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COURSE TITLE: PROCESS INSTRUMENTAION

QUESTION 1

1. What is Instrumentation?

Instrumentation and control engineering (ICE) is a [branch of](https://en.wikipedia.org/wiki/List_of_engineering_branches) [engineering](https://en.wikipedia.org/wiki/Engineering) that studies the measurement and control of [process variables](https://en.wikipedia.org/wiki/Process_variable), and the design and implementation of [systems](https://en.wikipedia.org/wiki/System) that incorporate them. Process variables include [pressure](https://en.wikipedia.org/wiki/Pressure), [temperature](https://en.wikipedia.org/wiki/Temperature), [humidity](https://en.wikipedia.org/wiki/Humidity), [flow](https://en.wikipedia.org/wiki/Fluid_dynamics), [pH](https://en.wikipedia.org/wiki/PH), [force](https://en.wikipedia.org/wiki/Force) and [speed](https://en.wikipedia.org/wiki/Speed). Therefore , Instrumentation can be defined as a collective term for [measuring instruments](https://en.wikipedia.org/wiki/Measuring_instrument) that are used for indicating, measuring and recording physical quantities.

1. Explain succinctly the mobile phase and stationary phase in Gas Chromatography.

In gas chromatography, the mobile phase is a carrier [gas](https://en.wikipedia.org/wiki/Gas), usually an [inert](https://en.wikipedia.org/wiki/Inert_gas) gas such as [helium](https://en.wikipedia.org/wiki/Helium) or an [unreactive](https://en.wikipedia.org/wiki/Reactivity_(chemistry)) gas such as [nitrogen](https://en.wikipedia.org/wiki/Nitrogen).

Helium remains the most commonly used carrier gas in about 90% of instruments although hydrogen is preferred for improved separations. WHILE;

The stationary phase is a microscopic layer of [liquid](https://en.wikipedia.org/wiki/Liquid) or [polymer](https://en.wikipedia.org/wiki/Polymer) on an inert [solid](https://en.wikipedia.org/wiki/Solid) support, inside a piece of [glass](https://en.wikipedia.org/wiki/Glass) or [metal](https://en.wikipedia.org/wiki/Metal) tubing called a column (a homage to the [fractionating column](https://en.wikipedia.org/wiki/Fractionating_column) used in distillation).

1. Highlight four reasons why moisture measurements are germane in process industries and list four methods of moisture measurement.

The reasons include ;

* Moisture measurements are necessary for manufacturing and process [quality assurance](https://en.wikipedia.org/wiki/Quality_assurance).
* Moisture measurement applications include dry air, [hydrocarbon](https://en.wikipedia.org/wiki/Hydrocarbon) processing, pure semiconductor gases, and bulk pure gases.
* - They  cover a variety of methods for measuring [moisture content](https://en.wikipedia.org/wiki/Moisture_content) in both high level and trace amounts in solids, liquids, or gases.
* Moisture in percentage amounts is monitored as a specification in commercial food production.

The methods of moisture measurement are ;

* Absolute measurement method
* Relative humidity method
* Capacitance method
* Oxide sensors

QUESTION 2

1. State four cogent reasons for measuring and controlling process variables.
2. A process variable is the current measured value of a particular part of a process which is being monitored or controlled.
3. Process variable is an engineering mechanism that uses continuous monitoring of an industrial process’ operational variables (e.g., temperature, pressure, chemical content) and algorithms and then uses that information to adjust variables to reach product output specifications and objectives.
4. Process variable is all about monitoring and controlling certain set of process variable (i.e. temperature, flow, level, pressure etc.) that leads to control whole process.
5. The value of the monitored output parameter is normally held within tight given limits.

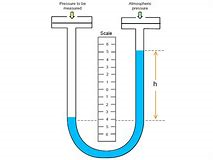
b.) Magnetic flow meters are highly important in process industries. Mention three typical applications of magnetic flow meters.

1. In order to ensure reliable performance over an expected period of operation and volume of moving fluid, flow meter scale—both in size and velocity limits—should be taken into careful account.
2. The [metallurgical](https://www.thomasnet.com/products/metallurgical-consulting-services-95957726-1.html) properties of the fluid conduit and the measuring apparatus can greatly influence measurement effectiveness.
3. A fluid’s velocity profile and the flow meter system’s capacity for handling flow disturbances or other interference often determine the type of device.

c.) With the aid of diagram briefly describe the working principle of any three pressure measuring devices.

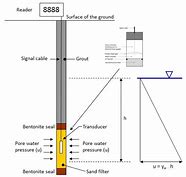
Manometer

Its purpose is to measure the pressure of a contained gas. it consists of a U-shaped glass tube with one end open to the atmosphere mercury in the bottom of the U and the gas to be measured in the other side of the u-tube. The gas is added then the glass tube is sealed on the gas side so the gas is trapped on one side of the mercury. The liquid, mercury is equalized in the two sides of the tube at atmospheric pressure. When the gas is added, it will exert pressure on the mercury will remain at the same levels on both sides. If the gas is exerting more pressure on the mercury then the atmosphere exerts, it will cause the mercury to be higher on the atmosphere side than on the sealed side .



Piezometer

It is used to measure underground water pressure. It converts water pressure to a frequency signal in a diaphragm and a tensional street wire. A change in pressure on the diaphragm causes a change in tension of the wire . When extracted by a magnetic coil, the wire vibrates at its natural frequency. The vibration of the wire is proximity of the magnetic coil generates a frequency signal that is transmitted to the readout device. The readout device processes the signal and displays a reading. Calibration factors which establish a relationship between pressure applied to the diaphragm and the frequency signal retained to the readout device, are used to covert Hertz reading to voltage .



Hygrometer

It is a methodological instrument that is used to measure the humidity of air. it uses one with a wet bulb and one with a dry bulb. Evaporation from the water on the wet bulb causes its temperature reading to drop, causing it to slow a lower temperature than the dry bulb .



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