PREMIER UNIVERSITY

Department of Computer Science & Engineering

Course Code	:	**EEE 310**
Course Title	:	**Communication Engineering Laboratory**
Report No	:	05
Name of Report	:	Frequency demodulation using the Phase-Locked Loop
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Section	:	**C**
Semester	:	**5th Semester**
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REMARKS

Experiment Name: Frequency demodulation using the Phase-Locked Loop

Objective: To observe the Frequency demodulation using the Phase-Locked Loop

Required Instruments :

1. IT-4101 Trainer Board

2. 2 mm Patch Cords

3. Oscilloscope

Theory :

Frequency demodulation is the process by means of which the original message signal is recovered from an incoming FM wave. For frequency demodulation, we need a device whose output amplitude is sensitive to variations in the instantaneous frequency of the input FM wave in a linear manner. Phase-Locked Loop: A phase-locked loop is a feedback system whose operation is closely linked to frequency modulation. It retrieves the message signal indirectly.

Procedure :

1. Turn on the IT-4103 module

2. Make the necessary connections for frequency modulation as given in experiment no. 3. Check the modulated waveform on the oscilloscope before proceeding.

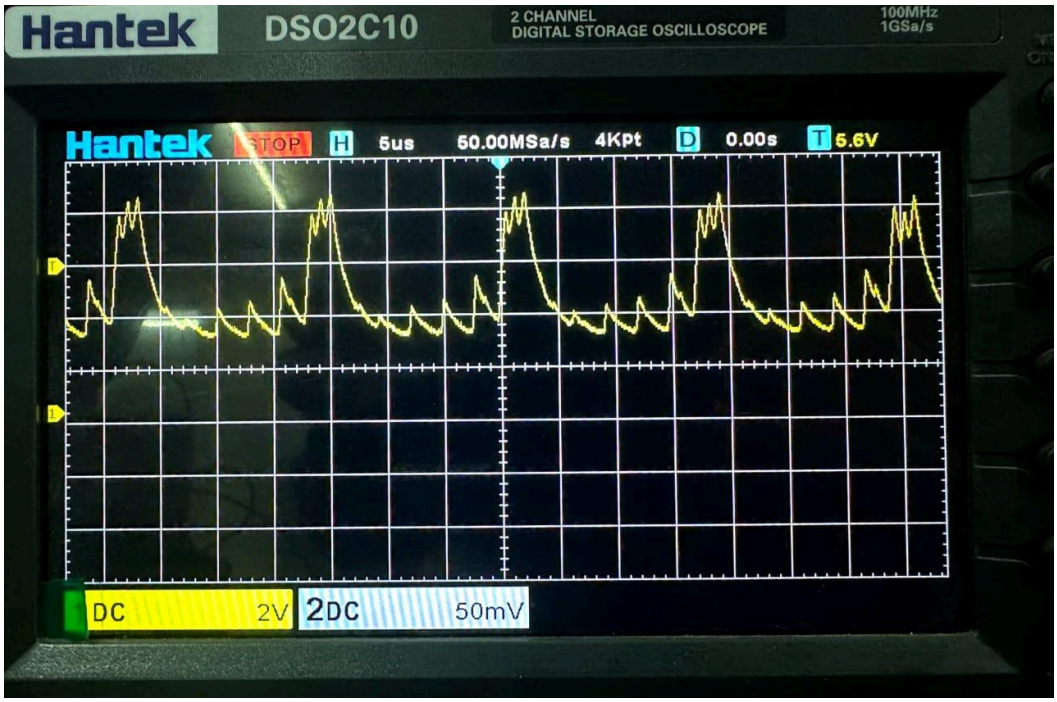

Fig 01: Phase-Locked Loop Output

3. Connect the Varactor Modulator O/P (TP9) with the Phase-Locked Loop I/P (TP12). Observe the Phase-Locked Loop O/P (TP13) on the oscilloscope.

4. Connect the Low Pass Filter O/P (TP 15) with the AC Amplifier I/P (TP15). At this point, the connection should look like below:

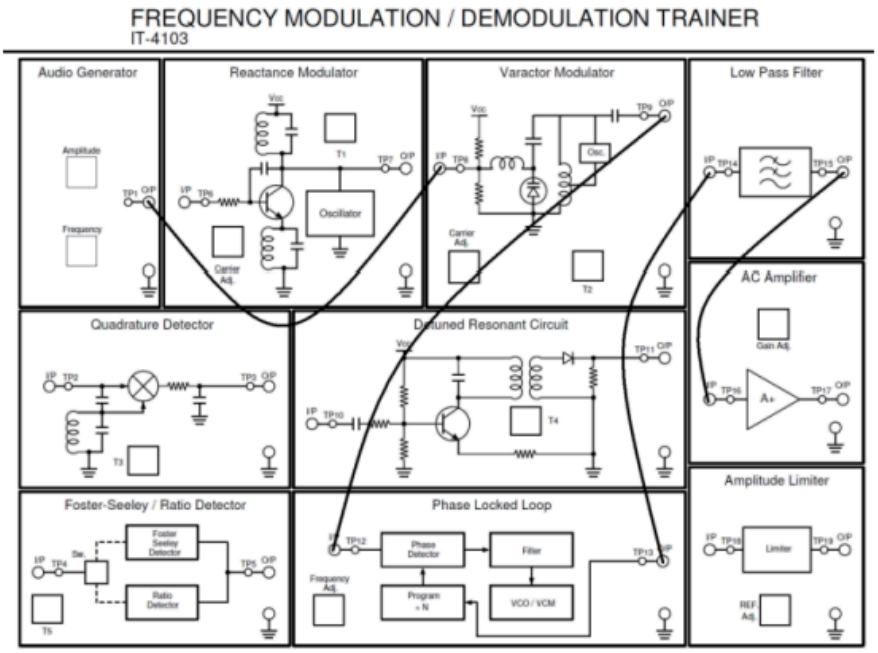

Fig 02: Circuit Diagram for Frequency

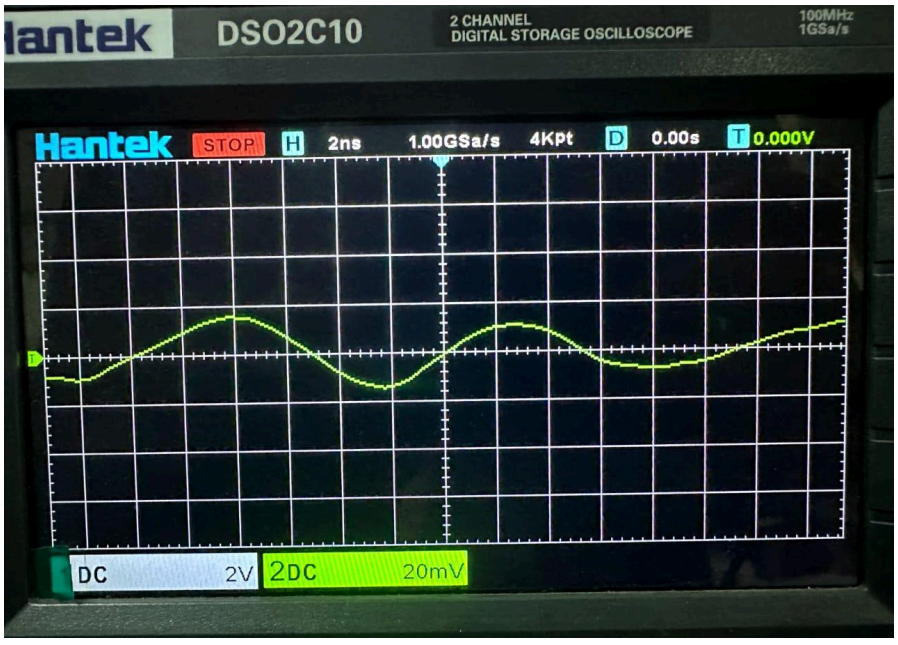

Fig 03: Demodulated Wave

Experimental Data :

