Roll No: AM.EN.U4ECE22135 Date: 21/03/2025

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19ECE384 / 19EAC386 Open lab-LabVIEW Programming (1-0-2-3)
S_6 B.Tech. ECE and EAC

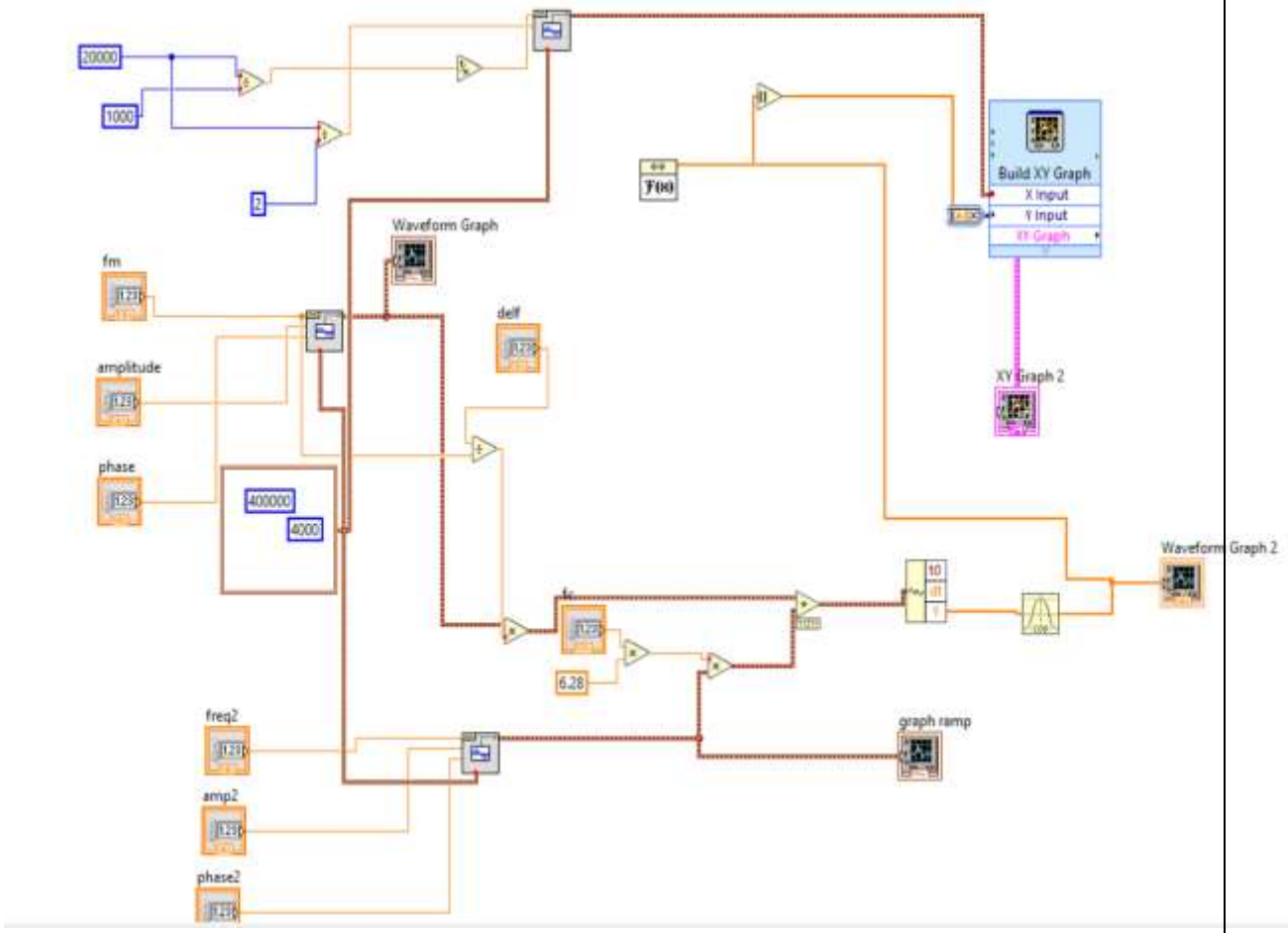
Lab sheet 4 Analog modulation and demodulation - 2 FM modulation

Course Outcome mapping

CO1	Ability to analyze practical problems and investigate scope for applying technology to develop feasible solutions	✓
CO2	Ability to review the state-of-the-art literature in the selected technology domain and arrive at functional solutions	
CO3	Design the required system using appropriate EDA tools and implement the hardware	
CO4	Ability to analyze the implementation impact and suggest improvements or modifications	
CO5	Present the concept with adequate validation on technical aspects and cost analysis using a report and seminar	

1. Implement FM modulator and plot the modulated waveform and the spectrum when frequency deviation Δf = 1000Hz, and message signal frequency fm=1000Hz. Choose a suitable β.

