Indian Institute of Information Technology, Allahabad
ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT
Course Name: Analog Communication Laboratory

EXPERIMENT NO: 7

Objective:

To generate frequency modulated wave and determine its modulation index.

Materials/ Component Required:

Name of the Component/ Equipment	Quantity Required
IC (555)	1
Diode (IN4007)	1
Resistors	2
Capacitors	2
DSO	1
Function Generator	1
Regulated Power Supply	1

Theory:

Frequency Modulation: Frequency modulation is an analog modulation technique in which the frequency of the carrier is varied in accordance with the message signal amplitude. Frequency modulation (FM) is the standard technique for high-fidelity communications as is evident in the received signals of the FM band (88-108 MHz). The main reason for the improved fidelity is that FM detectors, when properly designed, are not sensitive to random amplitude variations which are the dominant part of electrical noise. Modulation index for FM is

$$M = \delta f / f_m = \frac{fmax - fmin}{fm} = \frac{\text{frequency deviation}}{\text{modulating signal frequency}}$$

555 is an IC which can be used to to set up an astable multivibrator of 50% duty cycle whose frequency is determined by externally connected RC load.
The standard design equation for an astable mutivibrator using 555 timer IC is defined by the following equation for its time period

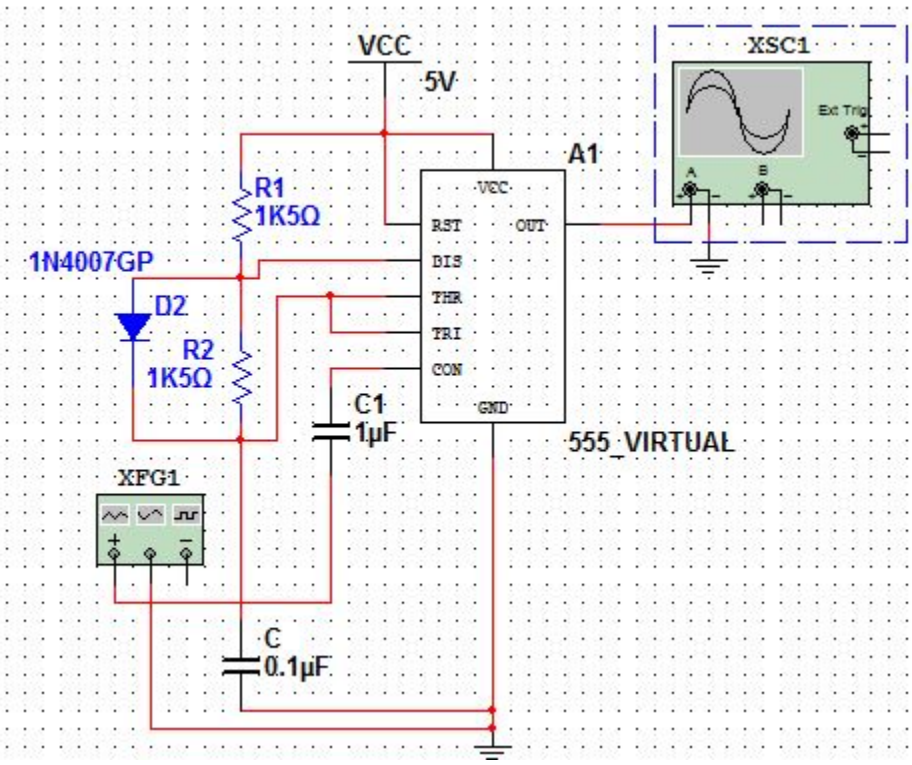
T = 1.38 RC
Thus its frequency of oscillation is
f_0 = 0.72/RC R=R_1=R_2 and C= 0.1uF

This frequency of oscillation remains constant as long as the pin-5 is supplied with a constant voltage. If the voltage at pin-5 is varying the frequency of oscillation of the astable multivibrator also changes along with it. Thus astable multivibrator using 555 can be used as a carrier pulse generator. The frequency of the carrier can be varied by feeding the pin-5 with message signal.