Fig 04: Phase-Locked Loop O/P (TP13) on the oscilloscope

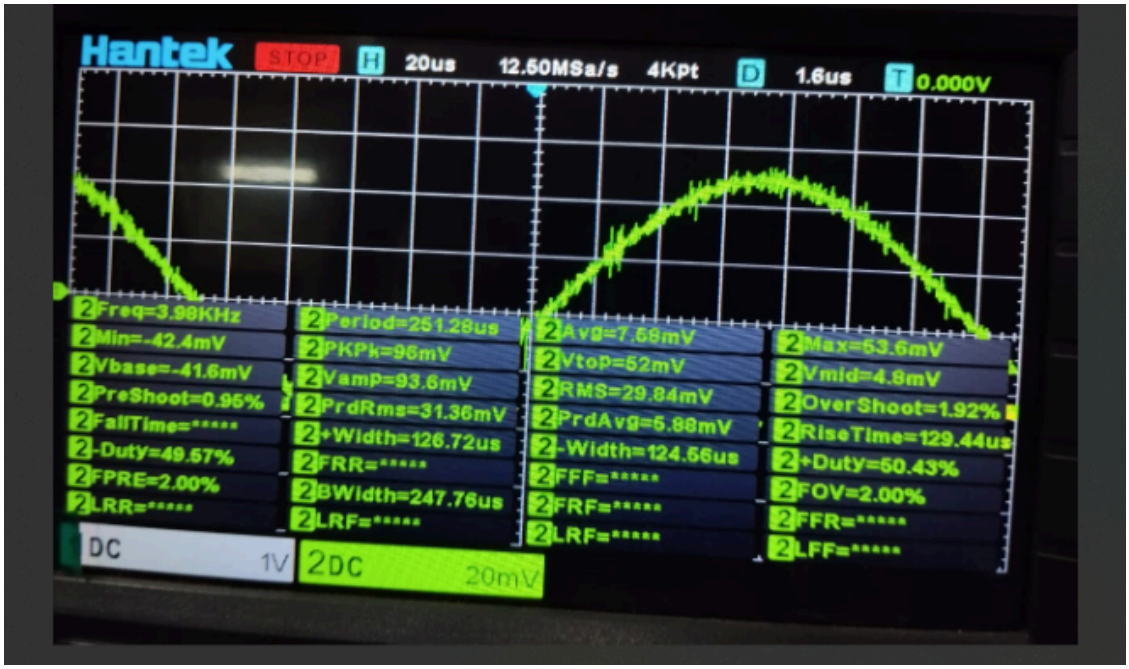

Fig 05: amplitude and the frequency of the frequency demodulated signal

Questions & Answers :

1. **Sketch the block diagram of the phase-locked loop.**

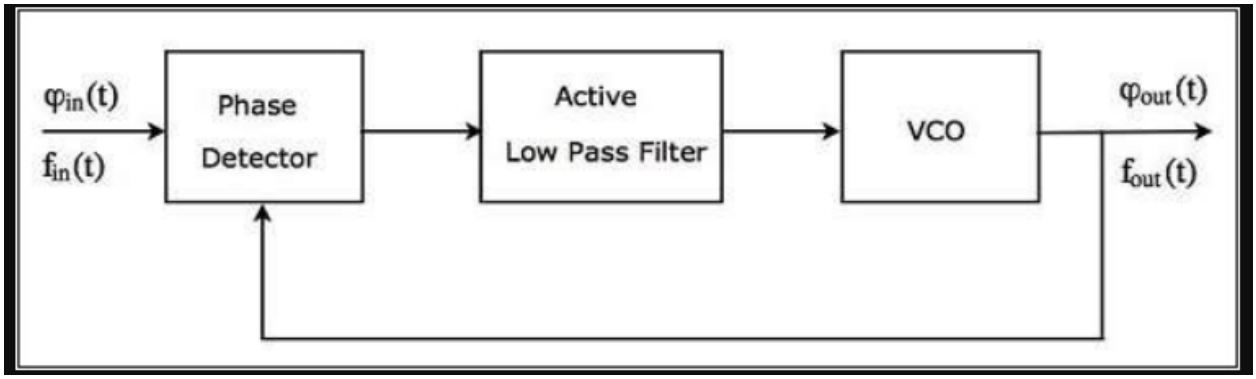

Fig 06: Block Diagram of Phase Locked Loop

2. **What conditions must be satisfied when the control signal of the Voltage-Controlled Oscillator of the phase-locked loop is zero?**

When the control signal of the Voltage-Controlled Oscillator (VCO) in a phase-locked loop (PLL) is zero, the following conditions must be satisfied:

1. **VCO at Free-Running Frequency**: The VCO operates at its natural or free-running frequency.
2. **No Phase Error**: The phase difference between the reference signal and the feedback signal is zero.
3. **Zero Control Voltage**: The loop filter outputs zero voltage.
4. **Matching Frequencies**: The reference frequency equals the VCO's free-running frequency.

Discussion:

In this lab, we investigated frequency demodulation using a Phase-Locked Loop (PLL). The PLL, comprised of a Phase Detector (PD), a Loop Filter (LF), and a Voltage-Controlled Oscillator (VCO), operates by locking the phase of the VCO to the input frequency-modulated (FM) signal. Through the PD, the phase difference between the input signal and the VCO output is converted into an error signal, which, after filtering by the LF, adjusts the VCO frequency. We observed that the PLL effectively tracked the input frequency variations, accurately demodulating the modulation signal. However, its performance was constrained by the lock range and sensitivity to noise. Proper design and tuning of the PLL components, particularly the loop filter, were crucial for achieving accurate demodulation. Overall, the experiment underscored the utility of PLLs in frequency demodulation applications, emphasizing the importance of optimizing their parameters for reliable operation in communication systems.