5.4 VOLTAGE CONTROLLED OSILLATOR:

A Varactor-tuned oscillator uses a varactor diode to achieve the desired frequency tuning, as shown in Fig 5.4.1. A varactor diode is a two-terminal semiconductor device that utilizes the voltage-sensitive property of a pn junction. In these diodes, unlike regular diodes, the pn junction capacitance under reverse-bias conditions is accentuated by proper choice of diode profiles.(e.g., use of hypewr-abrupt junctions).

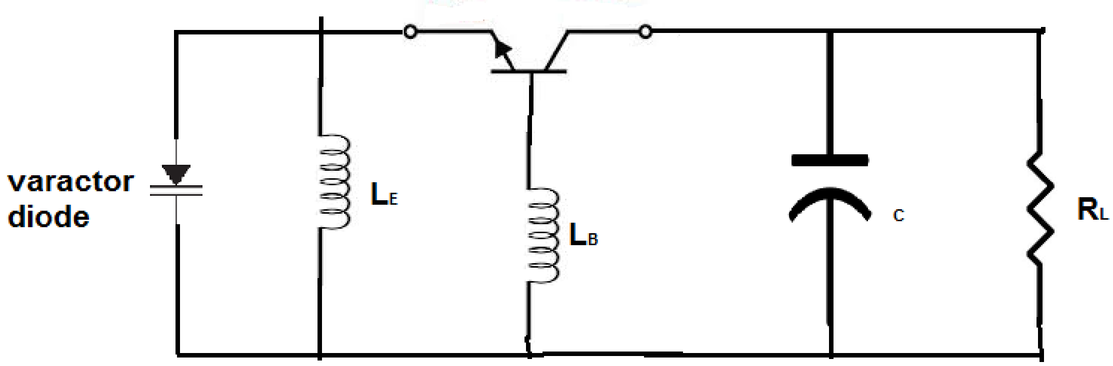

Fig:5. 4.1 Varactor-tuned BJT osillator

Assuming a one-sided junction ,the junction capacitance due to diode's junction capacitance(C_j) cab be shown to be a junction of the applied bias voltage as follows:

$$C_j = \frac{C_{jo}}{\left(1+\frac{V_a}{V_{bi}}\right)^S} \quad \text{.....(1)}$$

Where,

C_{jo} - The junction capacitance at zero bias voltage

V_a - The applied bias voltage across the junction ($V_a = -V_r$)

V_{bi} – The built in voltage

And

S = $\frac{1}{m+2}$

"m" is the power4 parameter in the doping distribution function (N) of the lighter side, defined as:

N(x) = $N_B\ x^m$

and N_B is an arbitrary constant established by the doping profile.

Equ (1) is plotted in Fig 5.4.2. From this figure, it is seen that the capacitor value becomes very high for V_a = V_{bi} , which is impractical.

A varactor is usually operated in the reverse bias region that is $V_a = -V_r$ <0.

