How to Answer a Question.?!

What Would be the Expected Answer.?!

How to get Maximum marks in VTU Valuation.?!

Solution to

Model Question Paper 2

Basic Electronics & Communication Engineering

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Model Question Paper-2 SOLUTION

Solution Explanation Video : https://youtu.be/LN8Be7b9Mwc

Subject Code-21ELN14/24

Model Question Paper-II with effect from 2021 (CBCS Scheme)

USN | | | | | | | | | | |

First/Second Semester B.E Degree Examination

Basic Electronics & Communication Engineering

Max. Marks: 100

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

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Module -1 (Power Supplies, Amplifiers, Operational amplifiers, Oscillators)			Marks
Q.01	a	Explain the working of Bi-phase Full wave rectifier circuit with neat diagram.	8
	b	List and describe the main types of amplifiers.	7
	c	Describe the working of a single stage astable oscillator using an opamp.	5
OR			
Q.02	a	Explain the operation of a simple shunt Zener voltage regulator.	7
	b	Sketch the circuit of each of the following based on the use of operational amplifiers (a) comparator (b) a differentiator (c) an integrator (d) Inverting Amplifier.	8
	c	With circuit diagram explain the following: Voltage Doubler, Voltage Tripler	5
Module-2 (Logic Circuits, Data representation, Shift registers, Counters)			
Q. 03	a	Design a 3-to-8 Decoder and show its implementation using basic gates.	8
	b	Construct a logic circuit that will produce a Logic 1 output whenever two or more of its inputs are at Logic 1.	7
	c	With the help of truth table explain full adder using logic gates.	5
OR			
Q.04	a	Explain Input and output states for a J-K bistable using clocked operation.	8
	b	With the help of a neat diagram explain the 4-bit shift register operation and types.	7
	c	With a neat block diagram explain the arrangement of a microcontroller system with typical inputs and outputs.	5

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Module-3 (Embedded Systems, Sensors and Interfacing, Actuators, Communication Interface)			
Q. 05	a	Compare Embedded systems and general computing systems. Also provide major application areas of Embedded Systems.	8
	b	Explain the different configurations of 7-segment LED Display.	6
	c	Describe the matrix keyboard interfacing and UART.	6
OR			
Q. 06	a	Define 'sensors' and give its classification with examples.	6
	b	With relevant diagrams explain the operation of Relay, push button and Piezo-buzzer.	8
	c	Explain the following external communication interfaces: USB, wi-fi	6
Module-4 (Analog and Digital Communication)			
Q. 07	a	Define and explain SNR, Noise Figure, channel types, amplitude modulation.	8
	b	Present the architecture of a wireless communication transmitter and its modulation scheme QPSK with waveforms and constellation diagrams.	6
	c	Discuss the various Multiple Access Techniques used in cellular network.	6
OR			
Q. 08	a	Describe the classification of RF (Radio Frequency) spectrum with applications in communications systems.	8
	b	Explain different types of radio wave propagation with a neat diagram.	6
	c	Write short notes on: Forward Error Correction, Automatic Repeat Request	6

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Module-5 (Cellular Wireless Networks, Wireless Network Topologies, Satellite Communication, Optical Fiber Communication, Microwave Communication)			
Q. 09	a	Define the terms cell & cluster in a cellular system and explain the cellular concept in wireless mobile networks.	6
	b	Discuss 3G technology with specific emphasis on CDMA.	6
	c	Bring out the features of FM transmitter, FM receiver and repeaters in microwave communications.	8
OR			
Q. 10	a	Define the following terms with respect to GSM system: Mobile Station (MS), Base Station Subsystem (BSS), Network & Switching System (NSS)	6
	b	With the help of a block diagram explain the generalized configuration of a fiber – optic communication system.	8
	c	Based on orbits, discuss the different types of satellites.	6

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Q.01	a	Explain the working of Bi-phase Full wave rectifier circuit with neat diagram.	8

Centre tapped full wave rectifier

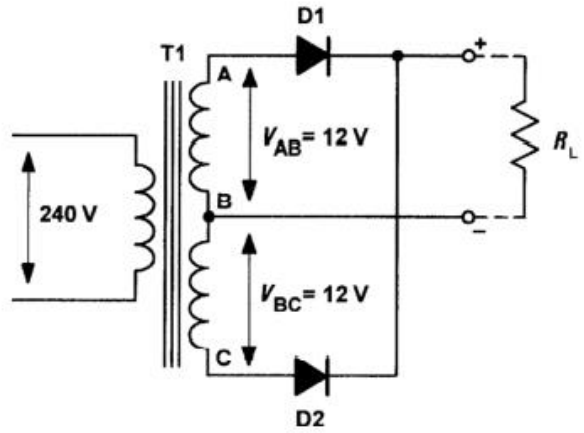
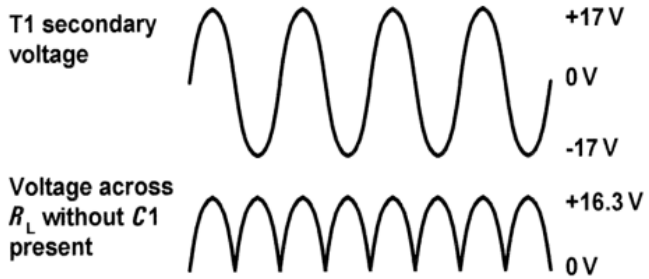
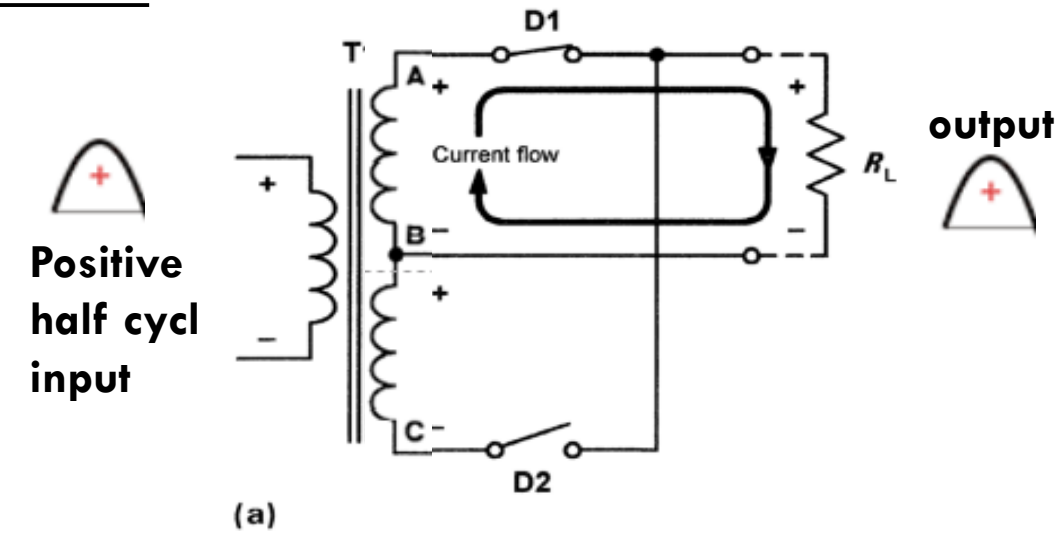


Figure 6.10 Bi-phase rectifier circuit

Waveform **1M**





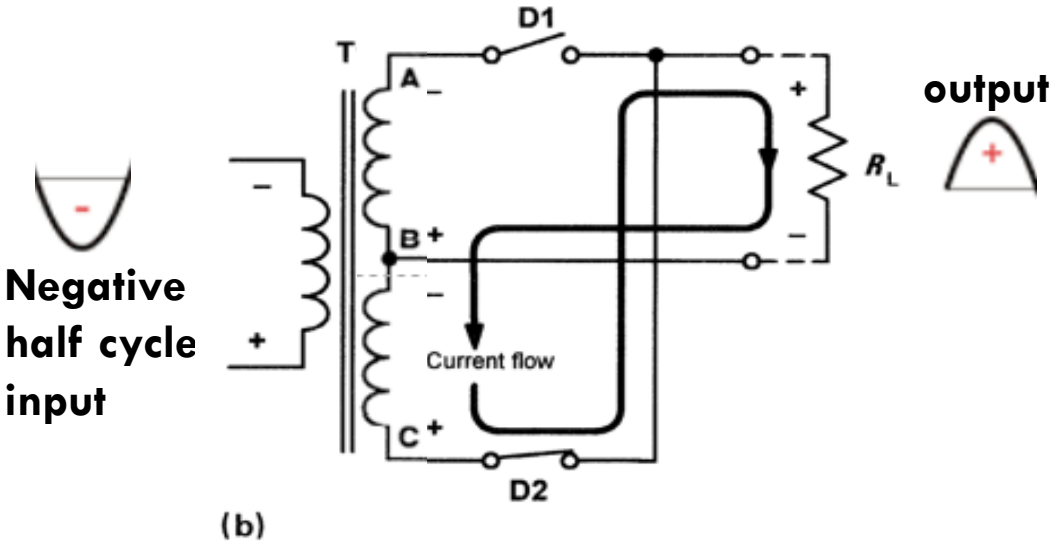


Diagram **3M**

Explanation **4M**

Write two to three lines of Explanation for +ve and –ve cycle

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b	List and describe the main types of amplifiers.	7

Explanation **7x1=7M**

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1. **A.C. Coupled Amplifiers**
   Stages are coupled together in such a way that only the ac components of a signal are transferred from stage to stage.
2. **D.C. Coupled Amplifiers**
   Stages are coupled together in such a way that both d.c and a.c components are transferred from stage to stage
3. **Large Signal Amplifiers**
   amplifiers are designed to amplify the appreciable voltage and/or current levels (typically from 1 V to 100 V or more).
4. **Small Signal Amplifiers**
   Small-signal amplifiers are designed to cater for low-level signals (normally less than 1 V and often much smaller)

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5	Audio Frequency Amplifiers	Audio frequency amplifiers operate in the band of frequencies that is normally associated with audio signals (e.g. 20 Hz to 20 kHz).
6	Wideband Amplifiers	Wideband amplifiers are capable of amplifying a very wide range of frequencies, typically from a few tens of hertz to several megahertz.
7	Radio Frequency Amplifiers	Radio frequency amplifiers operate in the band of frequencies that is normally associated with radio signals (e.g. from 100 kHz to over 1 GHz)
8	Low Frequency Amplifiers	Low-noise amplifiers are designed so that they contribute negligible noise to the signal being amplified. designed for use with very small signal levels (usually less than 10 mV or so).

