Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Enlightening Technical Minds Estd. 1998
An Autonomous Institution
(Since 2011)

Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Affiliated to Anna University, Chennai; Approved by AICTE ; Accredited by NAAC with Grade 'A++'
Accredited by NBA - Tier1 (Mech, Auto, Civil, EEE, ECE, EIE and CSE)
Udumalai Road, Pollachi - 642 003. Tel: 04259-236030/40/50 Fax: 04259-236070 www.mcet.in

Question Bank

# Modern Electronic Instrumentation

**DEPARTMENT OF**

**ELECTRONICS AND INSTRUMENTATION**

**ENGINEERING**

**Dr. Mahalingam College of Engineering and Technology**
**Department of Electronics and Instrumentation**
**Unit – I (Two Marks with answers)**

**1. Calculate the value of the multiplier resistance on 50V range of a DC voltmeter that uses 500μA meter movement with an internal resistance of 1KΩ.**

The sensitivity of a 500μA meter movement is given by
$S = 1/I_m = 1/500\mu A = 2K\Omega / V.$
The value of the multiplier resistance can be calculated by
$R_s = S * Range - R_m$
$= 2K\Omega / V * 50V - 1K\Omega$
$= 100\ K\Omega - 1\ K\Omega$
$= 99K\Omega$

2. **State the advantages of ramp type DVM.**

- It has a better resolution and it can be adjusted because the resolution of digital readout is proportional to the frequency of local oscillator.
- The polarity of the signal which is to be measured can be indicated by adding external logic.
- In this the analog to digital signal converted into time and the time can be easily digitized.
- It is easy to design and cost is low.
-

3. **Define Loading effect in voltmeter.**

A voltmeter is connected in parallel with the circuit across which the voltage is being measured. The loading effect of the meter will be minimal if the meter resistance is much larger than the circuit resistance. Ideally, the voltmeter resistance should be infinite.

4. **List the sources of errors present in the Q meters.**

At high frequencies, the electronic voltmeter may suffer from losses due to the transit time effect. The effect of shunt resistance is to introduce an additional resistance in the tank circuit, which can balance the meter, but only for certain period of time.

Distributed capacitance of self-capacitance of the measuring circuit may cause stray capacitances to enter the meter, which can affect the meter by modifying the actual Q and the inductance of the coil. It is the most significant source of error.

**5. State the principle used in a basic vector impedance meter.**

Impedance, which is having both magnitude and phase, is truly an opponent to the flow of current in AC circuits with the presence of an applied voltage. The **Vector Impedance Meter** is employed for measuring both the amplitude and phase angle of impedance (Z). Normally, in other measuring techniques of impedance, the individual values of resistanceand reactance are obtained in rectangular form. That is $Z = R + jX$ But here, the impedance can be obtained in polar form. That is |Z| and phase angle (θ) of impedance can be acquired by this meter.

**6. What are the requirements of a shunt used in DC ammeters?**

- The resistance of the **shunt** remains constant with time.
- The temperature of the material remains same even though substantial current flows through the circuit.
- The temperature coefficient of the instrument and the **shunt** remains low and same.

**7. What is multi range voltmeter?**

Addition of number of multipliers together with the range switch provides the instrument with the workable number of voltage ranges and this kind of instrument is called multi range voltmeter.

**8. Give the sensitivity of voltmeter**

S= 1/Ifsd V

Where S= sensitivity of voltmeter; V= voltage range;Ifsd= full scale deflection current.

**9. How the calibration of DC instrument is carried out.**

By determining the potential difference across standard resistor by voltmeter method and thencalculating the current by ohm's law. This calculation is compared with actual reading.

**10. What is the function of a digital voltmeter(DVM)?**

A digital voltmeter displays measurements of DC or AC voltage as discrete numerals instead of pointer deflections on a continuous scale as in analog instruments.

**11. How are the different varieties of DVM differ?**

The different varieties of DVM differ in the following ways:

a) Number of digits b) Number of measurements c) Accuracy d) Speed of reading e) Digital output of several types.

**12. State the advantages of digital voltmeters.**

a) Higher accuracy and resolution b) Greater speed c) No parallax d) Reduced human error e) Compatibility with other digital equipment for further processing and recording.

**13. State the characteristic features of DVMs.**

a) Input range : From ± 1.000V to ±1000V with automatic range selection and overload indication b) Absolute accuracy : As high as ±0.005% of the reading. C) Resolution : 1 part in million d)Calibration: Internally from stabilized reference sources, independent of measuring circuit.

**14. List the applications of DVMs.**

a)Used in ' data processing systems' or ' data logging systems'. B) A large number of input signals can be automatically scanned or processed and their values either printed or logged.

**15. Give the classification of digital voltmeters.**

a) Ramp type DVM b) Dual slope integrating type DVM c) Integrating type DVM d)Successive approximation DVM.

**16. What is a multimeter?**

The ammeter, the voltmeter and the ohmmeter, all use a basic D' Arsonval movement. The difference between these instruments is the circuit in which the basic movement is used. The instrument which contains a function switch to connect the appropriate circuits to the D' Arsonval

movement, is called a multimeter or VOM meter.

**17. What are the applications of digital multimeter (DMM)?**
It is mostly used in laboratory for the measurement of,
1. AC voltage and current measurement.
2. DC voltage and current measurement.
3. Resistance and Frequency measurement.

