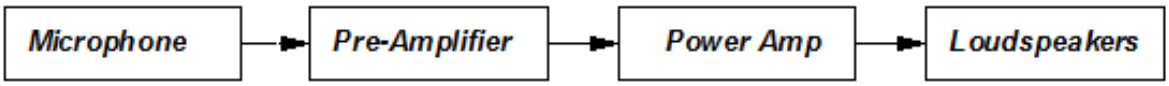
DEPARTMENT OF ELECTRNICS & COMMUNICATION ENGINEERING, KITSW

COURSE: **U14EI 205 - BASIC ELECTRONICS ENGINEERING**	**ECE-I, Semester-II, 2015-16**

ASSIGNMENT-7 HINTS &SOLUTIONS (PART-1- of -3)

1. **Draw the block diagram of Public Addressing System and explain the function of each block.**
   (refer to class notes for additional information)

- *A "Public Address" system is anything that amplifies sound so more people can hear it.*
- **A simple public address system** (or PA system) is shown in the following block diagram.



Stage 1 **Stage 2** **Stage 3** **Stage 4**

Stage 1: Microphone (Transducer)

The microphone converts sound waves into electrical signals that can be processed by the rest of the system. It is important that the microphone creates a faithful reproduction of the sound wave as an electrical signal – no distortion!

Stage 2: Pre-Amplifier

Its purpose is to take the small electrical signals from the microphone and increase the amplitude of the signal voltage.

Stage 3: Power Amplifier

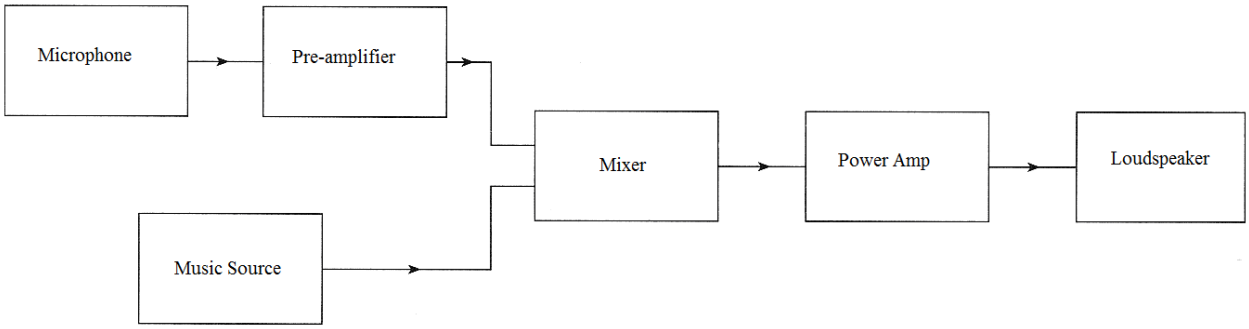
The power amplifier takes this enlarged voltage signal, and boosts the current so that it is strong enough to drive the loudspeaker.

Stage 4: Loud Speaker

The loudspeaker is the final part of the system where the electrical signal is transformed back into a sound wave.

- If the system has carried out its function correctly, the emerging sound wave will be an undistorted but amplified version of the original.

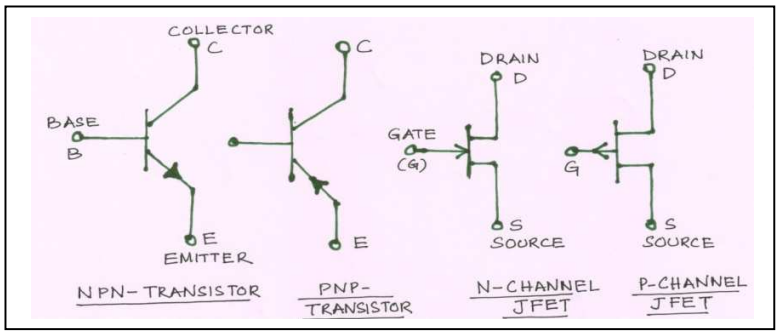
- **A more sophisticated PA system** would allow a number of inputs to be connected
- For example a band would have several microphone inputs and guitar pick-up inputs. These inputs would need to be faded in or out individually.
- Consider the following block diagram