Beta=1


20000
1000
2
Waveform Graph
fm
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Build XY Graph
X Input
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XY Graph 2
Waveform Graph 2
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freq2
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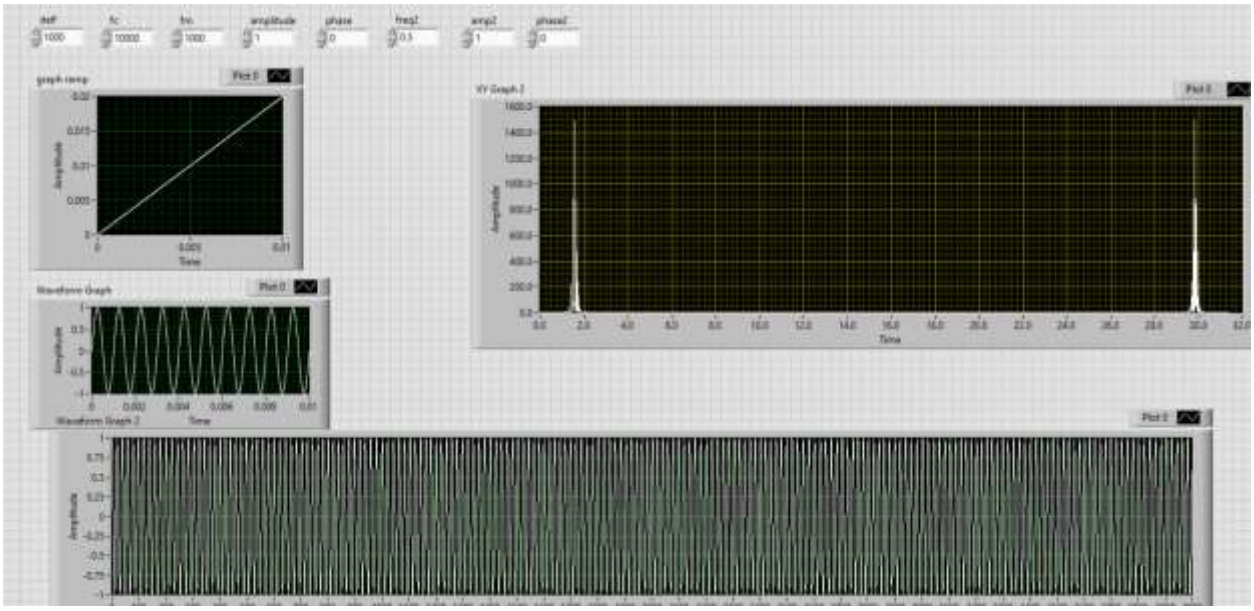
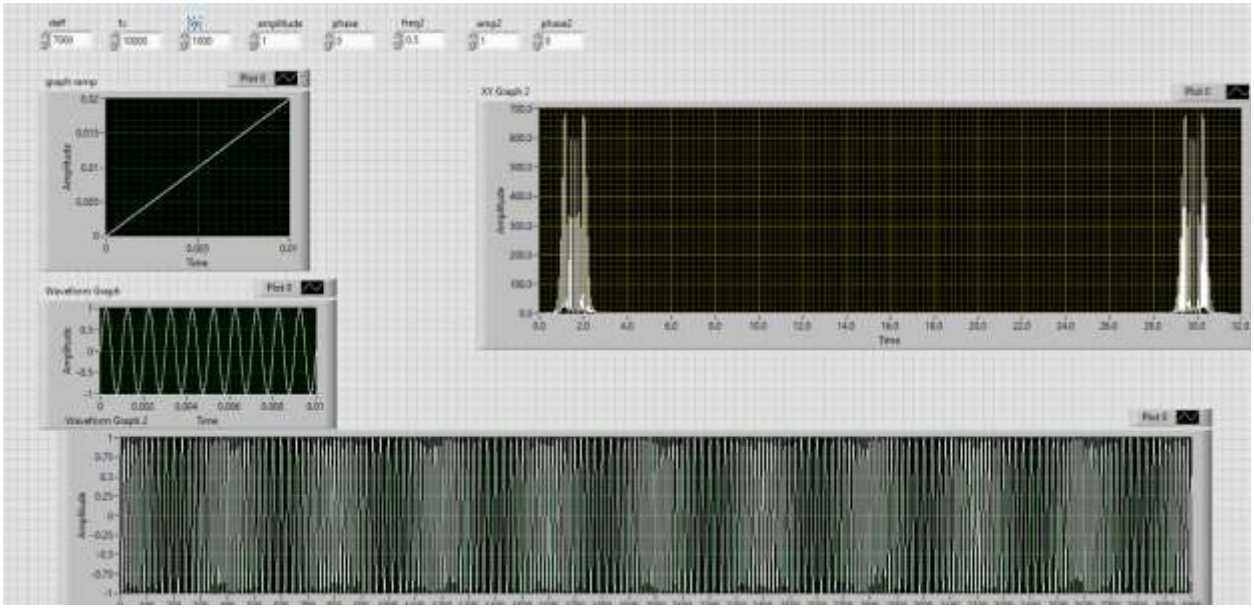
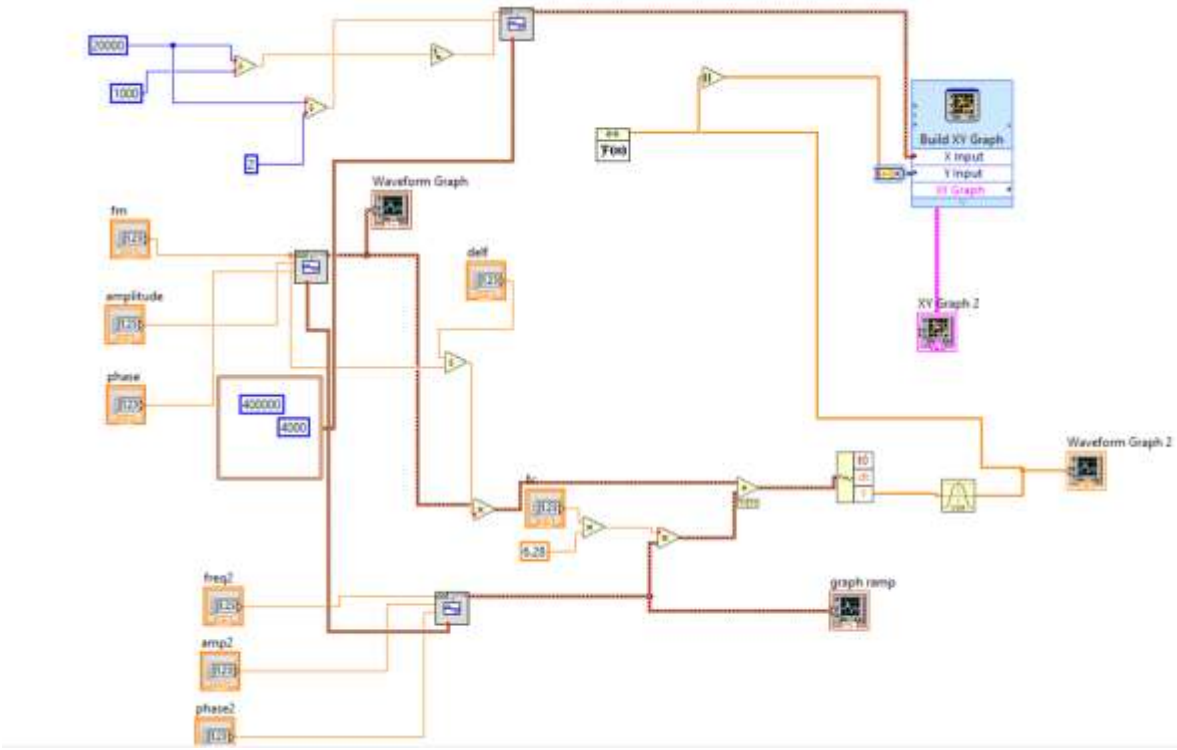
graph ramp