**18. What is automatic ranging in DMM?**
The DMM automatically adjusts its range to give a meaningful reading, and the display includes the unit of measurement (V or mV for voltage measurement)

**19. State the difference between Analog and Digital multimeters**.
**Difference between Analog and Digital Multimeter**

| CHARACTERISTICS | ANALOG MULTIMETER | DIGITAL MULTIMETER |
|---|---|---|
| **Accuracy** | Prone to error because of wrong pointer based reading | Measures with great accuracy |
| **Reading** | Provides reading on a scale against pointer | Provides reading in numeric form appeared on a LCD |
| **Calibration** | Calibration is done manually | They are calibrated automatically before taking any measurement |
| **Cost** | Less costly as they offer very few features | Expensive as they offer wide range of features |
| **Range** | Have to set a range of measurement manually | Mostly, they have auto-ranging feature but costlier than their counter-parts |
| **Measuring parameters** | Usually it measures current, voltage, and resistance | Measures current, voltage, resistance, capacitance, and inductance as well |
| **ADC Requirement** | Does not require analog-to-digital converter (ADC) to display reading | Requires ADC in order to display the reading on LCD |
| **AC Frequency** | Highest AC Frequency which can be measured is lower | Highest AC Frequency which can be measured is higher than its counter-part |
| **Construction** | Construction is easy and | Complicated construction because of |

| CHARACTERISTICS | ANALOG MULTIMETER | DIGITAL MULTIMETER |
|---|---|---|
| | simple | several electronic and logic components involvement |
| **Power supply** | Is not required | Is required in these types of meters |
| **Size** | Bigger in size | Very small like hand-held devices |
| **Noise** | Suffer less from electric noise | Suffer more from electric noise |
| **Input signals** | Displays only one input signal value | It is able to accept multiple inputs and has adjustable displays which allow user to choose between the input signals. |

**20. Calculate the sensitivity of a 200μA meter movement which is to be used as a DC voltmeter.**
$S = 1/I_{fsd}$ V = 1/200 S = 5 KΩ / V

**21. A basic D'Arsonval movement with a full scale deflection of 50μA and internal resistance of 500Ω is used as a voltmeter. Determine the value of the multiplier resistance needed to measure a voltage range of 0-10V.**
$Rs = (V/I_m)-R_m$ = (10/50) – 500 = 199.5 KΩ

**22. State the advantages of ramp type DVM.**
The ramp technique circuit is easy to design and its cost is low .Also, the output pulse can be transmitted over long feeder lines.

**23. State the disadvantages of ramp type DVM.**
Large errors are possible when noise is superimposed on the input signal.Input filters are usually required with this type of converter.

**24. State the advantages of staircase type DVM.**
a) Input impedance of the DAC is high when the compensation is reached.
b) The accuracy depends only on the stability and accuracy of the voltage and DAC. The clock has no effect on the accuracy.

**25. State the disadvantages of staircase type DVM.**
a) The system measures the instantaneous value of the input signal at the moment compensation
is reached. This means the reading is rather unstable, i.e. the input signal is not a pure dc voltage.
b) Until the full compensation is reached, the input impedance is low, which can influence the accuracy

**26. Define resolution**
If n = number of full digits, then resolution (R) is $1/10^n$.
The resolution of a DVM is determined by the number of full or active digits used.

**27. What is the resolution of a 4-1/2 digit display?**
$R = 1/10^4 = 1/ 10000 = 0.0001$

## Unit – II (Two Marks with answers)

**1.Write the function of attenuator in CRO.**

An **attenuator** is an electronic device that reduces the power of a signal without appreciably distorting its waveform. An attenuator is effectively the opposite of an amplifier, though the two work by different methods. While an amplifier provides gain, an attenuator provides loss, or gain less than 1.

The voltage in input terminal of the vertical amplifier causes the beam to deflect off the CRT screen, is unite low in amplitude. So that high amplitude signals may be displayed, an attenuator network is placed between the vertical input terminals of the vertical amplifier. The main function of the attenuator is to reduce the amplitude of the vertical input signal before applying it to vertical amplifier.

**2.Differentiate dual beam and dual trace oscilloscope.**

| Dual trace CRO | Dual beam CRO |
|---|---|
| It is used single electron beam to display two traces. | It is used two electron beams for displaying two signals. |
| A single vertical amplifier is used. | Two vertical amplifiers are used for two beams. |
| It is not able to capture two fast transient events. | It is captures two fast transient easily. |
| It cannot switch quickly between traces, so simultaneous display becomes difficult. | It can display two traces simultaneously. |
| The two signals may or may not have same frequency. | The two signals must have the same frequency or they must be harmonically related. |
| A single beam can be used for displaying multiple traces. | Multiple beams are used for displaying multiple traces. |
| Two signals can be displayed on a dual trace oscilloscope. But, the two signals cannot be displayed together in real time. | Two signals can be displayed simultaneously in real time. |

**3. Define a Wave Analyzer and list its types.**

The electronic instrument used to analyze waves is called **wave analyzer**. It is also called signal analyzer, since the terms signal and wave can be interchangeably used frequently.

Types:

1. Frequency Selective Wave Analyzer
2. Heterodyne Wave Analyzer
3. Harmonic distortion analyzer
4. Spectrum Wave Analyzer

**4. State different types of Harmonic Distortion Analyzer.**

1. Supress the fundamental frequency by means of high pass filter.
2. Employing a Resonance Bridge
3. Wein's Bridge Method
4. Bridge – T Network Method

**5. Mention the applications of Spectrum Analyzer.**

Spectrum Analyzer are widely used in radars, oceanography, bio medical fields, Study of the RF Spectrum produced in microwave instruments.

