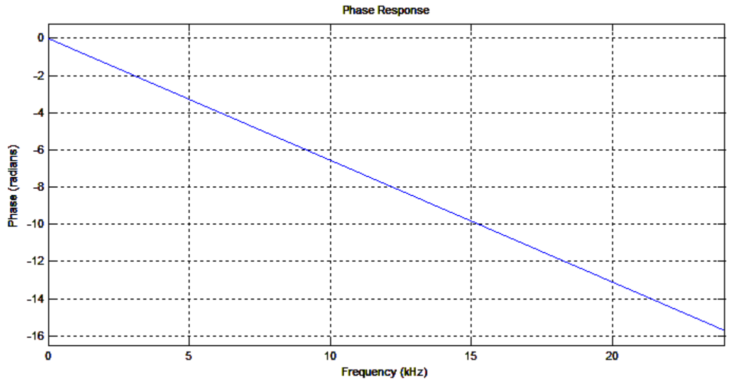

Fig1.4 Phase Response of Blackman Harris Window Technique.

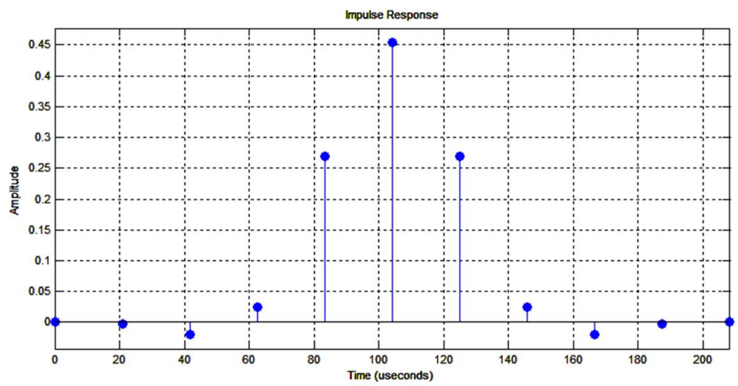

Fig1.5 Impulse Response of Blackman Window Technique.

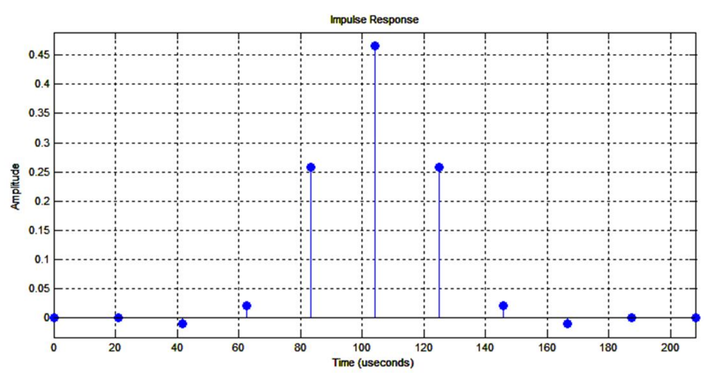

Fig1.6 Impulse Response of Blackman Harris Window Technique.

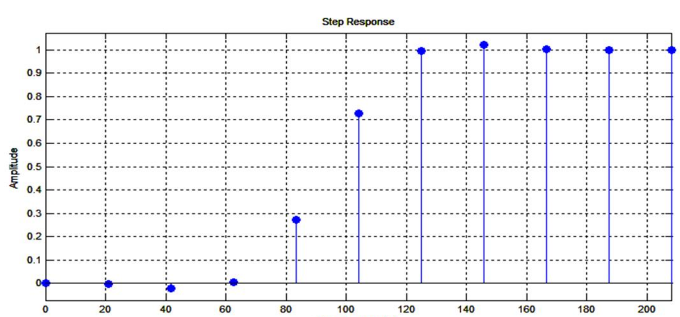

Fig1.7 Step Response of Blackman Window Technique.

