# SNS COLLEGE OF TECHNOLOGY

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## Department of Biomedical Engineering

Vision Tit 2 Vision Title 3

## Course Name: 23BMT204 – Biomedical Instrumentation

## III Year : V Semester

## UNIT 2- CARDIAC EQUIPMENT

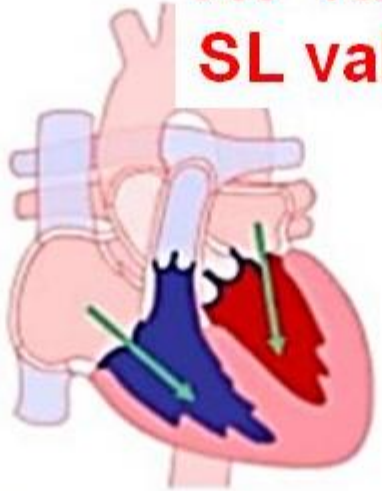
## Topic : PHONOCARDIOGRAM

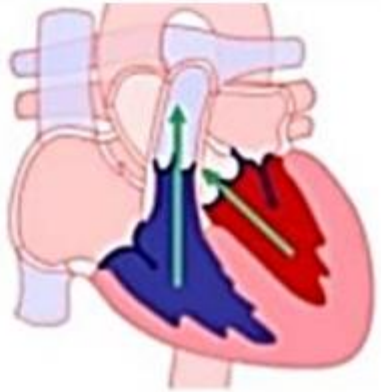
# PCG

- Phonocardiography – instrument to measure heart sounds and murmurs
- Phonocardiogram – graphic record of heart sound
- Two categories
  - Heart sound – transient characteristics with short duration ( closing & opening of valves)
  - Murmurs – noisy characteristics with long duration ( turbulent blood flow in heart)

# The Cardiac Cycle

**AV valves: tricuspid & bicuspid**
**SL valves: pulmonary & aortic**





| DIASTOLE | ATRIAL SYSTOLE | VENTRICULAR SYSTOLE |
|---|---|---|
| Atria and ventricles relaxed | Atria contract<br>Ventricles relaxed | Atria relaxed<br>Ventricles contract |
| Blood flows into heart from veins | Blood pushed into ventricles | Blood pushed into arteries |
| AV valves open **"DUB"** | AV valves open | AV valves closed (heart sound 1) |
| SL valves closed (heart sound 2) | SL valves closed | SL valves closed **"LUB"** |

# Origin of sound

- Valve closure
- Movement of heart wall
- Valve opening
- Extra cardiac sounds

1. Frequency - 10 to 1000 Hz.

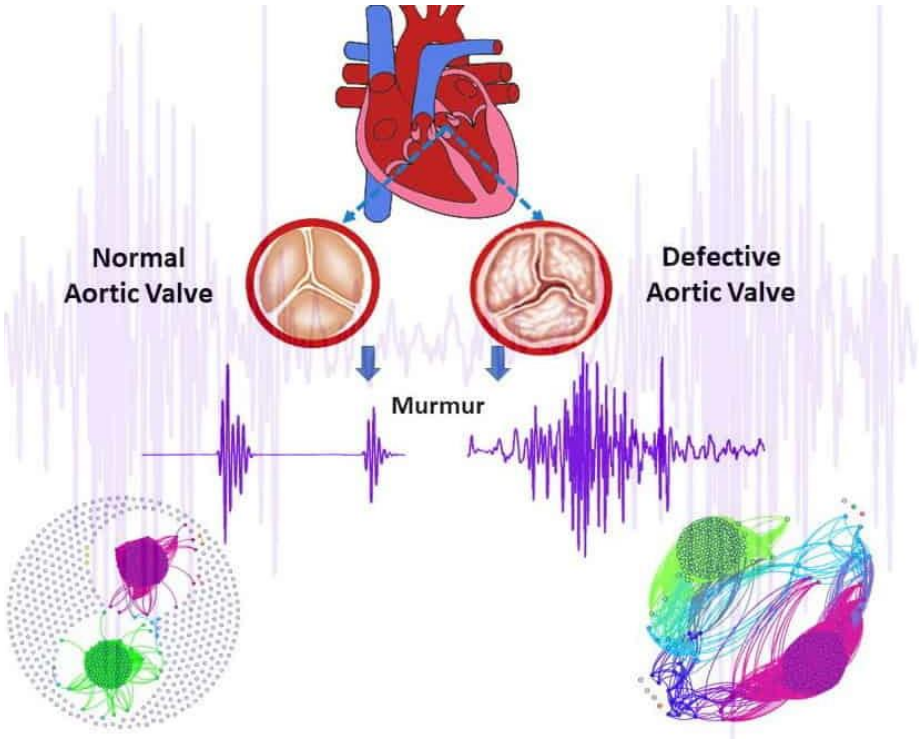
LOW RANGE - 10 - 60 Hz(3rd and 4th)