**6. Describe the different types of sweeps used in CRO.**

Sweeps available in CRO are Horizontal sweep and vertical sweep

**7. Give the different parts of CRT.**

CRT consists of following parts. They are Triode section, Focusing section, Deflection section, screen

**8. What are 'Lissajous patterns'?**

Two phase-shifted sinusoid inputs are applied to the oscilloscope in X-Y mode and the phase relationship between the signals is presented as a Lissajous figure.

**9. Give some applications of sampling oscilloscope.**

Sampling oscilloscopes are of great use when analyzing high frequency signals. That is, signals whose frequencies are higher than the oscilloscope's sampling rate.

**10. What are the applications of storage oscilloscope?**

Signal Integrity, Jitter, and Timing Analysis ,Validation, Debug, Characterization, and Compliance of Next-generation Digital Designs Computer, Datacom, Storage-area Network Equipment Designs, and High-speed Backplanes, High-energy Physics Measurements and Data Acquisition.

**11. What are the different types of probes?**

Probes used for CRO can be Attenuation probes, differential probes, and current probes.

**12. What is the function of wave analyzer?**

Wave Analyzer is an instrument designed to measure the relative amplitude of single frequency components, in complex waveform. It acts as a frequency selective voltmeter, which is tuned to the frequency of one signal, while rejecting all other signal components. The desired frequency is selected by a frequency calibrated dial to the point of maximum amplitude.

**13. Give the important characteristics of a signal generator.**

The characteristics are Frequency, range, resolution, spectral purity.

**14. What are the applications of function generators?**

Function generators are used in designing, testing, troubleshooting, and repairing of electronic or electro- acoustic devices.

**15. What is the function of frequency synthesizer?**

A **frequency synthesizer** is an electronic system for generating any of a range of frequencies from a single fixed time base or oscillator. A frequency synthesizer can combine frequency multiplication, frequency division, and frequency mixing (the frequency mixing process generates sum and difference frequencies) operations to produce the desired output signal.

**16. What is the working principle of Q meter?**
Q-meter works on the principle of Series Resonance

**17. What are the applications of frequency synthesizer?**
Frequency Synthesizers are used in commercial radio receivers, mobile telephones, radiotelephones, walkie-talkies, satellite receivers, GPS systems, etc.

**18. What are the applications of Q meter?**
Q meter is a piece of equipment used in the testing of radio frequency circuits.

**19. What are the different types of digital display devices?**
Cathode ray tube (CRT)
Flat panel display
Light-emitting diode (LED) displays
Plasma display panels (PDP)
Liquid crystal display (LCD).

## 19. How CRO is superior to ordinary measurement.

**CRO** is an electronic **device** that gives a graphical representation of alternating quantities under examination. The **CRO** gives very accurate **measurements** as it is free from the errors introduced by the moving parts. It is also free from damping mechanism and other inertia containing parts.

## 20. List three applications of digital storage oscilloscope

- used for testing signal voltage in circuit debugging.
- Testing in manufacturing.
- Designing.
- Testing of signals voltage in radio broadcasting equipment.
- In **the** field of research.
    - Audio and video recording equipment.

**Unit – III (Two Marks with answers)**

**1. List the requirements of a sweep generator.**

- The sweep must be linear (the sweep voltage must rise linearly to the maximum value required for full screen horizontal deflection of the spot).
- The spot must move in one direction only, i.e. from left to right only, else the signal will be traced backwards during the return sweep.

**2. Mention the different materials used in LED.**

The particular semiconductors used for LED manufacture are

- gallium arsenide (GaAs),
- gallium phosphide (GaP), or
- gallium arsenide phosphide (GaAsP).

**3. State the front panel controls of a pulse generator.**

- Frequency selector
- Frequency multiplier
- Amplitude multiplier
- Variable amplitude
- Symmetry control
- Amplitude
- Function switch
- Output available
- Sync
- On-Off Switch

**4. State the advantages and Disadvantages of LED.**

**Advantages :**

1. It has long life compared to lamps.
2. It has low voltage operation, making them compatible with integrated circuits.
3. LED are ideal for operation under cold and low outdoor temperature setting.
4. It is available in verity of colors.
5. It has light immunity to external noise.
6. It is more reliable.
7. It has light immunity to external noise.
8. It has good adaptability to coherent laser operation.

**Disadvantages:**

1. It is liable to get damaged by over voltage or over current.
2. LED are more expensive.
3. The radiant output power and its wavelength are temperature dependent.
4. Theoretical overall efficiency is not achieved except in special cooled or pushed conditions

**5. Differentiate signal generator and oscillators.**

The basic differences are a signal generator can provide several typical types of waves - square, triangle, sine, etc, and can do so for varying frequencies. In truth, a signal generator is just a very advanced oscillator. A basic discrete oscillator will only be able to provide 1 type of wave, and usually at a very limited frequency range.

**6. State the advantages and Disadvantages of LCD.**

**Advantages:**

1. LCD's are of low cost.
2. Provides excellent contrast.
3. It consumes less amount of power compared to CRT and LED.
4. It consists of some microwatts for display in comparison to some milliwatts for LED's.
5. It is thinner and lighter when compared to cathode ray tube and LED.