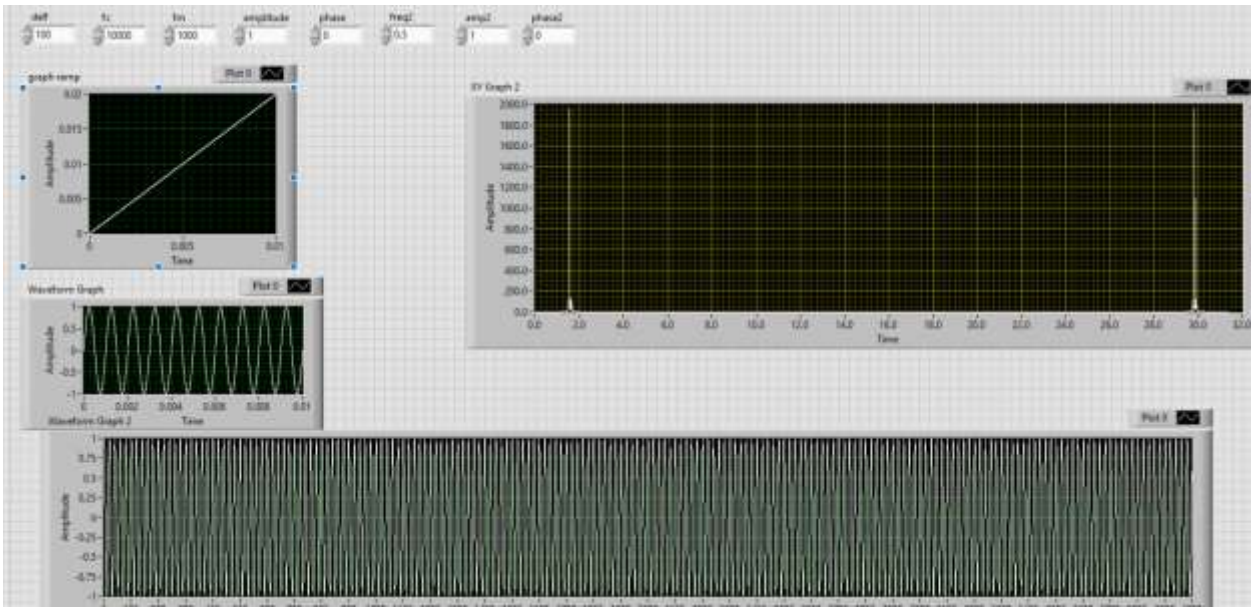
Suitable β=7 (7000/1000) (Wideband FM)



