BIOTELEMETRY:

- Biotelemetry is the use of the telemetry methods in order to remotely observe, document and measure certain physiological functions in human beings.
- Telemetry is a technology that allows remote measurement and reporting of information. The word is derived from Greek roots *tele* = remote, and *metron* = measure.
- Biotelemetry is the electrical technique for conveying biological information from a living organism and its environment to a location where this information can be observed or recorded. Thus it refers the communication between a living system and an observer.
- Biotelemetry is extended for monitoring patients in a hospital from a remote location, for monitoring patients who are on the job or at home and carrying implanted pacemaker or other stimulators.
- Medical telemetry is particularly important because it can be used to remotely track the vital signs of ambulatory patients.
- Biotelemetry system used for the purpose of measuring the functions like body temperature, heart rate, blood pressure, and muscle movement.
- Although the term commonly refers to wireless data transfer mechanisms (e.g.using radio or infrared systems), it also encompasses data transferred over other media, such as a telephone or computer network, optical link or other wired communications.
- Many modern telemetry systems take advantage of the low cost and ubiquity of GSM networks by using SMS to receive and transmit telemetry data.

- Bio telemetry is the measurement of biological parameters over long distance.
- For conveying biological information from a living organism and its environment to a different location where this can be recorded.

Elements of Biotelemetry System:

- The essential blocks of a biotelemetry system is shown in figure.
- The transducer converts the biological variable into electrical signal.
- The signal conditional amplifies and modifies this signal for effective transmission.
- The transmission link connects the signal input blocks to the readout device by wire or wireless link.

➢ ECG,EEG,EMG- Electrodes act as transducer

➢ For measuring temperatures-Thermistor is used as transducer

➢ For measuring blood pressure-strain gauge is used as transducer

➢ For measuring stomach pH-glass electrode is used as transducer.

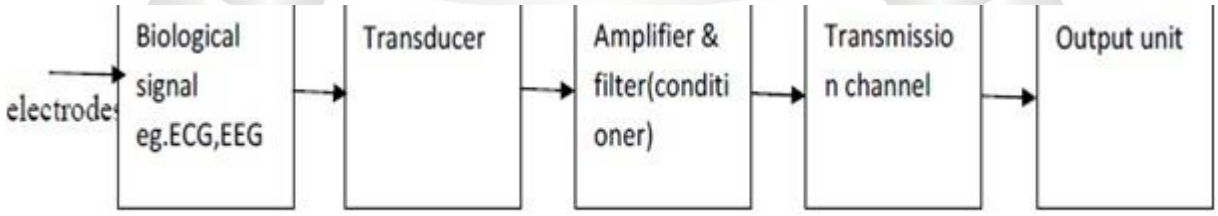


Fig: 4.6.1Block diagram of Biotelemetry system

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

DESIGN OF BIO TELEMETRY:

- Telemetry system should be selected to transmit the bio –electric Signal with maximum fidelity and simplicity.
- The system should not affect the living system by any interference.
- Smaller in size light in weight.
- It should have more stability and reliability.
- The power consumption at the transmitter and receiver should be small.
- It should reject common mode interference rejection.
- Miniatured radio telemetry system should be used to reduce noise.

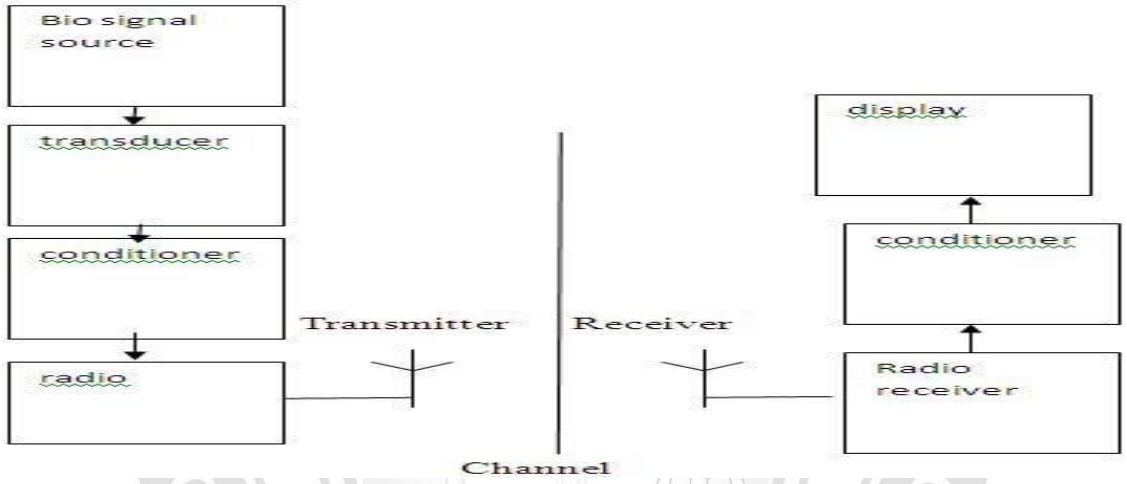
RADIO TELEMETRY SYSTEMS:

- Single channel telemetry system
- Multi channel telemetry system

SINGLE CHANNEL TELEMETRY SYSTEM

- For a single channel telemetry system, a miniature battery operated radio transmitter is connected to the electrodes of the patients.
- The transmitter broadcasts the biopotential to a remote place in which the receive detects the radio signal and recovers signal for further processing.
- The receiving system can be located in a room separately from the patients.

- The only risk is electrical shock to the patient is due to the battery powered transmitter itself. Since it is kept low there is negligible risk to the patient.
- The biosignals are amplified to radio frequency range of few hundred KHz to about 300 KHz and then they are transmitted by transmitter antenna.



- Further the amplitude modulation is not adapted because when relative motion occurs between the transmitter and receiver, the signal amplitude will be varied and thus introduces serious errors. Thus to adapt that we use either frequency modulation or pulse modulation technique to transmit the bio signals.

Transmission of bioelectric variables:

- In a single channel telemetry system, the measurements are made under of the two categories:

➢ Active measurements

➢ Passive measurements

Active measurements: Here the bioelectric variables like ECG, EMG and EEG are measured directly without using any excitation voltage.

- **Passive measurements:** Here the physiological variables like blood pressure, temperature, blood flow, etc are measured indirectly using transducers and excitation voltages.

Tunnel diode FM transmitter:

- The tunnel diodes exhibit a specific characteristics known as negative resistance.
- They have extremely low values of inductance an capacitance.
- It is used for the transmission of EMG,ECG, respiration rates.
- Tunnel diodes are used as active devices and this circuit has higher fidelity and sensitivity.
- Total weight is 1.44 gm with battery and the size is small.
- Varactor diode is basically a reverse biased PN junction which utilizes the - inherent capacitance of depletion layer.
- Varactor diodes are voltage capacitors used for frequency modulation.
- The signal is transmitted through the inductor L of the tank circuit of RF oscillator.

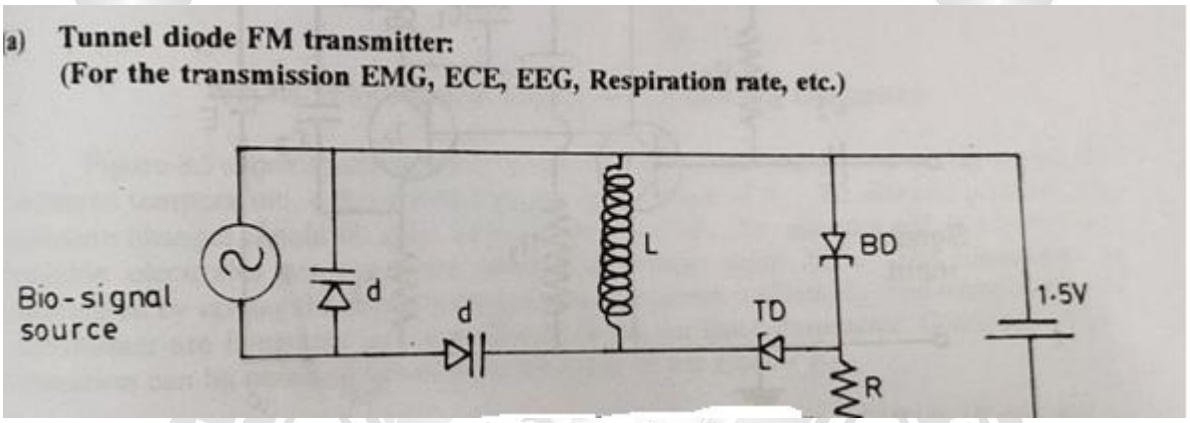


Fig. 4.6.2: Single channel FM Transmitter

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

Advantages:

- All the signal can be transmitted by using the circuit.
- No shielded room is needed.
- Interference is much reduced.

