CMR
INSTITUTE OF
TECHNOLOGY

Roll No	

Internal Assessment Test - II

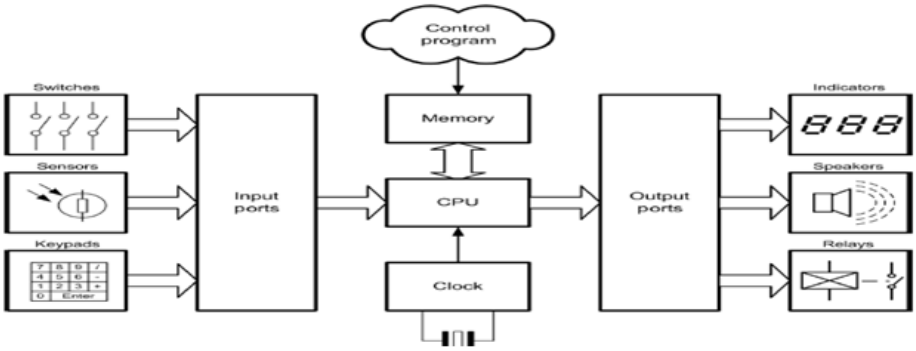
Sub:	Basic Electronics and Communication Engineering							Code:	21ELN14
Date:	Feb-2022	Duration:	90 mins	Max Marks:	50	Sem:	I	SEC:	I,J,K,L,M,N,O

Answer Any **FIVE FULL** Questions

		Marks	OBE CO	OBE RBT
1.	With a neat block diagram explain the arrangement of a microcontroller system with typical inputs and outputs.	[10]	CO2	L2

Microcontroller system

- A **microcontroller** is a small and low-cost microcomputer, which is designed to perform the specific tasks of embedded systems like displaying microwave's information, receiving remote signals, etc.
- The general microcontroller consists of the CPU, the memory (RAM, ROM, EPROM), Input Output Serial ports, peripherals (clocks), etc.



A typical microcontroller system

The sensed quantities(temperature, position) are converted to electrical signals using sensors

- Sensor outputs are either digital or analogue in nature

These signals passed to microcontroller. Microcontroller also accepts user options

- Software instructions control the operation of the microprocessor and output signals sent to controlled devices

Controlled device converts electrical energy from one form into another form

- In real world, systems are self regulating called closed loop system
- Ex. Heating control system

Micro controllers have a CPU which performs arithmetic, logical and timing operations

- Some input sources are switches, sensors, keypads
- Some output devices are LED indicators, LED 7 segment displays, motors and actuators, relays, transistor drivers and other solid-state switching devices

Input devices

PC

- Input device is keyboard, mouse scanner and modem

microcontroller Switches or contacts which make and break sensors which provide logic level outputs

- To connect an input device to a microcontroller, the device must provide a logic compatible signal.
- In microcontroller inputs can only accept digital input signals
- 0v= logic 0 and 5v = logic 1 signal

microcontroller Some devices sense analogue quantities

- Some microcontrollers provide ADC and provide digital data.
- Resolution of the ADC depends on the number of bits used (8, 10 or 12 bits)

Output devices

They are used to communicate information to the outside world

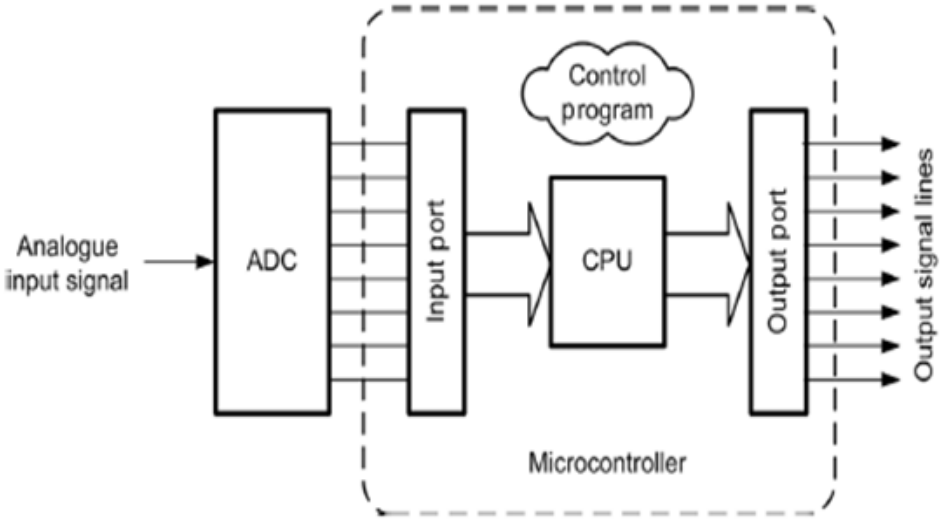
Common output devices are flat screen display, printers and modems