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c	Describe the working of a single stage astable oscillator using an opamp.	5

Diagram 2M

Explanation 3M

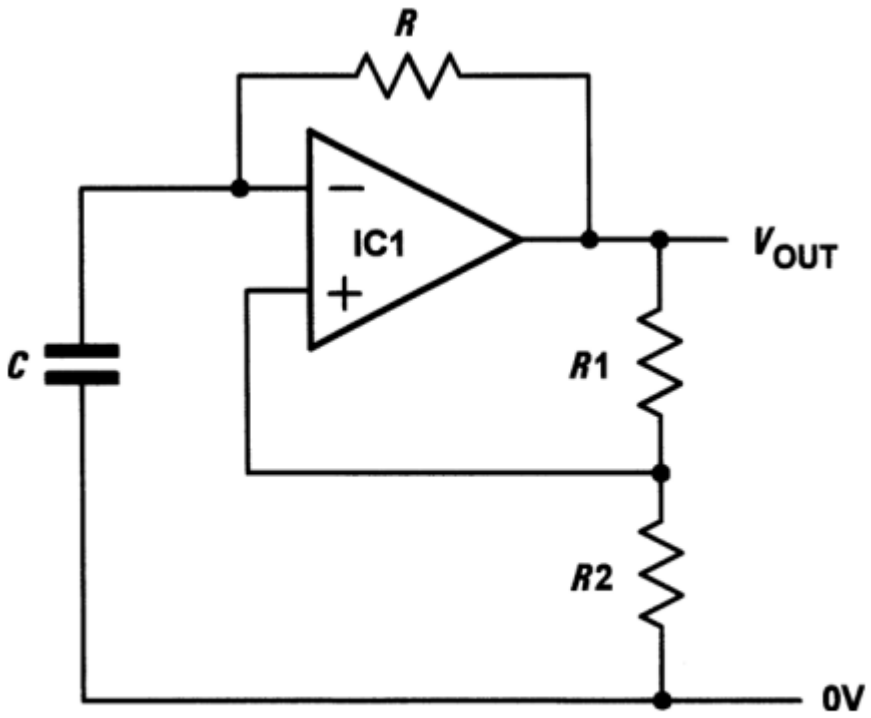
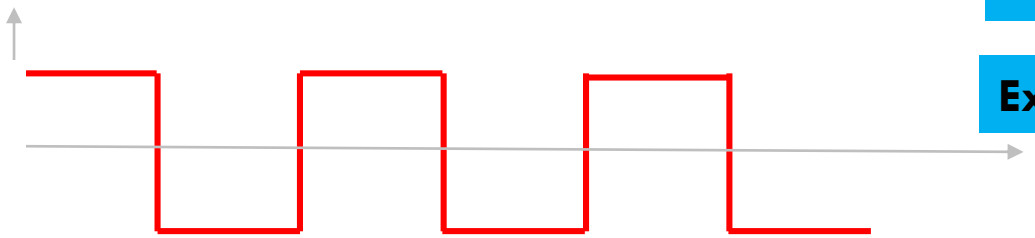


Figure 9.10 Single-stage astable oscillator using an operational amplifier



- Assume that C is initially uncharged and the voltage at the inverting input is slightly less than the voltage at the non-inverting input.
- The output voltage will rise rapidly to $+V_{CC}$ and the voltage at the inverting input will begin to rise exponentially as capacitor C charges through R.
- Eventually the voltage at the inverting input will have reached a value that causes the voltage at the inverting input to exceed that present at the non-inverting input.
- At this point, the output voltage will rapidly fall to $-V_{CC}$.
- Capacitor C will then start to charge in the other direction and the voltage at the inverting input will begin to fall exponentially.

$$V_{UT} = V_{CC} \times \left(\frac{R2}{R1+R2}\right) \qquad V_{LT} = -V_{CC} \times \left(\frac{R2}{R1+R2}\right)$$

$$T = 2CR\ln\left(1+2\left(\frac{R2}{R1}\right)\right)$$

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Q.02	a	Explain the operation of a simple shunt Zener voltage regulator.	7

Diagram + Expression	3M
Explanation	4M

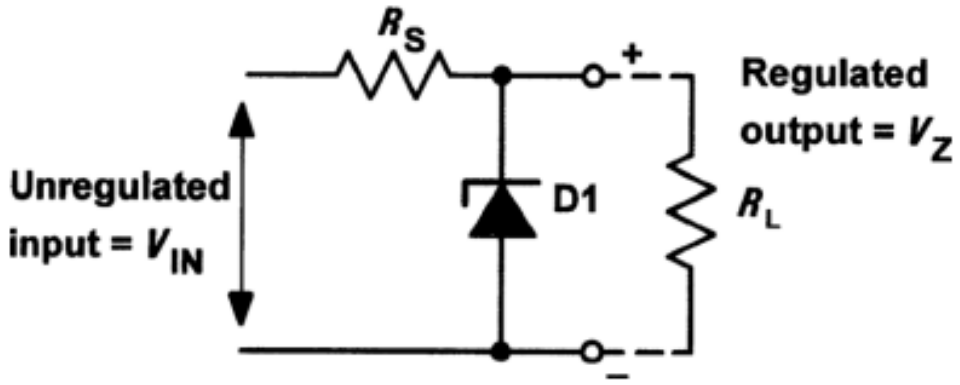

Figure 6.19 A simple shunt zener voltage regulator

- A simple voltage regulator is shown in Fig. 6.19.
- RS is included to limit the zener current to a safe value when the load is disconnected.

- The ratio of Rs to RL is significant as the input voltage is voltage divided by them and made available as Vz

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$$V_z = V_{IN}\ X\ \frac{R_L}{R_L + R_s}$$

Where V_{IN} is unregulated input voltage

The maximum value of Rs can be calculated from $R_{s(max)} = R_L\ X\ \left(\frac{V_{IN}}{V_z} - 1\right)$

- The power dissipated in the Zener diode will be given as Pz= Iz X Vz.
- The minimum value for Rs is determined from **off-load condition –**

$$R_{s\ (\min)} = \frac{(V_{IN}\,V_Z - V_Z^2)}{Pz\ \max}$$

where Pz max is the maximum rated power dissipation for the Zener diode.

	b	Sketch the circuit of each of the following based on the use of operational amplifiers (a) comparator (b) a differentiator (c) an integrator (d) Inverting Amplifier.	8

Diagram **4x2=8M**

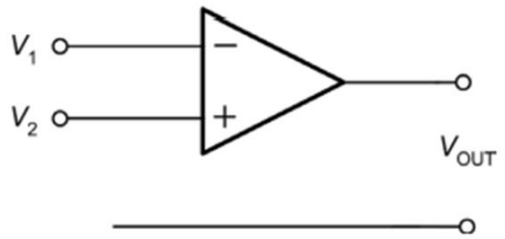
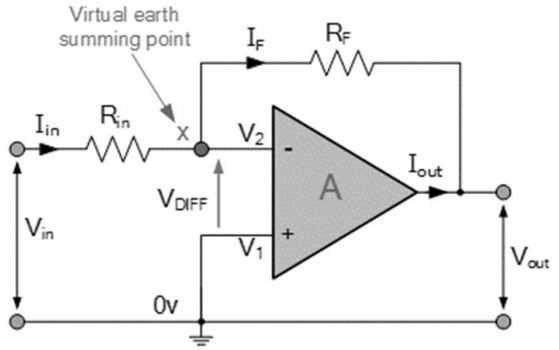


Figure 8.17 A comparator



$$Vout = -\frac{Rf}{Rin} \times Vin$$

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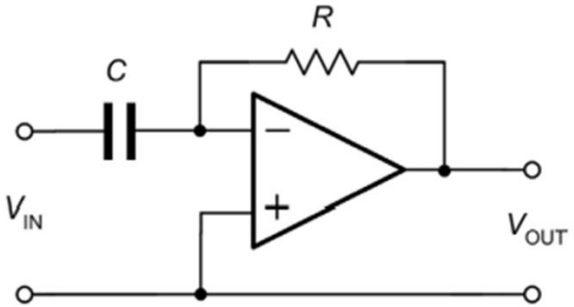

Figure 8.13 A differentiator

$$V_{OUT} = -R_F C \frac{dV_{IN}}{dt}$$

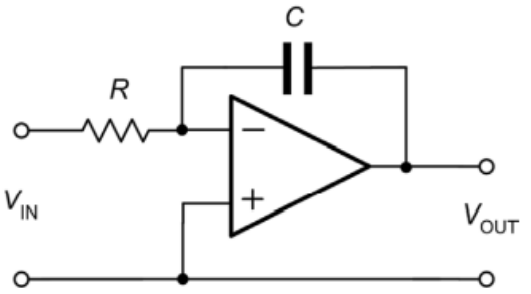

Figure 8.15 An integrator

c	With circuit diagram explain the following: Voltage Doubler, Voltage Tripler	5

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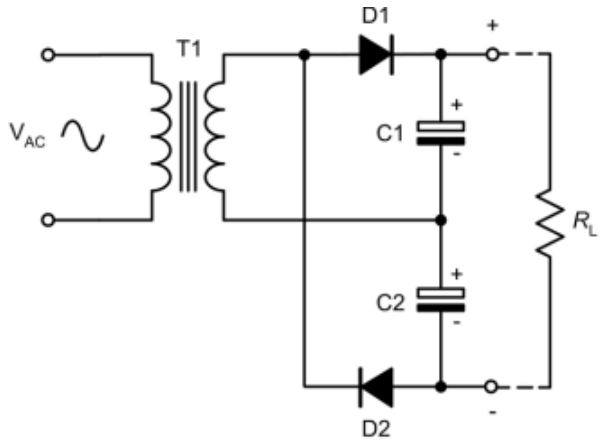
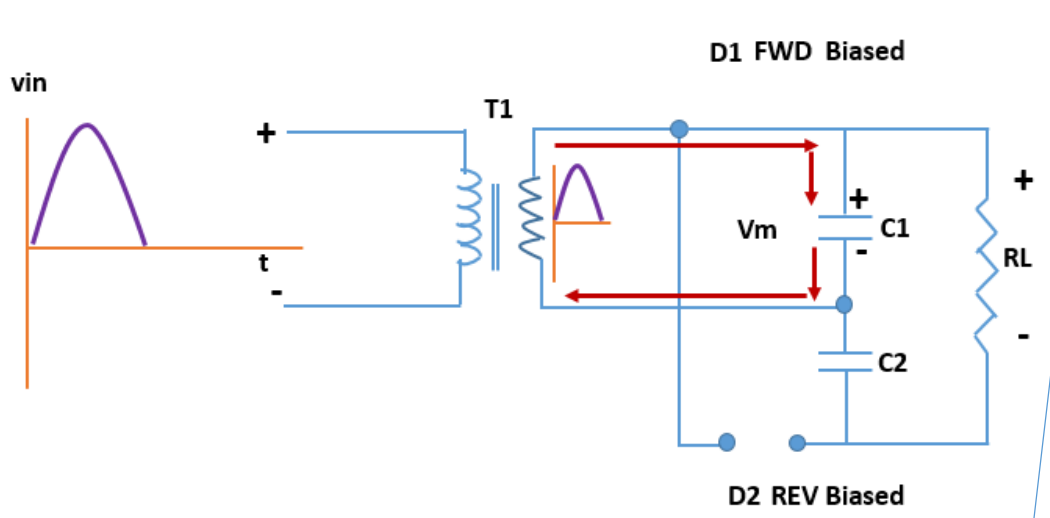
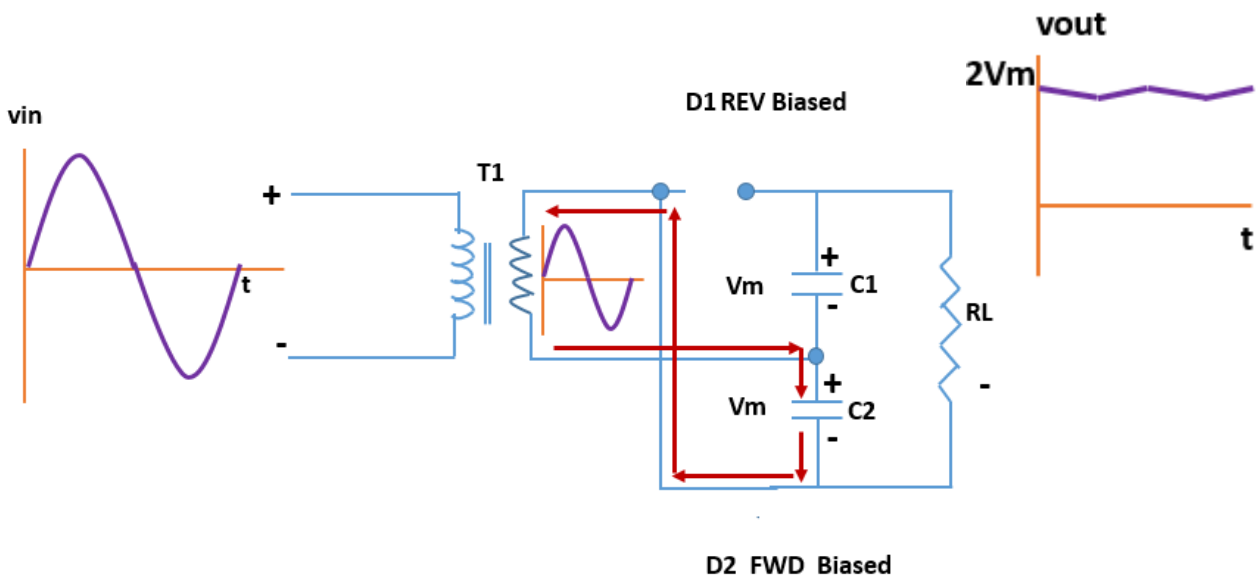


Figure 6.25 A voltage doubler

- In this arrangement C1 will charge to the positive peak secondary voltage while C2 will charge to the negative peak secondary voltage.
- Since the output is taken from C1 and C2 connected in series the resulting output voltage is twice that produced by one diode alone.