**Disadvantages:**

1. Require additional light sources.
2. Low reliability.
3. Speed is very low.
4. Range of temperature is limited for operation
5. It needs an AC Drive.

**7. State the advantages and Disadvantages of Seven Segment Display.**

**Advantages:**

1. Cost: The cost of the entire module of 7 segment display is very cheap as it only contains LEDs.

2. Efficiency: LED displays in general are extremely efficient.

3. Heat dissipation: The heat dissipated from this displays is very less and that increases the life of the devices.

**Disadvantages:**

1. limited characters: Seven-segment displays are capable to display only numbers from 0-9 and few alphabets.

2. Type of display: The appearance of the two types of display are very similar and that causes difficulty interfacing it with controllers.

**8. State the applications of Seven Segment Display.**

- Digital watches
- electronic device display
- timers
- calculators

- Car panel displays, etc.

**9. State the applications of LCD.**

- The liquid crystal displays (LCDs) are used in aircraft cockpit displays.
- It is used as a display screen in calculators.
- For displaying images used in digital cameras.
- The television is main applications of LCD.
- Mostly the computer monitor is made up of LCDs.
- It is used in instruments panel where all the lab instruments uses LCD screens for display.
- The LCDs are commonly used in all the digital wrist watches for displaying time.
- The LCDs are used in mobile screens.
- It is also used in video players.

**10. State the applications of LED.**

- LED is used as a bulb in the homes and industries
- The light emitting diodes are used in the motorcycles and cars
- These are used in the mobile phones to display the message
- At the traffic light signals led's are used

**11. State the advantages and Disadvantages of Dot Matrix Display.**

**Advantages:**

1. The Dot matrix printers are cheap and easily available in the market.
2. They can make carbon copies of the print out unlike non-impact printers.
3. The printing costs are the lowest as compared to other printers.
4. The printout fades gradually rather than coming to a halt suddenly. You therefore get plenty of time to change the ribbon before crisis emerges.
5. They use paper continuously unlike other printers that require frequent change of paper.
6. The maintenance cost is low as compared to other printers.
7. They tolerate dirty and hot conditions as are found in industrial environments.

**Disadvantages:**

1. The output is not high resolution. Color printout is limited and the print speed is also lesser as compared to non-impact printers. Therefore, the quality of print out in general is not very good. This affects the scanner readability of the print out.
2. The printer creates great deal of noise while the pins strike the ribbon to the paper.
3. The pins get bended easily destroying the print head.
4. The single sheet of paper has to wound and aligned by hand which is time-consuming and hectic. This also makes it prone to jamming frequently. Although paper jamming can happen with any printer, fixing it here is not an easy task.
5. The density of barcodes is low and may fail to match user's standards.

**12. What is Function Generator and its applications.**

The function generator is the device which is capable of producing several functions based on the trigger input given.

- Testing, Designing and Troubleshooting of electronic equipment

- Used in cascade accumulation.
- For alignment (adjustment of various tunable circuits) of electronic equipment's.
- Generates AM / FM / PM waveforms.

**13. What are the various types of signal generators?**

• Sweep signal generator • Audio frequency signal generator • RF signal generators

**14. Differentiate LED and LCD.**

## LED vs LCD:

| LED | LCD |
|---|---|
| LEDs Consume more power than LCDs. | LCD Consumes very less power. |
| Due to high power requirement, LED requires external interface circuits (called as LED Driver Circuit) when driven from ICs. | LCD can be driven directly from IC chips. Driver Circuits are not required. |
| The brightness level is very good for LEDs | LCDs have moderate brightness level. |
| Commercially available LEDs have operating temperature range of -40 to 85 degree celcius. | comparatively less temperature limit. The temperature range is limited to -20 to 60 degree celcius. |
| Life time is around 1,00,000 hours | Due to chemical degradation the life time is 50,000 hours. |
| LEDs have wide viewing angle.<br>The viewing angle is 150 degree | The viewing angle for LCD is 100 degree |
| Operating voltage range is 1.5V to 5VDC. | Operating voltage range is 3 to 20 VDC. |

**15. Write the elements of a conventional signal generator.**

(1) RF Oscillator
(2) Wide band amplifier.
(3) External Oscillator.
4) Modulation Oscillator
(5) Out put attenuator.

**16. Explain the five modes of operation present in electronic counters.**

The typical modes of operations are Totalising, frequency, period, ratio, time interval and averaging.

In the totalizing mode, if the count pulse exceeds the capacity of the decade counter, the overflow indicator is activated and the counter starts counting again.

In the frequency mode, the pulses are accurately controlled.

In the ratio mode, it simply displays the numerical value of the ratio of the frequencies of the two signals.

In the period mode, it measures the period of the signal.

In the time interval mode, it measures the time elapsed between two events.

## Unit – IV (Two Marks with answers)

**1. State the Objective of a DAS.**

- It must acquire the necessary data, at correct speed and at the correct time.
- It must monitor the complete plant operation to maintain on-line optimum and safe operations.
- It must be able to compute unit performance indices using on-line, real-time data.
- It must be reliable, and not have a down time greater than 0.1%.

**2. List the various characteristics of a modern data logger.**

- High signal to noise ratio
- High input impedance
- High CMRR
- Low output impedance
- Fast recovery time

**3. State the function of data loggers.**

Data logging is the collection of data over a period of time, and is something often used in scientific experiments. Data logging systems typically monitor a process using sensors linked to a computer. Most data logging can be done automatically under computer control.