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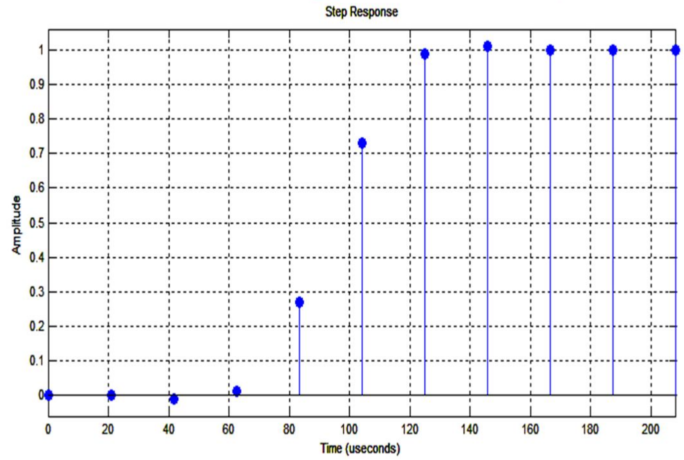

Fig1.8 Step Response of Blackman Harris Window Technique.

Numerator:
0
-0.0018953364575501706
-0.019125878537596695
0.025264102648754387
0.26903440134175749
0.45344542200927002
0.26903440134175749
0.025264102648754387
-0.019125878537596695
-0.0018953364575501706
0

Fig 1.9 Filter Coefficients for Blackman Window Technique.

Numerator:
0.0000027942585915432229
-0.00053143919370153699
-0.010075013629768275
0.019634472724500283
0.25819611419344796
0.46554614329386007
0.25819611419344801
0.01963447272450029
-0.010075013629768276
-0.0005314391937015371
0.0000027942585915432229

Fig 1.10 Filter Coefficients for Blackman Harris Window Technique.

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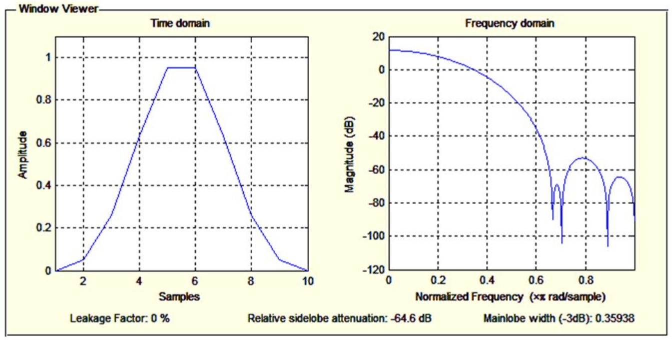

Fig 1.11 Time Domain & Frequency Domain of Blackman Window.

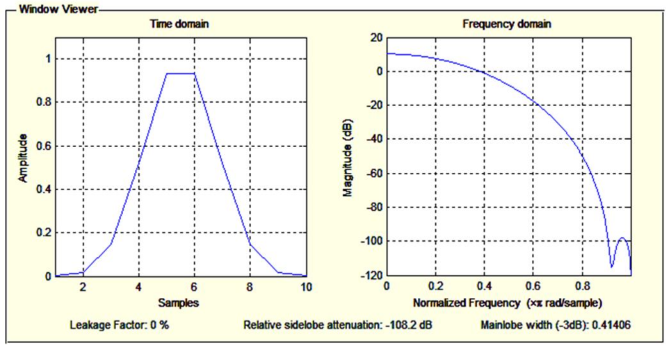

Fig 1.12 Time Domain & Frequency Domain of Blackman Harris Window.

IV. COMPARITIVE ANALYSIS

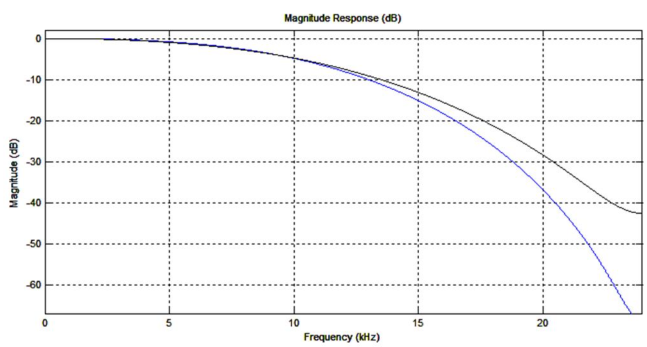

Fig 1.13 Magnitude Comparison of Blackman and Blackman Harris Window Technique.

