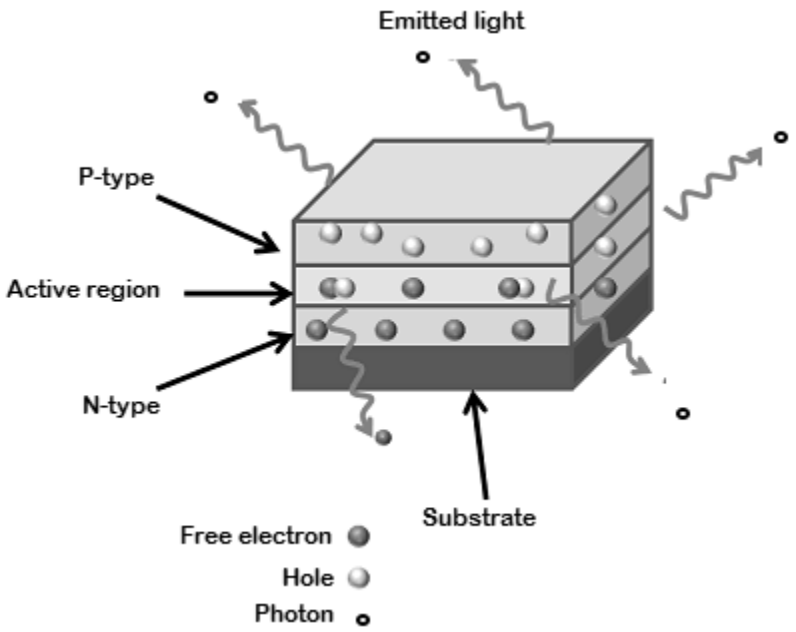
Basic Electronics Engineering

1. (a) Draw the construction diagram and explain working of LED. [6M]

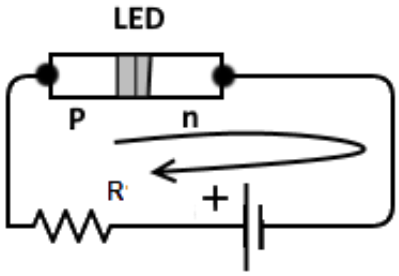
Construction Of LED:-



i) Light Emitting diode (LED) is two lead semiconductor light source.
ii) Basically it is p-n junction diode that emits light when activated.
iii) When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence.
iv) One of the methods used for the LED construction is to deposit three semiconductor layers on substrate
v) In between p-type and n-type there exists an active region
vi) This active region emits light, when an electron and hole recombine.
vii) The basic layered structure is placed in a tiny reflective cup so that the light from thee achive layers will be reflected towards the desired exit direction.

Basic operation:-

i) Whenever a p-n junction is forward biased, electrons cross the p-n junction from the n-type semiconductor material and recombine with the holes in the p-type semiconductor material.



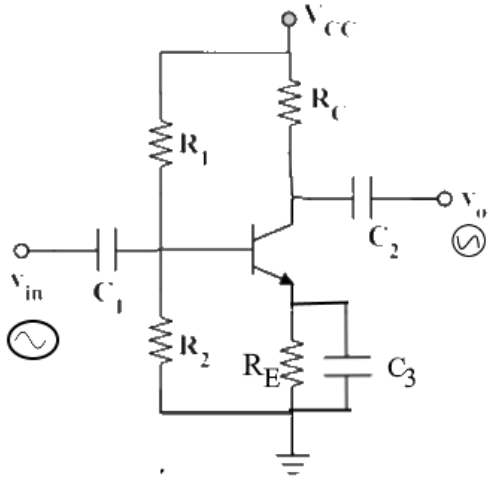
ii) Free electrons are at higher energy level with respect to the holes.
iii) When a free electron recombines with holes, if falls from conduction band to a valence band
iv) The energy level associated with it changes from higher value to lower value.
v) The energy corresponding to the difference between higher level and lower level is released by an electron while travelling from conduction band to valence band.
vi) This energy is released in the form of photons i.e. in form of light energy.
vii)The energy released in the form of light depends on energy corresponding to forbidden gap which determines the wavelength of light.
Let 'E_g' denotes the energy gap, then $E_g=h\nu$, where ν is the frequency of the emitted light. Then

$$E_g = h\nu = \frac{hc}{\lambda}$$

where λ is the wavelength of emitted light.

