UNIT III -Basic Electronics ISE-I

1 a. Explain the classification of an Embedded System. a) excluded

b. What is an Embedded System?

a)

b) An Electronic/Electro mechanical system which is designed to perform a specific function and is a combination of both hardware and firmware (Software)

e.g: Electronic Toys, Mobile Handsets, Washing Machines, Air Conditioners, Automotive control Units, Set Top Box, DVD Player etc...

2 a. Compare

i) Microprocessor and Microcontroller

b. Explain the elements of an embedded system with block diagram.

c. What is sensor and actuator? Explain how the LED and opto coupler

are used as an I/O subsystem in embedded system.

a) Microprocessor Vs Microcontroller:

Microprocessor	Microcontroller
A silicon chip representing a Central Processing Unit (CPU), which is capable of performing arithmetic as well as logical operations according to a pre-defined set of Instructions	A microcontroller is a highly integrated chip that contains a CPU, scratch pad RAM, Special and General purpose Register Arrays, On Chip ROM/FLASH memory for program storage, Timer and Interrupt control units and dedicated I/O ports
It is a dependent unit. It requires the combination of other chips like Timers, Program and data memory chips, Interrupt controllers etc for functioning	It is a self contained unit and it doesn"t require external Interrupt Controller, Timer, UART etc for its functioning
Most of the time general purpose in design and operation	Mostly application oriented or domain specific
Doesn"t contain a built in I/O port. The I/O Port functionality needs to be implemented with the help of external Programmable Peripheral Interface Chips like 8255	Most of the processors contain multiple built-in I/O ports which can be operated as a single 8 or 16 or 32 bit Port or as individual port pins
Targeted for high end market where performance is important	Targeted for embedded market where performance is not so critical (At present this demarcation is invalid)
Limited power saving options compared to microcontrollers	Includes lot of power saving features

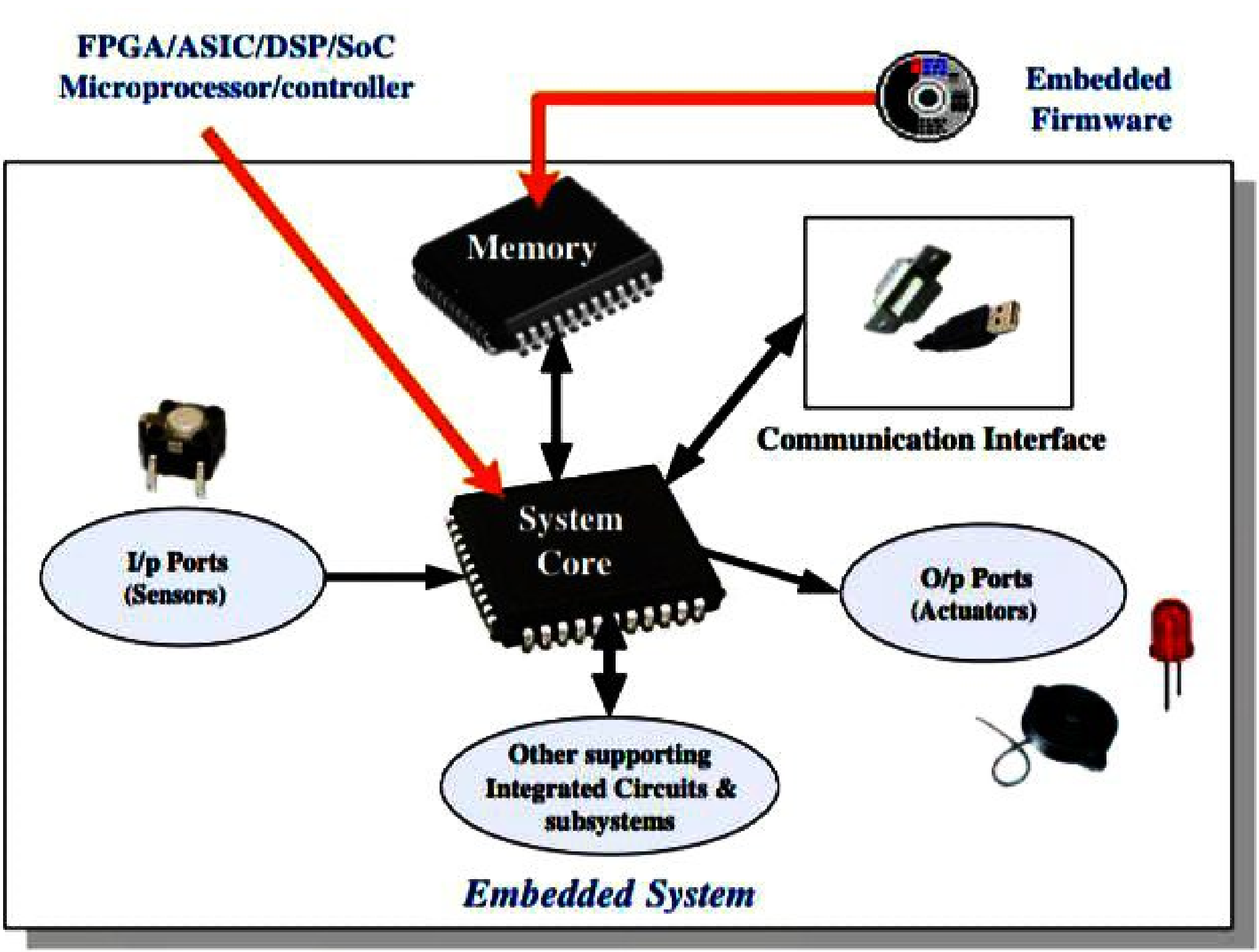
b) An embedded system is a combination of 3 things, Hardware Software Mechanical Components and it is supposed to do one specific task only. A typical embedded system contains a single chip controller which acts as the master brain of the system.