Hartley type FM transmitter:

- This method is used foe transmission of ECG, EEG and EMG.
- LC is tank circuit to generate the signal which is used for oscillation and a specified frequency can be designed: Bandwidth of the signal varied from 100 Hz to 1 KHz.

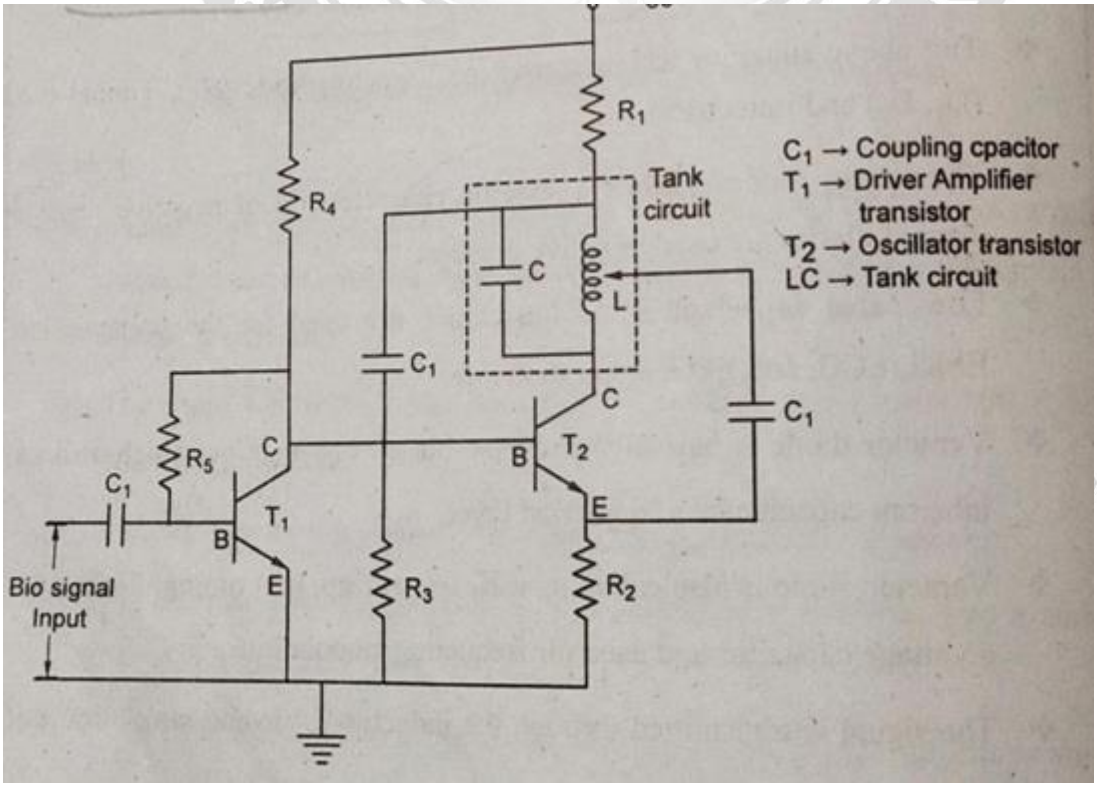


Fig.4.6.3: Hartley type FM Transmitter

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

Pulsed Hartley oscilator:

- This method is used for the transmission of temperature signals, pressure continuously for long periods.
- The transmitter is modulated by varying the rate of pulses of radio frequency oscillations. The transducer and conditioner are integrated into components of the oscillator-transmitter. Continuous wave operation can be obtained by reducing the value of the resistor R1
- The circuit is so simple and has low power consumption 5microW to 10 microW. Bit in the pulsed mode operation, large error can be produced by the power supply voltage variations,
- Interference can be generated over wide frequency band because of self blocking pulsed carrier mode operation.

