How to Answer a Question.?!

What Would be the Expected Answer.?!

How to get Maximum marks in VTU Valuation.?!

Solution to Model Question Paper 1

Basic Electronics & Communication Engineering

Model

Question Paper-1

SOLUTION

Solution Explanation Video : https://youtu.be/t_w_2wjmBKQ

Q.01	a	With neat block diagram explain the working of a DC power supply. Also mention the principal components used in each block.	7

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Diagram 2+2=4M

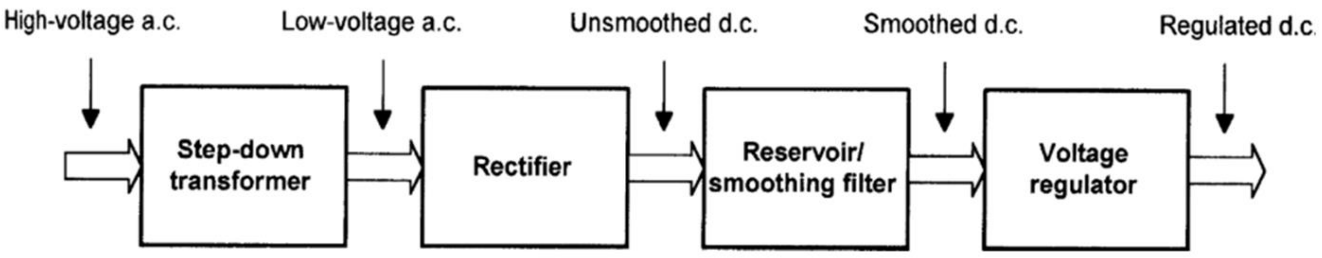

Figure 6.1 Block diagram of a d.c. power supply

Explanation 3M

Write two to three lines of Explanation for these points

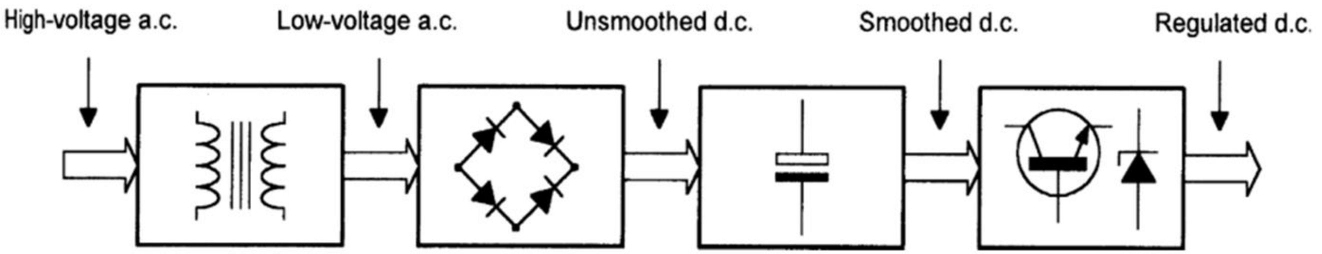

Figure 6.2 Block diagram of a d.c. power supply showing principal components

- Step down transformer reduces the AC voltage to low voltage
- Rectifier is a circuit which converts a.c signal into pulsating d.c signal
- Reservoir/smoothing circuit reduces ripples/pulses present in rectifier output
- Voltage regulator make the dc output voltage constant even in small variation in input

	b	Mention advantages of negative feedback in amplifiers circuits. With relevant equations and diagram explain the concept of negative feedback.	7

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Advantages of Negative Feedback

Advantages 3M

- Stabilizes Amplifier Gain.
- Reduces Non-linear Distortion.
- Increases Circuit Stability.
- Increases Input Impedance/Resistance.
- Decreases Output Impedance/Resistance.
- Reduces Noise Level.
- Improves Frequency Response & Bandwidth.

Equations & Explanation 2M

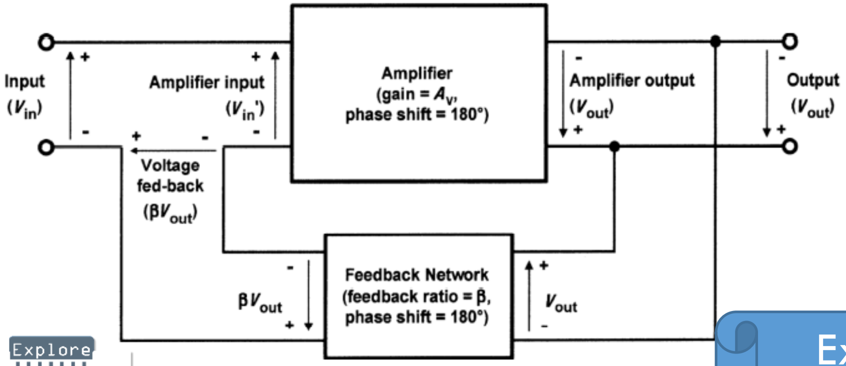
Overall Gain $G = \frac{V_O}{V_S}$ ....(1)

Amplifier Gain $A = \frac{V_O}{V_i}$

$V_O = AV_i$ ....(2)

$V_s = V_i + \beta V_O$ ....(3)

Diagram 2M



Explain Phase shift in three to four lines of explanation

Overall Gain

$$G = \frac{A}{1 + A\beta}$$

EXPLORE ELECTRONICS

	c	With circuit diagram and waveform show how operational amplifier can work as a comparator.	6

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Diagram **2M**

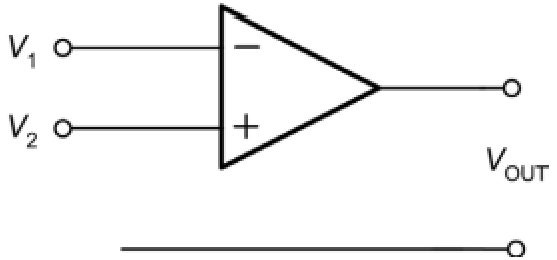

Figure 8.17 A comparator

Waveform & Explanation

4M

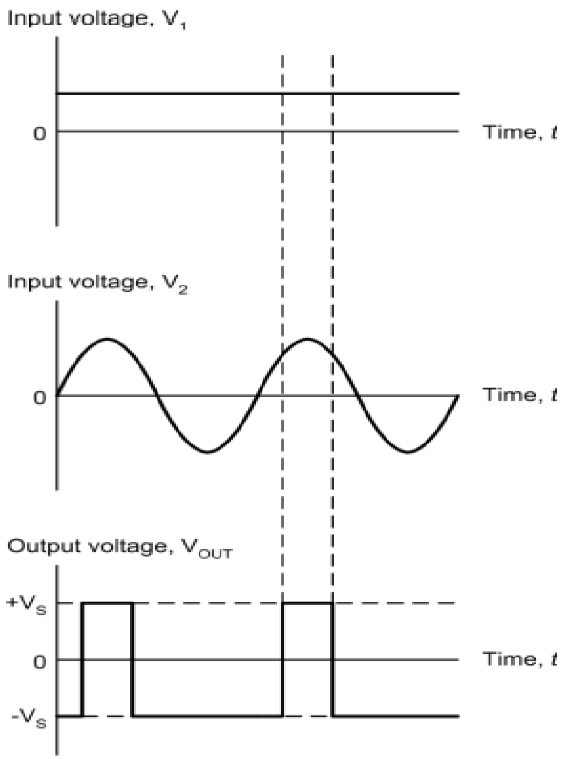

Figure 8.18 Typical input and output waveforms for a comparator

EXPLORE ELECTRONICS

Q.02	a	With neat circuit diagram and waveforms explain the working of bridge rectifier.	8

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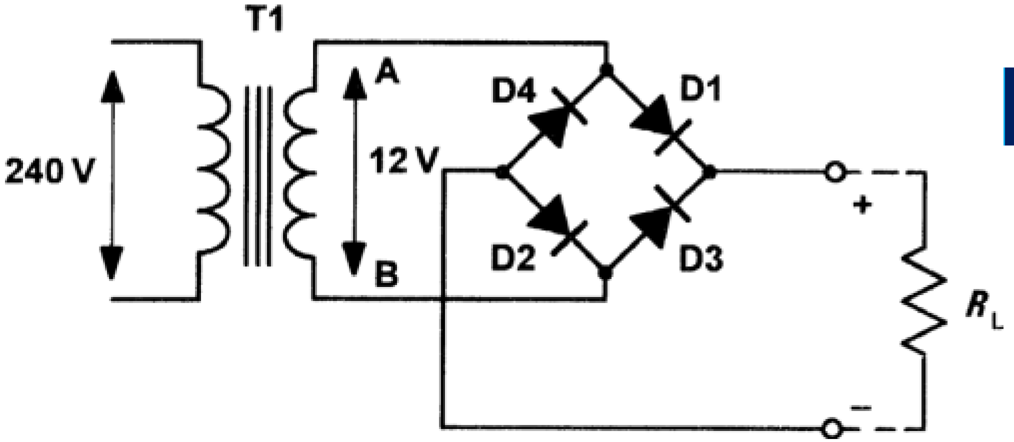


2M

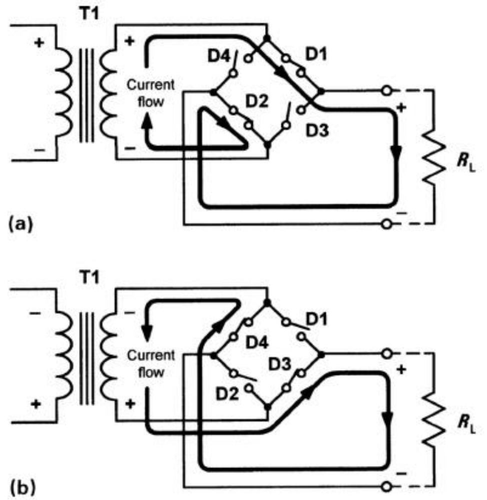


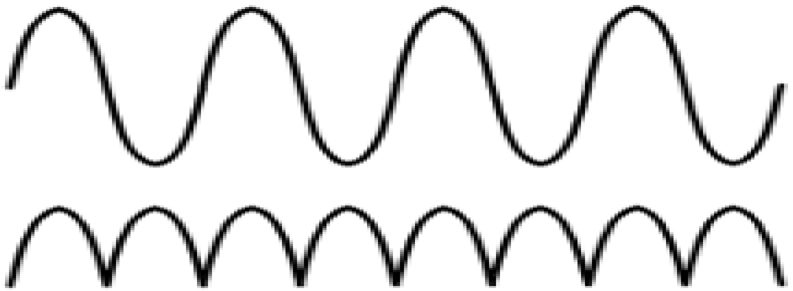
Figure 6.16 (a) Bridge rectifier with D1 and D2 conducting, D3 and D4 non-conducting (b) bridge rectifier with D1 and D2 non-conducting, D3 and D4 conducting

Diagram 2M

- On positive half-cycles,
- point A will be positive with respect to point B.
- In this condition D1 and D2 will allow conduction
- while D3 and D4 will not allow conduction.