**4. What is meant by multiplexing?**

Multiplexing is the the process of combining several input signals. Many inputs are multiplexed and the result is produced based on the select signal.

**5. What is a data logger?**

A data logger (or data recorder) is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors.

**6. Write the important factors present in Data Acquisition System.**

- Accuracy and resolution
- Number of channels to be monitored
- Analog or digital signal
- Single channel or multichannel
- Sampling rate per channel
- Signal conditioning requirements of each channel
- Cost

**7. Write the characteristics of Data Logger.**

- **Modularity**

Systems can be expanded whenever required, simply and efficiently, often entailing little or no interruption to the working system.

- **Reliability and Ruggedness**

Designed to operate continuously without interruption even in the worst industrial environments.

- **Accuracy**

  The specified accuracy is maintained throughout the period of use.

- **Management Tool**

  In addition to simple data acquisition, there are facilities to perform many other functions, and present the results in handy form.

- **Easy to Use**

  These communicate with operators in a logical manner, are simple in concept, and therefore easy to understand, operate and expand.

**8.State the basic parts of a Data Logger Operation.**

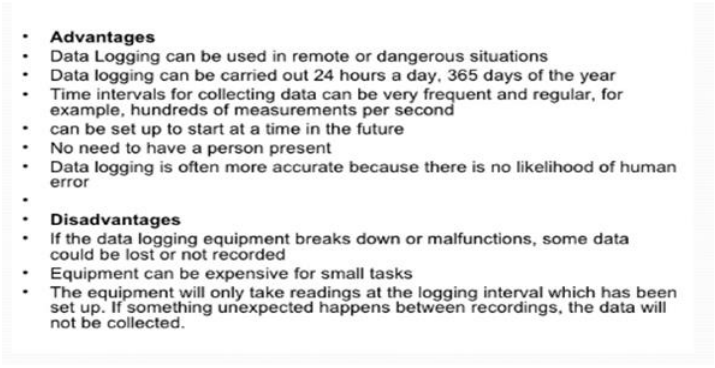
- Input scanner
- Signal conditioner
- A/D converter
- Recording equipment
- Programmer

**9. What are the ways that the signal can be linearized in data logger?**

The signal can be linearized at any one of the following three places.

- In the analog stage before conversion
- In the conversion process
- Digitally after conversion
- The first method is not suited to low level voltages, as it requires some form of amplification. The signal conditioner may be placed between the scanner and the converter. But, each type of transducer requires individual linearizing circuits.
- The third method requires a storage capability and a computer processing technique. The most satisfactory is the second method, whereby linearization is built into the conversion process.

**10. State the advantage and disadvantage of Data Loggers.**




**11. State the applications of Data Loggers.**

- Electric Utility Applications
- Meteorological Applications
- Process Industry Applications
- Mobile / Vehicle Test Applications
- Environmental Studies Applications
- Mining Industry Applications
- Water/Wastewater Utility Applications
- Water Resource Applications

**12. State the application of DAS.**

- DAS is used for collecting information.
- DAS is used for performing repeated calculations
- DAS is used to generate information for display.
- DAS find application in aircraft control system.
- DAS is used in electrical power generation.
- DAS is used in industrial process system.
- DAS is used to convert data into useful form.

**13. Differentiate Data logger and Data Acquisition**.

Data logging versus data acquisition

| Data logging | Data acquisition |
|---|---|
| • Data logger is a data acquisition system | • Data acquisition system is not necessarily a data logger. |
| • Typically have slower sample rates. | • Typically have fast sample rates. |
| • Data loggers are implicitly stand-alone devices | • Data acquisition system must remain tethered to a computer to acquire data. |
| • Data loggers used magnetic tape , punched paper tape ,directly viewable recorders Such as strip chart recorders | • Data acquisition used Static RAM, flash memory, EEPROM. |

**14. Write the two methods of signal conditioning of the inputs.**

Two methods of signal conditioning which are particularly applicable with advantage to data acquisition are

(i) Ratiometric conversion,

The analog method of achieving this is to incorporate an analog divider to which the amplifier output and excitation voltage are fed, so that the output voltage of the divider is the ratio of the amplifier output voltage to the excitation voltage.

(ii) Logarithm conversion,

A logarithm compression circuit enables the measurement of a fractional change in the input as a percentage of the input magnitude rather than a percentage of a range.

15. **Define the two drawbacks present in single channel Data acquisition system.**

The two major drawbacks are ,

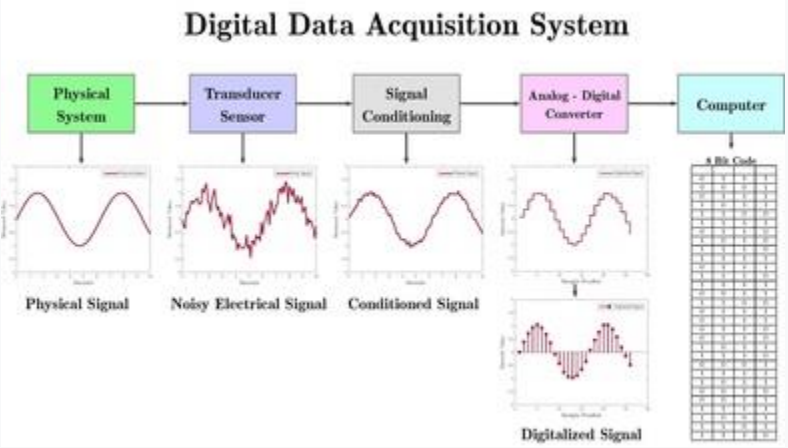
(i) It is slow and the BCD has to be changed into binary coding, if the output is to be processed by digital equipment.