- It can be noticed that there are two additions to the simple PA system. The first is a music source and the second is a mixer.
- **Mixer:** Its function is to add together electrical signals from microphones or pick-ups from electric guitars or backing tracks from a CD player.
- Most music sources produce a much larger signal than a microphone and do not need a pre-amplifier.
- ***In a real system, each microphone would have its own pre-amplifier.***
- **Clipping:** If we try to amplify the signal too much the system will not be able to provide the voltage required. This results in distortion of the output signal, called **clipping distortion**.
- Typically the output voltage maximum is between 1-2V less than that of the power supply.
- For example if the power supply was ±15V, then the maximum output would be limited to around ±13V. If the same amplifier was then connected to a ±5V supply, without making any changes to the circuit, the maximum output would then be limited to just ±3V. We call this effect saturation.

2. Differentiate between FET and BJT.

1. The circuit symbols of bipolar junction transistor (BJT) and the junction field effect transistor (JFET) are shown below



2. BJT's three terminals are named the *emitter, base and collector*, while FET's are named the *source, gate and drain.*
3. *BJT is bipolar*. Current is carried by both electrons and holes.
   JFET is unipolar. Its operation depends on flow of majority carriers, i.e., electrons in N-channel JFET and holes in P-channel JFET.
4. *BJT is a current controlled device*, while JFET is a voltage controlled device
5. *BJT offers low input impedance* (1 kΩ - 3 kΩ), as the input circuit is forward biased. *JFET offers very high input impedance* (≈10 MΩ), as its input circuit is reverse biased. [MOSFET offers very high input impedance in the order of $\approx 10^{12}$ Ω]
6. *JFET has low power dissipation* as compared to BJT
7. *Power gain of JFET* > power gain of BJT
8. *JFET has low noise* as compared to BJT
9. *BJTs are subjected to thermal runaway.* **No risk of thermal runaway in JFETs**
10. *BJTs are preferred in low frequency applications,* while JFETs are preferred in high frequency applications
11. *JFET is mostly used in digital circuits*
12. *JFETs are suitable for ICs*, as they are much easier to fabricate and occupy much less space than BJTs
13. *BJTs are cheaper* to produce than JFETs

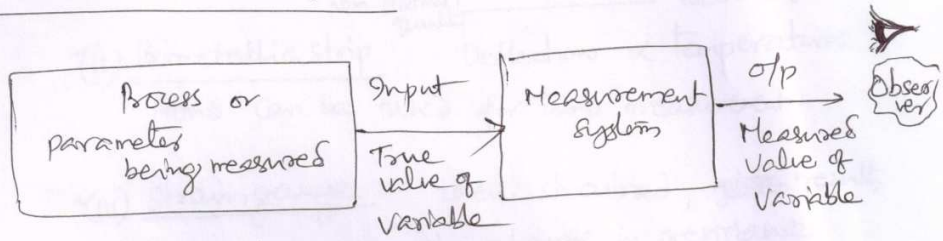
3. Explain the structure and operation of FET. *(refer to class notes)*

[*You are expected to cover: (i) The structure of N-channel JFET showing biasing voltages* V_{GS} *and* V_{DS} *(ii) Show the channel with no gate bias(*V_{GS} *=0) (iii) show and describe how the channel width changes when* V_{GS} *is varied, while keeping* V_{DS} *constant (iv) show and describe how the channel width changes when* V_{DS} *is varied, while keeping* V_{GS} *constant (v) Draw and explain JFET characteristics. Write Shockley's equation of drain current* $I_D = I_{DSS}\left[1-\frac{V_{GS}}{V_P}\right]^2$, *(vi) Define JFET parameters: Dynamic drain resistance* (r_d), *Amplification factor* (μ) *and Transconductance* (g_m) *and write the JFET relation* $\mu = r_d\, g_m$]

4. Draw the block diagram of a measurement System and explain the function of each block. As an example draw the block diagram for a weight measurement system using load cell and strain gauges.

