SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution
Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB301-ANALOG AND DIGITAL COMMUNICATION

III YEAR/ V SEMESTER

UNIT 2 – RADIO TRANSMITTER & RECEIVER

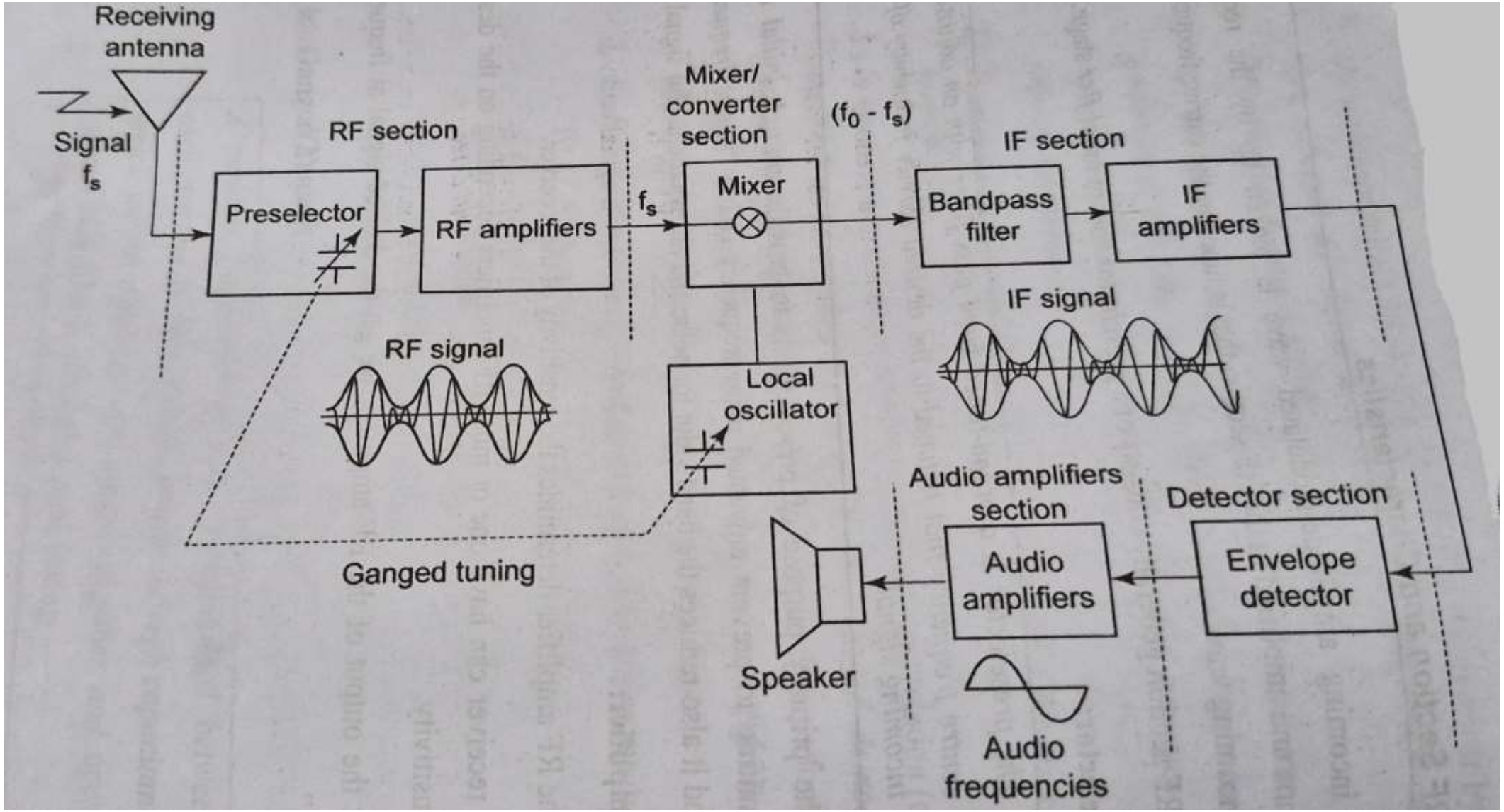
TOPIC – SUPERHETERODYNE RECEIVER

INTRODUCTION

- **In the super heterodyne receiver**, the incoming signal voltage is combined with a signal generated in the receiver.
- This local oscillator voltage is normally converted into a RF signal to a lower fixed frequency is called as **Intermediate frequency(IF)**
- The signal at this intermediate frequency contains the same modulation as the original carrier, and it is now amplified and detected to reproduce the original information.
- The super heterodyne Rx has the same essential components as the TRF receiver, in addition to the mixer, local oscillator and intermediate-frequency (IF) amplifier.