Diagrammatically an embedded system can be represented as follows: Embedded systems are basically designed to regulate a physical variable (such Microwave Oven) or to manipulate the state of some devices by sending some signals to the actuators or devices connected to the output port system (such as temperature in Air Conditioner), in response to the input signal provided by the end users or sensors which are connected to the input ports. Hence the embedded systems can be viewed as a reactive system. The control is achieved by processing the information coming from the sensors and user interfaces and controlling some actuators that regulate the physical variable.

Keyboards, push button, switches, etc. are Examples of common user interface input devices and LEDs, LCDs, Piezoelectric buzzers, etc examples for common user interface output devices for a typical embedded system. The requirement of type of user interface changes from application to application based on domain.Some embedded systems do not require any manual intervention for their operation. They automatically sense the input parameters from real world through sensors which are connected at input port. The sensor information is passed to the processor after signal conditioning and digitization. The core of the system performs some predefined operations on input data with the help of embedded firmware in the system and sends some actuating signals to the actuator connect connected to the output port of the system.

The memory of the system is responsible for holding the code (control algorithm and other important configuration details). There are two types of memories are used in any embedded system. Fixed memory (ROM) is used for storing code or program. The user cannot change the firmware in this type of memory. The most common types of memories used in embedded systems for control algorithm storage are OTP, PROM,UVEPROM, EEPROM and FLASH

An embedded system without code (i.e. the control algorithm) implemented memory has all the peripherals but is not capable of making decisions depending on the situational as well as real world changes. Memory for implementing the code may be present on the processor or may be implemented as a separate chip interfacing the processor. In a controller based embedded system, the controller may contain internal memory for storing code such controllers are called Micro-controllers with on-chip ROM, eg. Atmel AT89C51.


FPGA/ASIC/DSP/SoC
Microprocessor/controller
Embedded
Firmware
Memory
Communication Interface
System
Core
I/p Ports
(Sensors)
O/p Ports
(Actuators)
Other supporting
Integrated Circuits &
subsystems
Embedded System

c) Sensor:A transducer device which converts energy from one form to another for any measurement or control purpose. Sensors acts as input device

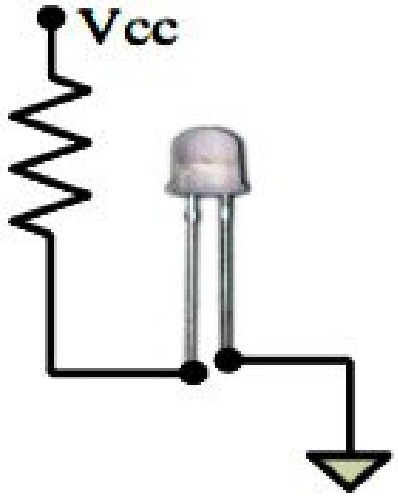
Example: IR, humidity, PIR(passive infra red) , ultrasonic , piezoelectric , smoke sensors.

Actuator:A form of transducer device (mechanical or electrical) which converts signals to corresponding physical action (motion). Actuator acts as an output device

Eg. Electric motor, sliding doors, Escalators, Adjusting the Car Seat.