MEDIUM RANGE - 60 - 150 Hz(1st and 2nd)

HIGH RANGE - 150 - 1000 Hz

2.Amplitude

3.Quality



## First heart sound

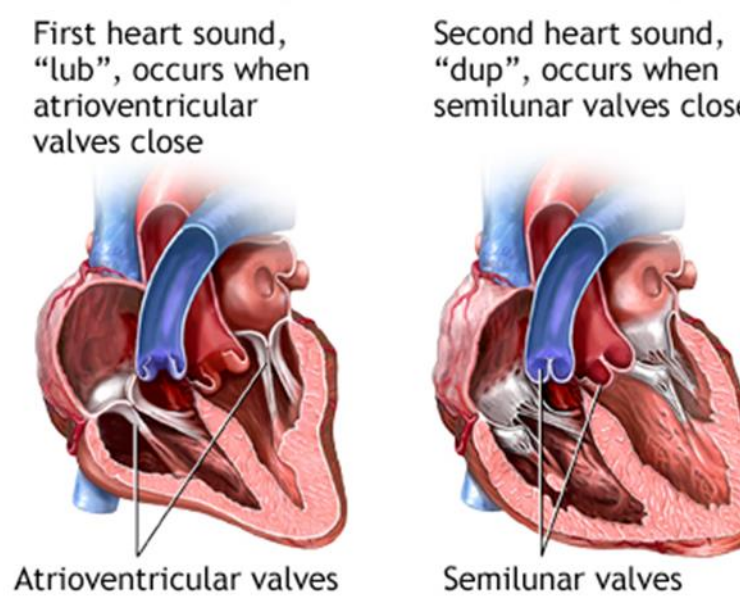
sudden closure of bicuspid and tricuspid valve

- Timing – occurs after the onset of 'QRS' complex of the ECG
- Duration – 0.1 to 0.12 secs
- Frequency – 30 – 50 Hz
- Ascultatory area – heard at the apex of mid pericardium

## Second heart sound

due to the vibration setup by closure of semilunar valve (aortic & pulmonary)

- Timing – occurs after end of T wave in ECG
- Duration – 0.08 to 0.14 secs
- Frequency – upto 250 Hz
- Ascultatory area – heard in aortic and pulmonary areas



- Third heart sound

arises due to relaxation of ventricles, AV valves open & blood moves rapidly to the ventricle chamber

  - Timing – after the onset of second heart sound
  - Duration – lasts approx. 0.04 – 0.08 sec
  - Frequency – 10 – 100 Hz
  - Ausculatory area – heard at the apex and left lateral position

- Fourth heart sound

Atrial sound, caused by accelerates blood flood on ventricles due to atrial contraction

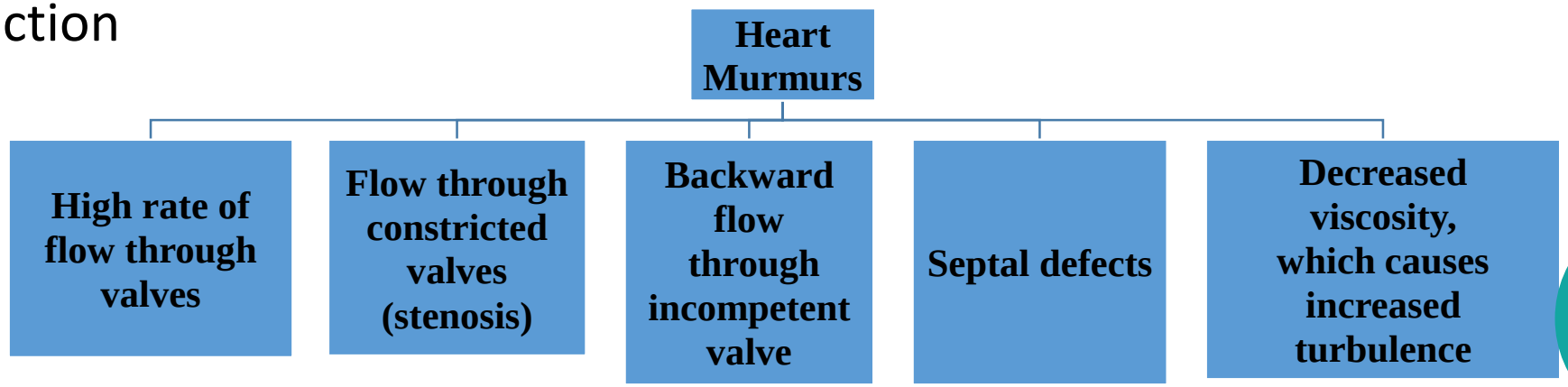
  - Timing – after the onset of P wave
  - Duration – 0.03 – 0.06 sec
  - Frequency – 10 – 50 Hz
  - Asculatory areas – extremely low frequency hence inaudible.