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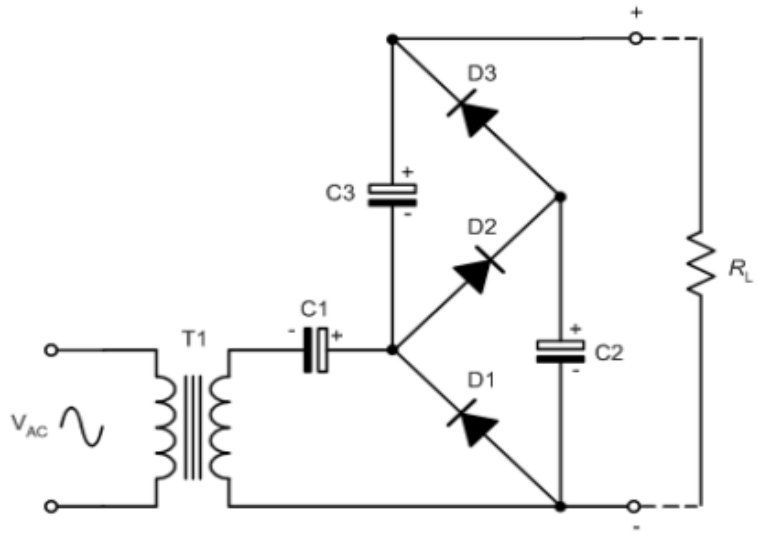
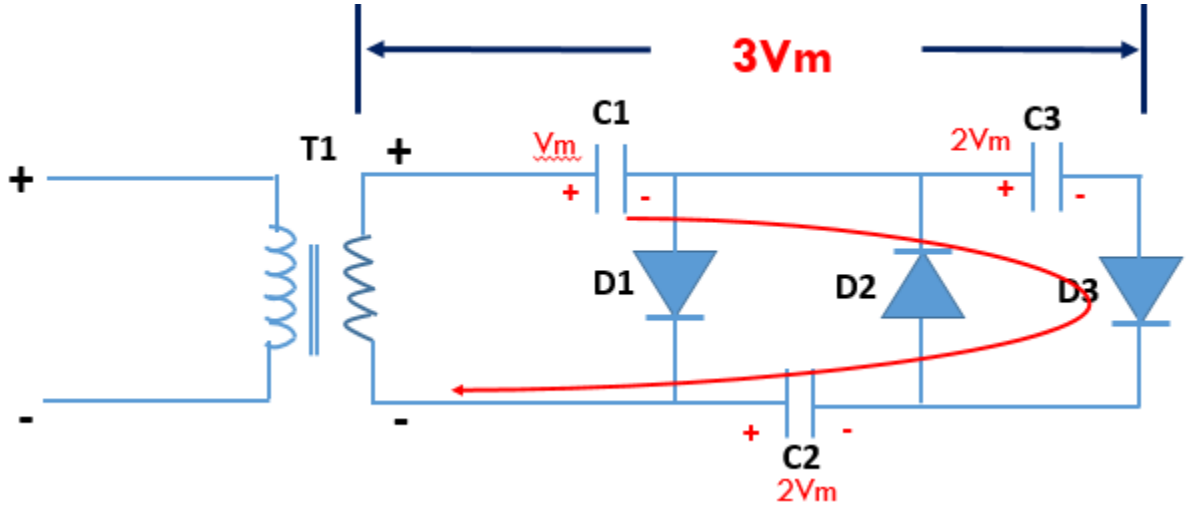


Figure 6.26 A voltage tripler

- Here C1 charges to the positive peak secondary voltage, while C2 and C3 charge to twice the positive peak secondary voltage.
- The result is that the output voltage is the sum of the voltages across C1 and C3 which is three times the voltage that would be produced by a single diode.



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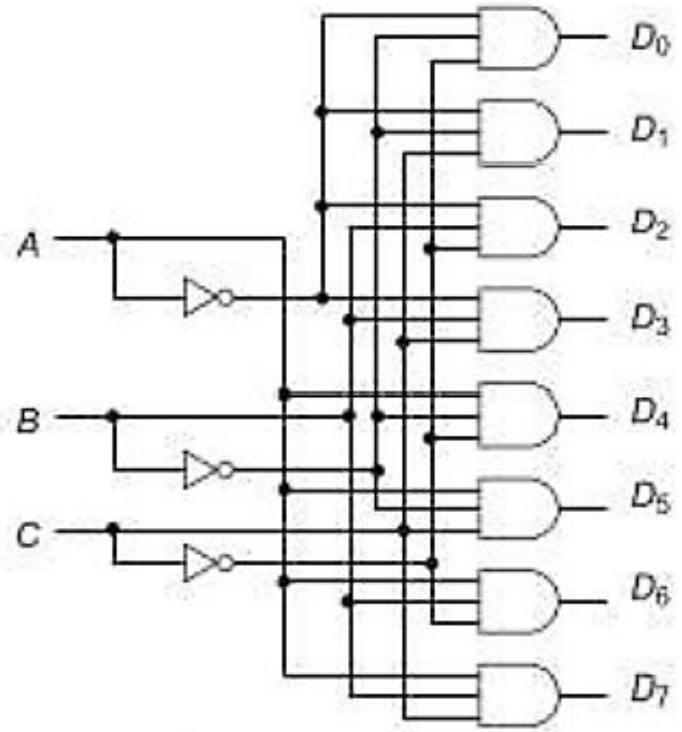
Q. 03	a	Design a 3-to-8 Decoder and show its implementation using basic gates.	8

Truth Table 3M

Diagram + Explanation 3+2=5M

3 to 8 decoder

A_2	A_1	A_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	1	0	0	0	0	0	0	1	0	0
0	1	1	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0	0	0
1	0	1	0	0	1	0	0	0	0	0
1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0



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b	Construct a logic circuit that will produce a Logic 1 output whenever two or more of its inputs are at Logic 1.	7

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

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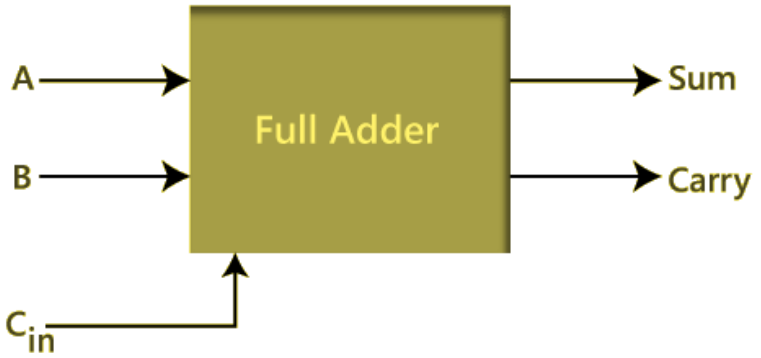
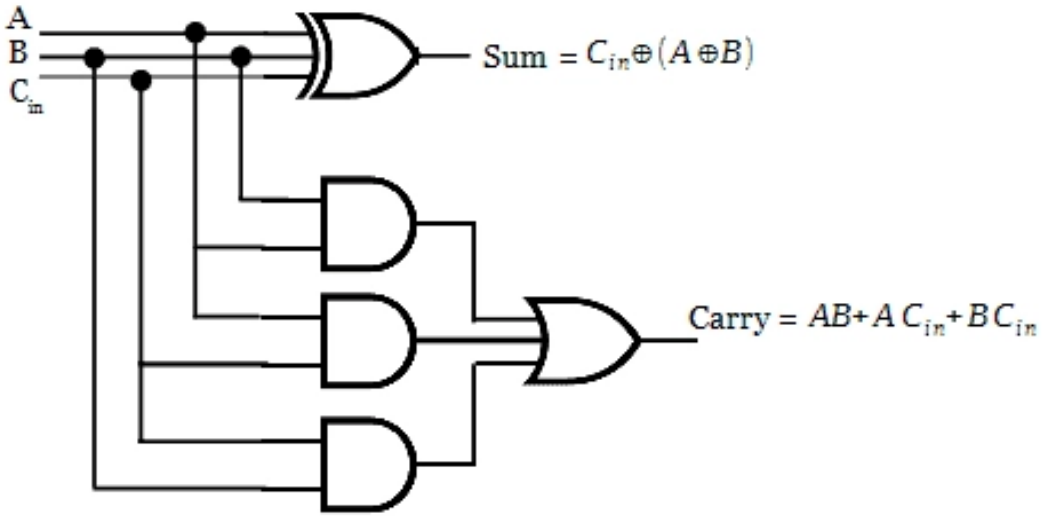
c	With the help of truth table explain full adder using logic gates.	5



Truth Table 2M

Circuit 3M

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



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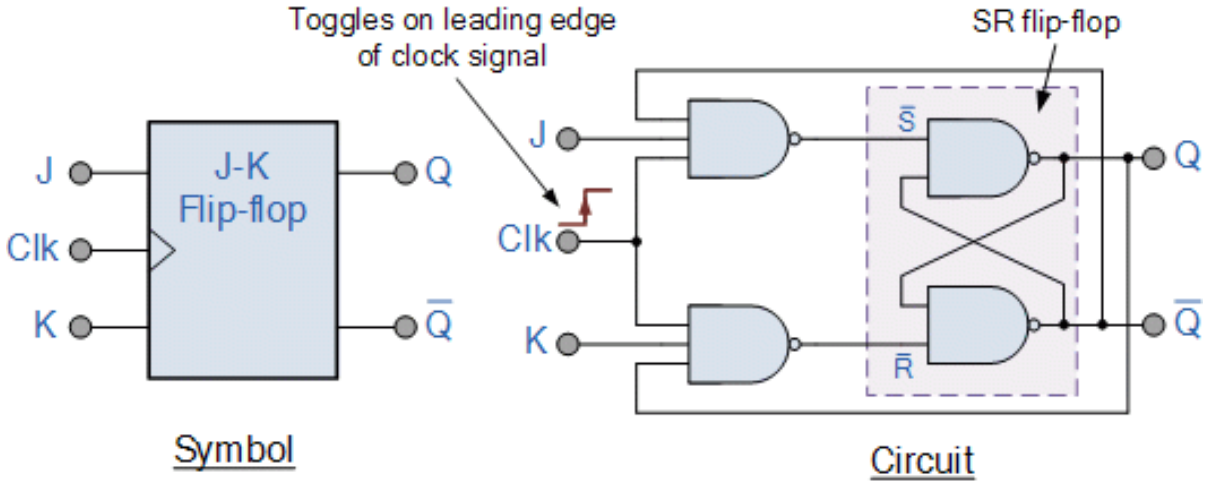
Q.04	a	Explain Input and output states for a J-K bistable using clocked operation.	8

Diagram **3M**



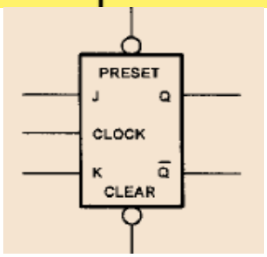


Table 10.5 Input and output states for a J-K bistable (clocked operation)