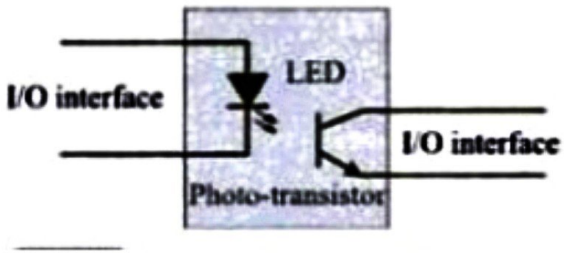
1. I/O Devices - Light Emitting Diode (LED):

- Light Emitting Diode (LED) is an output device for visual indication in any embedded system
- LED can be used as an indicator for the status of various signals or situations.
- For proper functioning of the LED, the anode of it should be connected to +ve terminal of the supply voltage and cathode to the –ve terminal of supply voltage
- The current flowing through the LED must limited to a value below the maximum current that it can conduct.
- A resister is used in series between the power supply and the resistor to limit the current through the LED

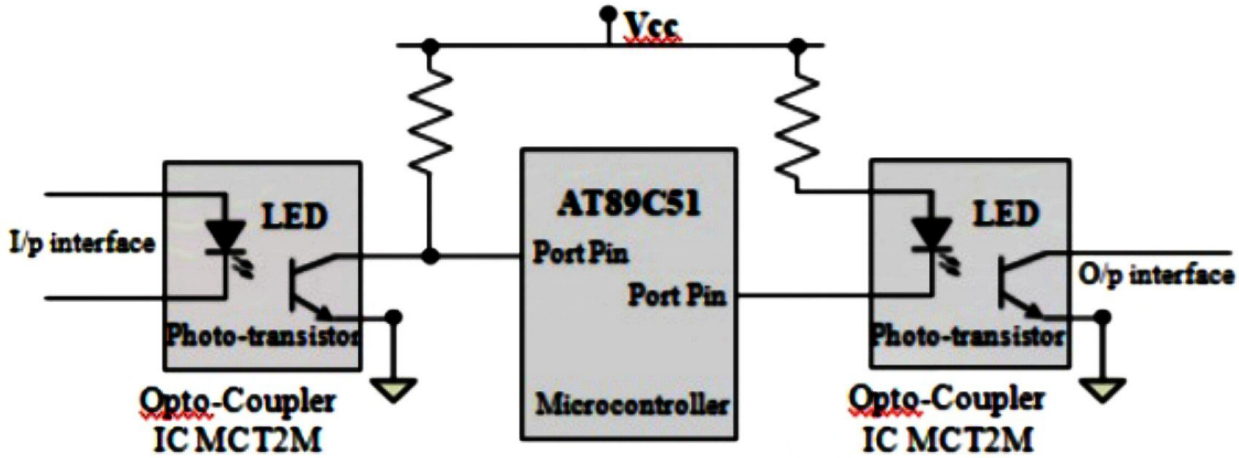


I/O Devices – Optocoupler

- Optocoupler is a solid state device to isolate two parts of a circuit.
- Optocoupler combines an LED and a photo-transistor in a single housing (package)
- Optocouplers can be used in either input circuits or in output circuits



- In electronic circuits, optocoupler is used for suppressing interference in data communication, circuit isolation, High voltage separation, simultaneous separation and Intensification signal etc. Below figure shows the usage of the optocoupler.



3. With neat diagrams discuss the basic elements of communication systems.

Information: Information or message to be communicated are generated from information sources. Examples for main sources of information are human brain or changes in the physical environment. Information may be the speech signal, image, data music, video etc.The amount of information is measured in bits.

Transmitter: The information generated from a source is *not* in a suitable form to be transmitted directly through the channel. The transmitter is an electronic circuit designed to convert the information into a signal suitable to be transmitted over a given communication channel.

Transmitter includes – transducer, modulator, filters, encoder and also amplifiers to ensure faithful signal transmission and reception.

Communication channel:The communication channel is the medium through which the electronic signal is transmitted.The channel connects the transmitter and receiver either through wire or without wire. In general the communication channel can be classified as:

-Wired channel or line communication

-Wireless channel or radio channel

Wired channel: The examples for a wired medium are: copper wire, coaxial cable, fibre optic cable. For applications like telephony two physical wires or conductors are connected between the transmitter and the receiver.

Wireless channel: most commonly known as radio channel or electromagnetic medium. This type of channel connects the transmitter and receiver wirelessly. No physical wire is necessary to carry the information, signal is sent through air or free space.