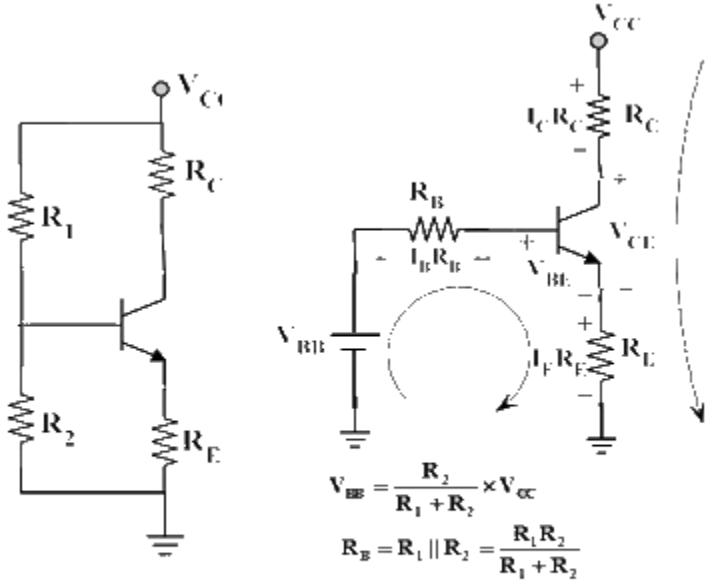
(b) Explain with a neat circuit diagram, function of each component in single stage CE amplifier. [6M]

Common Emitter Configuration:-
Following diagram shows is a single stage CE configuration using n-p-n transistor.



i) The amplifier consists of three main components that are a) transistor biased in active region b) Coupling and bypass capacitor and c) ac or small signal input.

ii) For transistor to be in active region of operation , Emitter – Base junction should be in forward bias and Colector-Base junction should be in reverse bias. This biasing is provided by the network of resistances and Vcc as shown in figure.
iii) So resistances R_1, R_2, R_E and R_C along with DC voltage V_{CC} provide proper DC biasing to operate the transistor in active region. Such type of biasing arrangement is called as Emitter bias or Self Bias.
iv) The capacitors C_1, C_2 are called as coupling capacitors. As these capacitors allow only ac voltage (or current) while blocking the DC voltages (or currents). These are very useful for coupling the ac input and taking out the ac output and hence called as coupling capacitors.
v) In amplifier circuit the transistor is already in the active region by DC biasing (V_{CC} and Resistance). For amplification, we apply ac input and take only ac output. So these coupling capacitors play very important role in coupling ac at input side as well as blocking DC at output side.
vi) In Common Emitter amplifier ac input is applied between the base and Emitter (Ground) and ac output is taken across the Collector and Emitter (Ground). Hence this configuration is called as Common emitter configuration. For common emitter configuration Base current I_B is input current while I_C is output current and V_{CE} is the output voltage.
vii) Consider the DC view of the circuit which keeps the circuit in active region i.e. E-B forward biased and C-B reversed biased. After applying thevenin's equivalent and applying KVL in the input and output loops, we have currents I_B, I_C and voltage V_{CE} as below.



$$V_{BB} = \frac{R_2}{R_1 + R_2} \times V_{CC}$$

$$R_B = R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$$

viii) All these are DC values and define operating point or Q point of the circuit to ensure the circuit in active region. This is the significance of biasing network i.e. R_1, R_2, R_C, R_E,and V_{CC}.
ix) We apply ac signal at the base, due to which the base current varies and the variations are amplified in collector current or output current. The process is called as amplification and we get amplified ac at collector.
x) Resistance R_E also provides stabilization of the DC biasing; lowers the ac amplification gain. Hence a capacitor is connected across it called as bypass capacitor shown in the diagram as C_3.
xi) This capacitor C_3, as like other capacitors C_1 and C_2, acts as an open circuit for DC and short circuit for ac. Hence bypasses the resistance R_E in ac analysis.
xii) R_C is the load resistance. The current flowing through the R_C produces the voltage output of the amplifier. The value of R_C is chosen so that at the amplifiers operating point (Q-point) this output voltage lies half way along the transistor load line.