Inputs		Output	Comments
J	K	Q_{N+1}	
0	0	Q_N	No change in state of the Q output on the next clock transition
0	1	0	Q output changes to 0 (i.e. Q is reset) on the next clock transition
1	0	1	Q output changes to 1 (i.e. Q is set) on the next clock transition
1	1	Q_N	Q output changes to the opposite state on the next clock transition

Note: Q_{N+1} means 'Q after next clock transition' while Q_N means 'Q in whatever state it was before'

Truth Table **2M**

Clk	J	K	Q	Q'	State
1	0	0	Q	Q'	No change in state
1	0	1	0	1	Resets Q to 0
1	1	0	1	0	Sets Q to 1
1	1	1	-	-	Toggles

Explanation **2M**

Write 4 lines of 4 cases of inputs

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b	With the help of a neat diagram explain the 4-bit shift register operation and types.	7

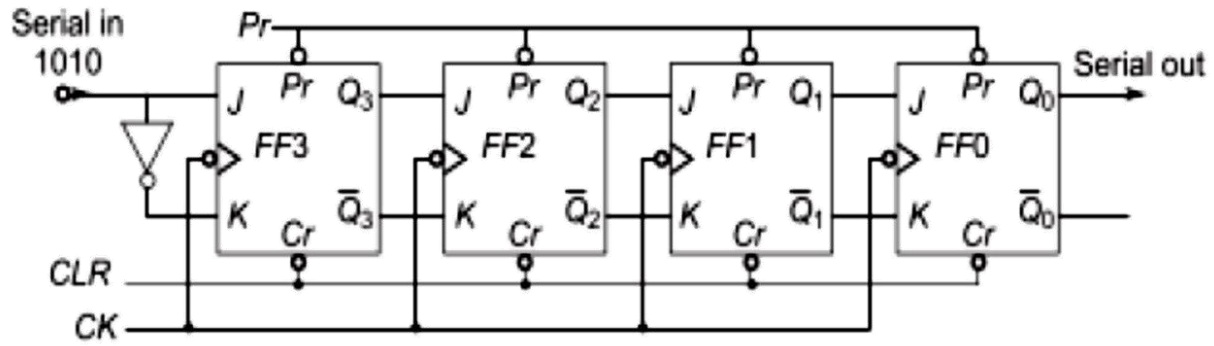

Diagram **3M**

Explanation **4M**

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

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c	With a neat block diagram explain the arrangement of a microcontroller system with typical inputs and outputs.	5

Diagram **3M**

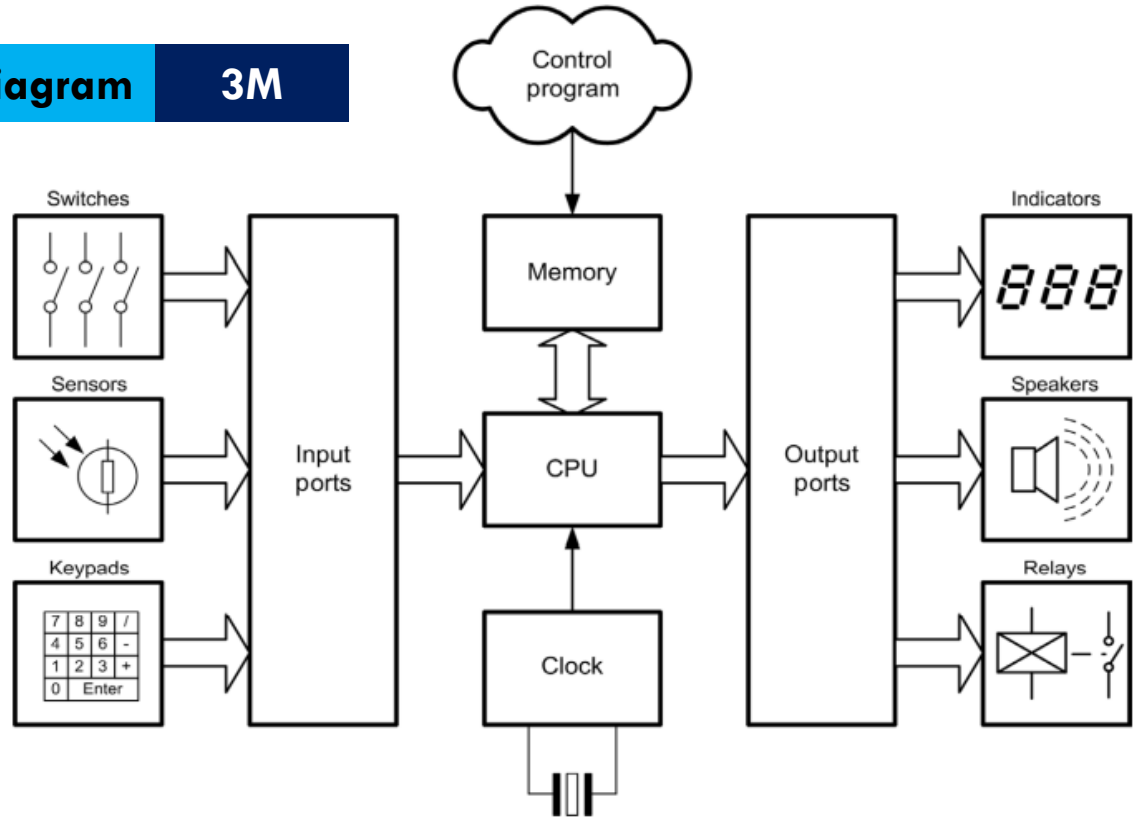

Figure 11.11 A microcontroller system with typical inputs and outputs

Explanation **2M**

- ✓ 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.

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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.

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Q. 05	a	Compare Embedded systems and general computing systems. Also provide major application areas of Embedded Systems.	8

5 Differences **5M**

General Purpose System	Embedded System
A system which is a combination of generic hardware and General Purpose Operating System for executing a variety of applications	A system which is a combination of special purpose hardware and embedded OS for executing a specific set of applications
Contain a General Purpose Operating System (GPOS)	May or may not contain an operating system for functioning
Applications are alterable (programmable) by user (It is possible for the end user to re-install the Operating System, and add or remove user applications)	The firmware of the embedded system is pre-programmed and it is non-alterable by end-user (There may be exceptions for systems supporting OS kernel image flashing through special hardware settings)
Performance is the key deciding factor on the selection of the system. Always 'Faster is Better'	Application specific requirements (like performance, power requirements, memory usage etc) are the key deciding factors
Less/not at all tailored towards reduced operating power requirements, options for different levels of power management.	Highly tailored to take advantage of the power saving modes supported by hardware and Operating System
Response requirements are not time critical	For certain category of embedded systems like mission critical systems, the response time requirement is highly critical
Need not be deterministic in execution behavior	Execution behavior is deterministic for certain type of embedded systems like 'Hard Real Time' systems

- **Consumer Electronics:** Camcorders, cameras, etc.
- **Household Appliances:** Television, DVD Players, Washing machines, Fridge, Microwave Oven, etc.
- **Home Automation and Security systems:** Air conditioners, Sprinklers, Intruder Detection Alarms, Closed Circuit Television Cameras, Fire Alarms, etc.
- **Automotive Industry:** Anti-lock breaking system (ABS), Engine Control, Ignition Systems, Automatic Navigation systems, etc.
- **Telecom:** Cellular Telephones, Telephone Switches, Handset Multimedia Applications, etc.
- Computer Peripherals: Printers, Scanners, Fax machines, etc.
- **Computer networking system:** Network Routers, Switches, Hubs, Firewalls, etc.
- **Healthcare:** Different kinds of scanners, EEG, ECG machines, etc.
- **Measurement & Instrumentation:** Digital multi meters, Digital CROs, Logic Analyzers, PLC systems, etc.
- **Banking & Retail:** Automation Teller Machine (ATM) and currency counters, Point of Sales(POS)
- **Card Readers:** Barcode, Smart Card Readers, Hand held Devices, etc.

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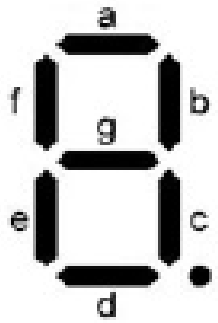
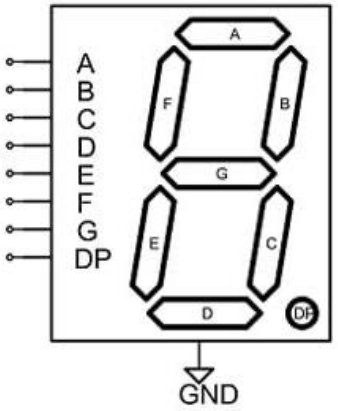
b	Explain the different configurations of 7-segment LED Display.	6



- ✓ The 7 – segment LED display is an output device for displaying alpha numeric (0–9 and A–F) characters.
- ✓ It contains eight LED segments arranged in a special form.
- ✓ Out of the 8 LED segments, 7 are used for displaying alpha numeric characters.
- ✓ The LED segments are named A to G and the decimal point LED segment is named as DP.
- ✓ The LED Segments A to G and DP should be lit accordingly to display numbers and characters.

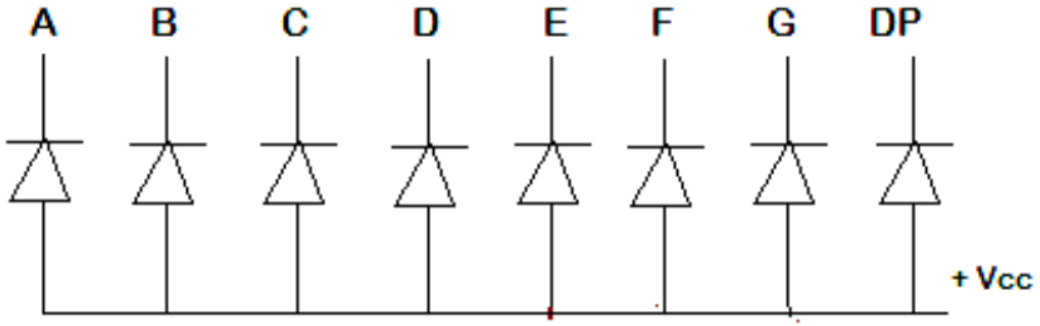


Diagrams 3M

Two different configurations

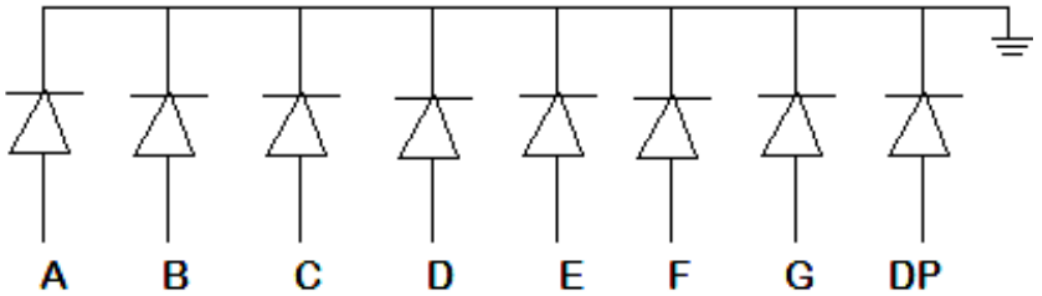
Explanation 3M

i) common anode



common anode configuration, the anodes of all LEDs connected together to +Vcc

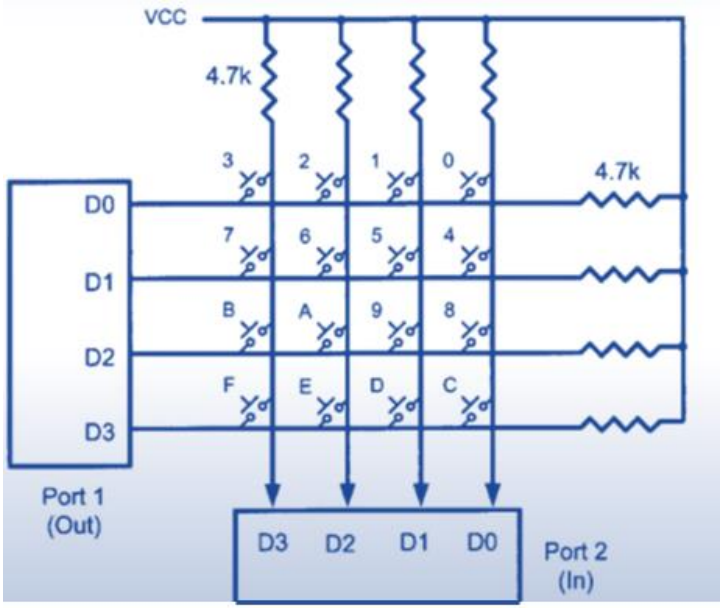
ii) common cathode



common cathode configuration, the cathodes of all LEDs connected together to ground

