ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS INSTITUTION
Approved by AICTE & Affiliated to Anna University
NBA Accredited for BE (ECE, EEE, MECH) | Accredited by NAAC with A+ Grade
Anjugramam - Kanyakumari Main Road, Palkulam,Variyoor P.O. - 629 401, Kanyakumari District.

VII Semester

AU3008 Sensors and Actuators

UNIT – 3 - Variable and Other Special Sensors

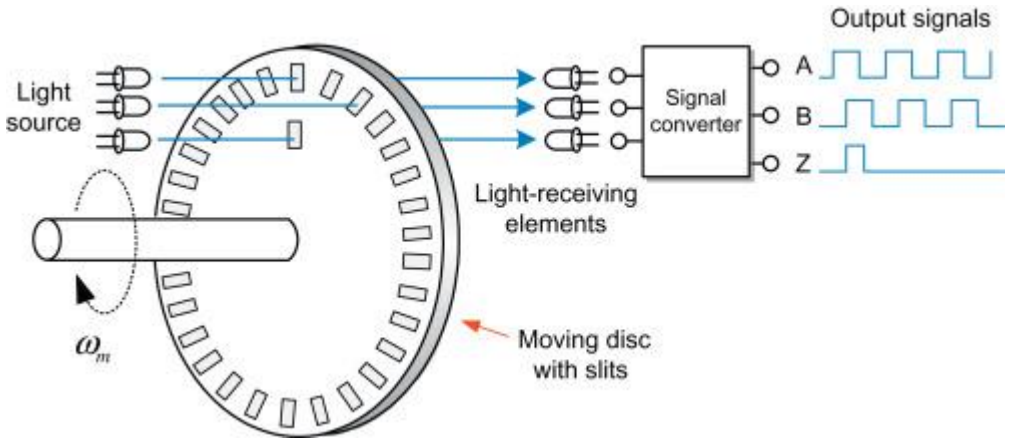
3.7 Digital Transducers

- A **digital transducer** converts a physical quantity into a digital signal, which can be directly processed by digital systems such as microcontrollers, computers, or other electronic devices.
- The construction and working of digital transducers involve sensor mechanisms for detecting the input quantity and digital circuitry for output signal generation.
- A transducer measures physical quantity and ***transmits the information as coded digital signals*** rather than as continuously varying currents or voltages.
- Any transducer that presents information as discrete samples and that does not introduce a quantization error when the reading is represented in the digital form may be classified as a digital transducer.
- Most transducers used in digital systems are primarily analogue in nature and incorporate some form of conversion to provide the digital output. Many special techniques have been developed to avoid the necessity to use a conventional analogue- to-digital conversion technique to produce the digital signal.
- This article describes some of the direct methods which are in current use of producing digital outputs from transducers.
- Some of the techniques used in transducers which are particularly adaptable for use in digital systems are introduced. The uses of encoder discs for absolute and incremental position measurement and to provide measurement of angular speed are outlined.
- The application of linear gratings for measurement of translational displacement is compared with the use of Moire fringe techniques used for similar purposes.
- Synchro devices are briefly explained and the various techniques used to produce a digital output from synchro resolvers are described.

- Brief descriptions of devices which develop a digital output from the natural frequency of vibration of some part of the transducer are presented.
- Some of them are as follows:
  - Shaft Encoders
  - Digital Resolvers
  - Digital Tachometers
  - Limit Switches

3.7.1 Shaft Encoders:

- An encoder is a device that provides a coded reading of a measurement.
- A Shaft encoder can be one of the encoders that provide digital output measurements of angular position and velocity.
- This shaft encoders are excessively applicable in robotics, machine tools, mirror positioning systems, rotating machinery controls (fluid and electric), etc.
- Shaft encoders are basically of two types-Absolute and Incremental encoders.
- An ***"absolute" encoder*** maintains position information when power is removed from the system.
- The position of the encoder is available immediately on applying power. The relationship between the encoder value and the physical position of the controlled machinery is set at assembly; the system does not need to return to a calibration point to maintain position accuracy.
- An **"incremental" encoder** accurately records changes in position, but does not power up with a fixed relation between encoder state and physical position.



❒ Devices controlled by incremental encoders may have to "go home" to a fixed reference point to initialize the position measurement. A multi-turn absolute rotary encoder includes additional code wheels and gears.

The image shown in a diagram of an incremental rotary encoder. This device is used to measure the angular position of a rotating shaft.

1. **Light Source:** A light source, usually an LED, emits light towards a rotating disc with slits.
2. **Moving Disc with Slits:** As the shaft rotates, the disc with slits moves, allowing light to pass through the slits and reach light-receiving elements.
3. **Light-Receiving Elements:** These elements, typically phototransistors, detect the light pulses and convert them into electrical signals.
4. **Signal Converter:** The electrical signals from the light-receiving elements are processed by a signal converter, which generates the output signals.
5. **Output Signals:** The output signals are typically square waves that represent the angular position of the shaft. There are usually three output signals: A, B, and Z.

- **A and B Signals:** These signals are quadrature signals, meaning they are 90 degrees out of phase with each other. This allows for precise measurement of the direction and speed of rotation.
- **Z Signal:** This signal is a zero reference pulse that occurs once per revolution of the shaft. It can be used for calibration or synchronization purposes.

❒ The resolution of the encoder, or the smallest change in angle that can be detected, depends on the number of slits on the disc. More slits result in higher resolution.

❒ Incremental rotary encoders are commonly used in robotics, automation, and other applications where precise measurement of angular position is required.

3.7.3 Application of Digital Transducers:

1. Industrial Automation: Monitoring and controlling parameters like pressure, temperature, and flow in manufacturing processes.

2. Consumer Electronics: Sensors in smartphones (e.g., gyroscopes, accelerometers) for orientation and motion detection.

3. Healthcare: Medical instruments such as digital thermometers, blood pressure monitors, and glucometers.

4. Automotive Industry: Used in engine control systems for monitoring temperature, pressure, and fuel levels. Sensors for advanced driver-assistance systems (ADAS), such as proximity sensors, lane detection, and parking assistance.

5. Aerospace and Defence: Monitoring environmental conditions in aircraft and.

6. Energy Sector: Digital flow meters in pipelines and Monitoring systems for wind turbines and solar panels.

7. IoT and Smart Systems: Integration into IoT devices for home automation, like smart thermostats, security systems, and environmental sensors.

8. Environmental Monitoring: Sensors for measuring temperature, humidity, air quality, and water quality. Used to Monitor systems for weather forecasting and disaster prediction.

9. Agriculture: Soil moisture and nutrient monitoring. Used in automation in irrigation systems.

10. Research and Development: Precise measurement tools in experimental setups. Monitoring systems in laboratories for controlled experiments.

****