- Microcontroler uses output devices such as LEDs, piezoelectric sounders, relays and motors

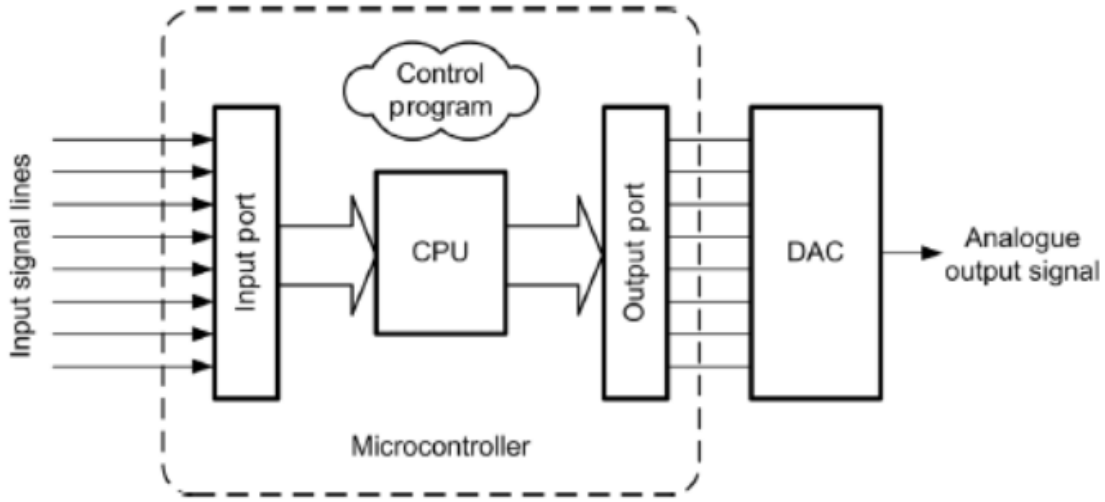
DAC are required at the output of the microcontroller

- The resolution of the DAC also depends on the number of bits

Ex. An analogue input signal connected to a microcontroller via ADC



Ex. An analogue output signal produced by connecting DAC to microcontroller output



2. Explain the working, principle of operation and applications of stepper motor. [10] CO3 L3

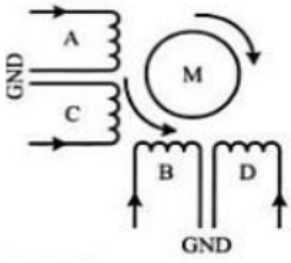
Stepper Motor

- A Stepper motor is an electro-mechanical device which generates discrete displacement (motion) in response to dc electrical signals.
- It differs from the normal dc motor in its operation.
- The dc motor produces continuous rotation on applying dc voltage whereas a stepper motor produces discrete rotation in response to the dc voltage applied to it.
- Stepper motors are widely used in industrial embedded applications, consumer electronic products and robotics control system, for position control applications (paper feed mechanism) such as dot matrix printers, disk drives, etc.
- Based on coil winding arrangements, a two phase stepper motor is classified into two types:
- 1. Unipolar
- 2. Bipolar