(ii) While it is free running, the data from the A/D converter is transferred to the interface register at a rate determined by the DPM itself, rather than commands beginning from the external interface

**16.Explain about the Computer based Data acquisition system.**

**Data acquisition** is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems, abbreviated by the acronyms *DAS* or *DAQ*, typically convert analog waveforms into digital values for processing. The components of data acquisition systems include:

- Sensors, to convert physical parameters to electrical signals.
- Signal conditioning circuitry, to convert sensor signals into a form that can be converted to digital values.
- Analog-to-digital converters, to convert conditioned sensor signals to digital values.




Digital Data Acquisition System Block Diagram

Data acquisition applications are usually controlled by software programs developed using various general purpose programming languages such as Assembly, BASIC, C, C++, C#, Fortran, Java, LabVIEW, Lisp, Pascal, etc. Stand-alone data acquisition systems are often called data loggers.

## Unit – V (Two Marks with answers)

**1. Define Telemetry System.**

- **Telemetry** is a technology that allows remote measurement and reporting of information.
- The word is derived from Greek roots *tele* = remote, and *metron* = measure.

**2. List the classifications of Telemetry System.**

Classification of Telemetry (or data transmission)

**1. On the basis of Domain**

A. Hydraulic transmission Telemetry
B. Pneumatic Telemetry
C. Electrical & Electronic Telemetry

**2. On the basis of characteristics of an electrical signal**

A. Current Telemetry
B. Voltage Telemetry
C. Frequency Telemetry
D. Position Telemetry
E. Pulse Telemetry

**3. On the basis of the type of transmission**

A. Analog Telemetry
B. Digital Telemetry

**3. List the classification of telemetry based on Modulation methods.**

- **DC Telemetry Systems**
  - 1. Direct voltage telemetry system
  - 2. Direct current telemetry system
- **AC Telemetry Systems**
  - 1. Amplitude modulation (AM) telemetry system
  - 2. Frequency modulation (FM) telemetry system
- **Pulse Telemetry Systems**
  - 1. Pulse amplitude modulation (PAM) telemetry system
  - 2. Pulse width modulation (PWM) telemetry system
  - 3. Pulse phase modulation (PPM) telemetry system
  - 4. Pulse frequency modulation (PFM) telemetry system
  - 5. Pulse code modulation (PCM) telemetry system

**4. Define Mutiplexing.**

Multiplexing (or *muxing*) is a way of sending multiple signals or streams of information over a communications link at the same time in the form of a single, complex signal; the receiver recovers the separate signals, a process called *demultiplexing* (or *demuxing*).

**5. Differentiate pulse code modulation and pulse amplitude modulation.**

Both PAM and PCM are used in telecom transmission domain for transmitting signal. PCM is a modulation technique used for converting analog signal to digital signal, for the betterment of signal to noise ratio causing out of attenuation, - comprising of some steps - sampling, quantization , encoding, companding etc. But in the modulation technique PAM power of a signal is modulated and train of analog pulse samples are sent so that it can transmit a longer distance and in the receiving end signal is demodulated and reconstructed and retrieved. In PAM there is no A to D conversion.

**6. Define Amplitude Modulation.**

Amplitude modulation (AM) is a modulation technique used in electronic communication, most commonly for transmitting information via a radio carrier wave. In amplitude modulation, the amplitude (signal strength) of the carrier wave is varied in proportion to that of the message signal being transmitted. The message signal is, for example, a function of the sound to be reproduced by a loudspeaker, or the light intensity of pixels of a television screen. This technique contrasts with frequency modulation, in which the frequency of the carrier signal is varied, and phase modulation, in which its phase is varied. (OR)

The **amplitude modulation definition** is, an amplitude of the carrier signal is proportional to (in accordance with) the amplitude of the input modulating signal. In AM, there is a modulating signal. This is also called an input signal or baseband signal (Speech for example). This is a low-frequency signal as we have seen earlier. There is another high-frequency signal called carrier. The purpose of AM is to translate the low-frequency baseband signal to a higher freq signal using the carrier**.** As discussed earlier, high-frequency signals can be propagated over longer distances than lower frequency signals.

**7**. **State the advantages and Disadvantages of Amplitude Modulation .**

**Advantages:**

Amplitude modulation is economical as well as easily obtainable.

It is so simple to implement, and by using a circuit with fewer components it can be demodulated.

The receivers of AM are inexpensive because it doesn't require any specialized components.

**Disadvantages**

The efficiency of this modulation is very low because it uses a lot of power

This modulation uses amplitude frequency several times to modulate the signal by a carrier signal.

This declines the original signal quality on the receiving end & causes troubles in the signal quality.

AM systems are susceptible toward the generation of noise generation.

The **applications of amplitude modulation** limits to VHF, radios, & applicable one to one communication only.

8. **Define Frequency Modulation.**

In telecommunications and signal processing, **frequency modulation** (**FM**) is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. In analog frequency modulation, such as FM radio broadcasting of an audio signal representing voice or music, the instantaneous frequency deviation, the difference between the frequency of the carrier and its center frequency, is proportional to the modulating signal.