2. (a) In a centre tapped FWR, the rms half secondary voltage is 10 V. Assuming ideal diodes and load resistance of 2 kΩ, find DC load current, ripple factor and efficiency of rectification. [6M]

Given:- Centre tapped FWR
V_{rms}= 10 V ; R_L= 2 kΩ

i) $I_m = \frac{V_m}{R_L}$
Now,

$$V_m = \sqrt{2}\, V_{rms} = 14.14\ V$$

$$I_m = \frac{14.14}{2} = 7.07\ mA \qquad \leftarrow (peak\ current)$$

$$I_{dc} = \frac{2I_m}{\pi} = \frac{2\times 7.07}{\pi} = 4.5\ mA.$$

ii) Ripple factor = $\sqrt{\left(\frac{I_{rms}}{I_{oc}}\right)^2 - 1}$

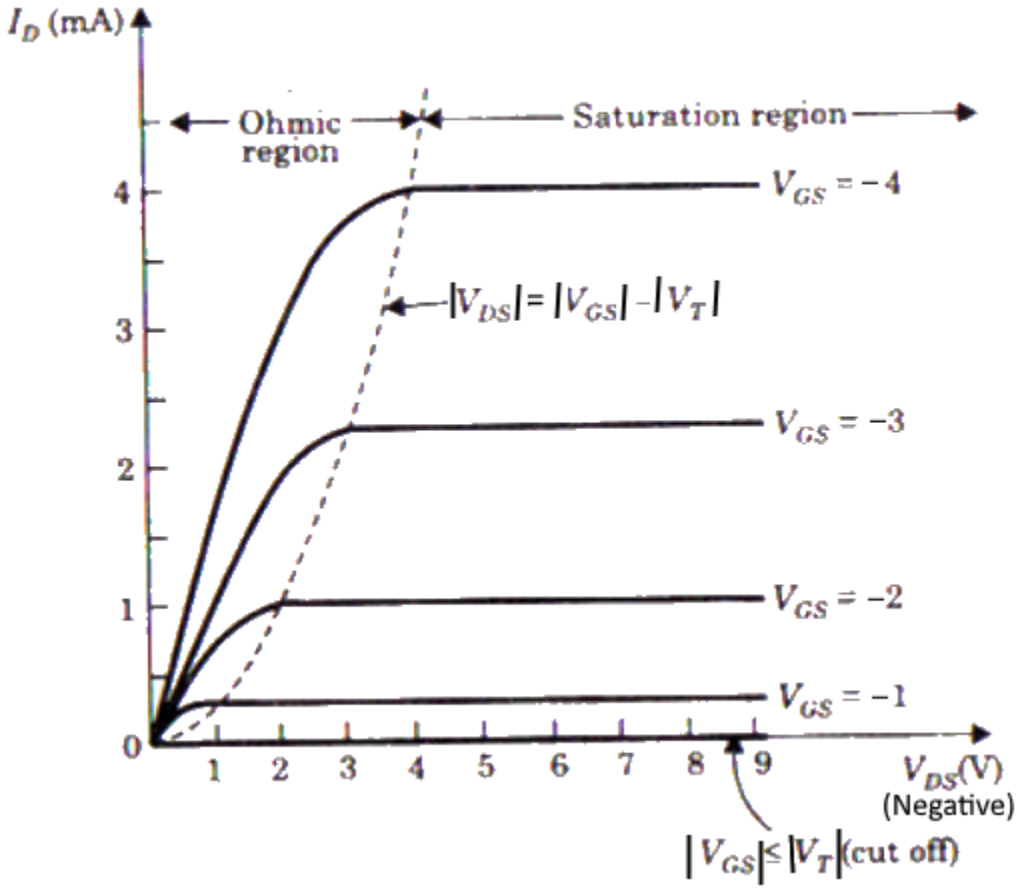
$$I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{7.07}{\sqrt{2}} = 4.99\ mA.$$

Ripple factor = $\sqrt{\left(\frac{4.99}{4.5}\right)^2 - 1}$
Ripple factor = 0.4839

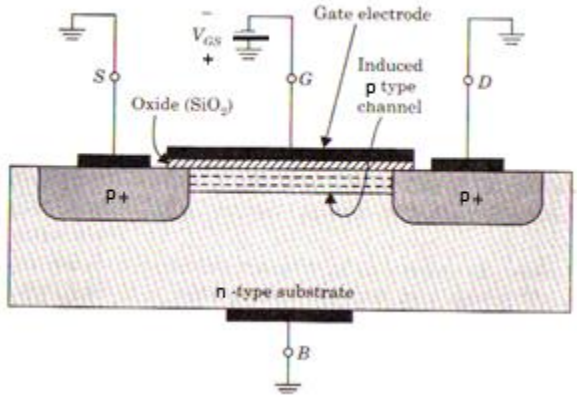
iii) Efficiency of rectification:-(η)

(b) Draw and explain drain and transfer, characteristics of enhancement type P-channel MOSFET. [6M]

i) Following figure shows the drain characteristics of p-channel enhancement type MOSFET.

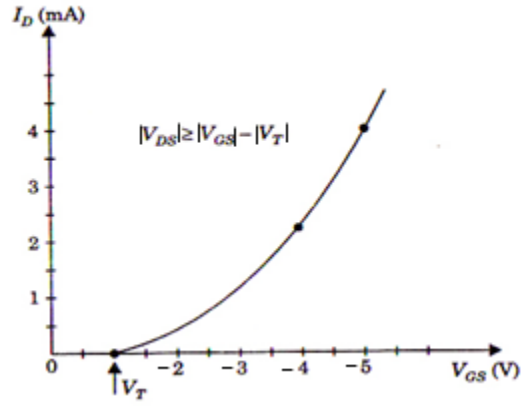


ii) If no voltage is applied to the gate terminal (i.e.V_{GS}=0) we can say that there are two back to back diodes between source and drain region. Thus current flowing is zero even if V_{DS} is applied.



iii) Now if we increase the V_{GS} in negative direction, the concentration of holes near the SiO_2 surface i.e. between source and drain starts increasing. This is known as induced p-channel.
iv) At particular value of V_{GS}, there are a sufficient number holes get induced to form conducting

channel and there is a measurable current flow between drain and source. This value of V_{GS} is called as threshold voltage denoted as V_T. The value of V_T is negative for p-channel MOSFET.
v) Drain characteristics for n channel enhancement type MOSFET is shown in the figure. It clearly indicates that current I_D is zero for $|V_{GS}|<|V_T|$. The region is known as cut-off region.
vi) Consider any constant value of V_{GS} and assume that V_{DS} is increasing in negative direction from 0V. For small values of V_{DS} current I_D increases linearly with increase in the voltage V_{DS}. This region is known as ohmic region.
vii) As V_{DS} is further increased(in negative direction), the channel starts tapering at drain end because of voltage drop across the length of channel. The current I_D no longer increases linearly. At particular value of V_{DS}, channel becomes pinched-off at drain end and current remains constant for further increase in V_{DS}. i.e. becomes saturated. This region is known as saturation region.
viii) Transfer characteristics is shown below.