1. Unipolar

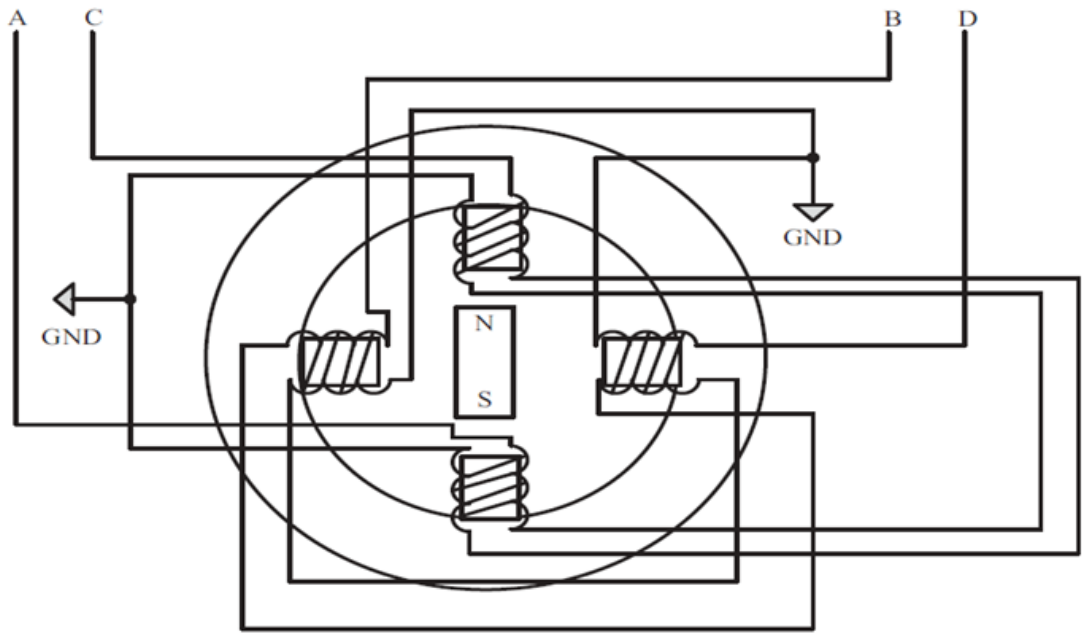
- A unipolar stepper motor contains two windings per phase.
- The direction of rotation (clockwise or anticlockwise) of a stepper motor is controlled by changing the direction of current flow.
- Current in one direction flows through one coil and in the opposite direction flows through the other coil.
- It is easy to shift the direction of rotation by just switching the terminals to which the coil are connected.
- The coils are represented as A, B, C and D.
- Coils A and C carry current in opposite directions for phase 1 (only one of them will be carrying current at a time).
- Similarly, B and D carry current in opposite directions for phase 2 (only one of them will be carrying current at a time).

2-Phase Unipolar stepper motor



2. Bipolar

- A bipolar stepper motor contains single winding per phase.
- For reversing the motor rotation, the current flow through the windings is reversed dynamically.
- It requires complex circuitry for current flow reversal.
- Fig. shows the stator winding details for a two phase bipolar stepper motor
- The stepping of stepper motor can be implemented in different ways by changing the sequence of activation of the stator winding.
- The different stepping modes supported by the stepper motor are explained.



- **Full Step**
- In the full step mode both the phases are energised simultaneously.
- The coils A,B,C and D are energised as shown in the Table.
- It should be noted that out of the two windings, only one winding of a phase is energised at a time.

Step	Coil A	Coil B	Coil C	Coil D
1	H	H	L	L
2	L	H	H	L
3	L	L	H	H
4	H	L	L	H

Wave Step

In the wave step mode only one phase is energised at a time and each coils of the phase is energised alternatively.

The coils A, B, C and D are energised in the following order:

Step	Coil A	Coil B	Coil C	Coil D
1	H	L	L	L
2	L	H	L	L
3	L	L	H	L
4	L	L	L	H

Step	Coil A	Coil B	Coil C	Coil D
1	H	L	L	L
2	H	H	L	L
3	L	H	L	L
4	L	H	H	L
5	L	L	H	L
6	L	L	H	H
7	L	L	L	H
8	H	L	L	H

Half Step: It uses the combination of wave and full step.

It has the highest torque and stability.

Coil energising sequence for half step

- The rotation of the stepper motor can be reversed by reversing the order in which the coil is energized.
- Two-phase unipolar stepper motors are the popular choice for embedded applications.
- The current requirement for stepper motor is little high and hence the port pins of a microcontroller/processor may not be able to drive them directly.
- Also, the supply voltage required to operate stepper motor varies normally in the range 5V to 24 V.
- Depending on the current and voltage requirements, special driving circuits are required to interface the stepper motor with microcontroller/processors.
- Commercial off-the-shelf stepper motor driver ICs are available in the market and they can be directly interfaced to the microcontroller port.
- ULN2803 is an octal peripheral driver array available from Texas Instruments and ST microelectronics for driving a 5V stepper motor.
- Simple driving circuit can also be built using transistors

The following circuit diagram illustrates the interfacing of a stepper motor through a driver circuit connected to the port pins of a microcontroller/processor