Waveform & Explanation 4M

- Conversely, on negative half-cycles, point B will be positive with respect to point A.
- In this condition D3 and D4 will allow conduction while D1 and D2 will not allow conduction.



EXPLORE ELECTRONICS

	b	Write a note on frequency response characteristics of an amplifier circuit, clearly mentioning the half power frequencies.	6

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Waveform 2M

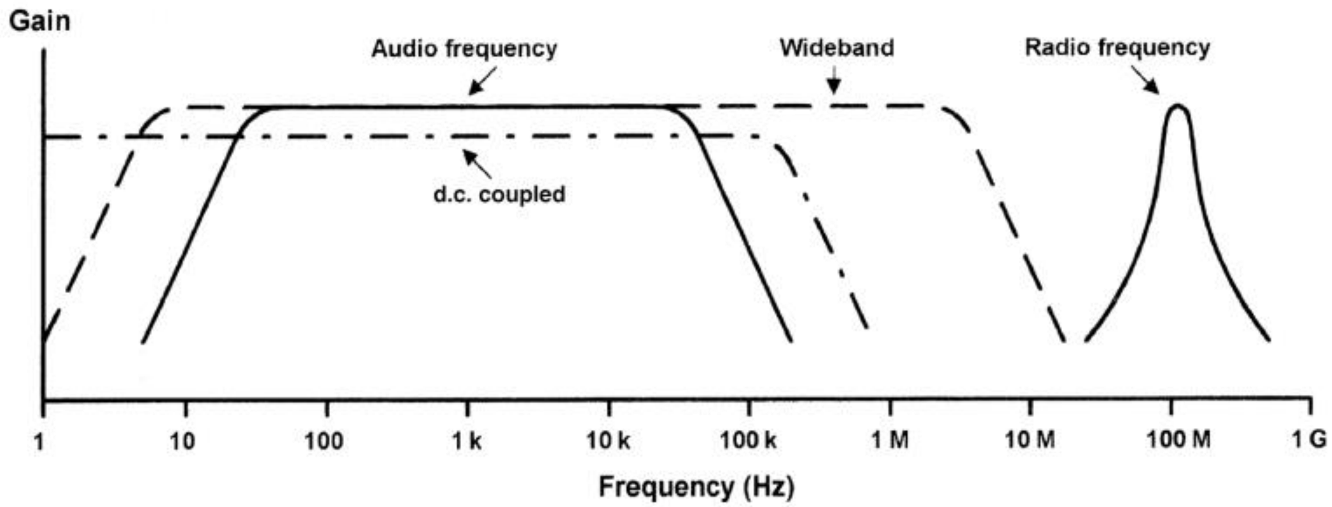

Figure 7.9 Frequency response and bandwidth (output power plotted against frequency)

Waveform 2M

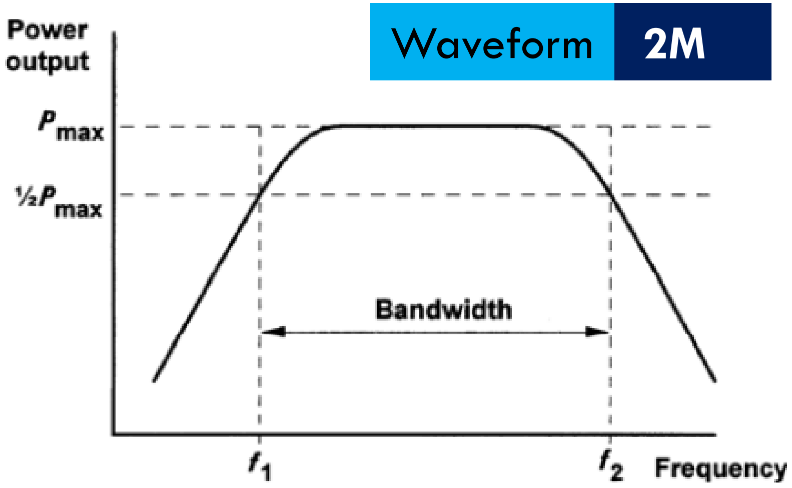

Figure 7.10 Frequency response and bandwidth (output power plotted against frequency)

These frequencies are those at which the output power has dropped to 50% (otherwise known as the **-3 dB points**) or where the voltage gain has dropped to 70.7% of its mid-band value.

Explanation 2M

	c	List and explain conditions for sustained oscillations. Determine the frequency of oscillation of a three-stage ladder network in which C=10 ηF and R=10 kΩ.	6

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1. The feedback must be positive
(The signal fed back must arrive back in-phase with the signal at the input).
Phase Shift of Amplifier and feedback network should be 0 or 360 degree
2. The overall loop voltage gain must be equal to 1
(The amplifier's gain must be sufficient to overcome the losses associated with any frequency selective feedback network). $|A.\beta|=1$

2 conditions	2M

Problem 16

Determine the frequency of oscillation of a three stage ladder network oscillator in which C = 10 nF and R = 10 kΩ.

RC phase Shift oscillator

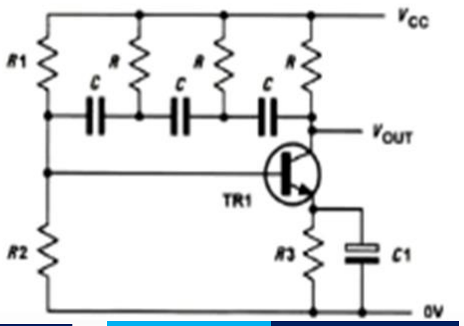
The frequency of oscillation of the circuit is

$$f = \frac{1}{2\pi\sqrt{6}\,RC} = \frac{1}{2\times3.14\times\sqrt{6}\times10\times10^{3}\times10\times10^{-9}}$$

Expression	1M

$$f = \frac{1}{2\pi\sqrt{2N}\,RC}$$

$$f = 647\,Hz$$



Solution	2M

Circuit	1M

Q. 03 | a | Discuss the design of a 3-bit asynchronous up-counter.

6

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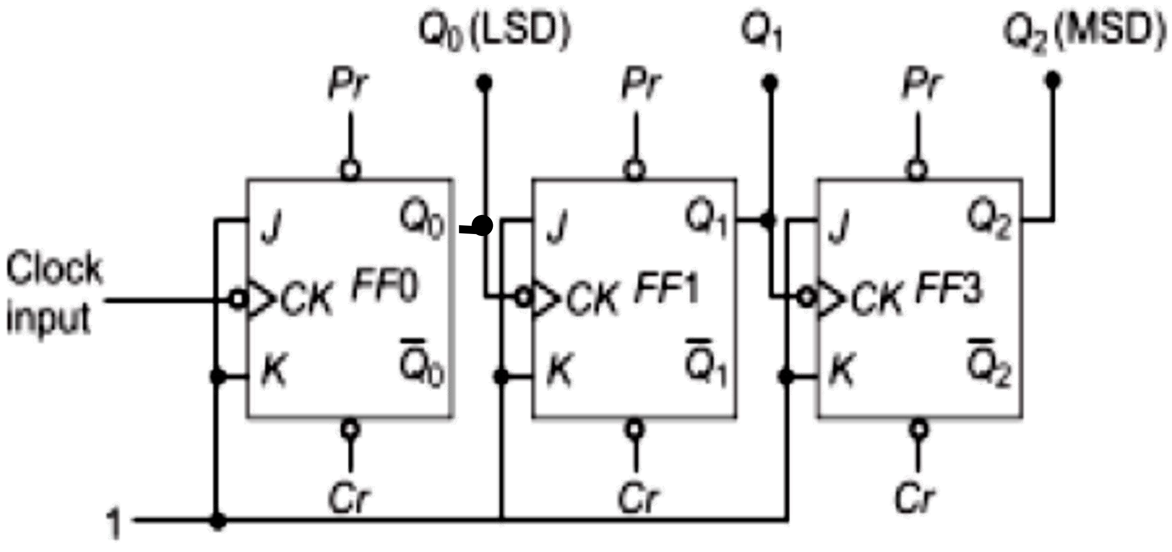
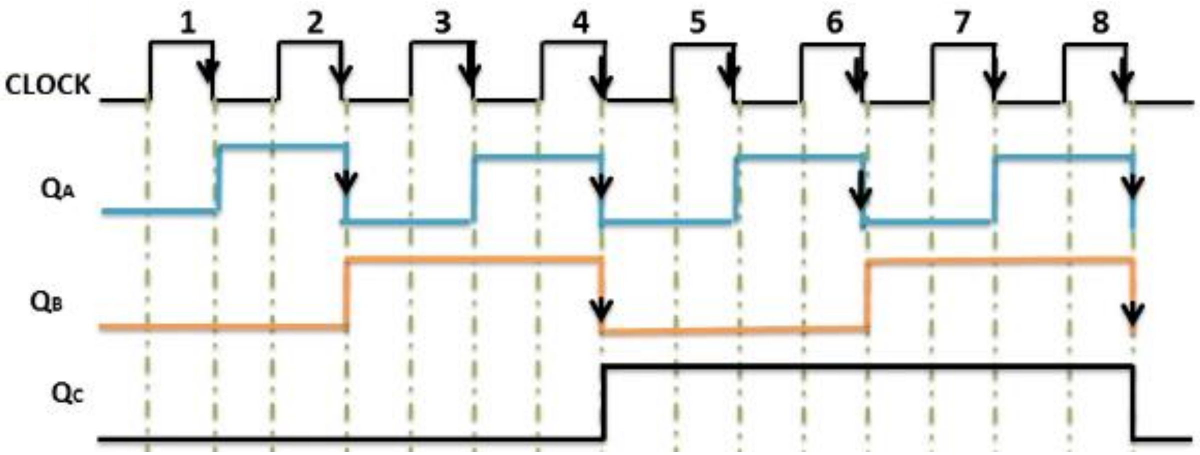
Circuit **2M**





Explanation **2M**

- Main clock is applied to First Bistable
- All the bistables are not clocked simultaneously
- Output of first will be the clock for second
- Similarly for next bistables