- A constant frequency difference is maintained between the local oscillator and the RF circuits normally through capacitance tuning, in which all the capacitors are ganged together and operated by one control knob. This is called as **ganged tuning.**
- The IF amplifier generally uses two or three transformers, each consisting of a pair of mutually Coupled tuned circuits.
- With this large number of double-tuned circuits operating at a constant, specially chosen frequency, the IF amplifier provides most of the gain (and therefore sensitivity) and bandwidth requirements of the receiver

- The characteristics of the IF amplifier are independent of the frequency to which the receiver is tuned, the selectivity and sensitivity of the super heterodyne are usually fairly uniform throughout its tuning range and not subject to the variations that affect the TRF receiver.
- The RF circuits are now used mainly to select the wanted frequency, to reject interference such as the image frequency and (especially at high frequencies) to reduce the noise figure of the receiver.


Receiving antenna
Signal f_s
RF section
Preselector
RF amplifiers
f_s
Mixer/ converter section
Mixer
$(f_0 - f_s)$
IF section
Bandpass filter
IF amplifiers
IF signal
RF signal
Local oscillator
Ganged tuning
Audio amplifiers section
Audio amplifiers
Detector section
Envelope detector
Speaker
Audio frequencies

WORKING

- **Receiving antenna**: The receiving antenna receives the signal which was sent by the transmitter. It sends the received signal for further processing.
- **RF amplifier**: The received signal is fed to the RF amplifier stage so as to amplify it, as the signal gets attenuated during long-distance transmission. It is tuned in such a way that it can choose the desired carrier frequency and amplify it.

- **Local Oscillator**: This circuit basically generates a signal with a fixed frequency and the output is then fed to the mixer.
- When we talk about **AM broadcast** system, the intermediate frequency is **455 KHz** that simply means that local oscillator should select such a frequency which is 455 KHz above the incoming signal frequency.
- **Mixer**: A mixer simply mixes the carrier frequency with the frequency of the signal generated by the local oscillator.

- Here, two different frequencies are to be mixed so as to have another frequency component of lower value.
- The summation of the carrier and local oscillator frequency at the output of the mixer will give rise to image frequency which is treated as a type of noise or distortion in the signal.
- This is the reason why the mixer generates a frequency difference at its output.
- This difference frequency is a constant value irrespective of the variations in the input, known as the **intermediate frequency.**

- The constant frequency at its output is gained by **capacitance tuning**.
- In capacitance tuning, several capacitances are arranged together and operated by a controlling knob.
- It doesn’t matter what the incoming signal frequency is, the RF amplifier and local oscillator must be tuned to it.
- **IF amplifie**r: This section basically amplifies the output of the mixer. IF amplifier provides sensitivity(gain) and selectivity (bandwidth requirement) to the receiver.

- As it consists of several transformers consisting of pairs of the tuned circuit.
- Here, the sensitivity and selectivity are uniform and does not show variations as in case of TRF receivers because **IF amplifier's characteristics are independent of that of the received signal frequency** as it works on the intermediate frequency.
- Due to this, the system design is quite easy so as to provide constant bandwidth along with high gain.

- This section has narrow bandwidth and due to its lower bandwidth, it rejects all other frequency so as to reduce the risk generated from interference.
- The lower bandwidth accepting nature supports Superheterodyne receivers to give much better performance than other types of receivers.
- **Demodulato**r: Demodulator is placed exactly after the IF amplifier so that the constant frequency signal is demodulated and the message signal can be extracted from it.

- **Audio amplifie**r: The original signal is fed to the audio amplifier which does not hold distortion or noise so that it can amplify audio signal to a particular level.
- **Power amplifier**: Here, the signal is further amplified to a particular power level which can activate the loudspeaker.
- The amplified signal is finally fed to the loudspeaker circuit which converts the electrical form of the signal into an audio sound signal which can be heard by the listeners.

ADVANTAGES

- It operates at low signal level.
- The mixer provides fixed frequency operations.
- Provides excellent selectivity and sensitivity.

Disadvantage:

- Overall system cost is increased as additional circuits are used.

Applications:

- Superheterodyne receivers find its use in various places as in Television, Radio receiver, commercial radios

ASSESSMENT

1. Define Intermediate frequency
2. What is meant by ganged tuning?
3. What are the advantages of superheterodyne receiver

THANK YOU