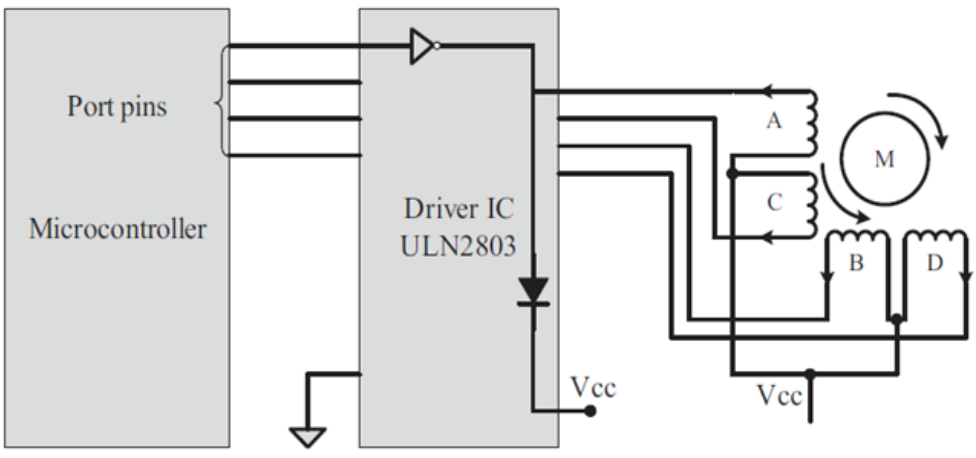


Fig. 2.20 Interfacing of stepper motor through driver circuit

3. A. Bring out the differences between RISC and CISC, Harvard & Von-Neumann. [6] CO3 L1

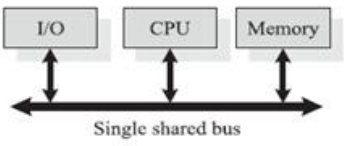
RISC vs CISC

RISC	CISC
Reduced Instruction Set Computing	Complex Instruction Set Computing
It contains lesser number of instructions.	It contains greater number of instructions.
Instruction pipelining and increased execution speed.	Instruction pipelining feature does not exist.
Orthogonal instruction set(allows each instruction to operate on any register and use any addressing mode.	Non-orthogonal set(all instructions are not allowed to operate on any register and use any addressing mode.
Operations are performed on registers only, only memory operations are load and store.	Operations are performed either on registers or memory depending on instruction.
A larger number of registers are available.	The number of general purpose registers are very limited.
Programmer needs to write more code to execute a task since instructions are simpler ones.	Instructions are like macros in C language. A programmer can achieve the desired functionality with a single instruction which in turn provides the effect of using more simpler single instruction in RISC.
It is single, fixed length instruction.	It is variable length instruction.
Less silicon usage and pin count.	More silicon usage since more additional decoder logic is required to implement the complex instruction decoding.
With Harvard Architecture.	Can be Harvard or Von-Neumann Architecture.

31-0: 12

Harvard vs Von-Neumann

Harvard architecture	Von-Neumann architecture
It has separate buses for instruction as well as data fetching.	It shares single common bus for instruction and data fetching.
Easier to pipeline, so high performance can be achieve.	Low performance as compared to Harvard architecture.
Comparatively high cost.	It is cheaper.
Since data memory and program memory are stored physically in different locations, no chances exist for accidental corruption of program memory.	Accidental corruption of program memory may occur if data memory and program memory are stored physically in the same chip.



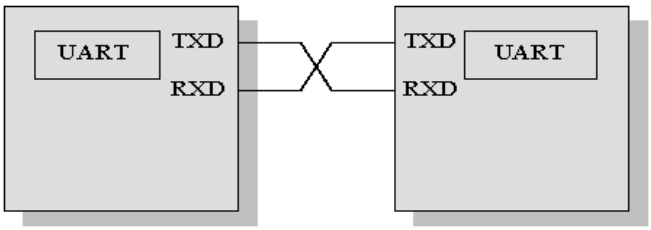
B. Bring out the main features of UART [4] CO3 L3

On-board Communication Interface – Universal Asynchronous Receiver Transmitter (UART)

- ✓UART based data transmission is an asynchronous form of serial data transmission
- ✓The serial communication settings (Baudrate, No. of bits per byte, parity, No. of start bits and stop bit and flow control) for both transmitter and receiver should be set as identical
- ✓The start and stop of communication is indicated through inserting special bits in the data stream
- ✓While sending a byte of data, a start bit is added first and a stop bit is added at the end of the bit stream. The least significant bit of the data byte follows the start bit.
- ✓The 'Start' bit informs the receiver that a data byte is about to arrive. The receiver device starts polling its 'receive line' as per the baudrate settings

On-board Communication Interface – Universal Asynchronous Receiver Transmitter (UART)

✓If parity is enabled for communication, the UART of the transmitting device adds a parity bit .
✓The UART of the receiving device calculates the parity of the bits received and compares it with the received parity bit for error checking.
✓The UART of the receiving device discards the 'Start', 'Stop' and 'Parity' bit from the received bit stream and converts the received serial bit data to a word.