Noise: Noise is basically any unwanted signal that disturbs the communication. Noise enters the communication system normally in the medium or channel. Noise may also be generated at the transmitter or receiver. Means noise can be internally generated in a system or externally added to the signal.

Receiver: The receiver is a collection of electronic circuits designed to convert the signal back to its original form. The process includes amplification, mixing, demodulation and decoding etc. The receiver performs the task of operating on the received signal to generate the estimation of the original signal. If the estimated signal is same as the original transmitted signal, then we say that the reception is proper.

3. With neat diagrams discuss the basic elements of communication systems.

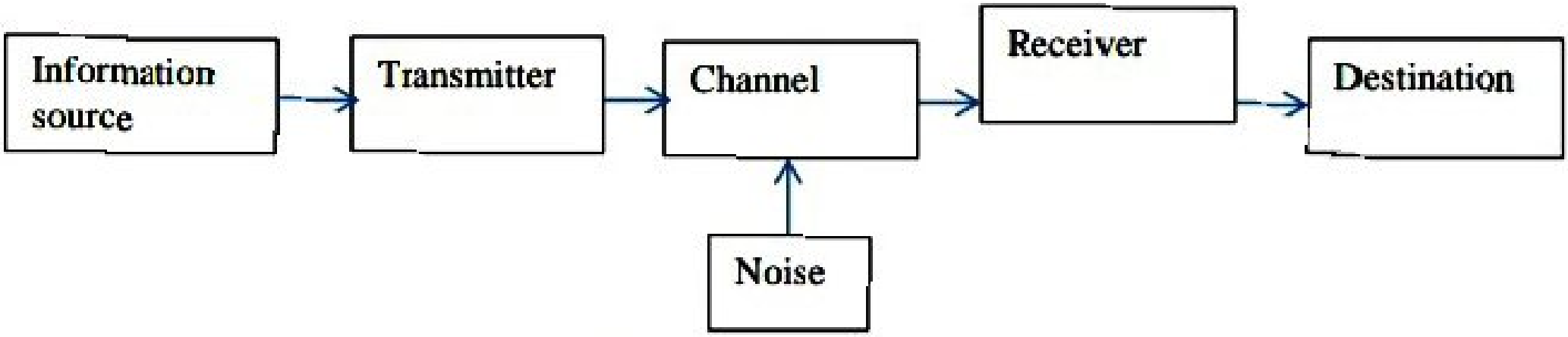


Figure 1: Block diagram of communication system

The elements of communication system are as follows:

- Information
- Transmitter
- Communication channel or medium
- Noise
- Receiver

4. Discuss the types of communication channels used for the transmission of signals.

The communication channel is the medium through which the electronic signal is transmitted.

The channel connects the transmitter and receiver either through wire or without wire. In general the communication channel can be classified as:

- Wired channel or line communication
- Wireless channel or radio channel

Wired channel: The examples for a wired medium are: copper wire, coaxial cable, fibre optic cable. For applications like telephony two physical wires or conductors are connected between the transmitter and the receiver. Latest applications use optical fibre cables, which are well known for their high capacity and immunity to noise. In optical fibres the information will be transmitted in the form of light wave. Coaxial cables are preferred over pair of wires as they have higher bandwidth and lower losses. Optical fibres are logical extension of coaxial cables which can be operated at higher frequencies and greater bandwidths. Optical fibres are also cheaper and are more immune to interference and noise.

Wireless channel: most commonly known as radio channel or electromagnetic medium. This type of channel connects the transmitter and receiver wirelessly. No physical wire is

5. Briefly discuss about the noise in communication systems.

Noise: Noise is basically any unwanted signal that disturbs the communication. Noise enters the communication system normally in the medium or channel. Noise may also be generated at the transmitter or receiver. Means noise can be internally generated in a system or externally added to the signal.

Noise can also be classified as natural noise or man-made noise. Natural noise includes – lightening during rainy season, radiations from the sun and cosmic radiations. Man-made noise is the noise generated by the electric ignition systems, industrial noise, fluorescent lights etc.

Noise imposes serious problem on electronic communication systems, if not controlled. Noise cannot be completely eliminated, but its effect can be reduced using different methods.