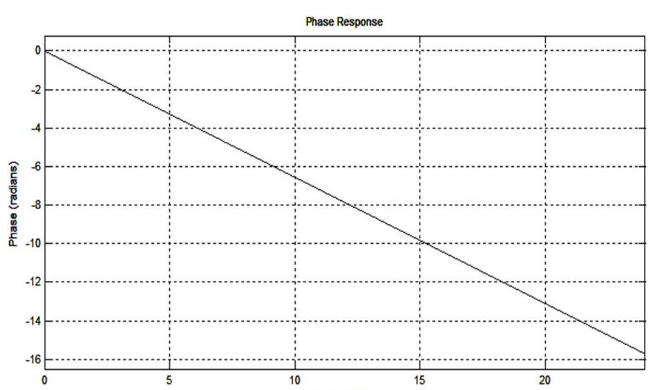

Fig 1.14 Phase Comparison of Blackman and Blackman Harris Window Technique**.**

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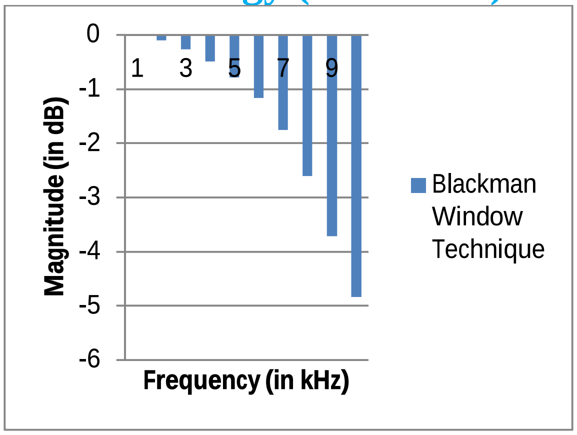

Chart 1.1 Magnitude and Frequency plot of Blackman Window Technique.

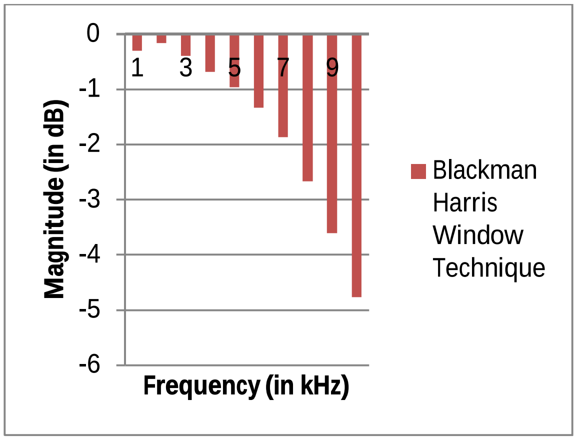

Chart 1.2 Magnitude and Frequency plot of Blackman Harris Window Technique.

V. RESULT

Table 1.2 Simulation results from MATLAB.

Window technique	Relative side lobe attenuation	Main lobe width (-3dB)	Leakage factor
Blackman window	-64.6dB	0.3593	0%
Blackman Harris window	-108.2dB	0.4140	0%

Table 1.3 Magnitude and Frequency results of Rectangular and Blackman Window Technique.

Frequency (kHz)	Magnitude (dB)	
	Blackman window	Blackman Harris window
1	-0.0230	-0.3077
2	-0.1053	-0.1667
3	-0.2662	-0.3978
4	-0.4927	-0.6864
5	-0.7910	-0.9722
6	-1.1689	-1.3386
7	-1.7542	-1.8756
8	-2.6064	-2.6673
9	-3.7155	-3.6089
10	-4.8382	-4.7668

From MATLAB simulation result of Rectangular and Blackman window technique at sampling frequency (f_s) 48000 Hz and cut-off frequency (f_c) 10800 Hz.

