Notes on Module 4 – Part 1

Noise : *Noise* is introduced into a communications system when it is passing through the transmission medium [and is random in nature].

Distortion: *Distortion* is introduced into a communications system by the circuit components themselves [and is systematic].

Gain: (means amplifying), the ratio of the output to the input, sometimes voltage(op amp) and sometimes current (transistor).

Attenuation: degradation of the signal as it is transmitted. – signal loses amplitude.

Base Bandwidth: Minimum range of frequencies needed to contain the information signal. eg. Base bandwidth for the telephone is 3.4kHz.

Broadcast bandwidth: The bandwidth needed to broadcast the signal. eg. Twice the base bandwidth for amplitude modulation.

Frequency division multiplexing (FDM): Giving each radio station a band of frequencies. Each radio station will have a different band within the frequency spectrum. eg. Radio 1 on 98.5Mhz, Radio 4 on a different frequency within the FM bandwidth.

When radio waves are used to transmit audio frequencies they can use AM or FM
AM amplitude modulation
FM frequency modulation

The wave that is transmitted consists of 2 signals, the carrier and the audio signal.

The carrier signal is a high frequency radio wave.(many kHz)

The audio signal (the sound that you want transmitting). 20Hz and 20kHz is the audible range but normally, only up to 5kHz is transmitted. – No great improvement noticed by increasing to 20kHz.

Modulation is the addition of information (or the signal) to an electronic or optical signal carrier.

Adding audio frequency to radio frequency is called **modulation**.
Retrieving the audio frequency from the transmitted radio signal is called **demodulation**

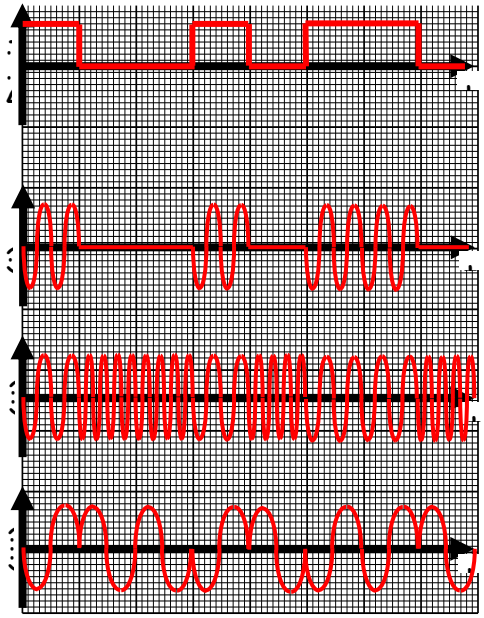
Depth of modulation (Vs/Vc) x100 Amplitude of signal/Amplitude of carrier x 100

FM vs AM

Frequency Modulation As a higher frequency carrier is used (VHF to UHF range) the **broadcast bandwidth is wider** improving the quality of the received

waveform.(can be used for stereo) The signal has good immunity to interference (less prone to noise) and is not affected by changes in amplitude of the carrier waveform**.**

Amplitude Modulation - Broadcast bandwidth narrower (10kHz bandwidth) – more stations can be broadcast but signal quality is poorer.



Amplitude Shift Keying(ASK)
Sends sine wave to represent 1
Sends no signal to represent 0

Frequency Shift Keying (FSK): transmitting binary information by transmitting two different frequencies 2FSK transmits 2 frequencies, one represents 0 and the other represents 1.
Frequency of carrier is changed to represent 1 or 0.
High frequency=0, Low frequency = 1.

Phase Shift keying (PSK)
Sends sine wave decreasing first for a 1 and increasing first for a 0

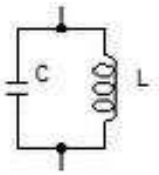
Analogue or Digital

Analogue can have any value, Digital has specific values (often only 0 and 1).

Analogue is difficult to regenerate – noise picked up as it is transmitted cannot easily be removed because it isn't clear what the original value should be.

Digital is easy to regenerate – noise can be removed easily.
Digital can travel grater distances before repeater.
Digital can be checked for accuracy using parity checks.
Digital can be easily encoded for secure transmission.

Tuned Circuits



A tuned circuit is a capacitor and an inductor in parallel.

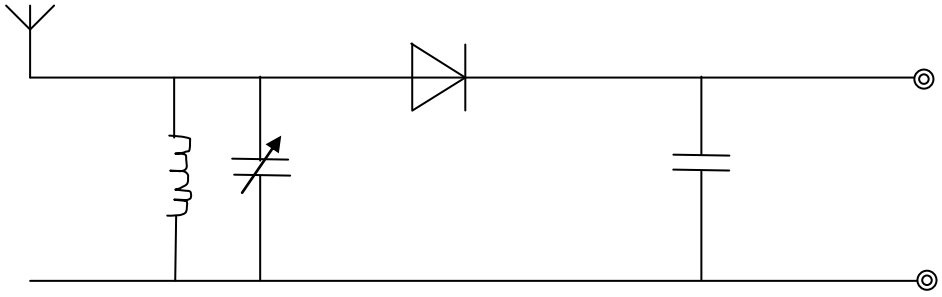
Tuned circuits are the first stage in a simple radio receiver and they are tuned by having a variable capacitor to change the resonant frequency of the circuit.

Resonance occurs when $X_C=X_L$ .This is the frequency that it is tuned to.

On the data sheet it tells you the equation for X_C ,X_L and the equation for the resonant frequency.

Crystal sets have poor **Selectivity and Sensitivity**
Poor *selectivity* means inability to select a narrow bandwidth – so likely to pick up neighbouring stations.
Poor *sensitivity* means that the receiver is unable to detect weak stations.

Learn the 5 blocks in a crystal set.
Antenna → Tuned Circuit → Demodulator /Detector → RF Filter →
Crystal /High Impedance Earpiece



Tuned circuit - L C in parallel
Demodulator – Germanium diode (not silicon)
RF filter – Capacitor

Superheterodyne Receiver

Tuned frequency and local oscillator frequency go into mixer.
4 frequencies at output: 1.Tuned frequency – this is the frequency of the carrier wave (f_c), 2. Local oscillator frequency (f_o), 3. (f_o – fc) – this is called the **intermediate frequency,** 4.(f_o - f_c).

Intermediate frequency is (f_o – fc) the difference between the carrier frequency and the local oscillator. It stays the same when the receiver is tuned to different frequencies because the local oscillator frequency goes up when the tuned rf is increased. It is normally about 450 – 470kHz.

Learn the blocks and what they do!! chapter 3.

Multiplexer a device for allowing digital signals from a number of sources to be directed in turn through a single connection.

Demultiplexer – a device for redirecting a number of digital signals from a single transmission line to several receivers.

Time division multiplexing – time slots are used to transmit a number of digital channels through a transmission line.

Frequency division multiplexing –

Depth of modulation for AM formula $$m = \frac{(V_{\max} - V_{\min})}{(V_{\max} + V_{\min})} \times 100\%$$