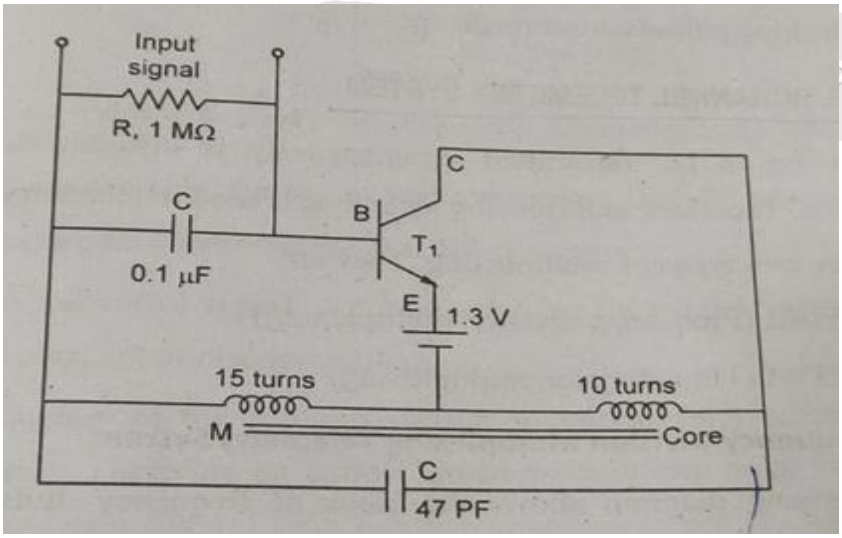


Fig:4.6.4 .Pulsed Hear tly Oscillator

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

MULTI CHANNEL TELEMETRY SYSTEM:

- For most biomedical applications, simultaneous recording of Bio signals are required for correlation study.
- Each signal is in need of one channel. When the number of channels is more than the two or three, the simultaneous operation of the several single channel is difficult. At that time multiple channel telemetry system is adopted**.**
- **Two types of multiplexing:**

I) Frequency Division Multiplex (FDM)

II) Time Division Multiplex (TDM)

Frequency division multiplex system:

- Each signal is frequency modulated on a sub carrier frequency.
- Modulated sub carrier frequencies are combined to modulate the RF carrier.
- At receiver the modulated sub carrier can be separated by the proper band pass filter.
- Then the each signals are demodulated by using specified frequency.
- Frequency of the sub carrier has to be carefully selected to avoid interference.
- The low pass filter are used to extract the signals without any noise. Finally the output unit displays the original signal