VI. CONCLUSION

In this research paper Low pass FIR filter has been designed using MATLAB Blackman and Blackman Harris window technique. It concludes by comparative values of both magnitude and phase response of the filter using both the techniques at same frequency *i.e.* f_s=48000Hz and f_c=10800Hz.

It is observed from the simulation that the Blackman window design having better result in passband region and shows more attenuation in stop band region with compare to Blackman Harris window technique.

REFRENCES

[1] Alan V. Oppenheim and Ronald W. Schafer "Digital Signal Processing" Eastern Economy Edition.
[2] Sanjit K Mitra "Digital Signal Processing" 3rd Special Indian Edition
[3] S. Salivahanan & C. Gnanapriya "Digital Signal Processing" 2nd edition Mc. Graw Hill publications
[4] Sumit Chakravorty, Pooja Pandey, Sashwat Vohra, Mukesh Chandra, Pranay Kumar Rahi "High Pass FIR filter design and performance analysis using rectangular and blackman technique" IJISET vol. No. 3, issue No.8, August 2016, ISSN (online) 2348 – 7968
[5] Sumit Chakravorty, Pooja Pandey, Durgesh Sahu, Pranay Kumar Rahi "Magnitude and Phase Response of Low pass FIR filter using Ractangular and Blackman window Techniques" IJISET vol. No. 3, issue No. 8, August 2016, ISSN (online) 2348 – 7968
[6] Mohd. Shariq Mahoob & Rajesh Mehera "Design of low pass FIR filter using Hamming, Blackman-Harris & Taylor window" IJARSE, Vol. No.3, Issue No.11, November 2014 ISSN-2319-8354(E)
[7] Math works, "Users Guide Filter Design Toolbox 4", March-2011
[8] Sumit Chakravorty, Pooja Pandey, Pranay Kumar "Magnitude and Phase Response of Low Pass Fir Filter Using Rectangular, Blackman, Hanning & Bartlett Window Techniques" IJRASET Volume 5 Issue IV, April 2017, ISSN: 2321-9653.
[9] Manju Rajput, Tripti Kurrey, Pranay Kumar Rahi "Low Pass FIR Filter Design and Performance Analysis using Blackman & Bartlett Window Techniques" IJRASET Volume 5 Issue V, April 2017, ISSN: 2321-9653.

AUTHORS

Dipti Rathore pursuing Bachelor of Engineering in Electrical & Electronics Engineering, in 4th semester from Institute of Technology, Korba, affiliated from Chhattisgarh Swami Vivekanand Technical University, Chhattisgarh, India.

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Anjali Gupta pursuing Bachelor of Engineering in Electrical & Electronics Engineering, in 4th semester from Institute of Technology, Korba, affiliated from Chhattisgarh Swami Vivekanand Technical University, Chhattisgarh, India.

Sumit Chakravorty pursuing Bachelor of Engineering in Electrical & Electronics Engineering in 6th semester from Institute of Technology, Korba, affiliated from Chhattisgarh Swami Vivekanand Technical University, Chhattisgarh, India. He has authored more than two international research papers in IJISET & IJRASET.

Pranay Kumar Rahi received the Bachelors of Engineering degree in Electronics and Telecommunication Engineering from Government Engineering College, Guru Ghasidas University, Bilaspur, Chhattisgarh, India in 2004, and pursuing Masters of Engineering in Electronics and Communication Engineering from National Institute of Technical Teacher's Training & Research, Punjab University, Chandigarh, India. Working as Assistant Professor in Electrical & Electronics Engineering Department of Institute of Technology, Korba since 2008. He has authored more than 40 research publications and published a number of Journal papers and research paper in the leading International & National Journal. His primary research interest includes Digital Signal Processing, VLSI Design, Control System and Digital Electronics and logic design.