TXD: Transmitter Line
RXD: Receiver Line

4.	A. List major application areas of Embedded Systems.	[4]	CO3	L1

Major Application areas of Embedded System

- **Consumer electronics:** *Camcorders, Cameras, etc.*
- **Household appliances:** *TV, DVD players, washing machine, refrigerator, oven, etc.*
- **Home automation & Security system:** *Air conditioners, sprinklers, intruder detection alarms, fire alarms, etc.*
- **Automotive industry:** *Anti-lock breaking system (ABS), engine control, ignition systems, automatic navigation system, etc.*
- **Telecom:** *Cellular telephones, handset, etc.*
- **Computer peripherals:** *printers, scanners, fax, machines, etc.*
- **Healthcare:** *scanners, EEG, ECG, etc.*
- **Measurement & Instrumentation:** *Digital multi meters, digital CRO's, etc.*
- **Banking& Retail:** *Automatic Teller Machine (ATM), currency counter, etc.*
- **Card Readers:** *barcode, smart card readers, handheld devices, etc.*

B. Describe the classification of RF (Radio Frequency) spectrum with applications in communications systems. [6] CO4 L1

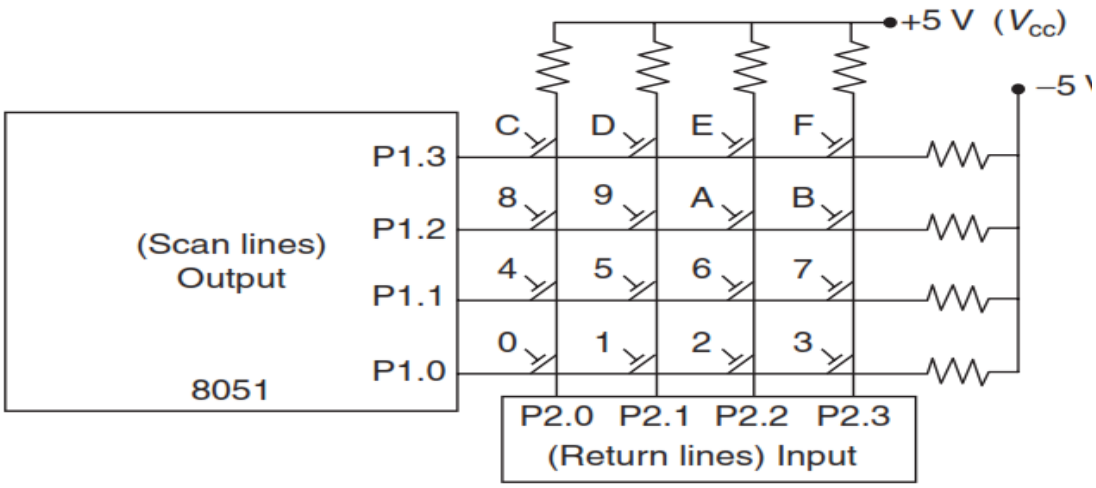
Table 1.1: Classification of radio frequency (RF) spectrum alongwith the associated applicatior communication systems.

Radio frequency range	Wavelength (meters)	Class	Applications
10–30 kHz	$3 \times 10^4 - 10^4$	Very Low Frequency (VLF)	Point-to-point communication (long distance)
30–300 kHz	$10^4 - 10^3$	Low Frequency (LF)	Point-to-point communication (long distance) and navigation
300–3000 kHz	$10^3 - 10^2$	Medium Frequency (MF)	Radio broadcasting
3–30 MHz	$10^2 - 10$	High Frequency (HF)	Overseas radio broadcasting, Point-to-point radio telegraphy, and telephony
30–300 MHz	10 – 1.0	Very High Frequency (VHF)	FM broadcast, television, and radar
300–3000 MHz	1.0 – 0.1	Ultra High Frequency (UHF)	Television and navigation
3000–30,000 MHz	0.1 – 0.01	Super High Frequency (SHF)	Radar navigation and radio relays

5. A. Describe the matrix keyboard interfacing [6] CO3 L3

Keyboard

- Keyboard is an input device for user interfacing.
- If the number of keys required is very limited, push button switches can be used and they can be directly interfaced to the port pins for reading.
- Matrix keyboard is an optimum solution for handling large key requirements. It greatly reduces the number of interface connections.
- Ex: For interfacing 16 keys, in the direct interfacing technique 16 port pins are required, whereas in the matrix keyboard only 8 lines are required. The 16 Keys are arranged in a 4 column, 4 Rows matrix.
- Fig illustrates the connection of keys in a matrix keyboard.
- In a matrix keyboard, the keys are arranged in matrix fashion (i.e., they are connected in a row and column style).



