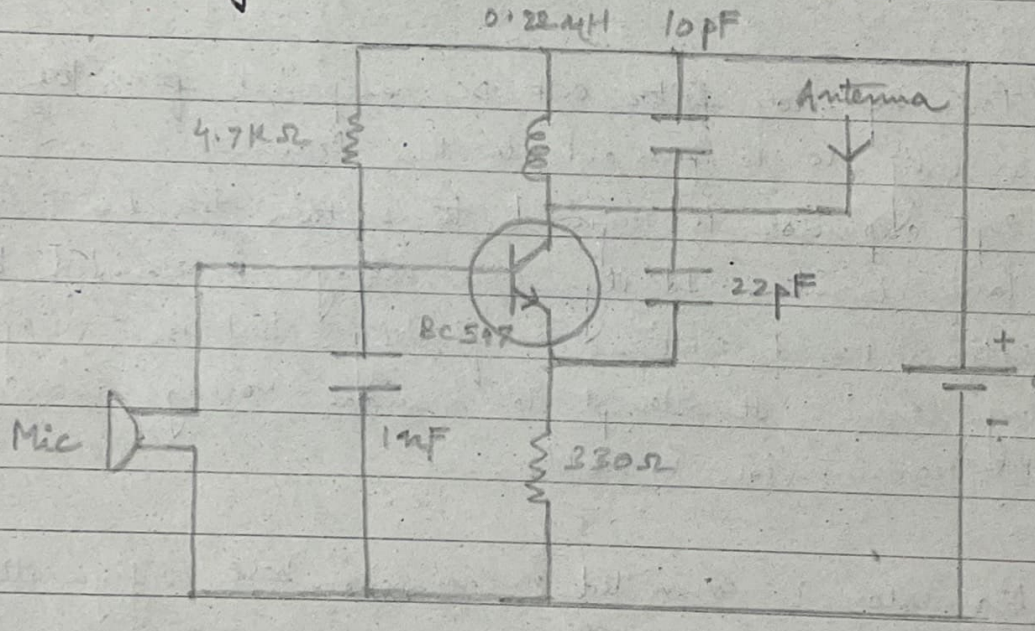
FM TRANSMITTER

Aim → To design and build a FM transmitter using a single transistor.

Components used → 330Ω, 4.7 KΩ resistor, 0.22μH inductor, 2x 10p, 22pF, 1nF capacitors, 1 microphone, antenna, 9V power source, Bc547 transistor.

Circuit diagram →



Working of circuit →

(i) OSCILLATOR ⇒ The transistor acts as oscillator and amplifier of the input signal. The 0.22μH inductor and 10pF capacitor form a tuned LC tank circuit. The values of L and C determine the carrier frequency (frequency at which radio waves are transmitted).

$$f = \frac{1}{2\pi\sqrt{LC}}$$

FM broadcast band lies between 88 MHz – 108 MHz. This is a Colpitts' oscillator (an oscillator that can generate sinusoidal waves of high frequency)

(iii) MODULATOR ⇒ Input audio signals from the microphone are coupled to the transistor's base by the 1nF capacitor. Variations in the input signals modulate the transistor's base current, which in turn causes variations in the carrier signal.
The 1nF capacitor filters out DC component from the input and allows only AC to pass out to the transistor.
The 22pF capacitor is required to sustain the LC oscillations in the tank circuit. Ideally, once voltage is provided the LC oscillations would continue indefinitely, but in reality there are heavy losses. It attempts to maintain voltage across circuit so that transmission is stable.

The transistor is connected in common base configuration.

$$\alpha \text{ (current gain)} = \frac{I_C}{I_E}$$

The 330Ω resistor maintains V_E which ensures that there is a gain across the transistor.

⇒ Voltage gain, $A = \beta \frac{R_C}{R_B}$, $\beta = \frac{\alpha}{(1-\alpha)}$

(iii) ANTENNA ⇒ The modulated signal from the transistor is amplified and fed ~~into~~ ~~into~~ into the antenna which broadcasts the signal at the resonant frequency. Ideally, length of antenna should be high, for better transmission.

Observations → Values of C were changed to get output frequency between 88 MHz – 108 MHz.

For $L = 0.22\,\mu H$

$C_1 = 20\,pF \Rightarrow f = \frac{1}{2\pi\sqrt{LC_1}} = 75.9\ MHz$ (not in range)

$C_2 = 10\,pF \Rightarrow f = \frac{1}{2\pi\sqrt{LC_2}} = 107.2\ MHz$ (in range)

A larger antenna produced a clearer output.

Results → In conclusion, this experiment demonstrates the practical applications of signal processing and transmission.

Precautions →
- Ensure power source is turned off before making any changes in circuit to prevent shocks.
- The 330 Ω resistor was observed to heat up significantly. So, take readings when components are cool