



NSCET E-LEARNING PRESENTATION

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Electrical and Electronics engineering

III YEAR/ Vth Semester

OMD551 Basics of Biomedical Instrumentation

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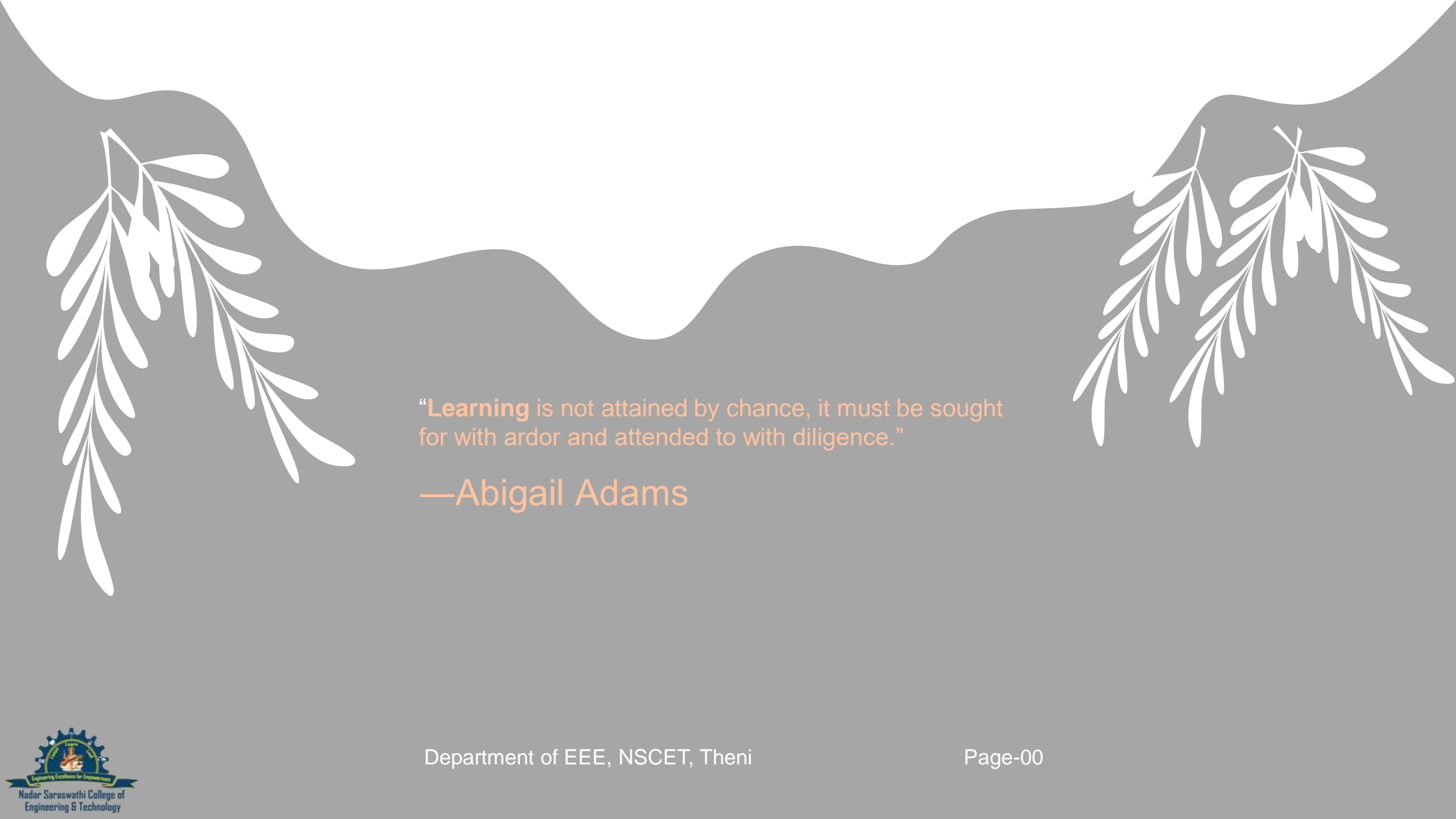




TOPIC NAME

UNIT 04 –MEASUREMENT OF NON ELECTRICAL
PARAMETERS





“**Learning** is not attained by chance, it must be sought for with ardor and attended to with diligence.”

—Abigail Adams

MEASUREMENT OF NON ELECTRICAL PARAMETERS

- Temperature, respiration rate and pulse rate measurements
- Blood pressure(indirect methods,direct methods)
- Blood flow and cardiac measurement(indicator dilution ,and dye dilution method)
- Ultrasound blood flow measurement

TEMPERATURE MEASUREMENT

Temperature is the one of the indicator of the general well being

Two types of temperature measurements can be done from the body

i)Systematic temperature

ii)Surface temperature

SYSTEMATIC TEMPERATURE

- Systematic temperature is the temperature of the internal regions of the body usually the heat is generated by the active tissues of the body and heat is lost by the body to the environment but the temperature of the body is maintained carefully.
- Normal mouth temperature is 37°C the normal underarm temperature is about 1°C lower than above temperature systematic temperature is measured accurately at tympanic membrane of the ear the brain contains the temperature control centre for the body.

SYSTEMATIC TEMPERATURE



SKIN TEMPERATURE MEASUREMENT

Electronic thermometers are convenient, reliable, and generally more accurate in practice. The skin temperature can be directly measured by using a thermistor as a temperature sensor. Infrared thermometers are particularly used for tympanic membrane temperature measurements. Skin temperature thermometers find applications in emergency room, neonatal intensive care unit, surgery room, outpatient departments, and intensive care units of hospitals at all levels

SKIN TEMPERATURE MEASUREMENT



RESPIRATION RATE MEASUREMENT

The function of respiration system are to supply oxygen and remove CO_2 from the tissues .the action of breathing is controlled by a muscular action causing the volume of the lung to increase and decrease

RESPIRATION RATE MEASUREMENT

- Various techniques are used for this measurement these are
 - i) Displacement method
 - ii) Thermistor Method
 - iii) Impedance pneumography
 - iv) CO₂ method
 - v) Apnora detectors

IMPEDANCE PNEUMOGRAPHY

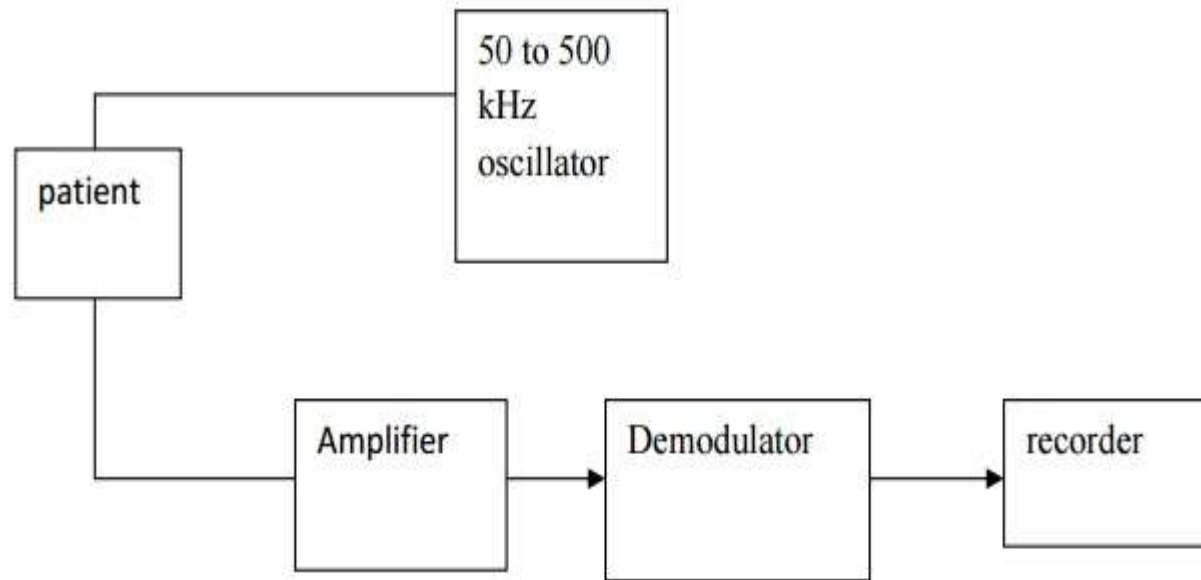


Figure 2.23 Impedance pneumography

APNORA DETECTORS

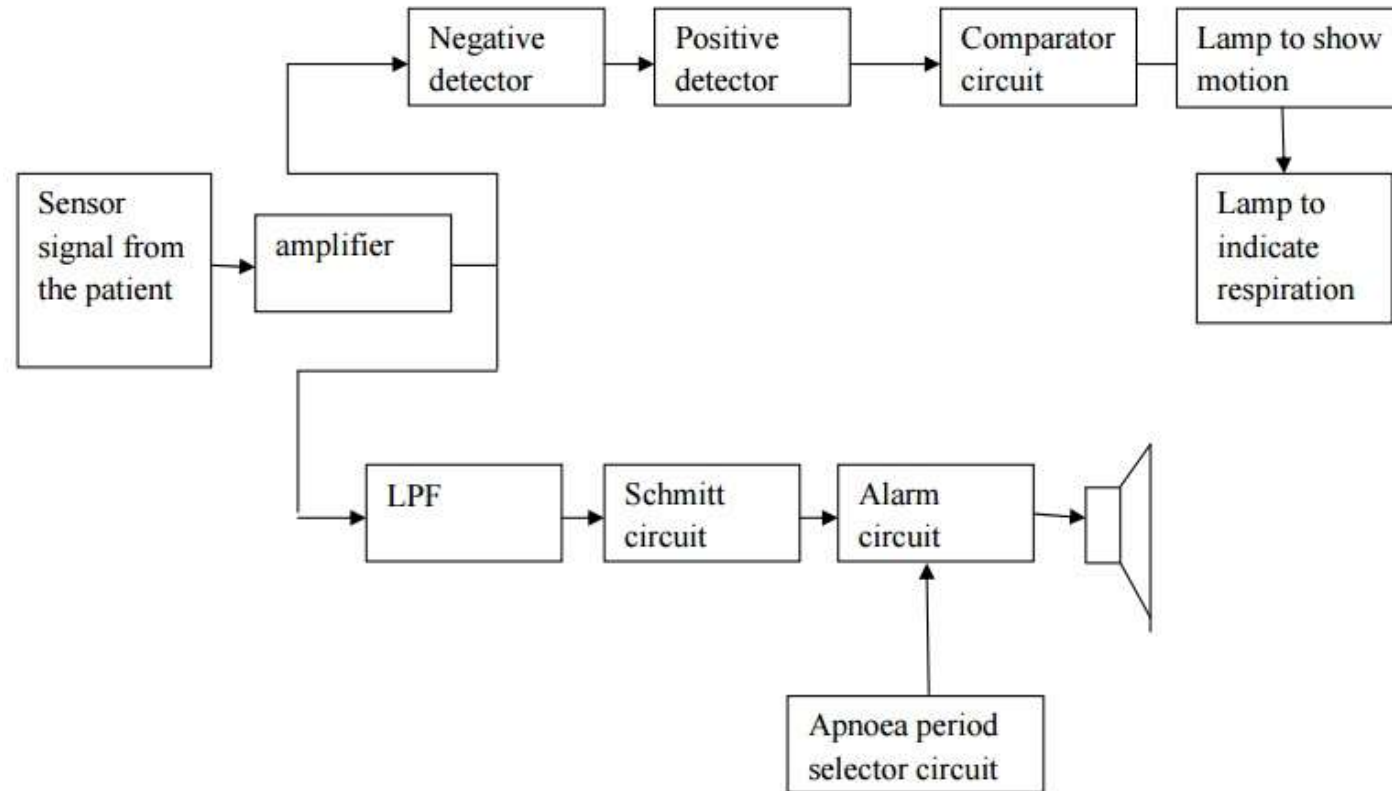


Figure 2.24 Block diagram of apnoea monitor

PULSE RATE MEASUREMENT

When heart muscle contract blood is ejected from the ventricles and a pulse of pressure is transmitted through the circulatory system .This pulse can be measured at various points.

PULSE RATE MEASUREMENT

Types

Photo elective method consists of 2 types

i) Transmittance method

ii) Reflectance method

MEASUREMENT OF BLOOD PRESSURE:

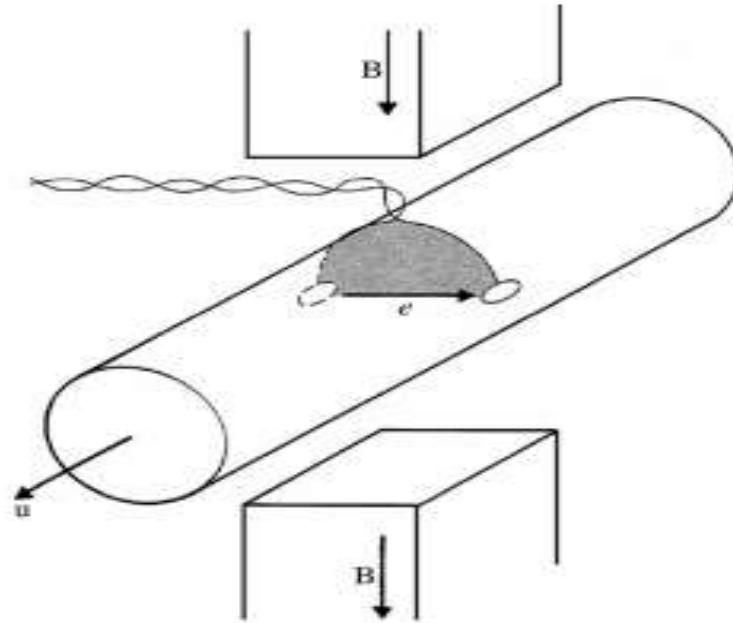
Blood Pressure (BP) – The force exerted by the blood against the arterial blood vessel walls. During a normal cardiac cycle, BP reaches a peak (systole) that is followed by a trough (diastole), or low point, in the cycle. The force is measured in millimeters (mm) of mercury (Hg). High blood pressure or hypertension is defined as having a systolic blood pressure greater than 140 mmHg or diastolic of more than 90 mm Hg.

BLOOD FLOW AND CARDIAC OUTPUT MEASUREMENTS:

ELECTROMAGNETIC BLOOD FLOW METER:

The electromagnetic flowmeter measures instantaneous pulsatile flow of blood and thus has a greater capability than indicator-dilution methods, which measure only average flow. It operates with any conductive liquid, such as saline or blood. The electric generator in a car generates electricity by induction. Copper wires move through a magnetic field, cutting the lines of magnetic flux and inducing an emf in the wire.

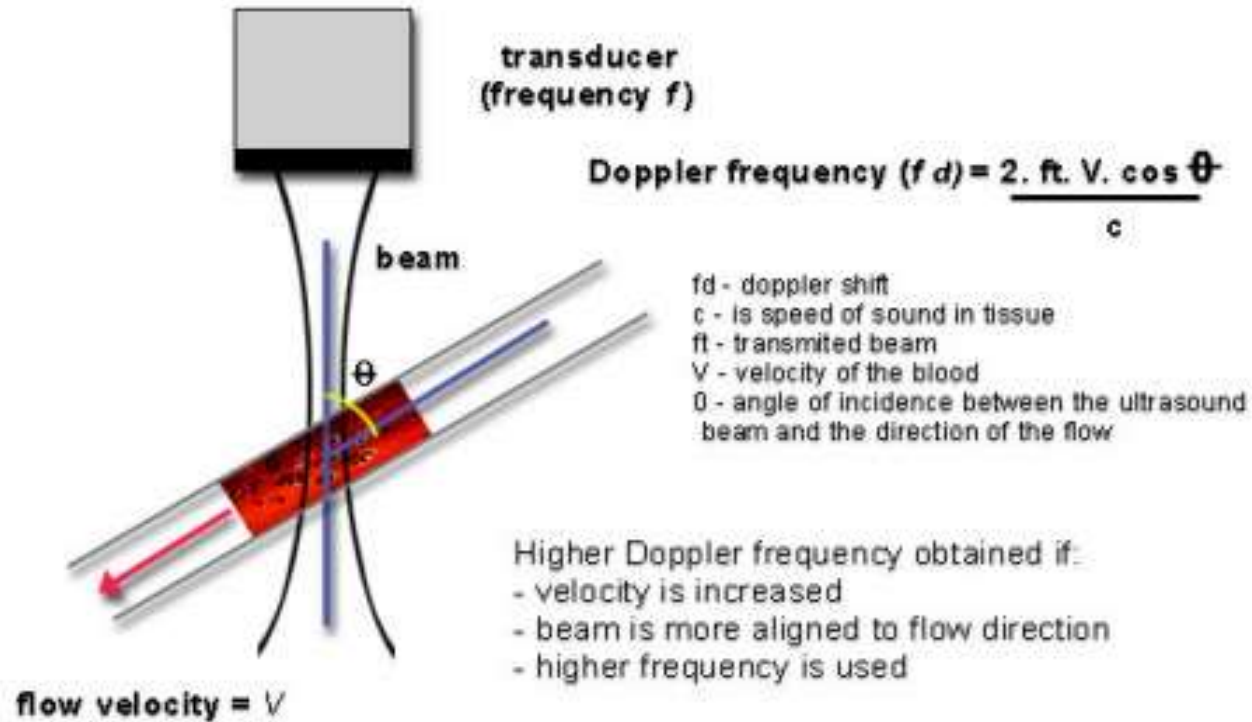
ELECTROMAGNETIC BLOOD FLOW METER:



ULTRASONIC BLOOD FLOW METER

Ultrasound images of flow, whether color flow or spectral Doppler, are essentially obtained from measurements of movement. In ultrasound scanners, a series of pulses is transmitted to detect movement of blood. Echoes from stationary tissue are the same from pulse to pulse. Echoes from moving scatterers exhibit slight differences in the time for the signal to be returned to the receiver. These differences can be measured as a direct time difference or, more usually, in terms of a phase shift from which the ‘Doppler frequency’ is obtained. They are then processed to produce either a color flow display or a Doppler sonogram.

ULTRASONIC BLOOD FLOW METER

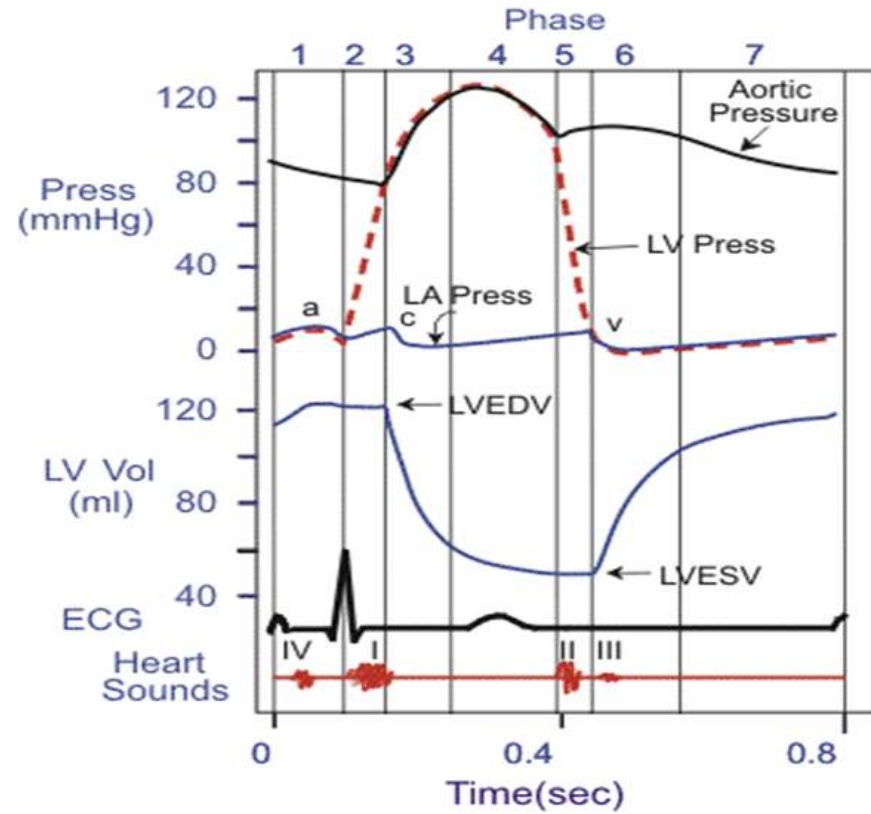


- It uses digital encoding of the input voltage and frequency modulation.
- The input voltage is converted to proportional charge on the switched capacitor.
- It has modulator and demodulator circuits.
- The signals are sent across a differential capacitive barrier.

BLOOD FLOW AND CARDIAC OUTPUT MEASUREMENT

CARDIAC OUTPUT

- Volume of blood ejected from left ventricle in one minute
- It is the determinant of global oxygen transport from the heart to the body
- It reflects the efficiency of cardiovascular system
- There no absolute value for cardiac output measurement



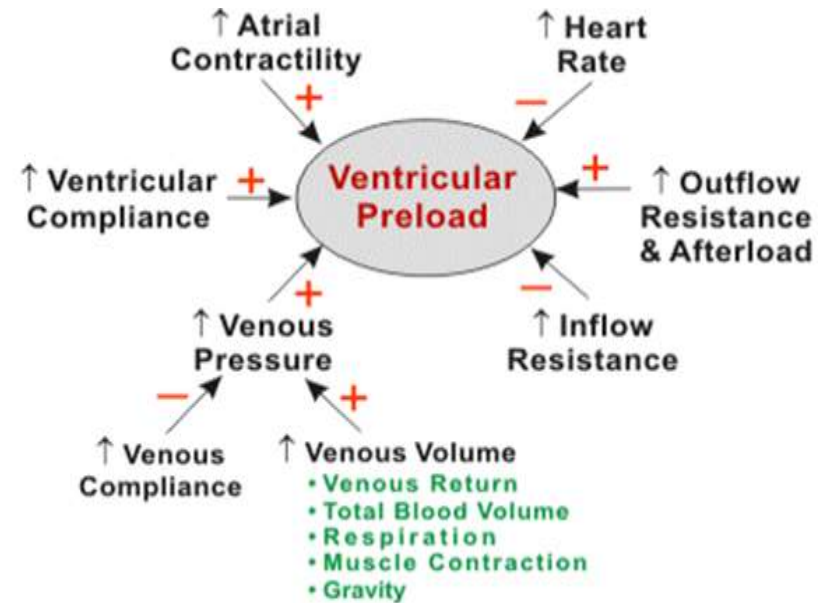
Abbreviations:

- LV Press, left ventricular pressure
- a, a-wave; c, c-wave; v, v-wave
- ECG, electrocardiogram
- LVEDV, left ventricular end-diastolic volume
- LVESV, left ventricular end-systolic volume

CARDIAC OUTPUT INFLUENCING FACTORS

- Ventricular Preload
- Volume of blood in the ventricle at the end of diastole
- Any changes in the ventricular preload will affect the ventricular stroke volume

VENTRICULAR PRELOAD



Factors determining ventricular preload. A "+" sign indicates that an increase in this particular variable increases ventricular end-diastolic volume, and therefore preload, while the "-" indicates that the variable decreases preload.

METHODS OF CALCULATING AND MEASURING CARDIAC OUTPUT

Simple method:

- $CO = SV \times HR$
- $SV = 2ml \times \text{pulse pressure}$
- $CO = [2ml \times \text{pulse pressure}] \times HR$

Fick Principle: “gold standard”

$$CO = VO_2 / O_2 \text{ art} - O_2 \text{ ven}$$

$$\text{Arterial } O_2 = Hb \times 1.34 \times O_2 \text{ sat.}$$

$$\text{Venous } O_2 = \text{Mixed venous blood}$$

VO_2 = Oxygen consumption

- Fick Principle relies on the total uptake of a substance by peripheral tissue is equal to the product of blood flow to the peripheral tissue and arterial – venous concentration difference of the substance
- Fick cardiac outputs are infrequently used because of difficulties in collecting and analyzing exhaled gas conc. In critically ill patients because they may not have normal

VO_2 value

THERMAL DILUTION METHOD

Limitations

- Affected by the phase of respiration and should be measured at the same point of respiratory cycle.
- Variations in the speed of cold water injection can result in altered measurement

NON INVASIVE METHODS

Doppler Method

Based on measuring the length of blood flow-velocity in the ascending aorta in unit time. Multiplied by the cross- sectional area of the aorta to give stroke volume.

Multiplied to heart rate to give cardiac output.