- For detecting a key press, the keyboard uses the scanning technique, where each row of the matrix is pulled low and the columns are read.
- After reading the status of each columns corresponding to a row, the row is pulled high & the next row is pulled low and the status of the columns are read.
- This process is repeated until the scanning for all rows are completed.
- When a row is pulled low and if a key connected to the row is pressed, reading the column to which the key is connected will give logic 0.

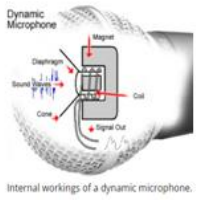
B. What is a transducer? Give the classification of transducers with examples. [4] CO3 L2

Transducers

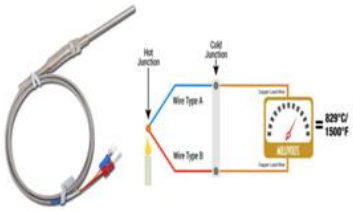
- Transducers are **devices** that **convert energy** in the form of sound, light, heat, etc., into an equivalent **electrical signal**, or **vice versa**.
- Transducers may be **used** both as **inputs** to electronic circuits & **outputs** from them.
- **Examples**:
  - A **loudspeaker** is a transducer that converts **low frequency electric current** into **audible sounds**. It is an **output Transducer**
  - A **microphone**, is a transducer that performs the reverse function, i.e. that of **converting sound pressure variations** into **voltage or current**. It is an **Input Transducer**
  - Loudspeakers and microphones can thus be considered as **complementary transducers**.

Table 15.1 Some examples of input transducers

Physical quantity	Input transducer	Notes
Sound (pressure change)	Dynamic microphone (see Fig. 15.3)	Diaphragm attached to a coil is suspended in a magnetic field. Movement of the diaphragm causes current to be induced in the coil.
Temperature	Thermocouple (see Fig. 15.2)	Small e.m.f. generated at the junction between two dissimilar metals (e.g. copper and constantan). Requires reference junction and compensated cables for accurate measurement.
Angular position	Rotary potentiometer	Fine wire resistive element is wound around a circular former. Slider attached to the control shaft makes contact with the resistive element. A stable d.c. voltage source is connected across the ends of the potentiometer. Voltage appearing at the slider will then be proportional to angular position.



Internal workings of a dynamic microphone.



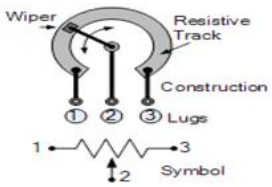
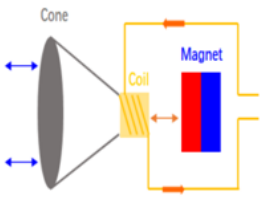


Table 15.2 Some examples of output transducers

Physical quantity	Output transducer	Notes
Sound (pressure change)	Loudspeaker (see Fig. 15.3)	Diaphragm attached to a coil is suspended in a magnetic field. Current in the coil causes movement of the diaphragm which alternately compresses and rarefies the air mass in front of it.
Temperature	Heating element (resistor)	Metallic conductor is wound onto a ceramic or mica former. Current flowing in the conductor produces heat.
Angular position	Rotary potentiometer	Multi-phase motor provides precise rotation in discrete steps of 15° (24 steps per revolution), 7.5° (48 steps per revolution) and 1.8° (200 steps per revolution).



6. Define 'Actuator' and briefly describe the following actuators - relay, push button, Piezobuzzer . [10] CO3 L3

Actuator

A form of transducer device (mechanical or electrical) which converts signals to corresponding physical action (motion).

Actuator acts as an output device

Eg. Linear and rotary actuators, stepped motors

Micro motor actuator which adjusts the position of the cushioning element in the Smart Running shoes from Adidas

Wearable Devices – certain smart watches use Ambient Light sensors to detect surrounding light intensity and adjust the screen brightness for better readability using electrical / electronic actuators.