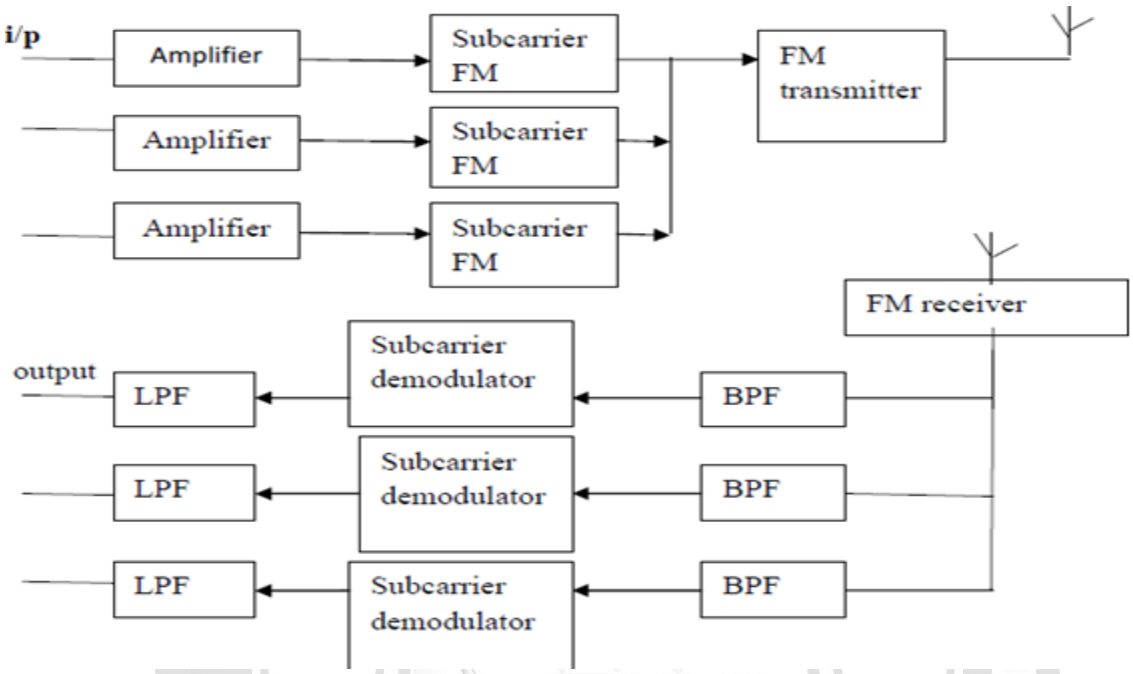


Fig:4.6.5 Frequency Division Multiple access system

Time division multiplex telemetry system:

- Most biomedical signals have low frequency bandwidth requirement, we can use time division multiple system by time sharing scheme.
- Transmission channel is connected to each signal channel input for a short time to sample and transmit that signal.
- Transmitter is switched to the next input signal channel in a definite sequence.
- All the channels have been scanned once, a cycle is completed and the next cycle will start. Scanning follows a order from signal 1 to signal 3.
- At the receiver the process is reversed. The sequentially arranged, signal pulses are given to the individual channels by using gate signal generator.
- If the number of scanning cycles per second is large and if the transmitter and the receiver are synchronized, the signal in each channel at the receiver side

can be recovered. But the scanning frequency fn has to satisfy the following condition i.e) The scanning frequency fn should be atleast greater than twice the maximum signal frequency fs .fscan >2fmax

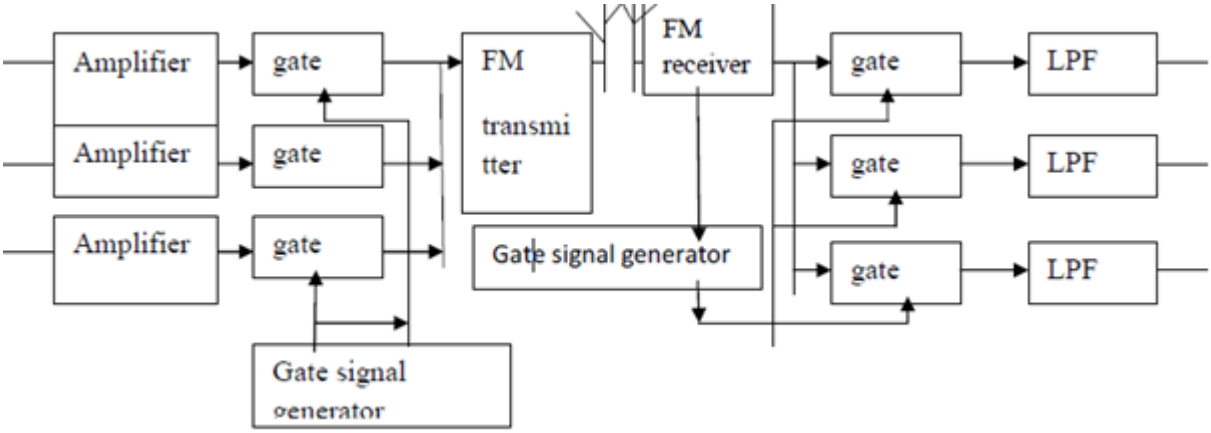


Fig:4.6.6Time Division Multiple Access system

Advantages of biotelemetry:

- Used to record the biosignals over long periods.
- Patient is not disturbed during recording
- For future reference or to study the treatment effect
- Monitor the athletes running a race.
- For monitoring the persons who are in action the biotelemetry is an ideal one.
- For recording on animals, particularly for research , the biotelemetry is greatly used.