	c	Describe the matrix keyboard interfacing and UART.	6

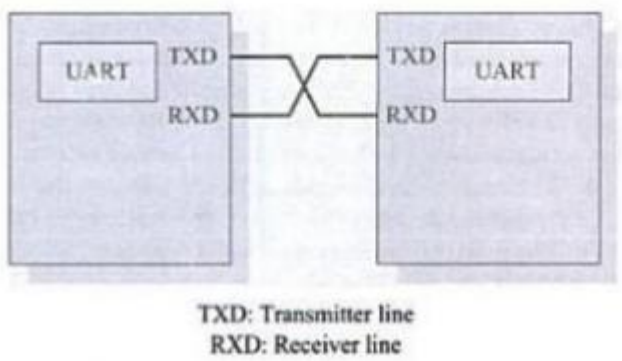
- ✓ 4×4 matrix keypad consists of 4 rows and 4 columns and each switch is placed between the rows and columns.
- ✓ When a key is pressed, a row and a column make a contact.
- ✓ Otherwise, there is no connection between rows and columns.



In order to detect the pressed key, the following points to be noted worthy.

i) the rows configured as an output port, making each row logic 0 and
ii) the columns configured as an input port, making each column at logic 1
iii) If all rows = 0000, and all columns = 1111, detecting no key is pressed
iv) If one of the column bits read logic 0, detecting a key is pressed
v) To detect the key pressed, microcontroller undergoes scanning technique by
vi) reading each row

- 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.



Q. 06	a	Define 'sensors' and give its classification with examples.	6

Definition **1M**

- ✓ A sensor is a special kind of transducer that is used to generate an input signal to a measurement, instrumentation or control system.
- ✓ The signal produced by a sensor is an electrical analogy of a physical quantity, such as distance, velocity, acceleration, temperature, pressure, light level, etc.

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Classification **3M**

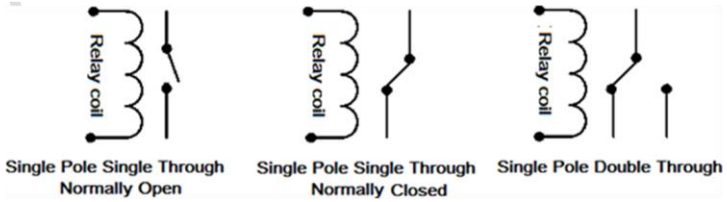
- ✓ Sensors can be categorized as either active or passive.
- ✓ An active sensor generates a current or voltage output with out any external supply.
- ✓ A passive transducer requires a source of current or voltage to generate output.

Examples **3M**

- ✓ Sensors can also be classed as either digital or analogue.
- ✓ The output of a analogue sensor is an analog signal, can take any one of an infinite number of voltage or current levels.
- ✓ The output of a digital sensor can exist in only two discrete states, either 'on' or 'off', 'low' or 'high', 'logic 1' or 'logic 0', etc

b	With relevant diagrams explain the operation of Relay, push button and Piezo-buzzer.	8

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



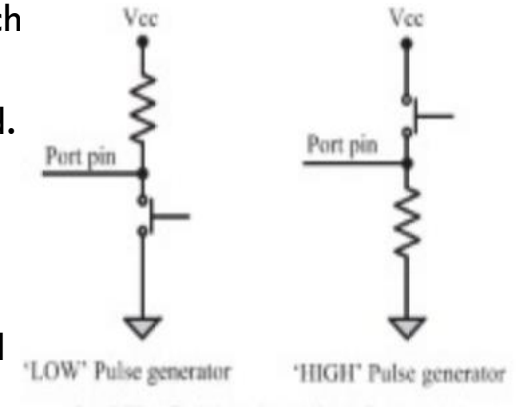
- ✓ When a voltage is applied to the relay coil, current flows through the coil, which in turn generates a magnetic field.
- ✓ The magnetic field attracts the armature core and moves the contact point. The movement of the contact point changes the path of power/signal.

Push to Make:

- ✓ In the push to make configuration the switch is *normally in the open state* and makes a circuit contact when it is pushed or pressed.

Push to Break:

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



- ✓ 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.

Self-driving

- It contains all the necessary components to generate a sound at a predefined sound.
- It generate tone by applying the voltage.

External driving

- It supports generation of different tones.
- Tone can be varied by applying variable pulse train to the piezoelectric buzzer.

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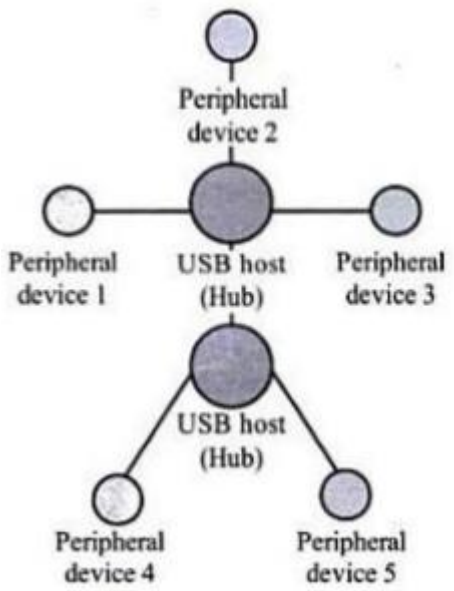
c	Explain the following external communication interfaces: USB, wi-fi	6

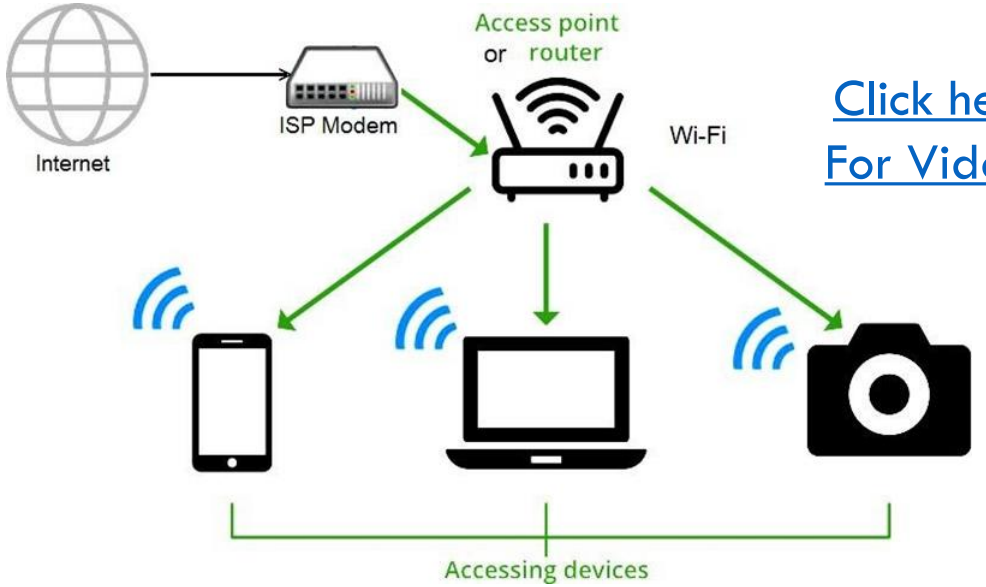
Diagrams 3M
Explanation 3M



- ✓ 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.

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

- Wi-Fi is a wireless high-speed internet connection technique used to connect computers, tablets, smart phones and other accessing devices for internet.
- Wi-Fi uses radio waves sent from a wireless router to a nearby device, which translates the signal into a data format.
- Wi-Fi connection is established from the access point to the Wi-Fi enabled devices within a specific range.
- There are four major types of Wi-Fi standards, operate in wide range of data speed and transmits on 2.4GHz or 5GHz frequency.



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Q. 07	a	Define and explain SNR, Noise Figure, channel types, amplitude modulation.	8

4 x 2 = 8M

$$SNR = \frac{P_{signal}}{P_{noise}} \begin{matrix} \text{(Wanted component)} \\ \text{(Unwanted component)} \end{matrix}$$

$$\left(\frac{S}{N}\right)_{dB} = 10\log_{10}\left(\frac{V_s^2}{V_n^2}\right)$$

$$\left(\frac{S}{N}\right)_{dB} = 20\log_{10}\left(\frac{V_s}{V_n}\right)$$

Noise Figure, *NF*

$$NF = 10\log F$$

$$= 10\log\frac{Si/Ni}{So/No}\ (dB)$$

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Hardwired channels

(Hardware Channels)Man Made Structure used as medium also called as Line Communication system

- Twisted pair cables used in telephony
- Coaxial cable used in TV transmission, to carry high-frequency signals
- *Optical Fibre*: consist of very thin hollow glass fibre through which signal is transmitted in the form of light energy.

Soft-wired channels

(Software Channels) Natural Resources are used as Transmission medium

- Air: Signals transmitted as Electromagnetic Waves (Radio Waves)
- Antenna Converts Electric Signal into EM Waves
- Open Space, Sea Water
- The signals are transmitted in the form of electromagnetic (EM) waves also called radio waves. Radio waves travel through open space at a speed equal to that of light ($c = 3 \times 10^8$ m/s)

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Amplitude Modulation

The process in which the amplitude of the carrier signal is varied according to the instantaneous values of the message signal, where as the frequency and phase are kept constant.

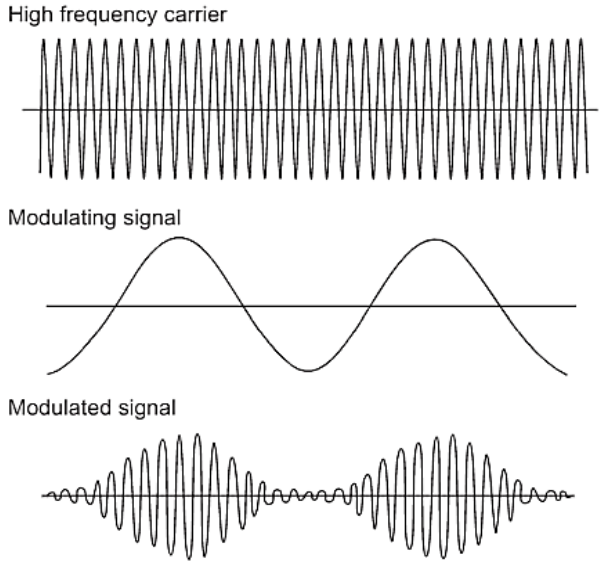
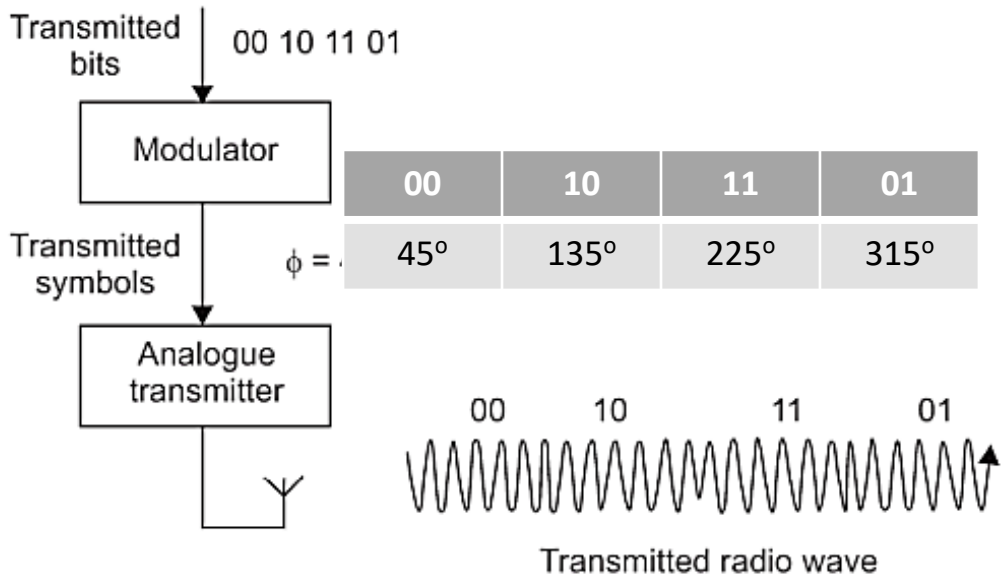


Fig. 2.1 Waveforms related to amplitude modulation

b	Present the architecture of a wireless communication transmitter and its modulation scheme QPSK with waveforms and constellation diagrams.	6



00	10	11	01
45°	135°	225°	315°

Diagram 4M

Explanation 2M

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Fig. 6A.1 Architecture of a wireless communication transmitter

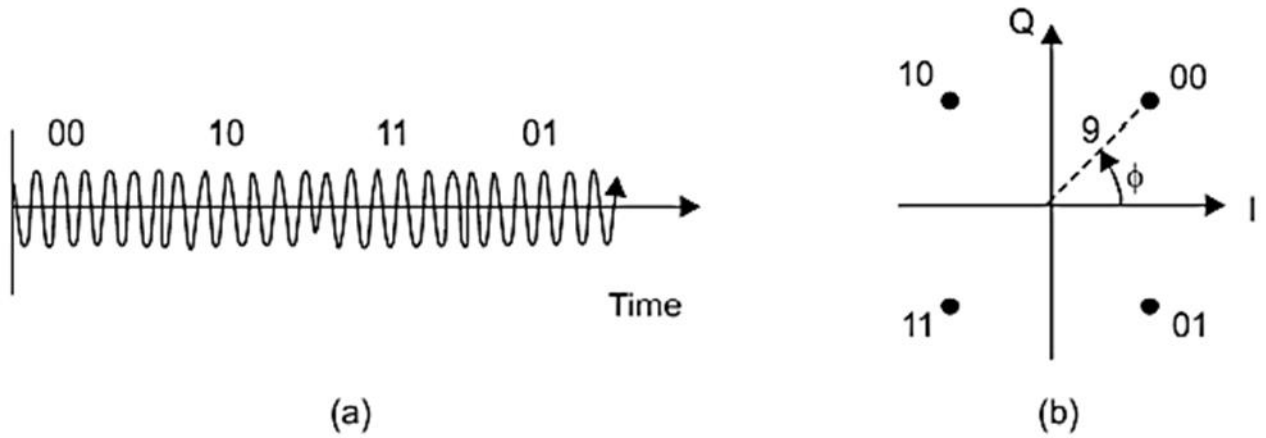

Fig. 6A.2 Quadrature phase shift keying. (*a*) Example QPSK waveform. (*b*) QPSK constellation diagram

c	Discuss the various Multiple Access Techniques used in cellular network.	6

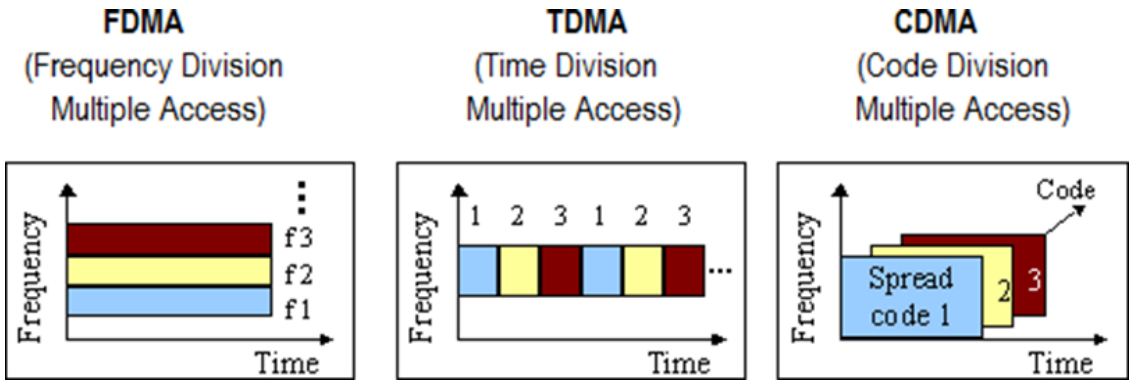

Diagram **2M**

Explanation **4M**

Multiple Access Techniques

FDMA

* Available frequency band is split into smaller frequency channels, and different channels are assigned to different users.
* The carriers are separated by guard bands, which avoid the interference between the users.

TDMA

* Various users can transmit at the same frequency band at different times.
* Every user is permitted to transmit only in specific time slots using a common frequency band.
* GSM uses a combination of both TDMA and FDMA techniques.
* LTE uses orthogonal FDMA techniques.

CDMA

* Mobiles receive signals on the same carrier frequency and at the same time. But the signals are labeled by the use of codes, which allows a mobile to separate its own signal from the others.
*CDMA is the common platform on which 3G technologies are built.

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Q. 08	a	Describe the classification of RF (Radio Frequency) spectrum with applications in communications systems.	8

Table 1.1: Classification of radio frequency (RF) spectrum alongwith the associated applications in 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

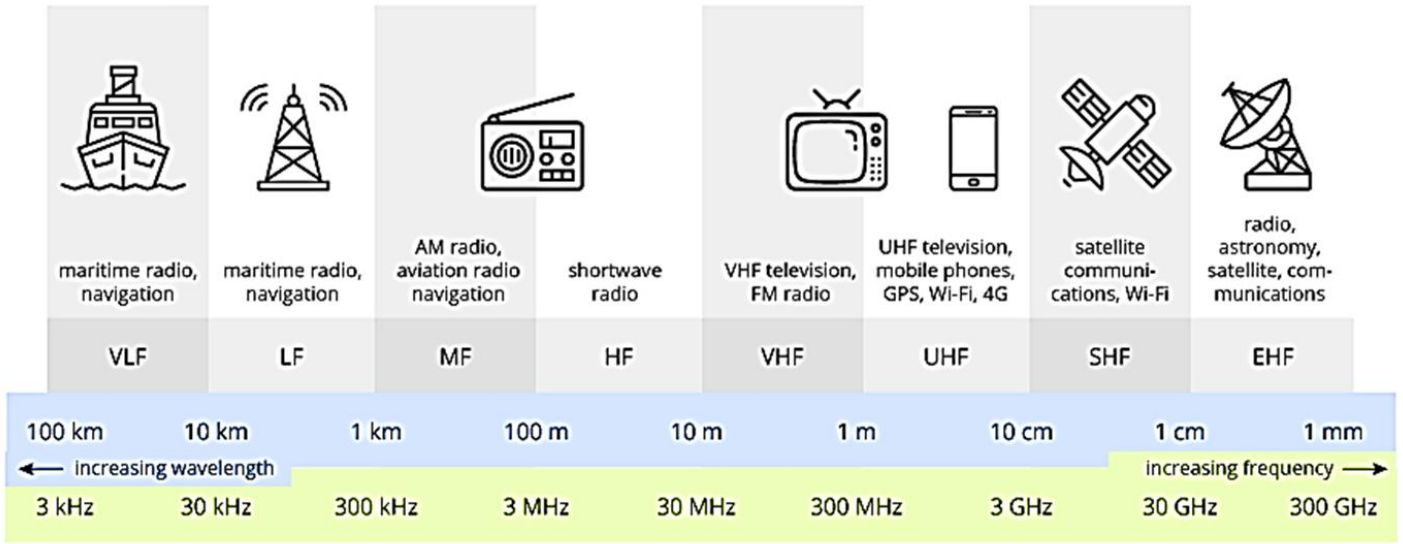

Diagram **3M**

Explanation **5M**

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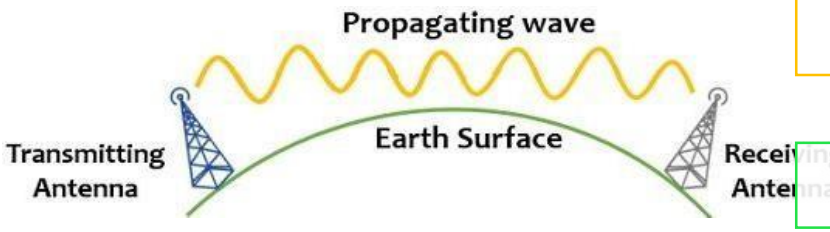
b	Explain different types of radio wave propagation with a neat diagram.	6

Diagram 3M

Explanation 5M

Ground or surface wave



Frequency range: 30 kHz to 3 MHz

Transmission distance: 100 to 1000 km

Example: AM radio broadcast in the medium areas.

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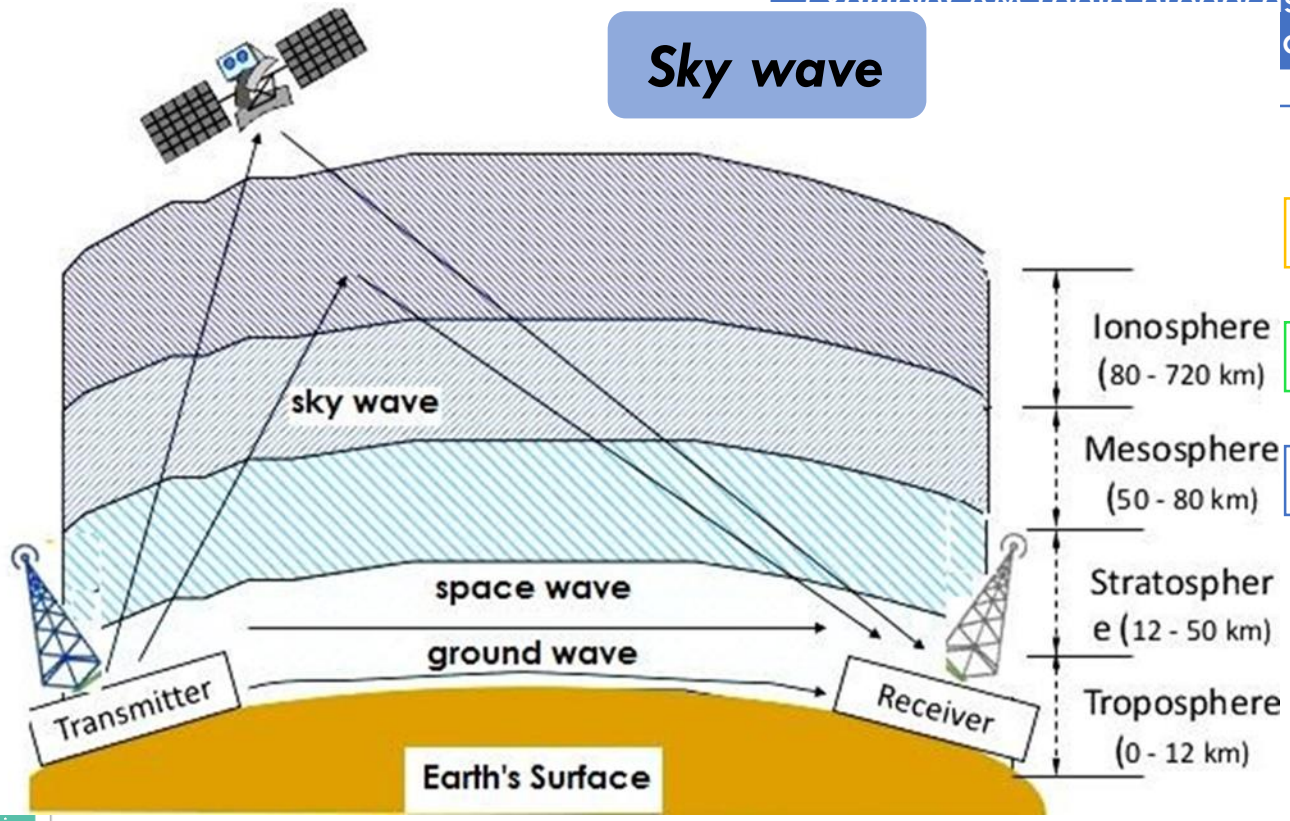
Sky wave



Frequency range: 3MHz to 30 MHz

Radio waves move in the earth's troposphere within about 12 KM over the surface of the earth.

Space wave is made up of Direct and Indirect Waves

Frequency range: few MHz to 40 MHz

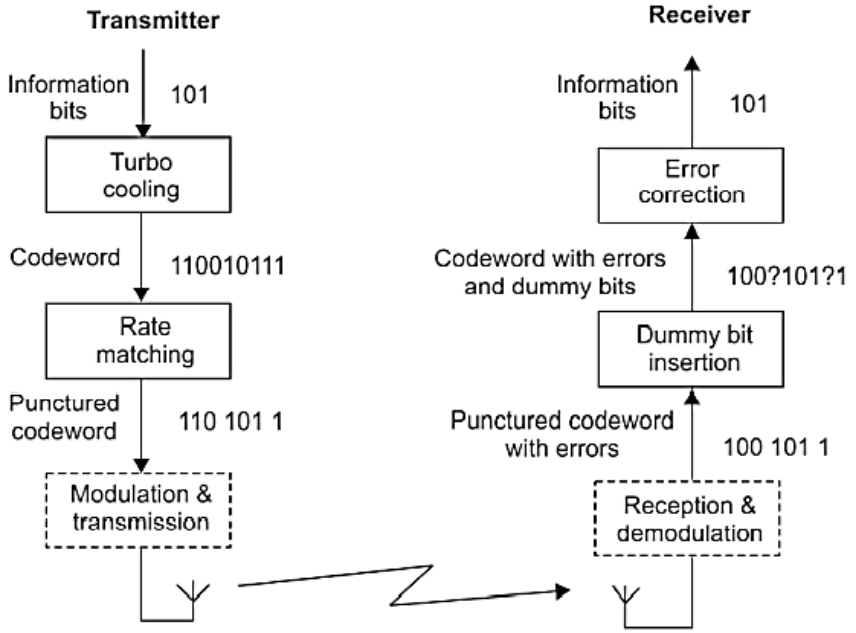
Radio waves transmitted from the transmitting antenna reach the receiving antenna after reflection from the ionosphere

The ionized region extending about 80 KM above the earth's surface

c | Write short notes on: Forward Error Correction, Automatic Repeat Request | 6

Diagrams 3M

Explanations 3M



First stage: Fixed Rate Encoder

LTE Uses Turbo Encoding with encoding rate of 1/3

Second Stage: Rate Matching

Some of the coded bits are transferred and remaining are discarded: Puncturing

- Receiver also has copy of Puncturing Algorithm
- Receiver adds dummy bits at discarded bit locations
- Then Pass through Turbo Decoder for Error Correction

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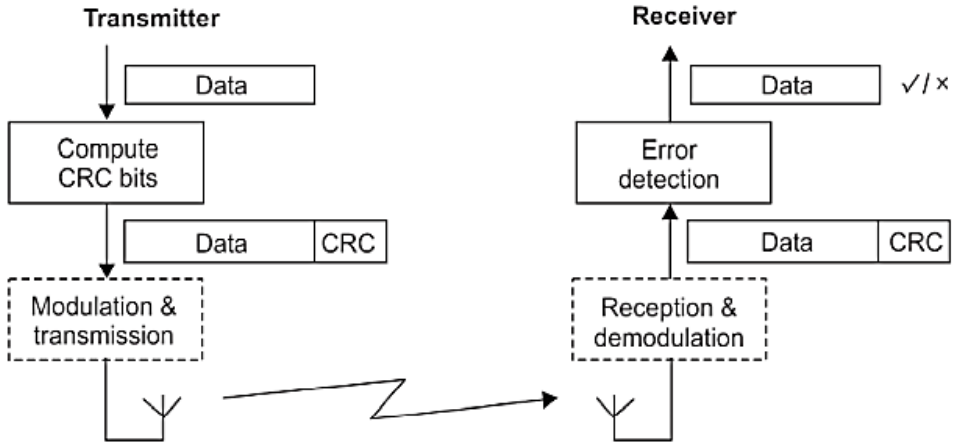
- Transmitter takes a block of information bits and uses them to compute some extra bits that are known as a **cyclic redundancy check (CRC).**
- Append these to the information block and then transmits the two sets of data in the usual way.
- Receiver separates the two fields and uses the information bits to compute the expected CRC bits.
- If the observed and the expected CRC bits are the same, then it concludes that the information has been received correctly and sends positive acknowledge back to the transmitter.

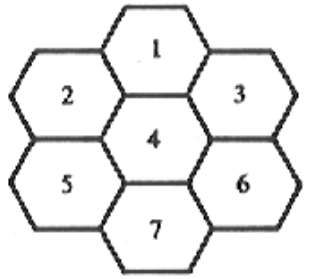


Q. 09	a	Define the terms cell & cluster in a cellular system and explain the cellular concept in wireless mobile networks.	6

Diagram 2M

Explanation 4M

- ✓ Geographical area is divided into number of smaller service areas (5-20kms) called as *cells*.
- ✓ The groups of cells are known as *clusters*, in which no frequency is reused within a cluster.
- ✓ Frequencies used in one cell can be *reused* in other cell of neighboring clusters.
- ✓ High power transmitter is replaced by many low power transmitters, each providing coverage to only a small portion of the service area.
- ✓ Cluster size is not fixed, it can be varied based on the subscriber density and the demand.
- ✓ Small cells will increase the network capacity.



Cluster

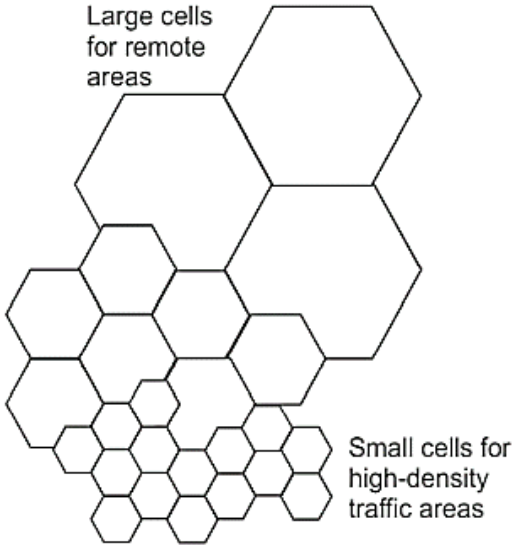


Fig. 8.2 Cellular concept in wireless and mobile networks

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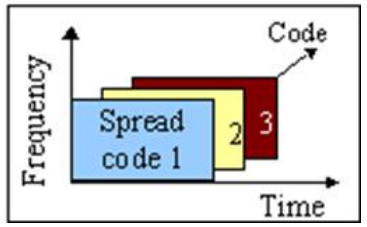
b	Discuss 3G technology with specific emphasis on CDMA.	6

Explanation **6M**

Two main 3G networks are:

1. UMTS (Universal Mobile Telecommunication System) and
2. CDMA-2000

CDMA
(Code Division Multiple Access)



- ✓ The dominant technology for 3G systems is CDMA.
- ✓ Code Division Multiple Access system is very different from time and frequency multiplexing.
- ✓ It optimizes the use of available bandwidth.
- ✓ The technology is commonly used in ultra-high-frequency (UHF) cellular telephone systems, bands ranging between the 800- MHz and 1.9-GHz. Though CDMA is used only by 24% of the users worldwide, CDMA phones emit less radiation than GSM phones.
- ✓ Capacity of a Mobile Telecommunication System is given by $C = B\ log2(1 + SINR)$
- ✓ CDMA offers these advantages: Error Control Coding, Spreading of the spectrum, Soft handoffs, Strict power control.

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c	Bring out the features of FM transmitter, FM receiver and repeaters in microwave communications.	8

Diagram **5M**

Explanation **3M**

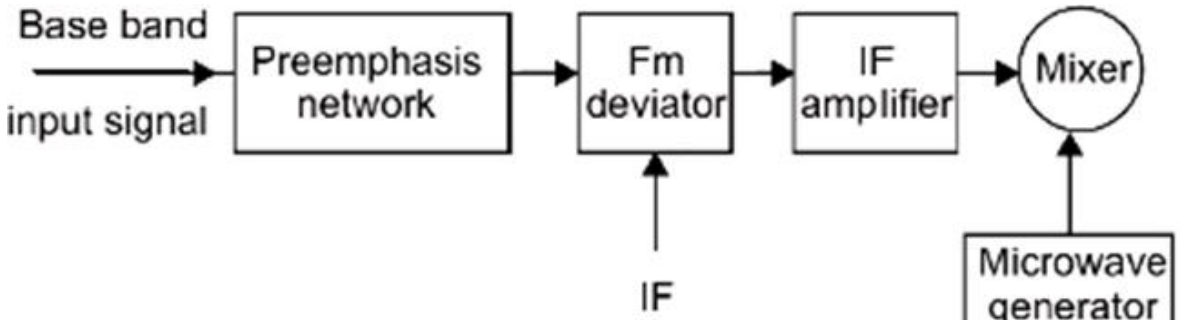

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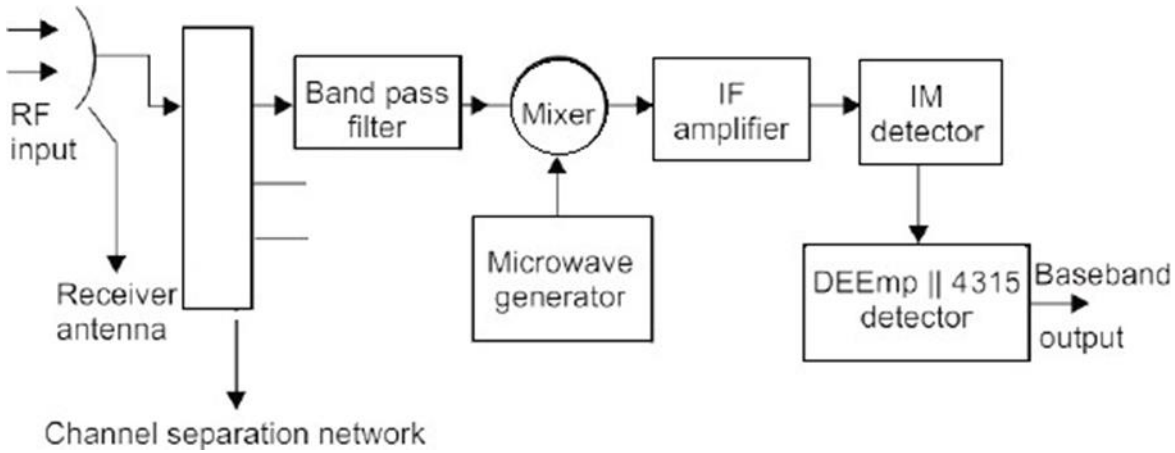
Fig.11 Block diagram of FM transmitter



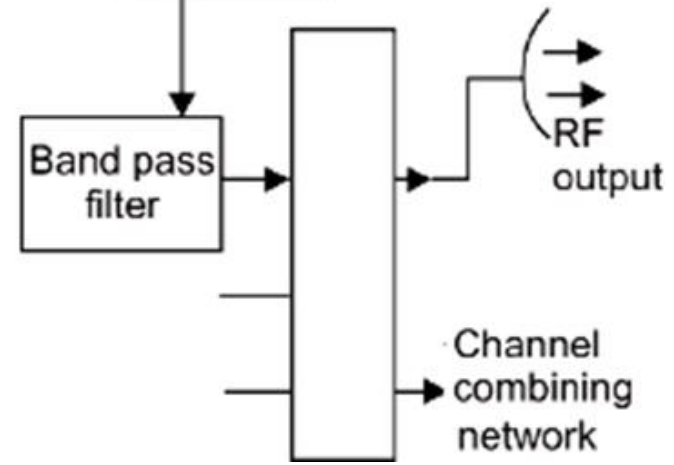
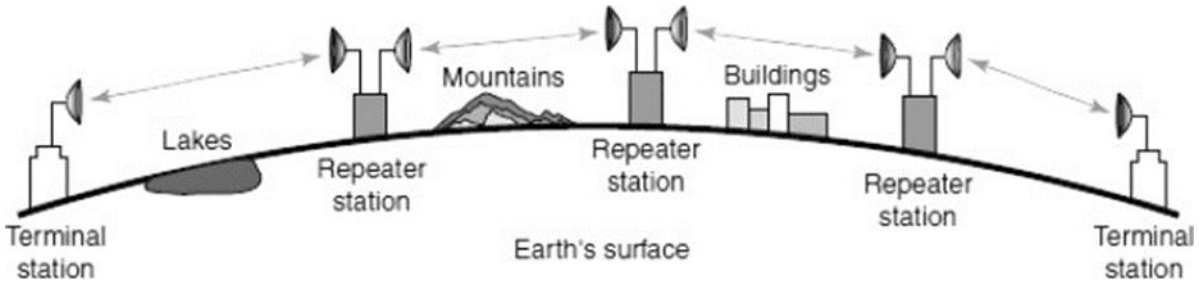


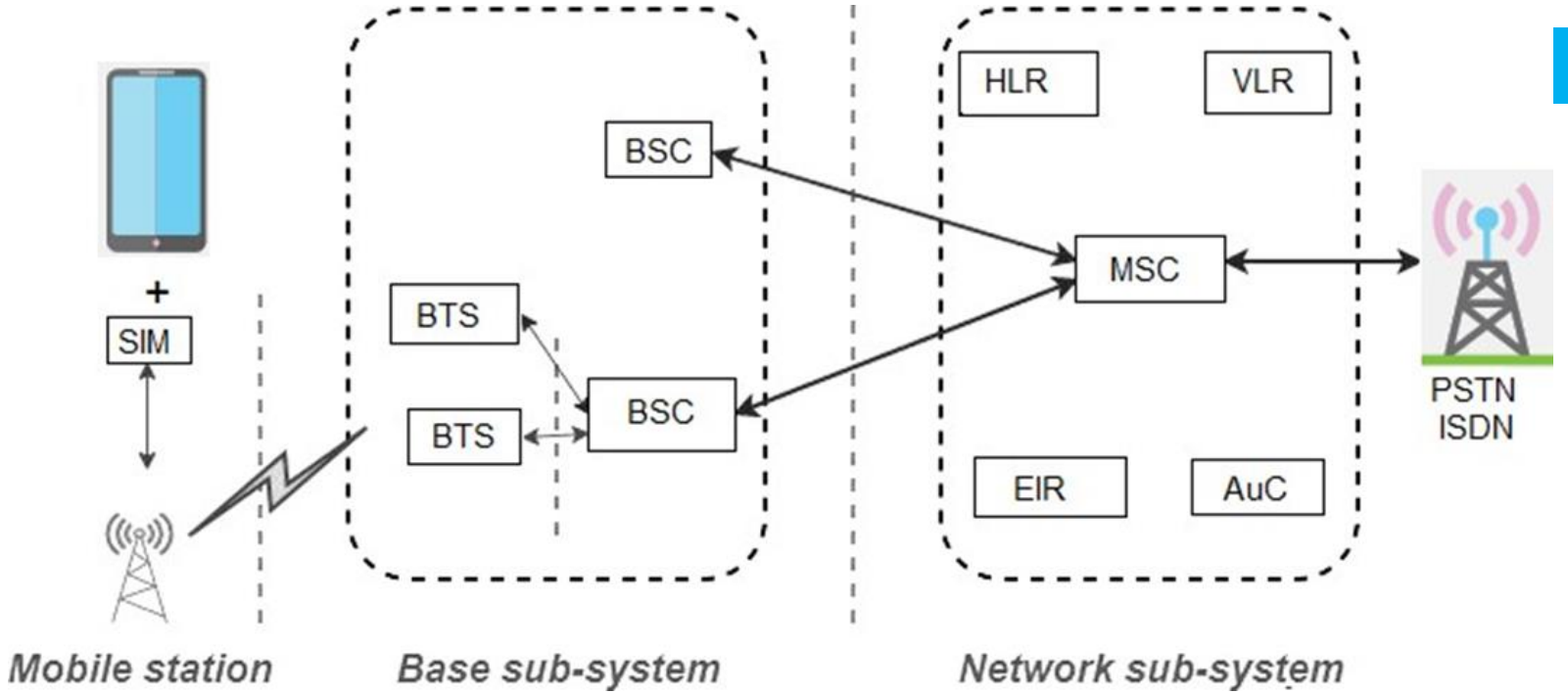
Fig.12 Block diagram of FM receiver



Q. 10	a	Define the following terms with respect to GSM system: Mobile Station (MS), Base Station Subsystem (BSS), Network & Switching System (NSS)	6

Diagram

Explanation **6M**



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Base sub-system (BSS): The BSS handles traffic between the MS and the NSS. It consists of two main components: the base transceiver station (BTS) and the base station controller (BSC). The BTS contains the equipment that communicates with the mobile phones, while the BSC is to allocate necessary time slots between the BTS and MSC.

Network Sub-system (NSS): The NSS is the core network that tracks the location of callers to enable the delivery of cellular services. It includes 5 functional units.

i) Mobile switching center (MSC): performs call setup, call release, call tracing, call forwarding and Short Message Service (SMS)

ii) Home location register (HLR): functions the subscriber's ID, plan and caller tune you are using location, authentication via SIM cards.

iii) Visitor location register (VLR): contains the exact location of all mobile subscribers currently present in the service area of MSC

iv) Equipment identity register (EIR): It is a database which contains a list of valid mobile equipment on the network. database that keeps the record of all allowed or banned in the network.

v) Authentication center (AuC): It perform authentication of subscriber.

	b	With the help of a block diagram explain the generalized configuration of a fiber – optic communication system.	8

Diagram **4M**

Explanation **4M**

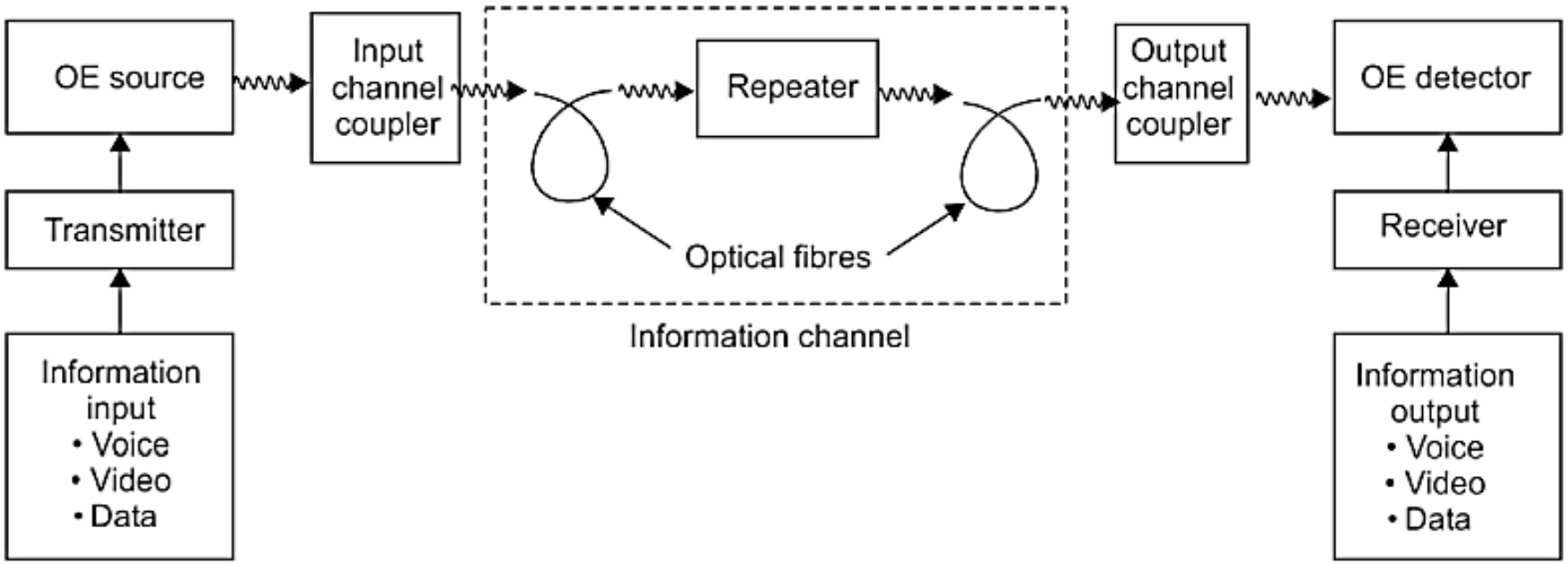

Fig. 10.15 Generalized configuration of a fiber-optic communication system

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c	Based on orbits, discuss the different types of satellites.	6

Low Earth Orbits (LEOs)

- Satellites in the low Earth orbit (LEO) circle Earth at a height of around **200 to 500 km** above the surface of the Earth.
- These satellites, being closer to the surface of the Earth, have much shorter orbital periods (95 to 120 minutes) and smaller signal propagation delays (4.5 ms).
- Each LEO satellite will be visible to earth for around ten minutes.

Application of LEO satellites is for remote sensing and mobile communication services.

Medium Earth Orbits (MEOs)

- Medium Earth orbit (MEO) satellites orbit at a distance of approximately 10,000 to 20,000 km above the surface of the Earth.
- They have an orbital period of 6 to 12 hours.
- Propagation delays about 70-80 ms
- These orbits are generally polar in nature and are mainly used for communication and navigation applications.

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Geostationary Earth Orbits (GEO)

Orbital period: The orbital period should be equal to 23 hours 56 minutes

- A geosynchronous Earth orbit is a prograde orbit whose orbital period is equal to Earth's rotational period (earth moves from west to east)(synchronous with earth) called geostationary Satellites.
- If such an orbit were in the plane of the equator and circular, it would remain stationary with respect to a given point on the Earth. (no tracking required)
- The inclination of the Satellite is zero deg

For the satellite to have such an orbital velocity, it needs to be at a height of about 36,000 km (35,786 km to be precise), above the surface of the Earth.

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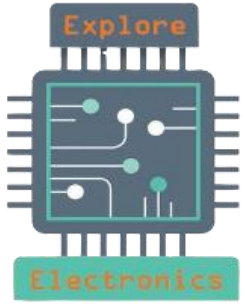

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