Truth Table **2M**

Input (Clock)	Q_2 MSD	Q_1	Q_0 LSD
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1
8	0	0	0

b	With a neat block diagram show how typical input and output blocks are connected to a microcontroller unit.	7

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Diagram **3M**

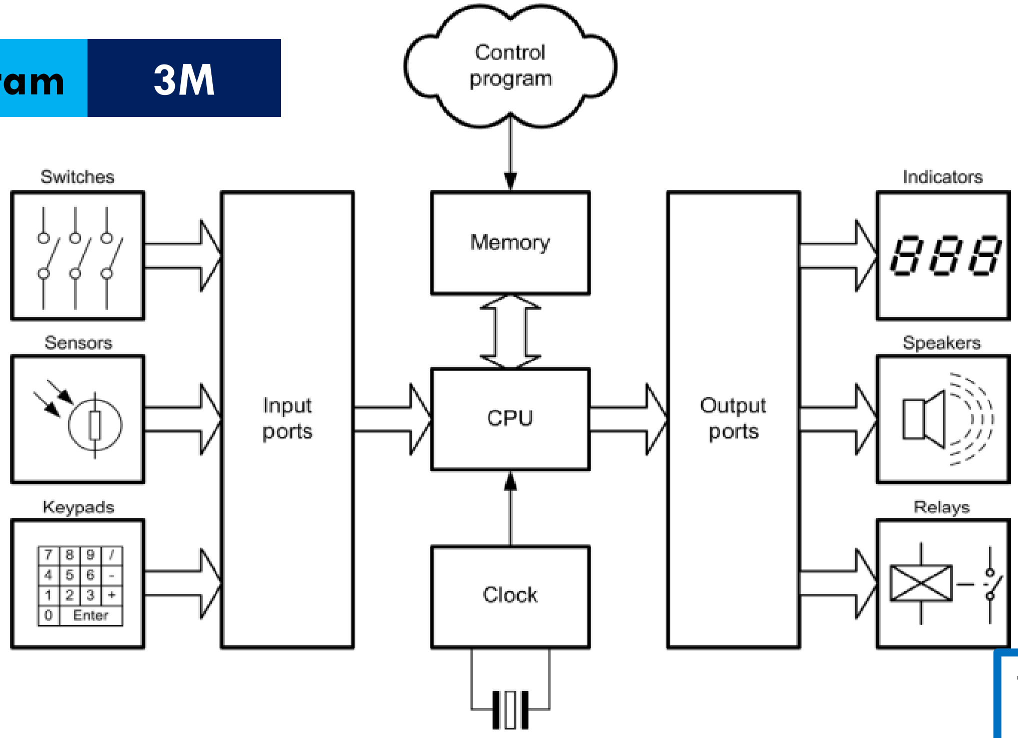


Figure 11.11 A microcontroller system with typical inputs and outputs

Explanation **4M**

The operation of the microcontroller is controlled by a sequence of software instructions known as a control program.

The control program operates continuously, examining inputs from sensors, user settings and time data before making changes to the output signals sent to one or more controlled devices.

The **input port** signals can be derived from a number of sources, including:

- switches (including momentary action push-buttons)
- sensors (producing logic-level compatible outputs)
- keypads (both encoded and unencoded types)

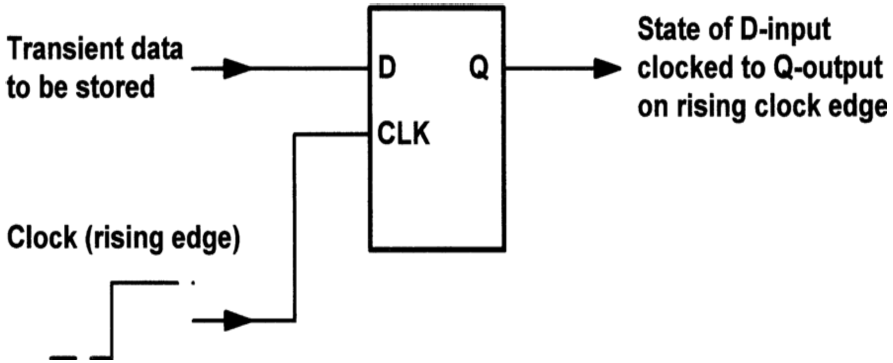
The **output port** signals can be connected to a number of devices, including

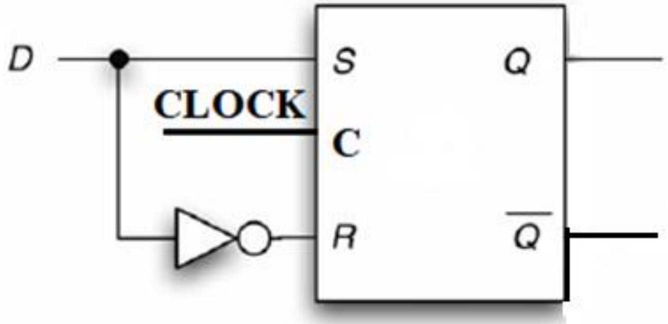
- LED indicators (both individual and multiple bar types)
- LED seven-segment displays (via a suitable interface)
- Motors and Actuators (both linear and rotary types) via a suitable buffer/driver or a dedicated interface
- Relays (both conventional electromagnetic types and optically couple solid-state types)
- Transistor drivers and other solid-state switching devices.

c	With the help of a timing diagram explain how D-type bistable circuit works.	7

- The D-type bistable has two inputs: D (standing for ‘data’ or ‘delay’) and CLOCK (CLK).
- D-type bistable is a modified Set-Reset bistable with the addition of an inverter to prevent the S and R inputs from being at the same logic level.

Diagram **1M**





Timing Diagram **2M**

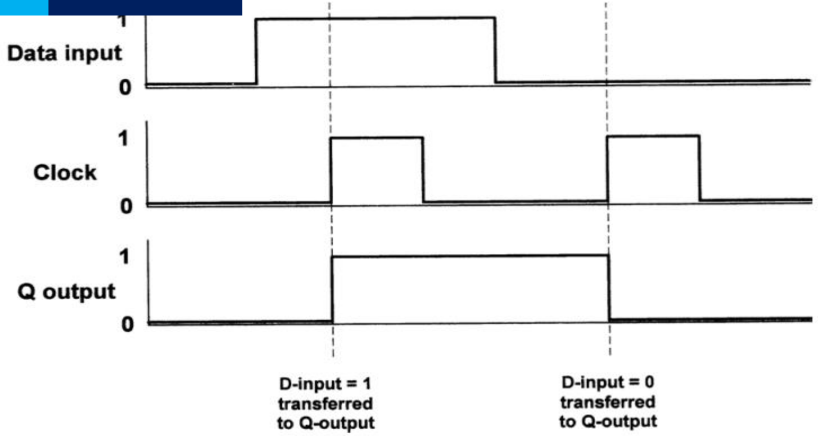


Figure 10.21 Timing diagram for the D-type bistable

Truth Table **2M**

INPUTS		OUTPUTS		COMMENTS
CLOCK	D	Q_{N+1}	$\overline{Q}_{N+1}$	
0	X	Q	Q	Memory (Hold)
1	0	0	1	Reset
1	1	1	0	Set

Q.04 | a | Design a full adder using two half adders and an OR-gate.

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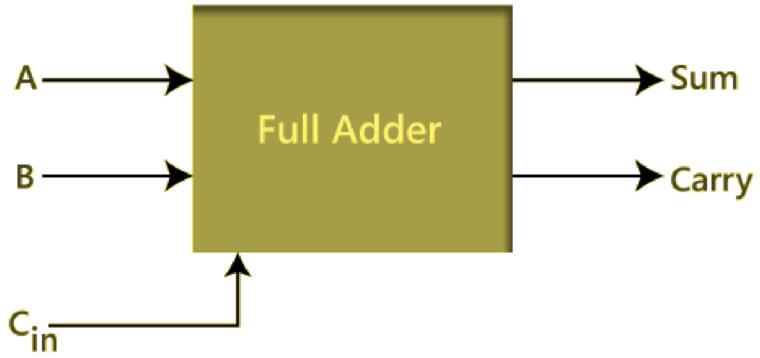
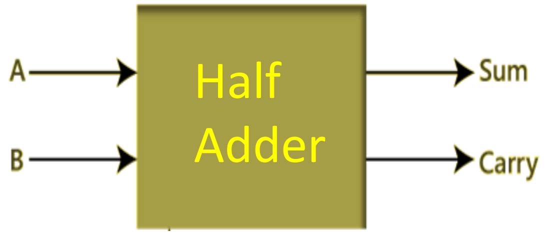
Diagram **1M**

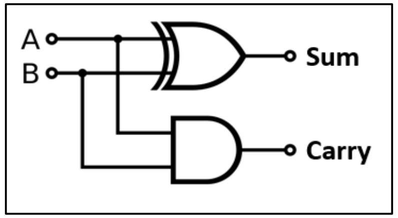




Truth Table			
Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Half Adder **2M**