General Measurement System

Purpose of Measurement System (MS)



→ The purpose of the MS is to present an observer with a numerical value corresponding to the variable being measured.

→ In general this numerical or measured value does not ~~equal~~ equal the true value of the variable.

→ The measuring system consists of several functional elements or blocks. The parameter being measured is called measurand.

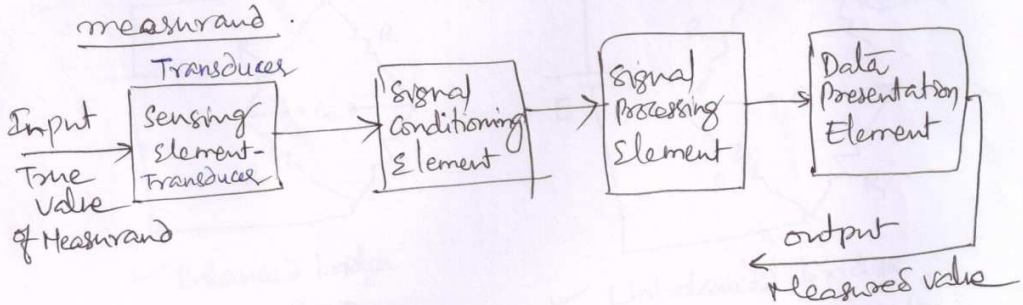


Fig: Block diagram of General Measurement System.

(1) **Sensing element** (Sensor or Transducer).

It senses the input and converts to a more convenient and practical form.

Transducer converts one form of energy into another form.
(or) Non-electrical quantities to electrical quantities.

Ex: (i) Thermocouple → depends on seebeck and peltier effects to produce an emf depending on the temperature. Hence can be used for temp measurement.

Temp (Non-electrical quantity) → Thermocouple → emf (electrical quantity)

(ii) Bimetallic strip: Deflection ∝ temperature. Hence can be used for temp measurement.

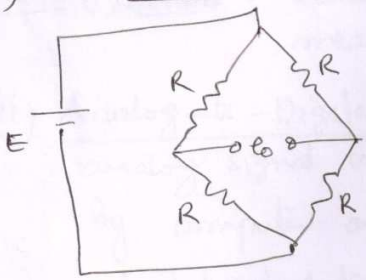
(iii) Straingauge: when strained, results in change in resistance.

Force (Non-electrical quantity) → Strain Gauge Resistance R → R±ΔR (electrical parameter)

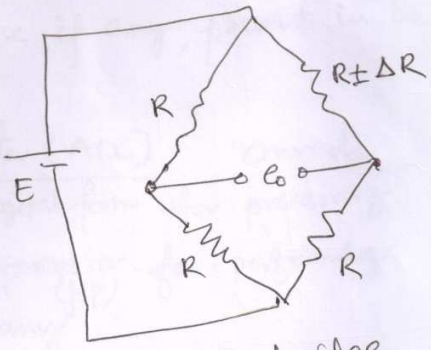
(2) Signal Conditioning element:

It takes the o/p of sensing element and converts it into more suitable form for further processing usually a dc voltage or dc current or frequency signal.

(i) Ex: Wheatstone bridge:



✓ Balanced bridge $e_o = 0$



✓ Unbalanced bridge, the ΔR change results in

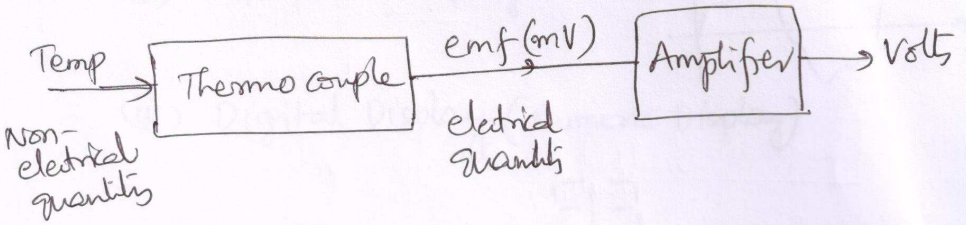
$$e_o = \frac{1}{4} E \cdot \frac{\Delta R}{R}$$

or $e_o \propto \Delta R$

✓ Wheatstone bridge converts resistance change into a voltage change

Strain / Force (Non-electrical quantity) → Strain Gauge Resistance=R → R±ΔR → Wheatstone Bridge → electrical o/p $e_o \propto \Delta R$