**9. State the advantages and Disadvantages of frequency Modulation.**

**Advantages**

*Resilience to noise*
*Easy to apply modulation at a low power stage of the transmitter*
*It is possible to use efficient RF amplifiers with frequency modulated signals*

**Disadvantages**

*FM has poorer spectral efficiency than some other modulation formats*
*Requires more complicated demodulator*
*Some other modes have higher data spectral efficiency*
*Sidebands extend to infinity either side.*

**10. Define Phase Modulation.**

**Phase modulation** (**PM**) is a modulation pattern for conditioning communication signals for transmission. It encodes a message signal as variations in the instantaneous phase of a carrier wave. Phase modulation is one of the two principal forms of angle modulation, together with frequency modulation. The phase of a carrier signal is modulated to follow the changing signal level (amplitude) of the message signal. The peak amplitude and the frequency of the carrier signal are maintained constant, but as the amplitude of the message signal changes, the phase of the carrier changes correspondingly. Phase modulation is widely used for transmitting radio waves and is an integral part of many digital transmission coding schemes that underlie a wide range of technologies like Wi-Fi, GSM and satellite television. PM is used for signal and waveform generation in digital synthesizers, such as the Yamaha DX7, to implement FM synthesis. A related type of sound synthesis called phase distortion is used in the Casio CZ synthesizers.

**11. State the advantages and Disadvantages of Phase Modulation.**

**Advantages**

- Phase modulation (PM) is a simple contrasted to Frequency modulation (FM).
- It is used to find out the velocity of a target by removing Doppler data. This needs constant carrier which is achievable during phase modulation however not in FM (frequency modulation).
- The main benefit of this modulation is signal modulation because it permits computer for communicating on high-speed using a telephone system.

- When the information is being transmitted without intrusion then the speed rates can be observed.
- And one more advantage of PM (phase modulation) is improved immunity toward the noise.

**Disadvantages**

- Phase modulation needs two signals by a phase variation among them. Through this, both the two patterns are required like a reference as well as a signal.
- This type of modulation requires hardware which obtains more complex due to its conversion technique.
- Phase ambiguity arrives if we exceed index pi radian of modulation (1800).
- Phase modulation index can be enhanced by employing frequency multiplier.

**12. State the applications of Phase Modulation.**

- This modulation is very useful in **radio waves transmission**, and it is an essential element in several digital transmission coding schemes.
- Phase modulation is widely used for transmitting radio waves and is an integral element of many digital transmission coding schemes that support an ample range of wireless technologies such as **GSM**, Satellite television, and **Wi-Fi**.
- Phase modulation is used in digital synthesizers for generating waveform and signal
- PM is used for signal and waveform generation in digital synthesizers like Yamaha DX7 for **phase modulation synthesis** implementation, and Casio CZ for sound synthesis which is known as phase distortion.

**13. State the applications of Frequency Modulation.**

The **applications of frequency modulation** include in FM radio broadcasting, radar, seismic prospecting, telemetry, & observing infants for seizure through EEG, music synthesis, two-way radio systems, magnetic tape recording systems, video broadcast systems, etc. From the above information, finally, we can conclude that, in frequency modulation, both efficiencies as well as bandwidth depends on the maximum the modulation index and modulating frequency. Contrasted to amplitude modulation, the frequency modulation signal has a larger bandwidth, superior efficiency, & improved immunity toward the noise.

**14. State the applications of Amplitude Modulation.**

***Broadcast transmissions***
***Air band radio***
***Single sideband***
***Quadrature amplitude modulation***

**15. Define Time Division Multiplexing.**

**Time-division multiplexing** (**TDM**) is a method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern. It is used when the bit rate of the transmission medium exceeds that of the signal to be transmitted. This form of signal multiplexing was developed

in telecommunications for telegraphy systems in the late 19th century, but found its most common application in digital telephony in the second half of the 20th century.

16. **Mention the advantages and disadvantages of Time Division Multiplexing.**

**Advantages:**

1. Full available channel bandwidth can be utilized for each channel.
2. lnter modulation distortion is absent.
3. TDM circuitry is not very complex.
4. The problem of crosstalk is not severe.

**Disadvantages:**

1. Synchronization is essential for proper operation.
2. Due to slow narrowband fading, all the TDM channels may get wiped out.

**17. State the applications of Time Division Multiplexing.**

- It used in ISDN (Integrated Services Digital Network) telephone lines.
- It is used in PSTN (public switched telephone network).
- It is used for some telephone system.
- It is used in wire line telephone lines.

**18. Define Frequency Division Multiplexing.**

Frequency Division Multiplexing (FDM) is a networking technique in which multiple data signals are combined for simultaneous transmission via a shared communication medium. FDM uses a carrier signal at a discrete frequency for each data stream and then combines many modulated signals.

**19. Mention the advantages and disadvantages of frequency Division Multiplexing.**

**Advantages:**

- It does not need synchronization between its transmitter and receiver.
- Frequency division multiplexing (FDM) is simpler and easy demodulation.
- Due to slow narrow band fading only one channel gets affected.
- It is used for analog signals.
- A large number of signals (channels) can be transmitted simultaneously.