Half Adder



Truth Table **2M**

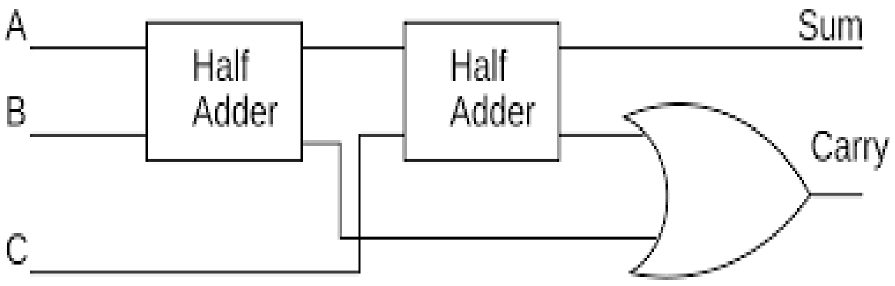
Input			Output	
A	B	Cin	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Expressions **1M**

$$Sum = C_{in} \oplus (A \oplus B)$$

$$Carry = AB + A\,C_{in} + B\,C_{in}$$

Circuit **2M**



EXPLORE ELECTRONICS

	b	Design a 4-stage shift register using J-K bistables.	7

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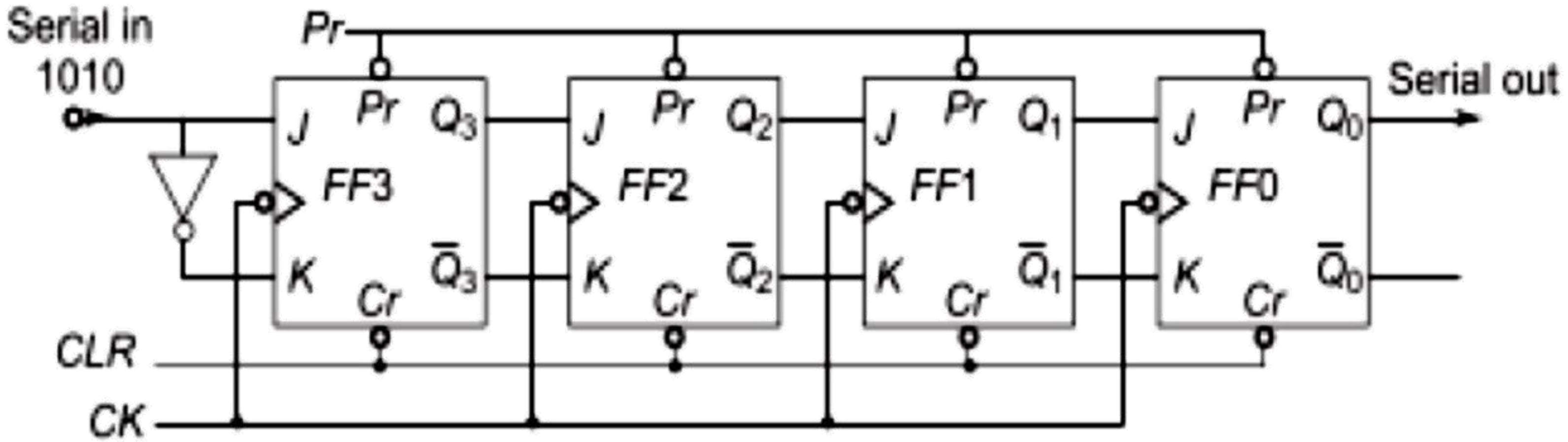
- Shift register is a **type of digital circuit using a cascade of flip-flops** where the output of one flip-flop is connected to the input of the next.
- They share a single clock signal, which causes the data stored in the system to shift from one location to the next.



Circuit **3M**

Explanation **2M**

When CLR=0 all Flip-Flop output is 0
When Pr= 0 all Flip-Flop output is 1
When CLR=1 and Pr=1 and depends on Serial in data, Flip-Flop stores data and shift to next stage in clock cycle

Truth Table **2M**

Clock Pulse	Serial In	Q_3	Q_2	Q_1	Q_0 (Serial Out)	
0	0	0	0	0	0	
1	1	1	0	0	0	
2	0	0	1	0	0	
3	1	1	0	1	0	Data Entered
4	0	0	1	0	1	
5	0	0	0	1	0	
6	0	0	0	0	1	
7	0	0	0	0	0	1 Register Cleared

EXPLORE ELECTRONICS

	c	Write a note on different data types mentioning the bit size and range of values supported.	5

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Explanation **2M**

- Individual bits within a byte are numbered from 0 (least significant bit) to 7 (most significant bit).
- In the case of 16-bit words, the bits are numbered from 0 (least significant bit) to 15 (most significant bit).
- In Signed: most significant bit indicates the sign of the number (1 = negative, 0 = positive).

Representation **2M**

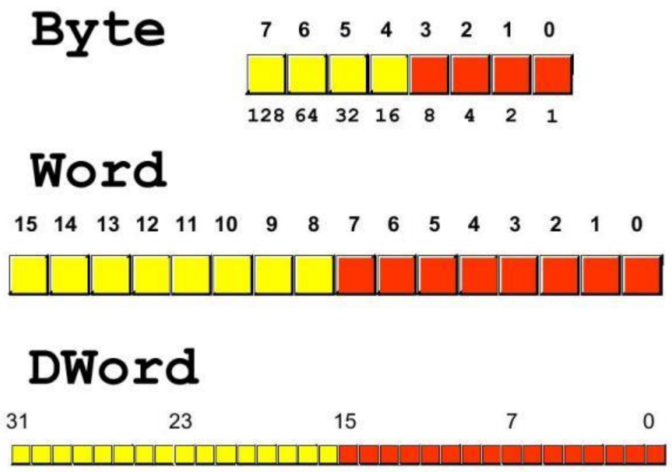

Table **2M**

Table 11.2 Data types

Data type	Bits	Range of values
Unsigned byte	8	0 to 255
Signed byte	8	–128 to +127
Unsigned word	16	0 to 65,535
Signed word	16	–32,768 to + 32,767

Q. 05	a	Explain the working, principle of operation and applications of stepper motor.	8

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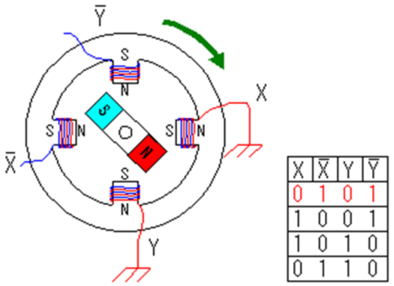
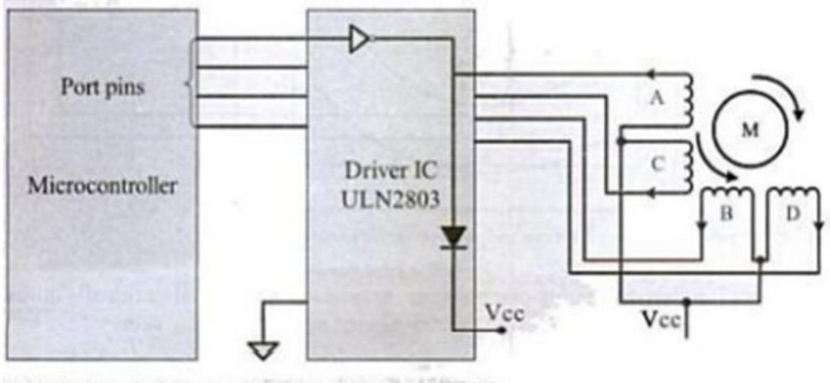
Explanation 2M

- ✓ A Stepper motor is an electro-mechanical device which generates discrete rotation in response to dc electrical signals.
- ✓ Stepper motor rotor has a permanent magnet and the stator has four electromagnetic coils which remain stationary.
- ✓ Whenever the coils energized by applying the current, the electromagnetic field is created, resulting the rotation of rotor.
- ✓ Coils should be energized in a particular sequence to make discrete rotation of the rotor.

Diagram 2M





Interfacing of stepper motor through driver circuit

Full Step

Table 2M

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

Two coils are energized at a time, produces more torque. Hence, the power consumption is also high.

Applications 2M

- 3D printing equipment., Textile machines.
- Printing presses., Gaming machines.
- Medical imaging machinery.
- Small robotics., CNC milling machines.
- Welding equipment.

	b	Write a note on classification of embedded systems.	6

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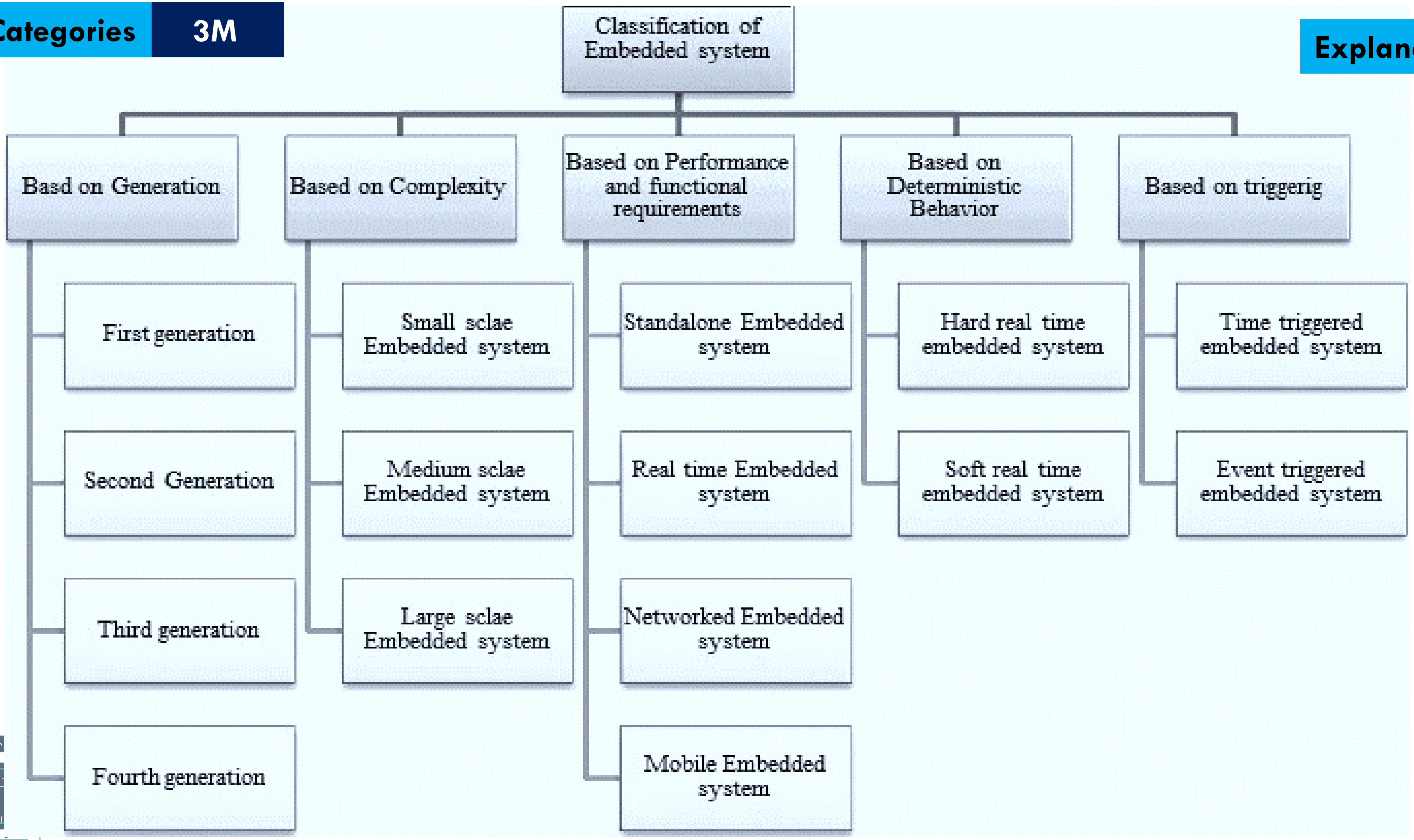
Categories **3M**

Explanation **3M**



	c	Bring out the main features of UART and USB.	6

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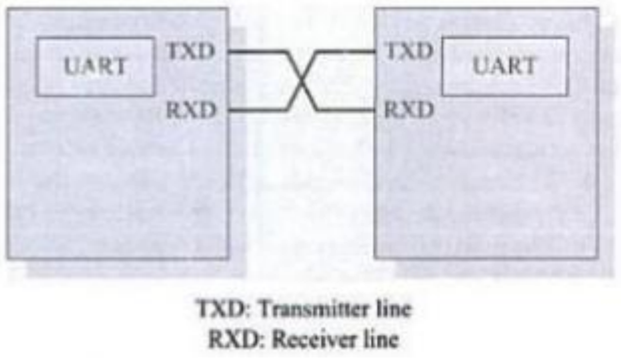
UART

- Protocol for serial data communication
- Only two wires are needed to transmit data between two UARTs.
- Data flows from the TXD pin of the transmitting UART to the RXD pin of the receiving UART and vice versa.