6. Briefly discuss about the modulation process and also discuss types of modulation.

The transmission of an information- bearing signal over a communication channel requires a shift in the range of frequencies from the original to another frequency range suitable for transmission. This is accomplished through the process of modulation. Modulation is defined as the process by which some characteristic of a carrier signal is varied in accordance with a modulating signal. The message signal is referred to as modulating signal and the result of modulation is referred to as modulated signal. The carrier signal is usually a high frequency signal than the message signal. The message signal modifies the amplitude, frequency or phase of the carrier signal in the process of modulation. Hence, the types of modulation are:

- Amplitude modulation – amplitude of the carrier is varied in accordance with the modulating signal, keeping the frequency and phase of the carrier constant
- Frequency modulation – the frequency of the carrier signal is varied according to the modulating signal
- Phase modulation – phase of the carrier is varied in accordance with the modulating signal

7. a) Explain the following schemes of cellular communication,

(i) Forward Control Channel

(ii) Reverse control channel

(iii) Duplexer

(iv) Hand-off

b) Draw the diagram of a cellular system and show the frequency reuse mechanism in it.

a) Type of Channels	Name of the channel	Channels used for:
Control channels	Forward Control Channel (FCC)	Initiating mobile calls from the base station to mobiles.
	Reverse Control Channel (RCC)	Initiating mobile calls from the mobiles to base station.

a) ***Hand-off process:***

Whenever a mobile user crosses one cell boundary and moves to another cell with an active call, the call is softly handed over to a new frequency band. the MSC adjusts the transmitted power of the mobile phone and changes the channel of the mobile unit and base stations in order to maintain call quality. This is called a hand-off in mobile communication.

b)

Explain the concept of 'frequency reuse' in a cellular system.

Cellular systems have grown Figure 3 illustrates the concept of **cellular frequency reuse**, with the hexagon shaped cells.

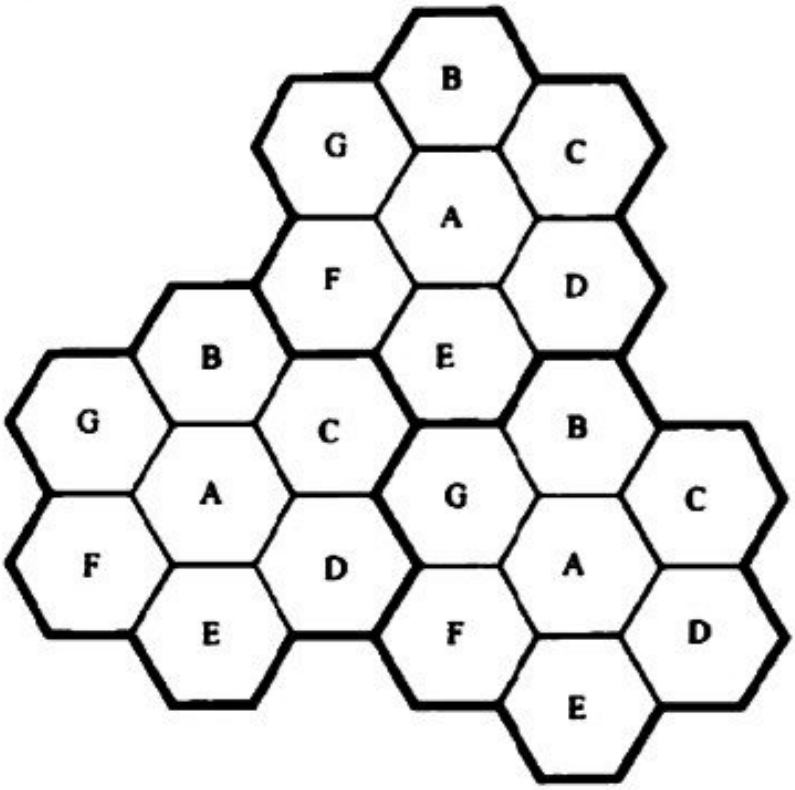


Figure 3. Cellular Frequency Reuse concept

In the Figure 3, cells numbered from A – G forms a group of cells called Cluster. There are 3 such clusters shown in the Figure, with the frequency bands repeated. Cells with the same letter use the same set of frequencies. A cell cluster is outlined in bold and replicated over the coverage area. The N cells which collectively use the complete set of available frequencies is called a cluster. From the Figure, it is clear that

1. A cluster uses frequency bands A – G is not repeated in the adjacent cells.
2. The frequency bands are repeated only in the next cluster.
   The number of cells in a cluster is cluster size, denoted as 'N.
   Frequency reuse factor is the reciprocal of cluster size.

Frequency reuse factor = 1/N

In this example, the **cluster size, N, is equal to seven**, and the **frequency reuse factor is 1/7** since each cell contains one-seventh of the total number of available channels.