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EEE 319 (MEASUREMENT AND INSTRUMENTATION) ASSIGNMENT

QUESTION 1: Describe briefly (with examples) sensors and actuators for biomedical applications.

A sensor is a device that receives and responds to a signal produced by some sort of energy e.g light, heat, motion or chemical reaction, whereas an actuator is a device which actuates or moves something, using energy to provide motion.

Some examples of sensors and actuators for biomedical applications are:

SENSORS

i. Heart sound sensor

This is a heart sound sensing device placed on the body of a patient and used to detect low frequency sound waves. It is used with medical diagnostic ~~services~~ devices and comprises a cylindrical housing structure, a strap, a fluid ingress/egress aperture, an open end which receives electric signals in response to transmitted heart sound waves

ii Respiration sensor

This is a sensitive girth sensor worn using an easy fitting high durability woven elastic band fixed

with a length adjustable webbing belt. It detects chest or abdominal expansion/contraction and outputs respiration waveform.

iii. Blood gas sensor

This is used to measure arterial blood gas (pO_2 and pCO_2) as well as pH.

ACTUATORS

i. Surgical tools

Surgical tools are actuators based on chape-memory materials, pneumatic and pizoelectric principles in ~~order~~ order to improve surgical procedures.

ii. Cardiac devices

Cardiac implants are a good example of implantable actuators targeted at improving diagnoses and treatments for certain cardiac complications. Stents, for example are used as chronic vascular scaffolds to keep the blood vessel open during procedures.

iii Drug delivery systems

These are implantable biomedical devices specially designed to assist in the diagnosis and treatment of acute diseases.

As we have seen via the examples above, a lot of sensors and actuators find themselves useful in biomedical applications. Biomedical sensors and actuators

can majorly be described as physical or chemical.

Several types of physical sensors are used in biomedical applications, such as blood pressure, muscle displacement, blood flow, core/external body temperature, bone growth and cerebrospinal fluid pressure measurements. Among most of the physical sensors, optical sensors are mostly used in the biomedical applications.

Chemical sensors are equally poised to revolutionalize fundamental scientific research and our daily lives, as they play a more and more important role in various areas within clinical ~~dig~~ diagnosis.

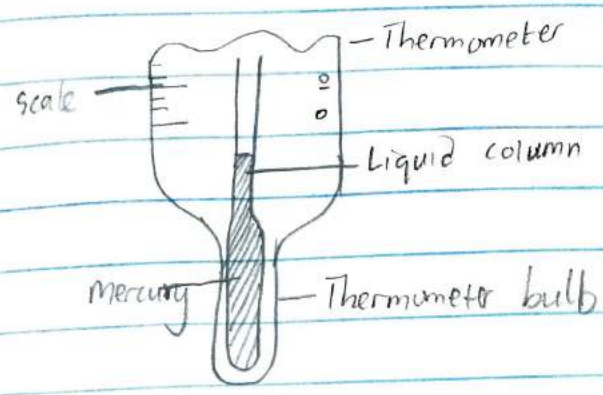
QUESTION 2: Describe, with sketches and examples, the components of a basic measuring instrument

A measuring instrument is a device to measure a physical quantity. A good example of a measuring instrument is a thermometer. So using a thermometer as our studied instrument, we can say that a basic measuring instrument should consist of;

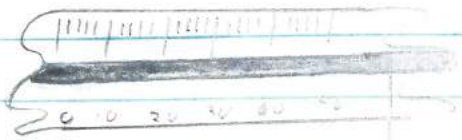
- a primary sensing component
- variable conversion and manipulation component
- signal conditioning element
- data transmission element (for more advanced instruments
- data presentation component.

In the thermometer, our primary sensing component is

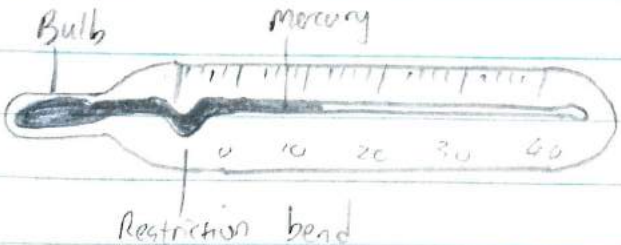
the thermometer bulp containing mercury, as well as our variable conversion component.



It senses the input quantity and reacts accordingly. As the mercury expands it moves into the capillary tube whose cross sectional area is constant. Thus the volume signal is converted into linear distance signal, this acts as our signal manipulation and data transportation component



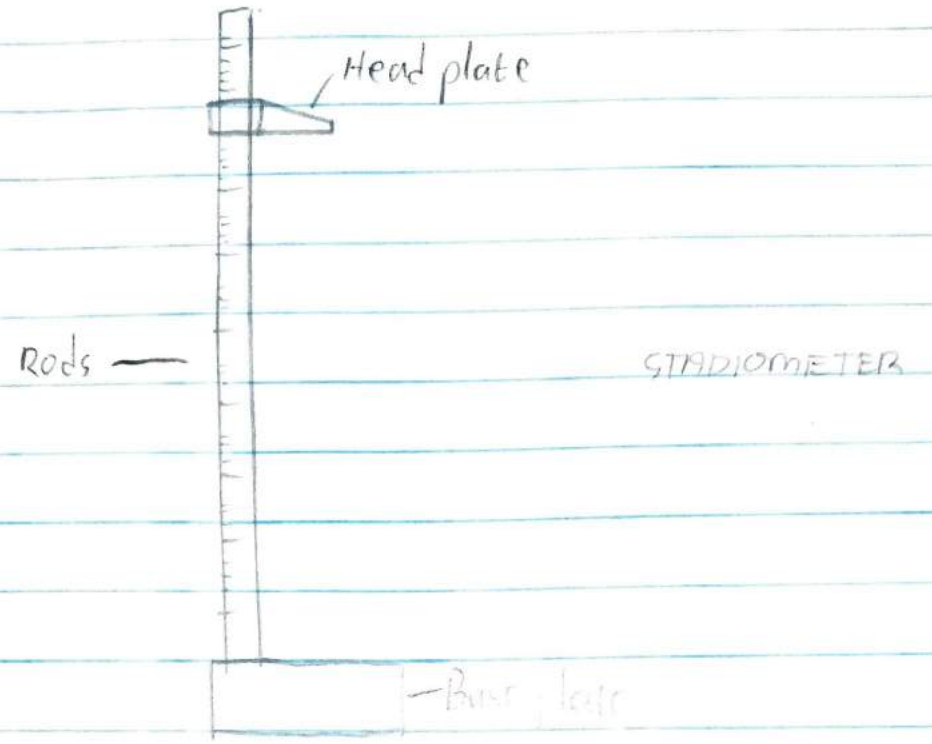
A restriction bend is provided to prevent back flow of mercury to the bulb once expanded. This is our data storage component.



THE THERMOMETER

QUESTION 3: Describe briefly case studies of two medical measurement instruments

1.) STADIOMETER



A stadiometer is a piece of medical equipment used for measuring human height. It is usually constructed out of ruler and sliding horizontal headpiece adjusted to rest on top of the head. They are used in routine medical examinations and clinical tests.

COMPONENTS

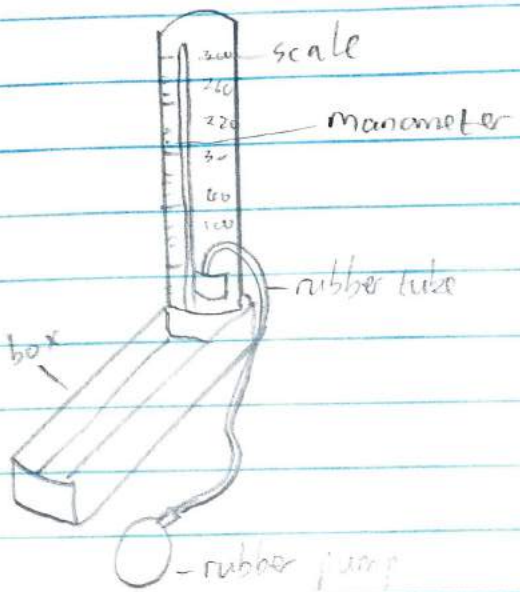
- Measuring ruler
- Head plates and base plates

PROCESS

The ~~measurement~~ stadiometer should be checked for accuracy. The person being measured, in minimal clothing should stand straight, feet together and hands to the side. The

head plate is then brought to rest on the subjects head and the point on the ruler is recorded.

2.) SPHYGMOMANOMETER



This is a device which measures blood pressure. It is composed of an inflatable rubber cuff, a measuring device, a bulb and a valve for indicating the cuff pressure, inflating the cuff and releasing pressure.

The cuff is inflated above systolic pressure, valve is opened and pressure slowly decreases. When the pressure equals the systolic pressure, blood starts to flow past the cuffs creating turbulence and audible sound which is then heard using a stethoscope and recorded.

~~Systo~~ There are ~~many~~ different ~~three~~ types of sphygmomanometers, ~~digital, manual~~ Digital sphygmomanometers are automated but less accurate, manual sphygmomanometers require someone to operate but are generally more accurate than their digital counterparts.