# art murmurs

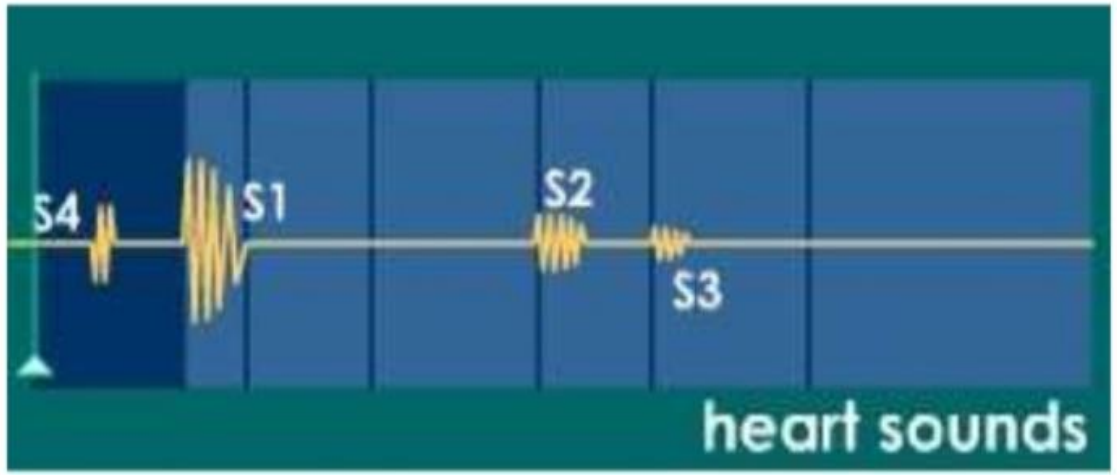
- unds related to non linear flow ( turbulence) of blood in the heart and vessels
- It has noisy character, longer duration , high frequency components upto 1000 Hz

## Condition causing blood flow turbulence

- Local obstruction in blood flow
- Abrupt changes in blood stream
- Insufficient valve function