Relay

✓An electromechanical device

✓In an embedded application, the 'Relay Unit' acts as dynamic path selectors for signals and power

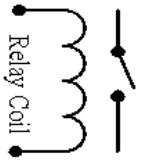
✓The 'Relay' unit contains a relay coil made up of insulated wire on a metal core and a metal armature with one or more contacts.

✓'Relay' works on electromagnetic principle. When a voltage is applied to the relay coil, current flows through the coil, which in turn generates a magnetic field.

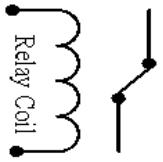
✓The magnetic field attracts the armature core and moves the contact point.

✓The movement of the contact point changes the power/signal flow path.

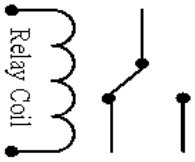
- Single Pole Single Throw (SPST) configuration has only one path for information flow.
- The path is either open or closed in normal condition.
- For Normally Open SPST relay, circuit is normally open and it becomes closed when relay is energized.
- Vice versa for NC (normally closed) SPST relay
- Single Pole Double throw relay, there are two paths for information flow & they are selected by energizing and de-energizing the relay



Single Pole Single Throw Normally Open



Single Pole Single Throw Normally Closed



Single Pole Double Throw

Piezo Buzzer

- Piezo buzzer is a piezoelectric device for generating audio indications in embedded application.
- A piezoelectric buzzer contains a piezoelectric diaphragm which produces audible sound in response to the voltage applied to it.
- Piezoelectric buzzers are available in two types:

1. Self driving
2. External driving

- The 'Self-driving' circuit contains all the necessary components to generate sound at a predefined tone.
- It will generate a tone on applying the voltage.
- External driving piezo buzzers supports the generation of different tones.
- The tone can be varied by applying a variable pulse train to the piezoelectric buzzer.
- A piezo buzzer can be directly interfaced to the port pin of the processor / control.
- Depending on the driving current requirements, the piezo buzzer can also be interfaced using a transistor based driver circuit as in the case of a "Relay".

Push Button Switch

✓Push Button switch is an input device

✓Push button switch comes in two configurations, namely 'Push to Make' and 'Push to Break'

✓The switch is normally in the open state and it makes a circuit contact when it is pushed or pressed in the 'Push to Make' configuration

✓In the 'Push to Break' configuration, the switch is normally in the closed state and it breaks the circuit contact when it is pushed or pressed

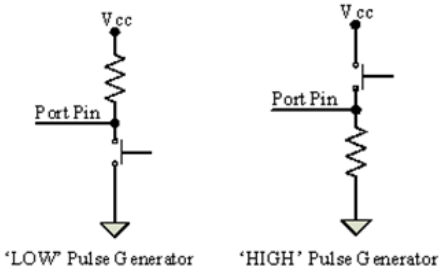
✓The push button stays in the 'closed' (For Push to Make type) or 'open' (For Push to Break type) state as long as it is kept in the pushed state and it breaks/makes the circuit connection when it is released

✓Push button is used for generating a momentary pulse.

✓In embedded application push button is generally used as reset and start switch and pulse generator.

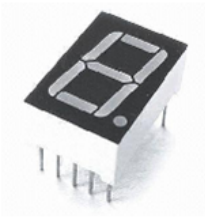
✓The Push button is normally connected to the port pin of the host processor

✓Figure shows how "High" and "LOW" pulses are generated



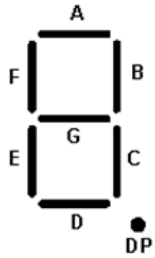
7. Explain the different configurations of 7-segment LED Display. [10] CO3 L3

7-Segment LED Display



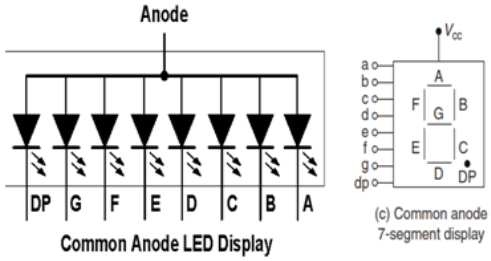
The 7 – segment LED display is an **output device** for displaying alpha numeric characters

- ✓It contains 8 light-emitting diode (LED) segments arranged in a special I form. 7 are used for displaying alpha numeric characters and 1 is used for representing decimal point .
- ✓The LED segments are named A to G and the decimal point LED segment is named as DP. It should be lit accordingly to display numbers and characters