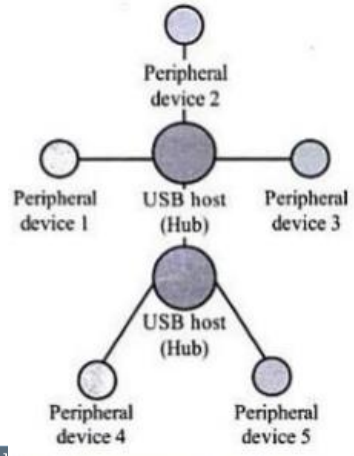


Packet

1 start bit	5 to 9 data bits	0 to 1 parity bits	1 to 2 stop bits

Diagram	3M
Explanation	3M

USB



Pin No.	Pin Name	Description
1	VBUS	Carries Power 5v
2	D-	Differential Data Carrier Line
3	D+	Differential Data Carrier Line
4	GND	Ground Signal Line

- ✓ The USB communication system follows a star topology with a USB host at the center and one or more USB peripheral devices.
- ✓ A USB host can support connections up to 127, including slave peripheral devices and other USB hosts.
- ✓ Each device receives unique address from the host (PC). USB transmits data in packet format. Each data packet has a standard format.

Q. 06	a	Give the classification of transducers with examples.	6

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- ✓ A loudspeaker is a transducer that converts low frequency electric current into audible sounds.
- ✓ A microphone, on the other hand, is a transducer that performs the reverse function, converting sound pressure variations into voltage or current.

- ✓ A loudspeaker is an **output transducer** designed for use in conjunction with an audio system.
- ✓ A microphone is an **input transducer** designed for use with a recording or sound reinforcing system.

Explanation	3M
Examples	3M

- ✓ A **Active transducer** operate without any external power supply called as self generative.
- ✓ A **Passive transducer** operate with external power supply.

Passive Transducer	Active Transducer
• It operates under energy controlling principle.	• It operates under energy conversion principle.
• It require external power supply.	• Not require external power supply.
• The energy required for the production of the output signal is obtained from the power supply.	• The energy required for the production of the output signal is obtained from the physical quantity.
• E.g. Thermistors, strain gauge, LDR etc.	• E.g. Photovoltaic cell, Piezoelectric crystal etc.

	b	Bring out the differences between RISC and CISC, Harvard & Von-Neumann.	6

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RISC	CISC
✓ Reduced Instruction Set Computer.	✓ Complex Instruction Set Computer.
✓ Software centric design.	✓ Hardware centric design.
✓ Low power consumption.	✓ High power consumption.
✓ Requires more RAM	✓ Requires a minimum amount of RAM
✓ Simple decoding of instruction.	✓ Complex decoding of instruction.
✓ Processors are highly pipelined.	✓ Processors are not pipelined or less pipelined.
✓ Execution time is very less	✓ Execution time is very high
✓ Uses multiple registers.	✓ Uses a single register.
✓ It does not require external memory for calculations	✓ It requires external memory for calculations
✓ Compound addressing mode.	✓ Limited addressing mode.
✓ RISC architecture can be used with high-end applications like telecommunication, image processing, video processing, etc.	✓ CISC architecture can be used with low-end applications like home automation, security system, consumer goods etc.
✓ Large Code Size.	✓ Small Code Size.
✓ Fixed Instruction format (32-bit)	✓ Varying formats (16 to 64 bits for each instruction).
✓ Examples: ARM, PIC, Power Architecture, Alpha, ✓ AVR, ARC and the SPARC.	✓ Examples: VAX, Motorola 68000 family, ✓ System/360, AMD and the Intel x86 CPUs.

Any 5

3M

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Any 5

3M

VON NEUMANN ARCHITECTURE	HARVARD ARCHITECTURE
✓ It is ancient computer architecture based on stored program computer concept.	✓ It is modern computer architecture based model.
✓ CPU is connected data memory (RAM) and program memory (ROM) by a single memory.	✓ CPU is connected data memory (RAM) and program memory (ROM), separately.
✓ CPU cannot access instructions and data at the same time.	✓ CPU can access instructions and data at the same time.
✓ Same physical memory address is used for ✓ instructions and data.	✓ Separate physical memory address is used for ✓ instructions and data.
✓ Common bus is used for data and instruction ✓ transfer.	✓ Separate buses are used for data and instruction transfer.
✓ The speed of execution is slower. It is because it is not capable of fetching the instructions and data both at the same time.	✓ The overall speed of execution is faster. It is becausethe processor is capable of fetching both instructions and data at the very same time.
✓ It is cheaper in cost.	✓ It is costly.
✓ Requires less hardware, but low performance.	✓ Requires more hardware, but high performance.
✓ It is used in personal computers and small ✓ computers.	✓ It is used in microcontrollers and digital signal ✓ processing.

	c	Define 'Actuator' and briefly describe the following actuators - relay, Piezo-buzzer	8

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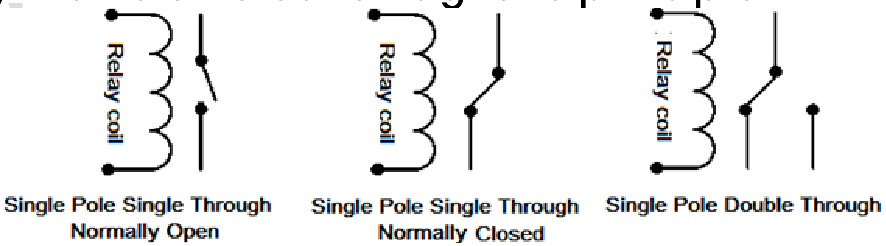
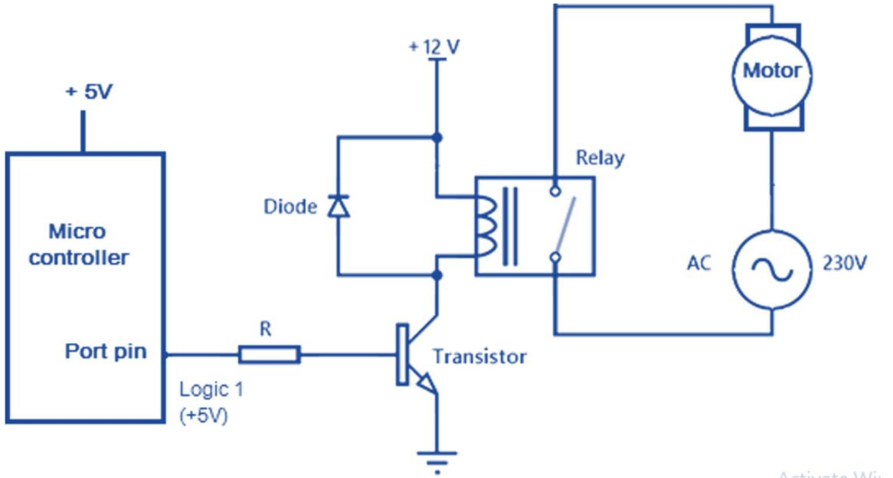
Definition **1M**

- ✓ Actuator is a transducer which converts electrical signals to corresponding physical action (motion).
- ✓ Actuator acts as an output device.

Relay **4M**

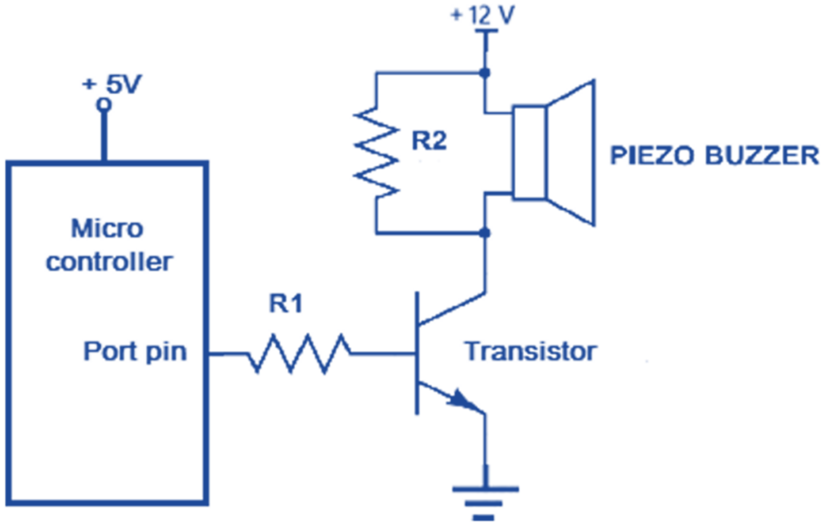
- ✓ An electro mechanical device which acts as a dynamic path selector for signals and power.
- ✓ Relay works on electromagnetic principle.





Piezo Buzzer **3M**

- ✓ It is a piezoelectric device for generating audio indications in embedded applications.
- ✓ A Piezo buzzer contains a piezoelectric diaphragm which produces audible sound in response to the voltage applied to it.
- ✓ Buzzer can be used as an alarm or as a fire alarm or as an intruder alarm.