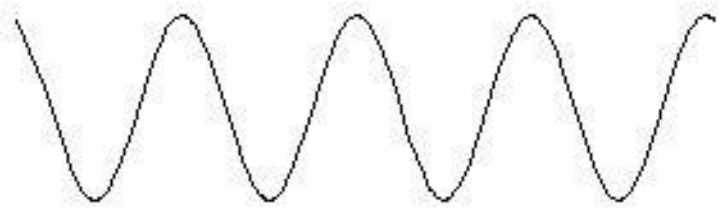
Frequency modulation is not only used in commercial radio broadcasts, but also in police and hospital communications, emergency channels, TV sound, wireless (cellular) telephone systems, and radio amateur bands above 30 MHz.

Circuit Diagrams:

For Modulation



Waveforms and graphs:



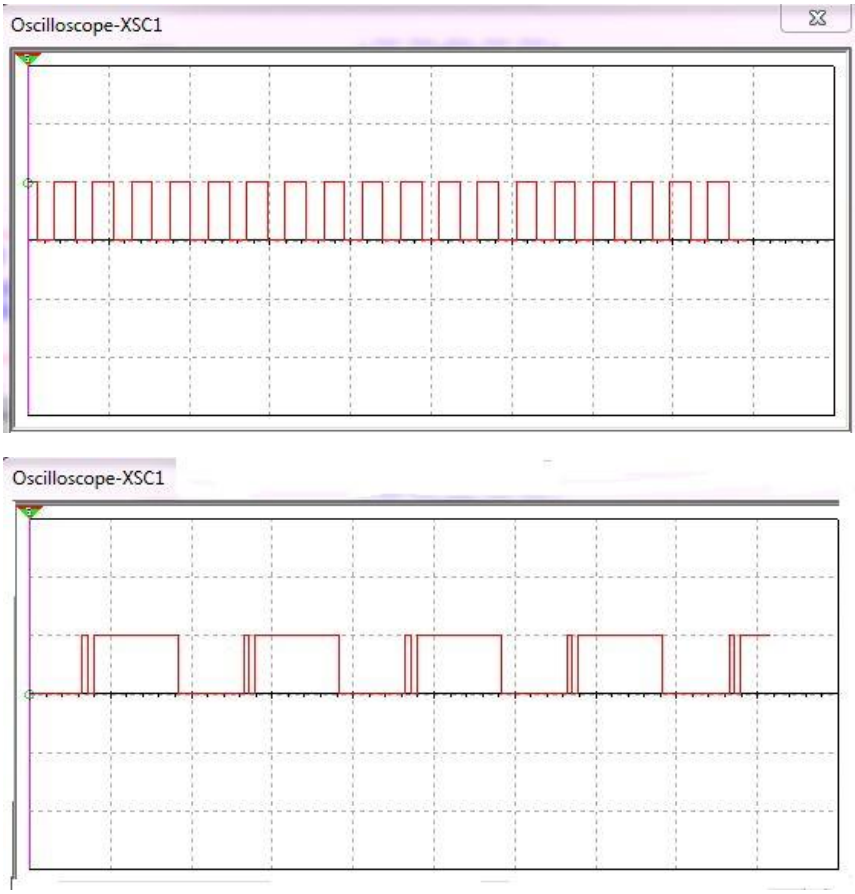


Fig. Message, Carrier and frequency modulated waveforms.

Procedure:

1. The circuit is connected as per the circuit diagram shown in Figure.
2. Switch on +5 volts V_{CC} supply.
3. Apply sinusoidal signal of 1 KHz frequency and amplitude 4 Vp-p as modulating signal.
4. Observe the FM output at pin number-3 and and note down fmax and fmin.
5. Calculate modulation index using equation

Observation Table

S.No.	Modulated Wave		f_m	Modulation Index
	f_{max}	f_{min}		
1				
2				
3				
4				

Report:

- Calculate f_c
- Calculate frequency deviation

Result: Implemented frequency modulation of pulse carrier by sinusoidal message using 555 timer IC.

Precautions:

1. Check the connections before giving the power supply.
2. Observations should be done carefully.