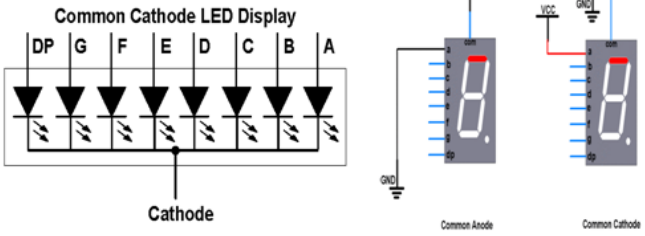


- ✓ The current flow through each of the LED segments should be limited to the maximum value supported by the LED **display** unit
- ✓The typical value for the current falls within the range of 20mA
- ✓The current through each segment can be limited by connecting a current limiting resistor to the anode or cathode of each segment
- ✓7-segment LED display is a popular choice for low cost embedded applications like, Public telephone call monitoring devices, point of sale terminals, etc.
- ✓The 7 – segment LED displays are available in two different configurations, namely; **Common anode and Common cathode**

The anode of the common anode LED display is connected to the 5V supply voltage through a current limiting resistor and the cathode of each LED segment is connected to the respective port pin lines.
For an LED segment to lit in the Common anode LED configuration, the port pin to which the cathode of the LED segment is connected should be set at logic 0.



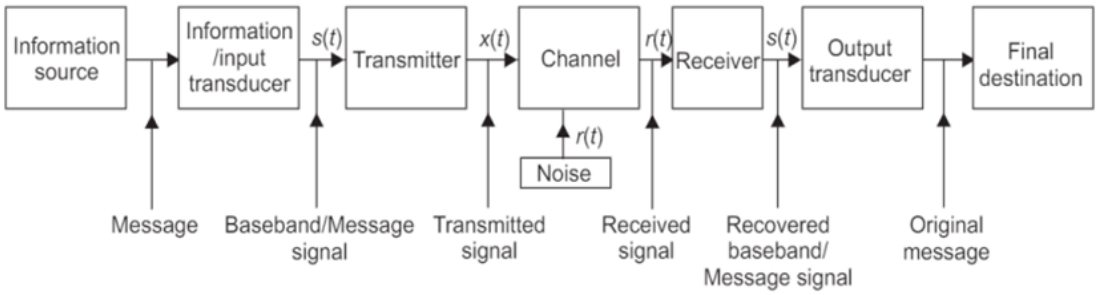
For common cathode configurations, the anode of each LED segment is connected to the port pins of the port to which the display is interfaced.



8. Describe the blocks of the basic communication system. [10] CO4 L1

Modern communication system scheme

- Electrical communication is a process by which the information/message is transmitted from one point to the another, from one person to another, from one place to another in form of electrical signal, through some communication link
- A basic communication system consists of certain unit, called constituents, subsystems and stages.



Information Source and Transducer

- A communication system transmits information from an ***information source (message)*** to a ***destination***.
- The physical form of information is represented by message originated by information source (person)
- Examples: Voice, Live scenes(video), music, written text, and e-mail.
- A *transducer is a device that* ***converts a non-electrical energy*** *into its corresponding* ***electrical energy*** called ***signal*** *and vice versa.*

Example Transducers: Sound : Microphone

Picture: Camera

Text : Keyboard

Temperature/Pressure: Sensor with transducer

TRANSMITTER

- The base band signal, output from the input transducer, is input to the transmitter.
- The transmitter section processes the signal prior to transmission. The nature of processing depends on the type of communication system.
- There are two options for processing signals prior transmission
  - ***(i)*** **The baseband signal, which lies in the low frequency spectrum, is translated to a higher frequency spectrum---*** ***carrier communication system***
  - ***(ii)*** **The baseband signal is transmitted without translating it to a higher frequency spectrum.----*** ***baseband communication system.***

CHANNEL OR MEDIUM

- The transmission medium between the transmitter and the receiver is called a **channel.**
- The transmitted signal should have adequate power to withstand the **channel noise.**
- The channel characteristics also impose constraints on the **bandwidth**
- Depending on the physical implementations, one can classify the channels in the following two groups:
- **a)Hardwired channels and**
- **b) Softwired channels.**

NOISE

- Noise is defined as unwanted electrical energy of random and unpredictable nature .
- Noise is a highly undesirable part of a communication system, and has to be minimized.
- When noise is mixed with the transmitted signal, it rides over it and deteriorates its waveform
- SNR and Noise figure (F)

RECEIVER

- The task of the receiver is to provide the original information to the user.
- The signal received by the receiver is r(t).
- This signal contains both the transmitted signal, x(t), and the noise, n(t), added to it during transmission