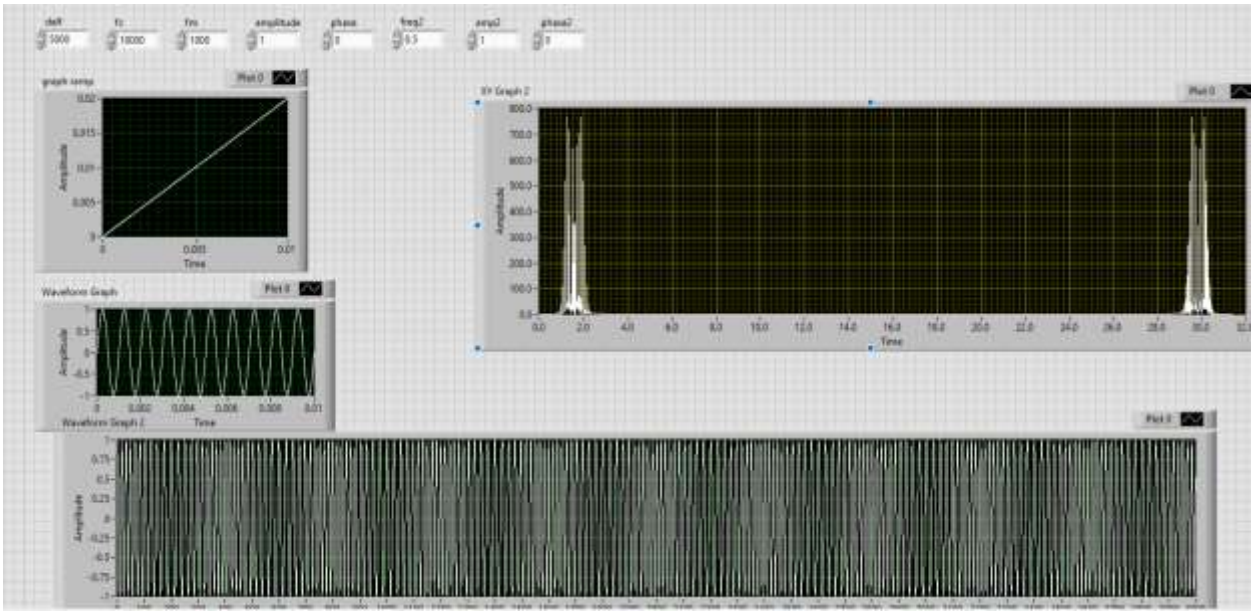
2. Plot the modulated waveform and the spectrum of FM signal for modulation index/phase deviation β of (i) 0.1, (ii) 1 and (iii) 5, and message signal frequency fm=1000Hz. Use appropriate carrier and sampling rate.



β=0.1 (100/1000)



β=5 (5000/1000)



3. Write your observations about the modulated waveform and the spectrum as the value of β changes.

   As the modulation index (β) increases, the characteristics of frequency modulation (FM) change significantly. For narrowband FM (β = 0.1), the frequency deviation is minimal, making the modulated signal closely resemble the carrier wave, with most of the power concentrated in the carrier and very few sidebands. As β reaches 1, marking the transition

between narrowband and wideband FM, the frequency deviation equals the message signal frequency, causing the sidebands to become more noticeable, though still limited in number. In wideband FM (β = 5), the frequency deviation is much greater, leading to more significant variations in the waveform and a broader spectrum with numerous sidebands, increasing the occupied bandwidth. Overall, as β increases, the frequency variations become more pronounced, and the spectrum expands, resulting in a trade-off between bandwidth and noise resistance—where wideband FM (β ≥ 5) offers better signal quality but demands more bandwidth.

RESULT AND INFERENCE

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Signature with date: