

Name: Nneji Ifeanyi Daniel

Matric No: 191ENG021077

Department: Computer Engineering

EEA 319 Assignment

F

- 1) Describe briefly (with examples) sensors and actuators for biomedical applications
- 2) Describe with sketches and examples, of the components of a basic measuring instrument
- 3) Describe ~~with~~ briefly with case studies of two medical measuring instruments.

Question 1

Biomedical sensors are special electronic devices that can transduce biomedical signals into easily measurable electronic devices. Some biomedical sensors include;

- a) Biosensor - An analytical device used for the detection of a chemical substance, that combines a biological component with a physicochemical detector
- b) Biochip - Biochips are essentially miniaturized laboratories that can perform hundreds or

Thousands of simultaneous biochemical reactions. They help researchers in disease diagnosis and detection of bioterrorism agents.

Biomedical actuators are known for their accuracy. They are fit for changing over different types of energy e.g. physical energy into mechanical energy. Some examples of biomedical actuators applications are;

a) Scanners: CT, MRI, and PET scanning instruments are used in hospitals, clinics, palliative care units for examination and diagnosis purposes. These scanners are powered with linear actuators, which allow easy movement in any direction.

b) Laser positioning equipment: Linear actuators help control the accuracy and positioning of the beam in the laser positioning equipment.

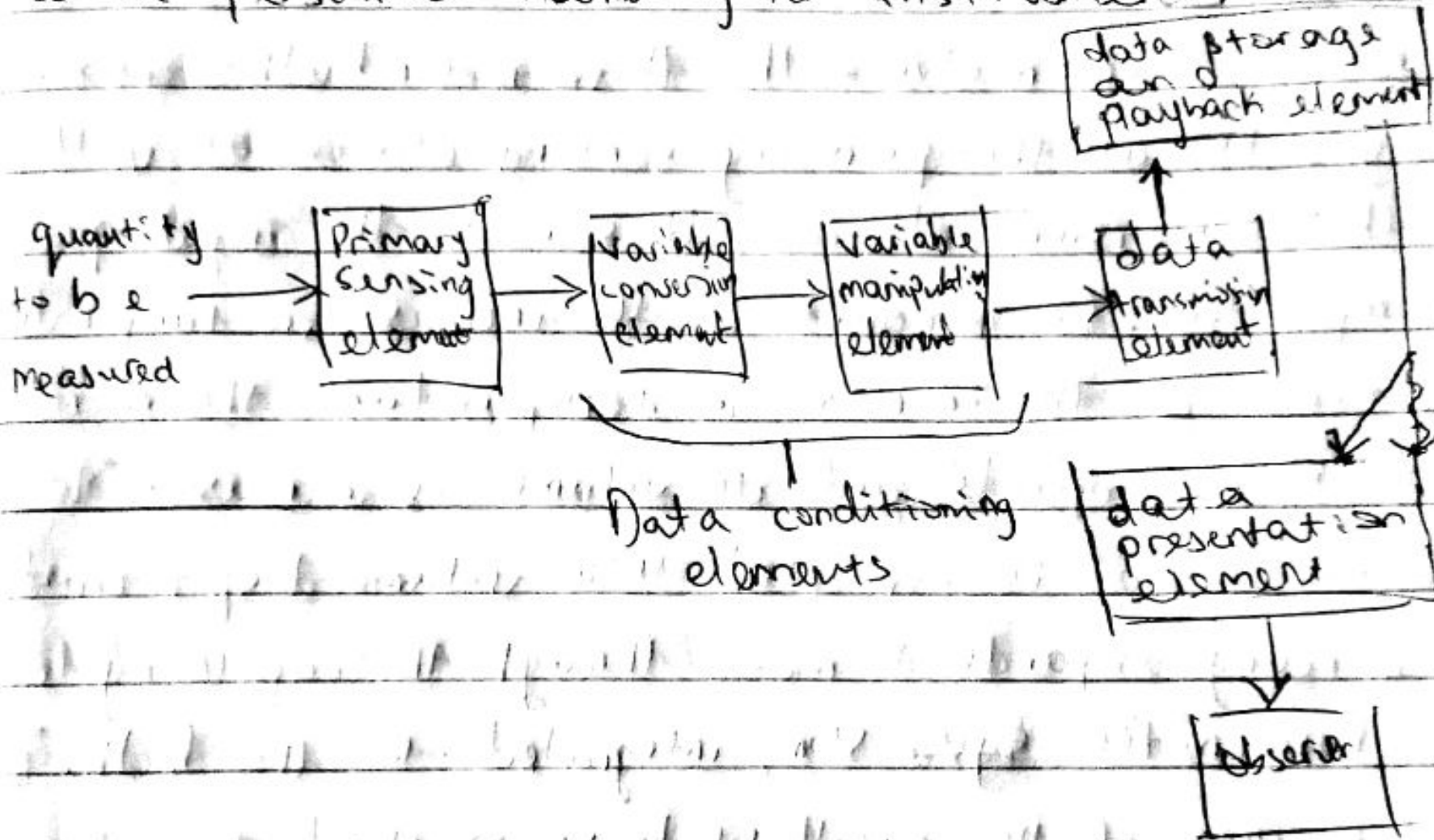
Question 2

An instrument is a device or a system which is designed to maintain a functional relationship between prescribed properties of physical variables being measured.

To understand a measuring instrument / system it is important to have a systematic organization and analysis of measurement systems. The operation of a measuring system could be described in a generalized manner in terms of functional elements:

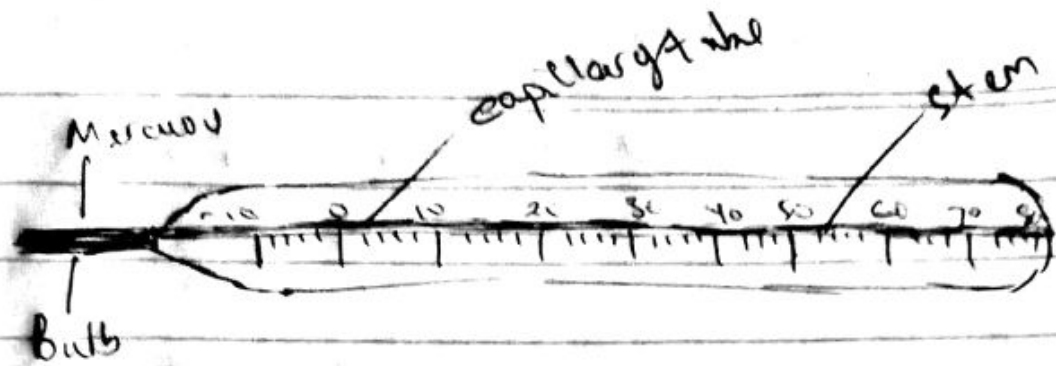
- i) Primary sensing element - quantity being measured makes its first contact with the primary sensing element of a measurement system
- ii) Variable conversion element - Converts the output signal of the quantity
- iii) Variable manipulation element - to manipulate the signal presented to this element while preserving original nature of the signal
- iv) Signal conditioning element - to remove signal distortion
- v) Data transmission element - transmits data from one element to another
- vi) Data presentation element - To convey the information about the quantity under measurement

to the personnel handling the instrument.



Question 3

1) Clinical thermometer - The thermometer bulb containing mercury acts as the primary sensing element as well as a variable conversion element. It senses the input quantity the temperature. On account of the increase in temperature. On account of the increase in temperature the mercury in the bulb expands and its volume is increased. The temperature signal is converted into volume displacement. As the mercury expands it moves through the capillary tube in the thermometer ~~system~~ stem, integrated to the bulb. The cross section area of the capillary being constant, the volume signal is thus converted into linear distance signal. The capillary thus has the role of signal manipulation and data transportation elements. The final data presentation stage consists of the scale on the thermometer stem, which is calibrated to give the indication of the temperature signal applied to the thermometer bulb. A restriction bend is provided in the clinical thermometers at the junction of the bulb and the capillary, which does not allow the back flow of mercury to the bulb once it has expanded to the capillary. Thus the restriction in the capillary acts as the data storage function of the instrument.



2) Sphygmomanometer - This is used to measure blood pressure. It is composed of an inflatable rubber cuff, which is wrapped around the arm. A measuring device indicates the cuff's pressure. A bulb inflates the cuff and a valve releases pressure. As the heart beats, blood forced through the arteries cause a rise in pressure, called systolic pressure followed by a decrease in pressure as the heart's ventricles prepare for another beat. This low pressure is called the diastolic pressure.