Q. 07	a	Describe the blocks of the basic communication system.	6

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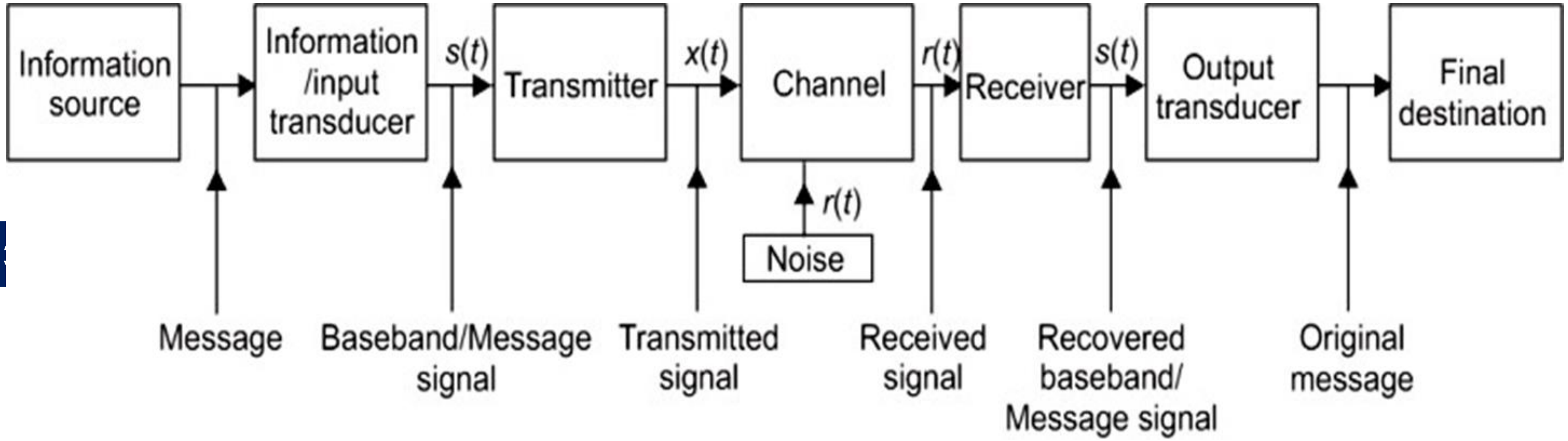
Diagram



Explanation **3M**

Write two to three lines of Explanation for these points

- ✓ Information source and transducer
- ✓ Transmitter
- ✓ Channel or medium
- ✓ Noise
- ✓ Receiver
- ✓ Output transducer and final destination

	b	Define the following terms: (i) Modulation (ii) Carrier communication system (iii) Baseband communication system with neat and suitable waveforms.	6

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Modulation is the process in which any **one of the parameters (amplitude, frequency or phase)** of the high frequency **carrier signal is varied according to the instantaneous values of the low frequency message signal, keeping other parameters constant**

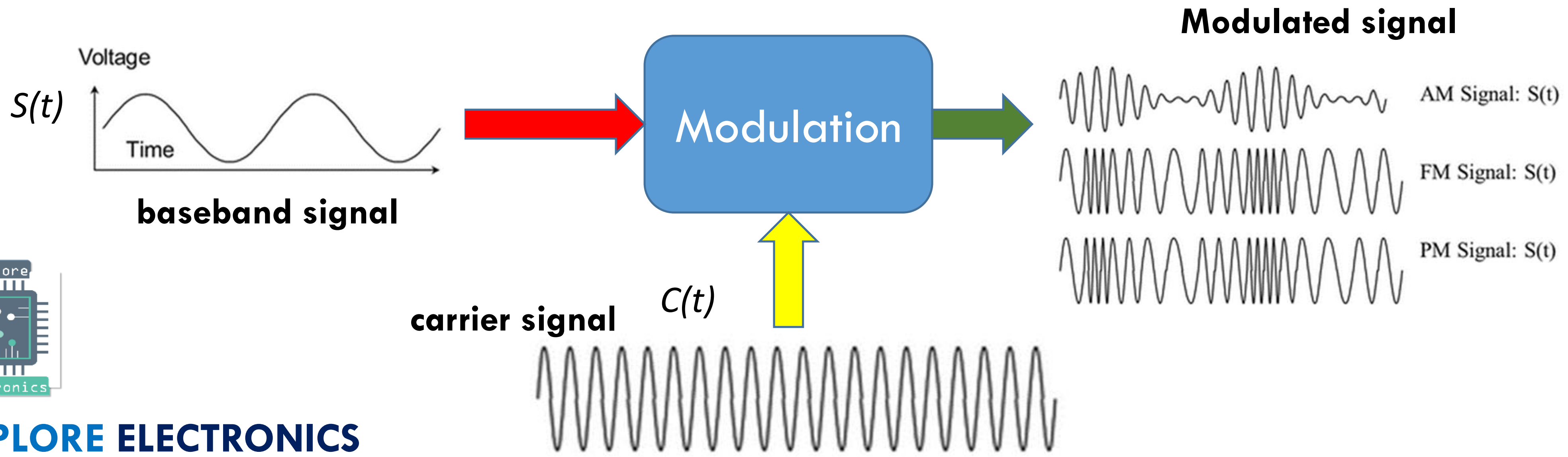
3 * 2 = 6M

Carrier Communication

- The baseband signal, which lies in the low frequency spectrum, is translated to a higher frequency spectrum
- Modulation is the main function of the transmitter.

Baseband Communication

- The baseband signal is transmitted without translating it to a higher frequency spectrum
- No Modulation



EXPLORE ELECTRONICS

	c	Explain the following with the help of waveforms. (i) PAM (ii)PWM (iii)PPM (iv) PCM	8

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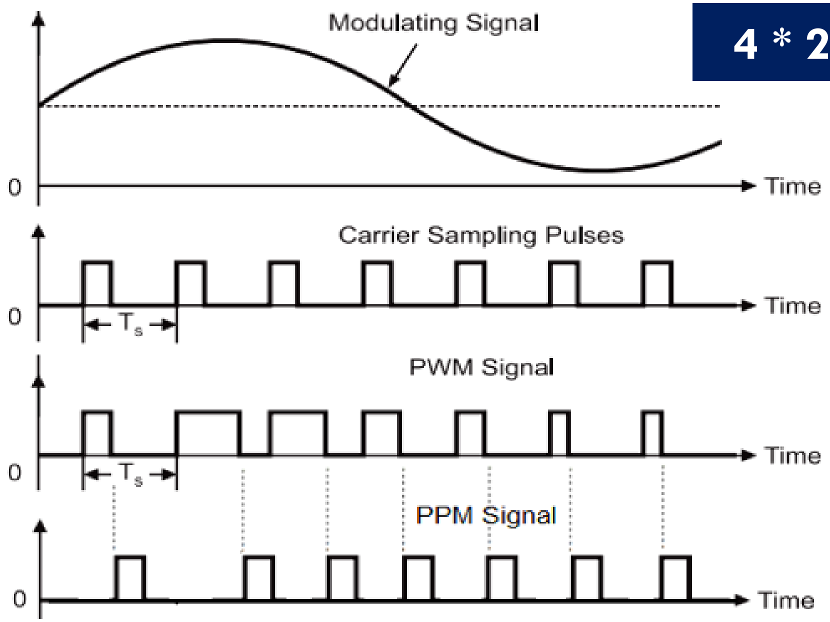
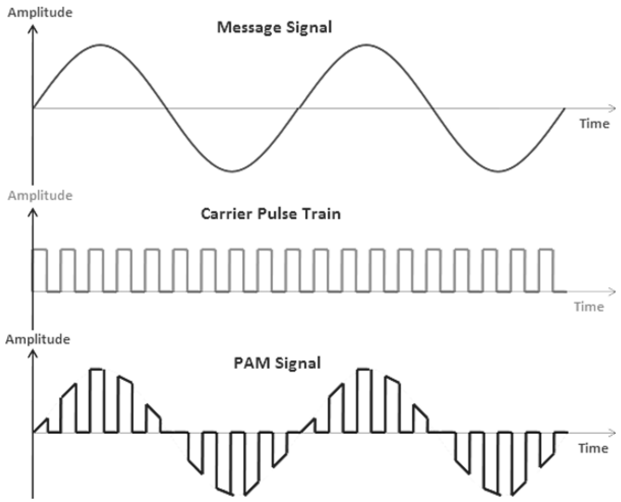
4 * 2 = 8M

Don't Write like this.

EXPLAIN

S.No	Pulse Amplitude Modulation (PAM)	Pulse Duration/Width Modulation (PDM/PWM)	Pulse Position Modulation (PPM)
1	Amplitude of the pulse proportional to amplitude of modulating signal	Width of the pulse is proportional to amplitude of modulating signal	The relative position of the pulse is proportional to amplitude of modulating signal
2	Bandwidth of the transmission channel depends on the pulse width	Bandwidth of the transmission channel depends on the rise time of the pulse	Bandwidth of the transmission channel depends on the rising time of the pulse
3	Instantaneous power of the transmitter varies	Instantaneous power of the transmitter varies	Instantaneous power of the transmitter remains constant
4	Noise interference is high	Noise interference is minimum	Noise interference is minimum
5	System is complex to implement	System is simple to implement	System is simple to implement
6	Similar to amplitude modulation	Similar to frequency modulation	Similar to phase modulation





Q. 08	a	Define sampling theorem and explain when aliasing can happen. Also mention the different ways in which aliasing can be avoided.	6	Click here For Videos

Statement	1M
Expressions	2M

A band limited analog signal can be sampled and perfectly reconstructed from its samples if the sampling frequency is at least twice the maximum frequency of the base band signal.

i.e, $f_s \geq 2f_{max}$

Nyquist Rate: the minimum rate at which a signal can be sampled without introducing errors

$$f_s = 1/T_s \qquad T_s = 1/f_s$$

Explanation	3M

Aliasing occurred when $f_s < 2f_{max}$.

Aliasing can be avoided when $f_s > 2f_{max}$

Aliasing is avoided by:

- ✓ Applying low-pass filters or anti-aliasing filters (AAF) to the input signal before sampling and when converting a signal from a higher to a lower sampling rate.
- ✓ Sampling the signal at a higher rate than the Nyquist rate ($f_s \geq 2f_{max}$).