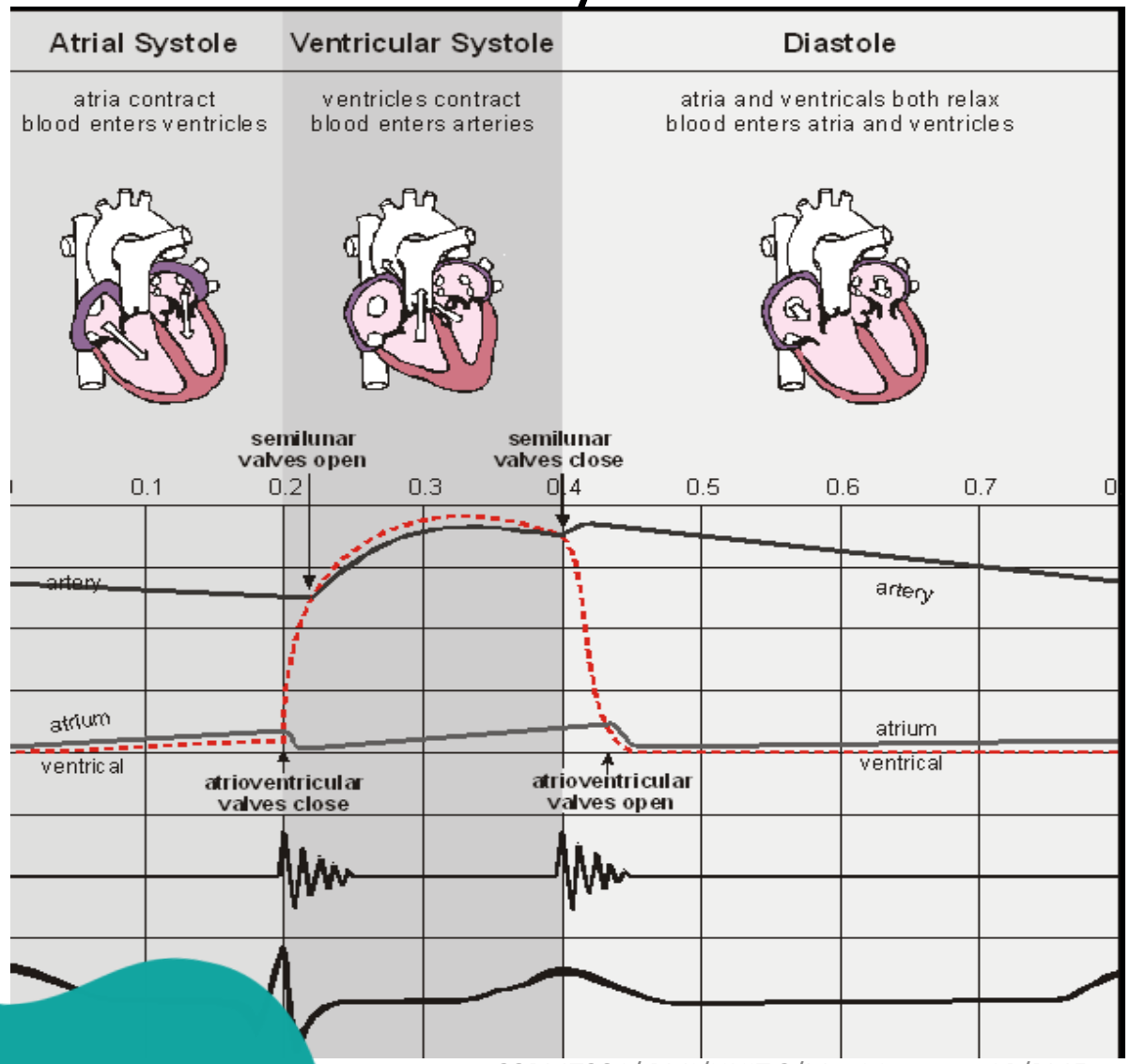


# Heart Sounds



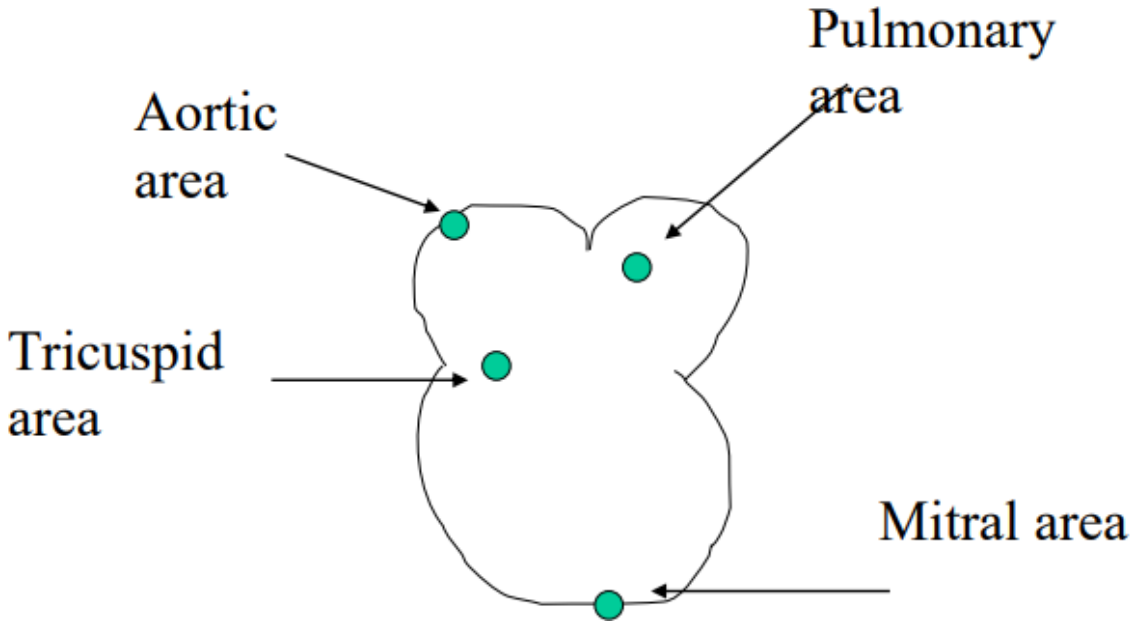

- **S1** - onset of the ventricular contraction
- **S2** - closure of the semilunar valves
- **S3** - ventricular gallop
- **S4** - atrial gallop
- **Other** - opening snap, ejection sound
- **Murmurs**

# Heart cycle

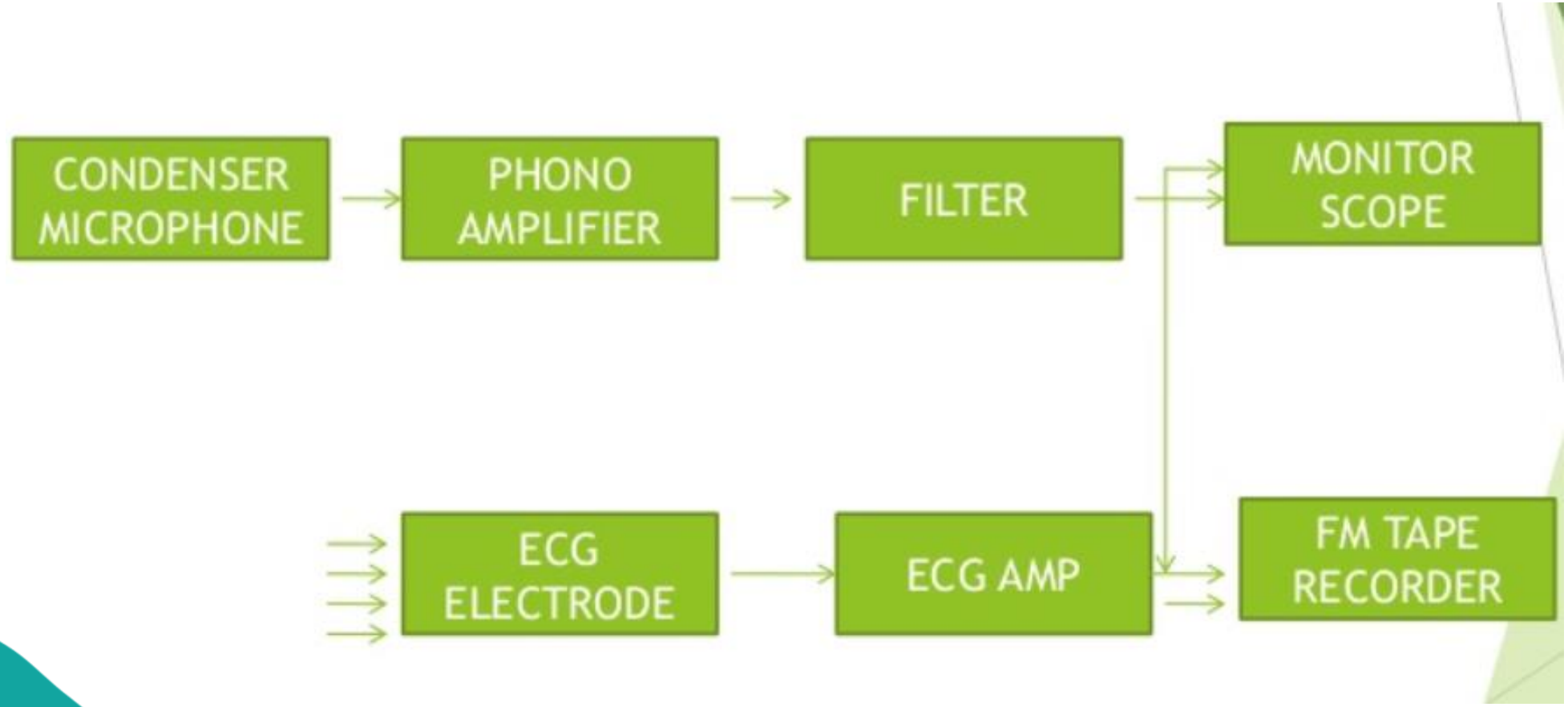

Atrial Systole
Ventricular Systole
Diastole
atria contract
blood enters ventricles
ventricles contract
blood enters arteries
atria and ventricals both relax
blood enters atria and ventricles
semilunar
valves open
semilunar
valves close
0.1
0.2
0.3
0.4
0.5
0.6
0.7
artery
artery
atrium
ventrical
atrium
ventrical
atrioventricular
valves close
atrioventricular
valves open

# Microphones for PCG

- Crystal microphone : contains wafer of piezo-electric material, which generates potential when subjected to mechanical stresses due to heart  sound. Smaller in size, high sensitivity
- Dynamic microphone : consists of a moving coil having a fixed magnetic core inside it. The coil moves with the heart sound and produce a voltage because of interaction with the magnetic flux



# Recording setup



- The heart sound  are converted into electrical signal by microphone fastened to the chest wall by adhesive strip.
- The electrical signals are amplified by a phonocardiographic preampilifer followed by suitable filters and recorder.
- Further, electrodes are placed on limbs to pickup the electrical activity of the heart  act as reference for PCG

- Application
  - Fetal Phonocardiogram
  - Esophageal phonocardiogram