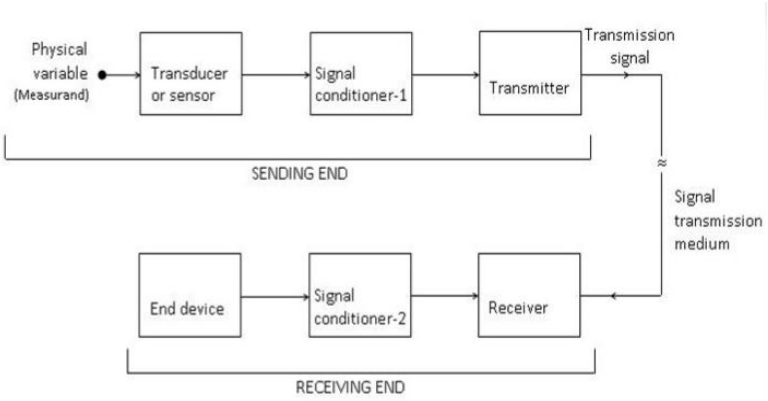
**Disadvantages:**

- It is suffers problem of cross-talk.
- It is used only when a few low speed channels are desired.
- Intermodulation distortion takes place.

20. **State the applications of frequency Division Multiplexing.**

- It is used to public telephones and in cable TV systems.
- It is used in broad casting.
- It is used in AM and FM broadcasting.

21. **Draw the block diagram of telemetry system.**




**22. Write the working of radio frequency telemetry.**

A tracking receiver designed for radio telemetry should be used to pick up the transmitter's signal. An antenna is cabled to the receiver. The frequency range of the receiver must match up with the frequencies the transmitters are using. Advanced receivers utilize digital signal processing techniques, or DSP.

**23.Compare frequency division Multiplexing and Time Division Multiplexing techniques.**

**TDM (Time Division Multiplexing) and FDM (Frequency Division Multiplexing)** are the two techniques of multiplexing. The common difference between TDM and FDM is that TDM share the timescale for the different signals; Whereas FDM shares the frequency scale for the different signals.

**Time-division multiplexing (TDM)** is considered to be a digital procedure which can be employed when the transmission medium data rate quantity is higher than the data rate requisite of the transmitting and receiving devices. In TDM, corresponding frames carry data to be transmitted from the different sources. Each frame consists of a set of time slots, and portions of each source is assigned a time slot per frame.

**Frequency-division multiplexing (FDM)** is an analog technique which is implemented only when the bandwidth of the link is higher than the merged bandwidth of the signals to be transmitted. Each sending device produces signals which modulate at distinct carrier frequencies. To hold the modulated signal, the carrier frequencies are isolated by adequate bandwidth.

TDM and FDM, both are the techniques used for multiplexing. FDM uses analog signals, and TDM uses Analog and digital both types of signals. However, the efficiency of TDM is much greater than FDM.

Comparison Chart

| BASIS FOR COMPARISON | TDM | FDM |
|---|---|---|
| Basic | Times scale is shared. | Frequency is shared. |
| Used with | Digital signals and analog signals | Analog signals |
| Necessary requirement | Sync Pulse | Guard Band |
| Interference | Low or negligible | High |
| Circuitry | Simpler | Complex |
| Utilization | Efficiently used | Ineffective |

## Key Differences Between TDM and FDM

1. The time-division multiplexing (TDM) includes sharing of the time through utilizing time slots for the signals. On the other hand, frequency-division multiplexing (FDM) involves the distribution of the frequencies, where the channel is divided into various bandwidth ranges (channels).
2. Analog signal or Digital signal any could be utilized for the TDM while FDM works with Analog signals only.
3. **Framing bits** (Sync Pulses) are used in TDM at the start of a frame in order to enable synchronization. As against, FDM uses **Guard bands** to separate the signals and prevent its overlapping.
4. FDM system generates different carriers for the different channels, and also each occupies a distinct frequency band. In addition, different bandpass filters are required. Conversely, the TDM system requires identical circuits. As a result, the circuitry needed in FDM is more complex than needed in TDM.

## 24. Difference between amplitude and frequency modulation.

| Difference Between AM and FM | |
|---|---|
| **Amplitude Modulation (AM)** | **Frequency Modulation (FM)** |
| First successful audio transmission was carried out in the mid-1870s | Developed in 1930 by Edwin Armstrong, in the United States |
| The radio wave is called a carrier wave and the frequency and phase remain the same | The radio wave is called a carrier wave, but the amplitude and phase remain the same |
| Has poor sound quality, but can transmit longer distance | Has higher bandwidth with better sound quality |
| The frequency range of AM radio varies from 535 to 1705 kHz | The frequency range of FM is 88 to 108 MHz in the higher spectrum |
| More susceptible to noise | Less susceptible to noise |

**25. Define Pulse Modulation.**

**Pulse modulation** is "the process in which signal is transmitted by pulses (i.e., discontinuous signals) with a special technique". The pulse modulation is classified as analog pulse modulation and digital pulse modulation. The analog pulse modulation is again classified as,

1. Pulse amplitude modulation
2. Pulse width modulation and
3. Pulse position modulation.

The digital pulse modulation is classified as,

1. Pulse code modulation (PCM) and
2. Delta modulation (DM)

**26. State the applications of telemetry system.**

**Applications**

Meteorology

Oil and gas industry

---

**Motor racing**

**Transportation**

**Agriculture**

**Water management**

**Defense, space and resource exploration**

***Space science***

***Rocketry***

***Flight testing***

***Military intelligence***

**Energy monitoring**

**Resource distribution**

***Dry goods***

***Fluids***

***Bulk solids***

**Medicine/healthcare**

**Fishery and wildlife research and management**

**Retail**

**Law enforcement**

**Energy providers**

**Falconry**

**Testing**

**Communications**

**Mining**

**Software**