Ex: Amplifier amplifier millivolts to volts



Ex: Oscillator : converts an impedance change into a variable frequency signal.

(3) Signal Processing Element

This takes the output of conditioning element and converts into a form more suitable for presentation.

Ex: (i) Filters : Remove noise, if any, present in the measurand

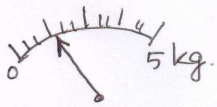
(ii) Analog-to-Digital Converter (ADC) : converts analog signal into digital form for processing by computer or microprocessor (µP) for performing typical calculations, if any.

~~(iii)~~

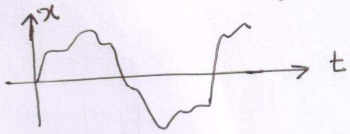
(4) Data Presentation Element :

This presents the measured value in a form which can be easily recognized by the observer

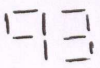
Ex: (i) Simple pointer – scale indicator



(ii) Graphical display



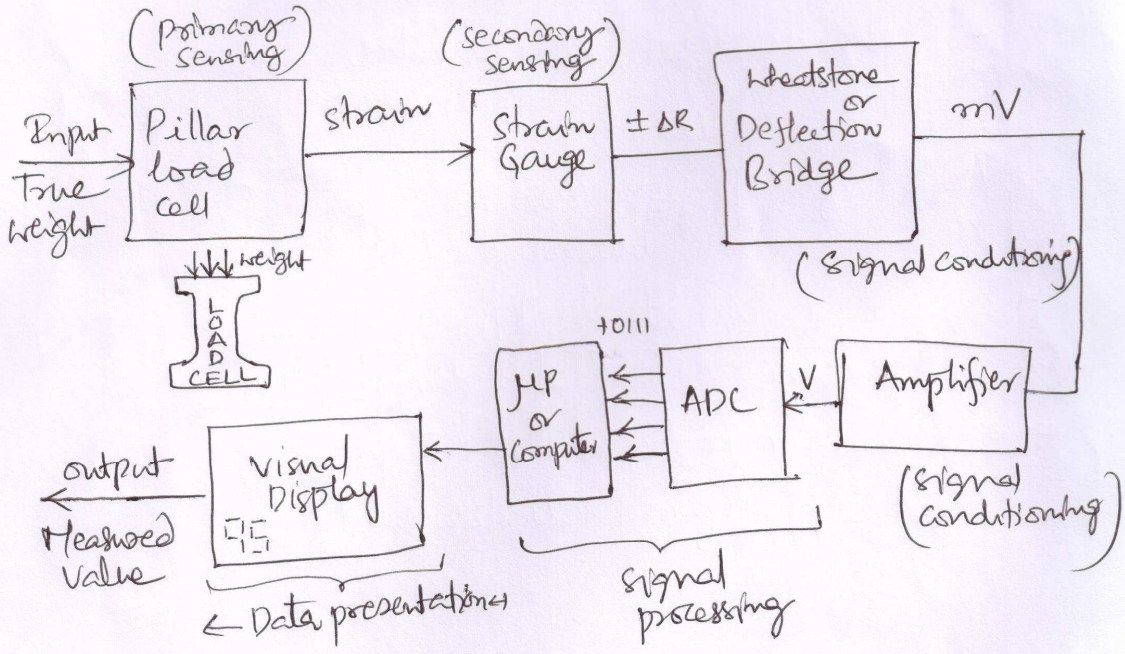
(iii) Digital Display (Numeric Display)



(iv) Chart recorder

As an example,

The general block diagram for weight measurement system is shown below.



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