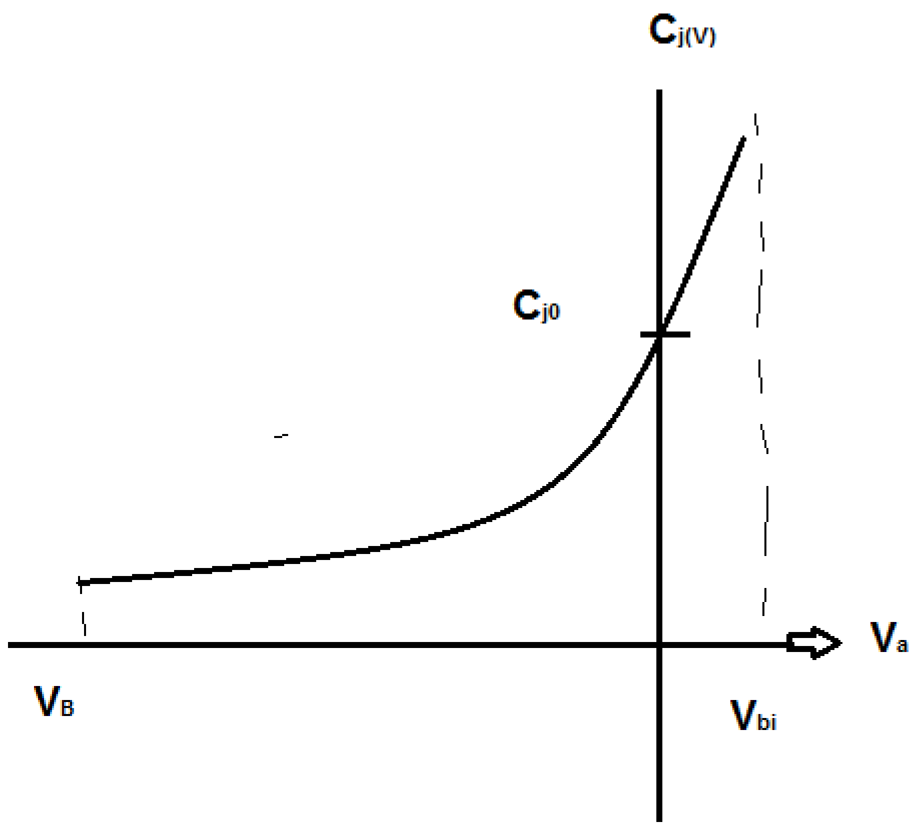

Fig: 5.4.2 varactor characteristic ($C_j$vs V_a) with V_B as the breakdown voltage.

then m=0

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

The equ (1)becomes,

$$C_j = \frac{C_{jo}}{\sqrt{1+\frac{V_a}{V_{bi}}}} \qquad \ldots\ldots(2)$$

MIXERS:

A mixer is a nonlinear device that allows the translation of frequencies. It is used to bring either the modulated signal to the RF carrier or translate the RF signal to IF. When mixing two signals, a mixer generates both higher and lower translations (i.e., the sum and difference of input signals). A low pass or a high pass filter is required to select the desired frequency product. Generally, a LO is required as input to allow the signal down- or up-conversion. When the mixer is used as an up-converter (e.q., in a transmitter), the “sum frequency” is utilized and the “difference frequency” is rejected, as shown in figure 5.4.3.

Various technologies are used to build mixers: A mixer can be based on diodes or transistors. In both cases, the device is nonlinear. Its nonlinear behavior has to be monitored (e.g., its 1dB-compression point and intermodulation distortion, etc.). Refer to references 20 and 29 for more information about mixers.

The **RF mixer** can be considered ON when the LO voltage switches it on and OFF when the local oscillator signal switches it off. This then acts upon the incoming signal on the **RF** port to enable the two signals to **mix** and provide the two output signals required.

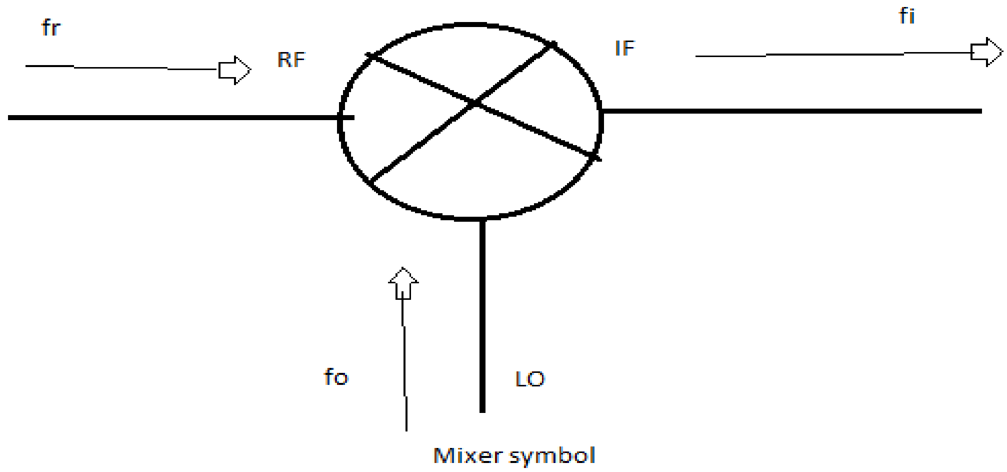

Fig: 5.4.3 Mixer Symbol