EXPLORE ELECTRONICS

	b	Define the following terms: Multipath, Constructive and destructive interference, Coherence time, Coherence bandwidth, Delay spread	10

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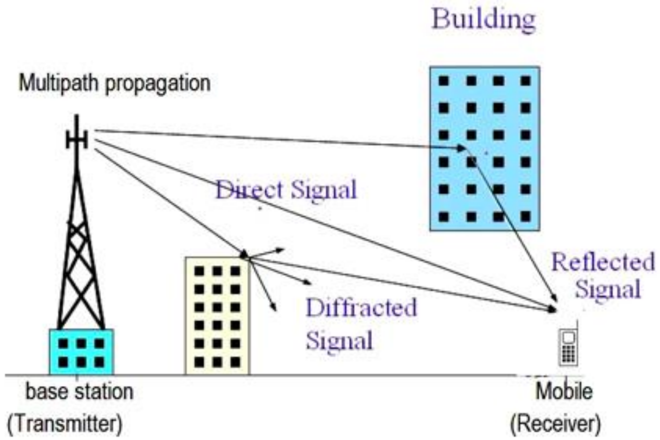
Definitions + 1 or 2 line explanation

2M each

- ✓ As a result of reflections and diffractions the signals can take several different paths from the transmitter to the receiver. This phenomenon is known as *multipath*.
- ✓ At the receiver end, the incoming rays can add together in different ways, which are classified as *constructive interference* and *destructive interference.*
- ✓ If the peaks of the incoming rays coincide, then they reinforce each other, a situation known as *constructive interference.*
- ✓ If the peaks of one ray coincide with the troughs of another, the result is *destructive interference*, in which the rays cancel.
- ✓ Destructive interference can make the received signal power drop to a very low level, a situation known as *fading.*



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If the mobile moves from one place to another, then the ray geometry changes, so the interference pattern changes between constructive and destructive. Fading is therefore a function of time.

The amplitude and phase of the received signal vary over a time scale called the coherence time, T_c that can be estimated as

$$T_c = \frac{1}{f_D}$$

Where, f_D is mobile Doppler frequency, given by

$$f_D = \frac{v}{c} f_c$$

Where, f_c is carrier frequency, v is speed of mobile and **c** is speed of light ($3\text{x}10^{-8}$m/s)

If the carrier frequency changes, wavelength of the radio signal also changes. This makes the pattern change between constructive and destructive interference. The amplitude and phase of the received signal vary over a scale called the coherence bandwidth, B_c that can be estimated as

$$B_c = \frac{1}{r}$$

Where, r is delay speed of radio channel.

c	Define an antenna and discuss different types of antennas.	4

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Antenna is a device used for converting electromagnetic radiation in space into electrical currents in conductors or vice-versa, depending on whether it is being used for receiving or for transmitting, respectively

Definition **1M**

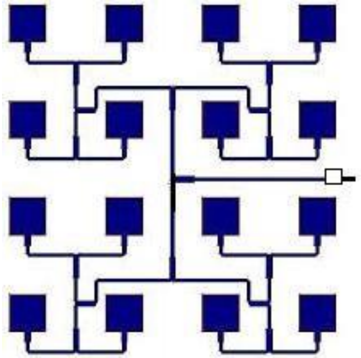
Types of Antenna

- Omni-directional Antennas
- Dipole Antennas
- Collinear omni Antennas
- Directional Antennas
- Patch Antennas
- Patch Array Antennas
- Yagi Antennas

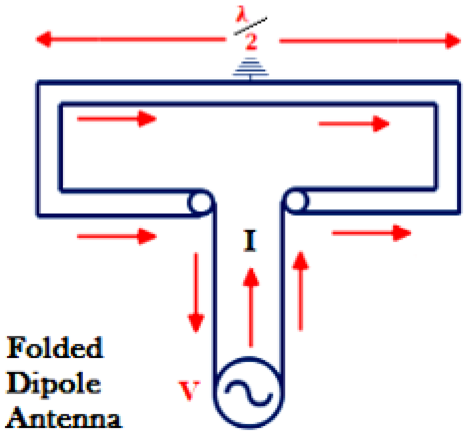
Types + 1 or 2 lines explanation

3M

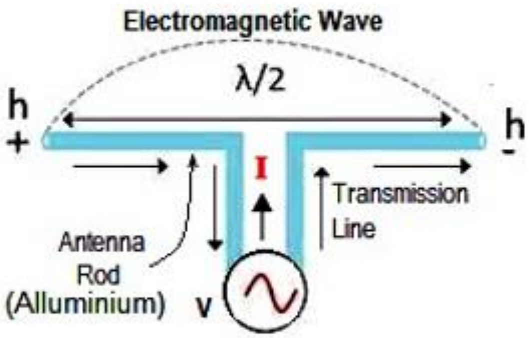
Omni-directional Antenna



Patch array antenna



Dipole Antenna



Q. 09	a	Draw the schematic diagram of a cellular telephone system and define its basic components.	6

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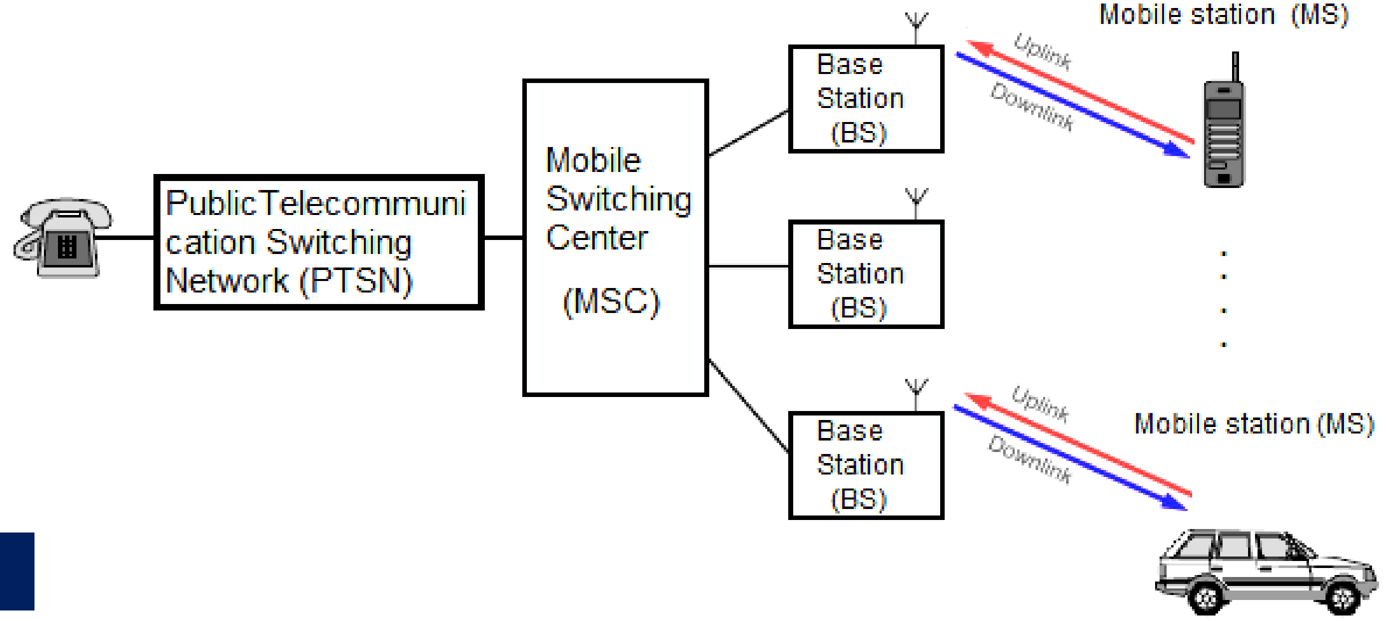
Diagram **3M**



Explanation **3M**

b	Explain the optical fiber communication system with a block diagram.	6

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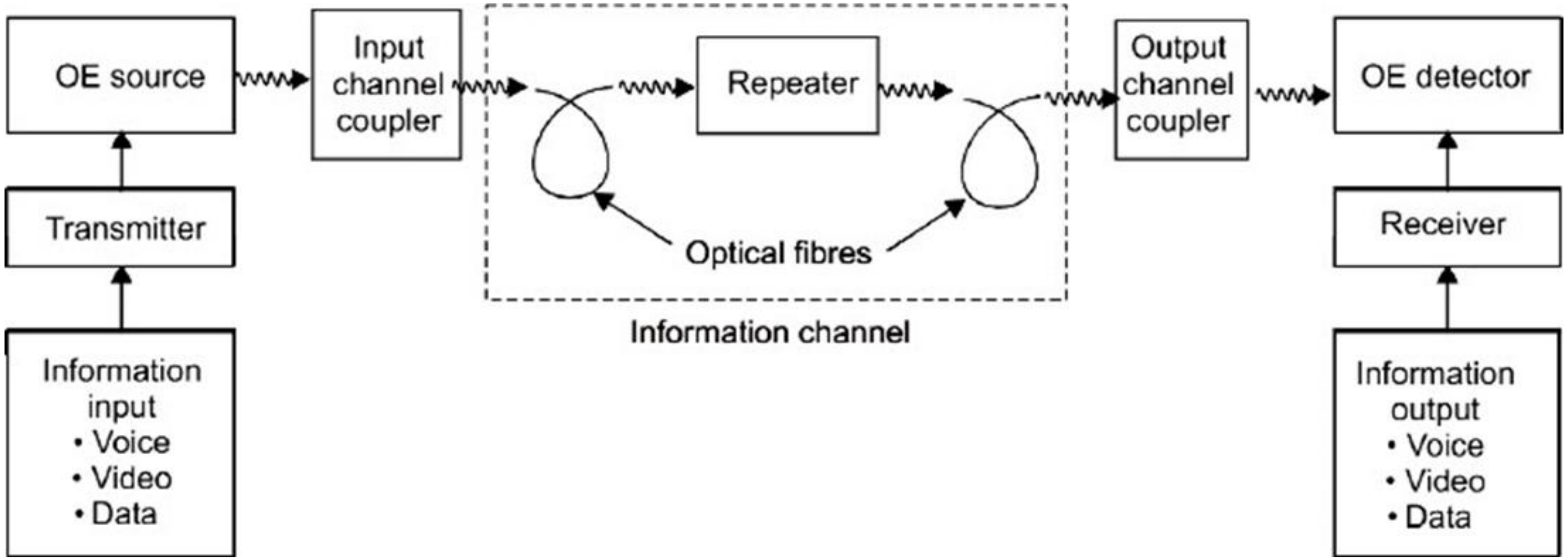

Diagram	3M
Explanation	3M

	c	With the help of diagrams, discuss the following types of network topologies: Ad-Hoc Network Topology, Infrastructure Network Topology	8

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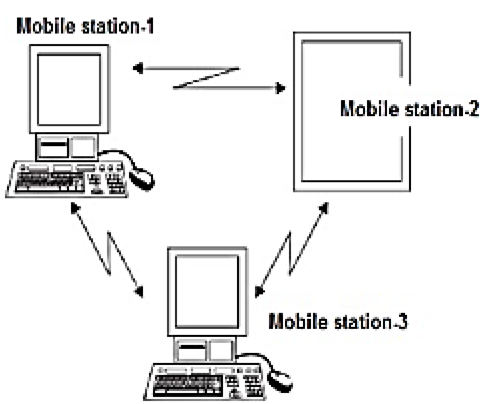
Single ad-hoc network



Multi ad-hoc network

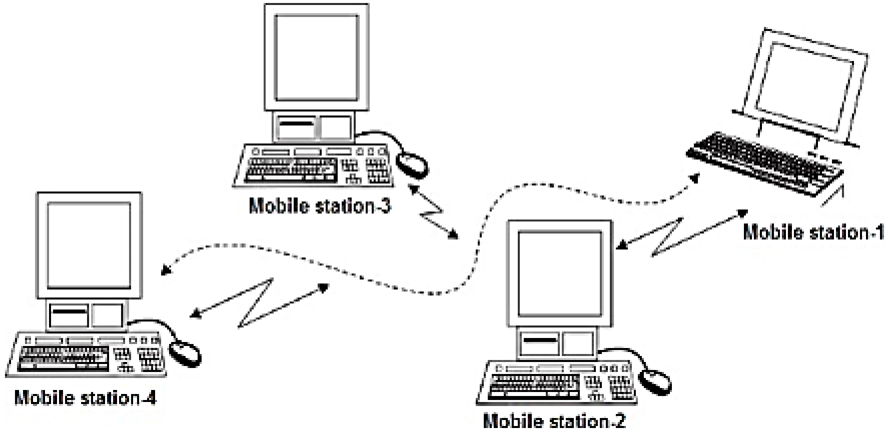
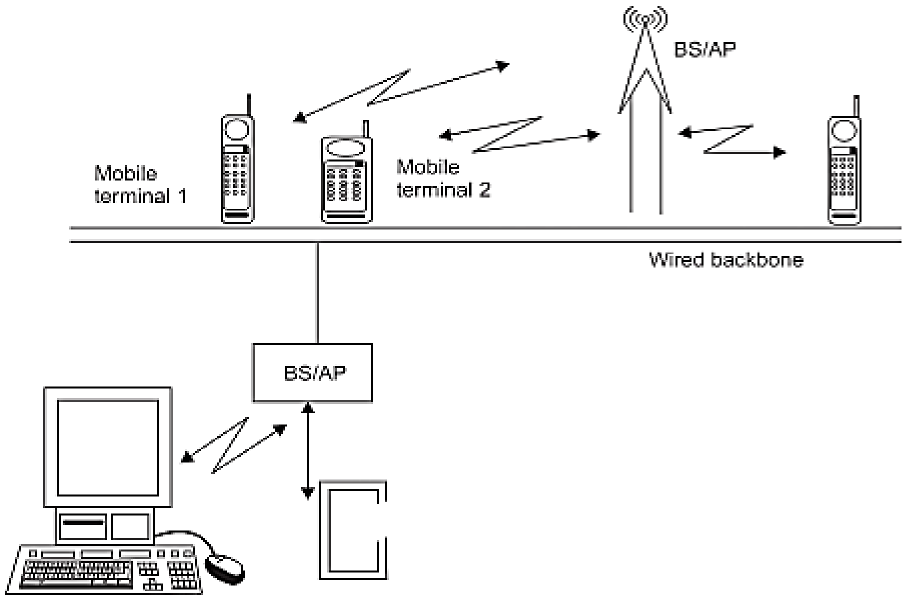


Diagram **2M + 2M**

Explanation **4M**



Q. 10	a	With the help of architecture figures explain the evolution from GSM to LTE.	8

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Diagram **2M + 2M**

Explanation **4M**

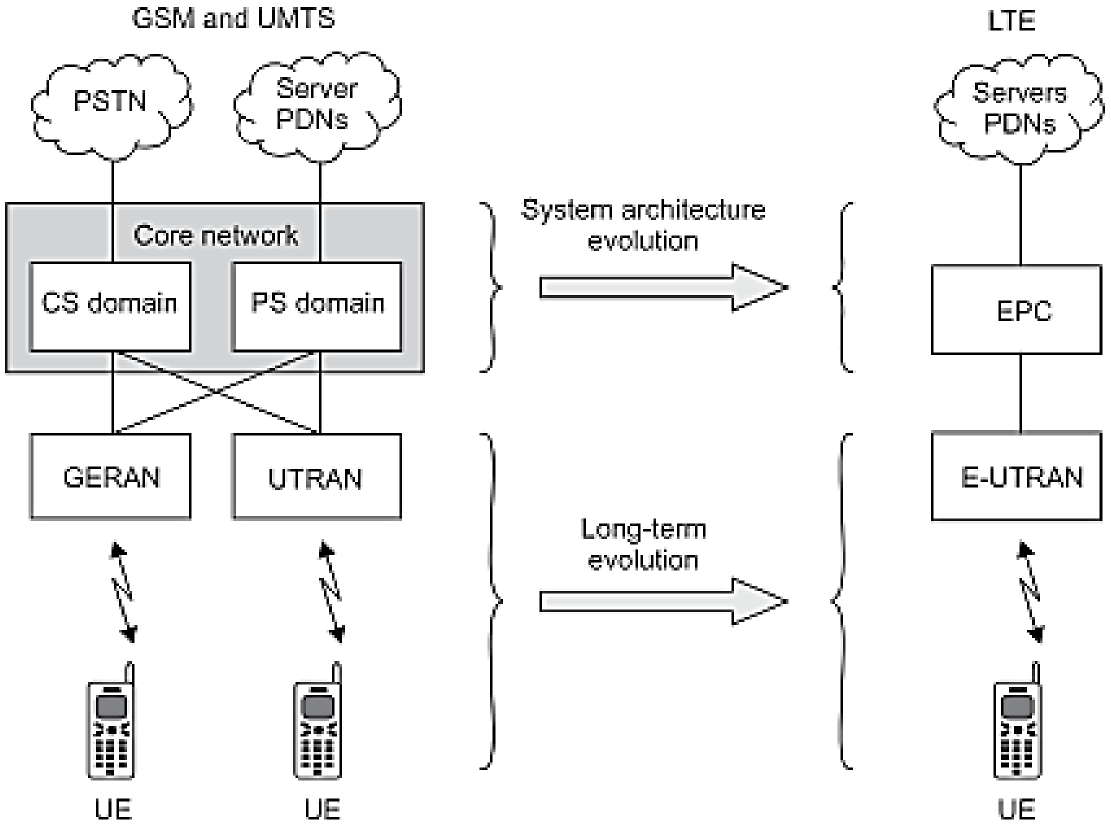

Fig. 8.14 Evolution of the system architecture from GSM and UMTS to LTE

UMTS (universal Mobile Telecommunication Services) is the main technology responsible behind 3G. *Universal Terrestrial Radio Access Network* (UTRAN) consists of multiple *Radio Network Sub-systems* (RNSs) which is equivalent to the *base station subsystem* (BSS). RNS consists of radio transceivers referred to as Node B which are equivalent to the BTSs in the GSM architecture.

	b	List the requirements identified for the 4G technology.	4

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4 points + Explanation **4M**

The high level requirements for a 4G technology were identified as:

i) High spectral efficiency
ii) Reduced cost per bit
iii) Increased services by increasing the efficiency
iv) Open interfaces
v) Power efficiency
vi) Flexible usage of frequency bands

c	Draw the block diagram showing the basic elements of a satellite communication system and briefly explain them.	8

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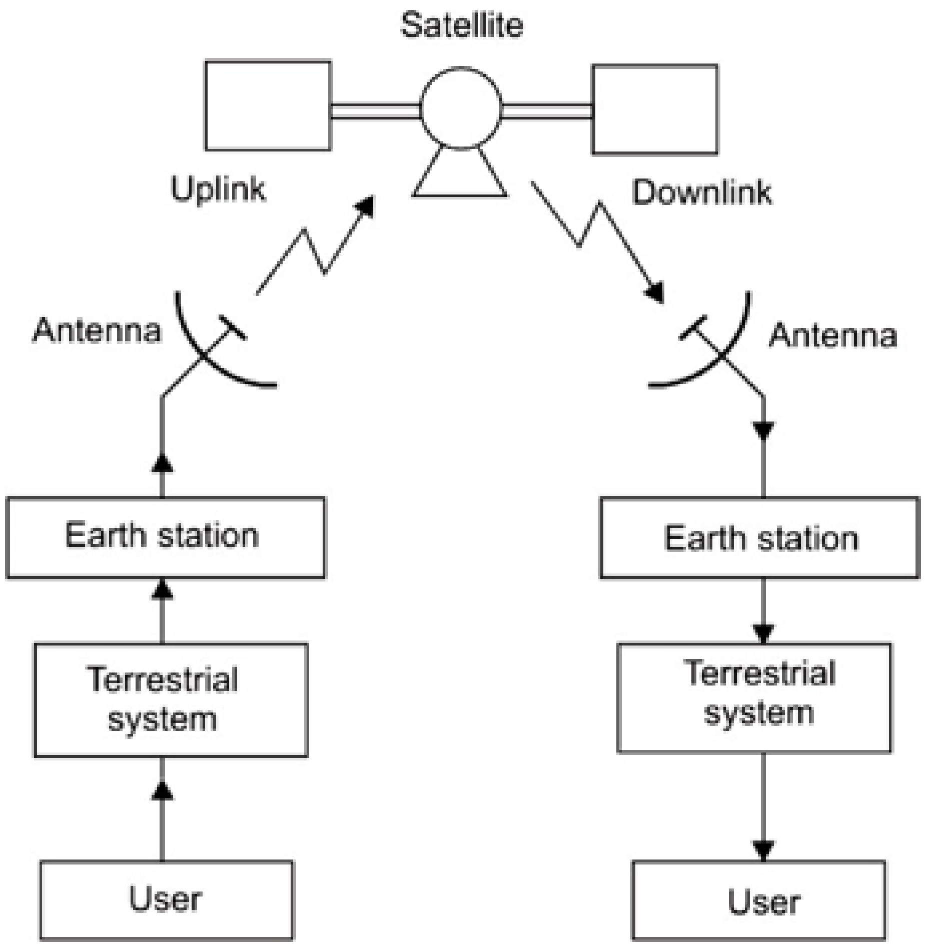

Diagram	3M
Explanation	5M

THANK YOU

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