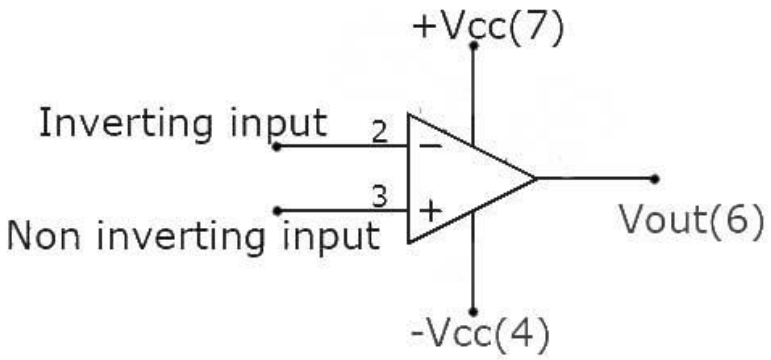
ix) Transfer characteristics is a relation between I_D and V_{GS} for constant is shown in the figure. For PMOS device it is in the negative V_{GS} region and the current I_D is zero till $V_{GS}=V_T$.
x) For the $|V_{GS}|>|V_T|$, i.e. more negative than threshold voltage, relation between drain current I_D and V_{GS} is given by following non-linear relation:

$I_D=k(V_{GS}-V_T)^2$
where k is constant and function of the geometry of the device.

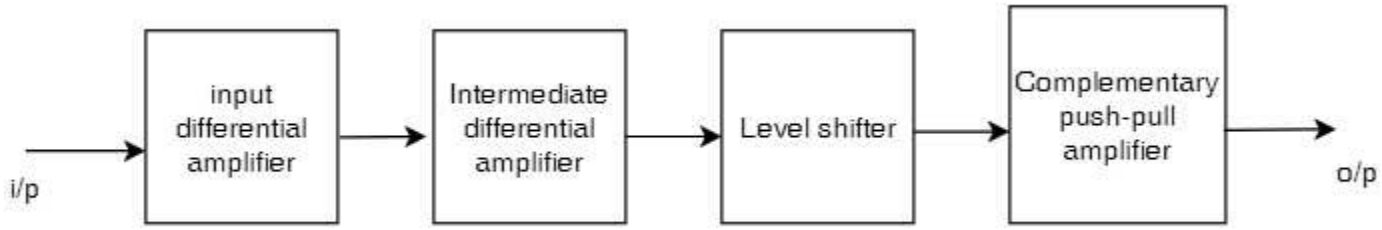
3. (a) Define Op-Amp. Draw and explain the functional block diagram of an Op-Amp. [6M]

i) It is a high grain DC amplifier with high input impedance and low output impedance.
ii) It is very sensitive electronic device. It does mathematical as well as logical operation that is why it is known as operational amplifier.
iii) It is a voltage controlled voltage source (VCVS) device.

iv) For op-amp, we generally use on IC 741 which has max. power supply of ±15V.



Functional block diagram



Input differential amplifier:- It is dual input balanced output differential amplifier which provides major part of high gain and high input impedance. If input is AC then output is also AC.

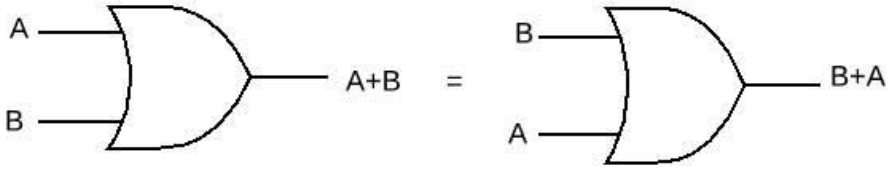
Intermediate differential amplifier:- It is dual input unbalanced output differential amplifier. Which is also used for increasing the gain of amplifier. Since It is direct coupled amplifier, so DC voltage at the output of intermediate stage may arise.

Level shifter:- It is emitter follower, main function of level shifter is to eliminate DC present at the output of intermediate stage. If has high value of input impedance and low value of output impedance.

Complimentary push pull amplifier:- It is a class B power amplifier. In general used at the final stage. Since it is the power amplifier, so it can drive high value of load.

(b) Write law of commutation, law of association and law of distribution for AND and OR logic function. [6M]

Commutative law:-
Law 1:- A+B = B+A
This law states that A OR B is the same as B OR A

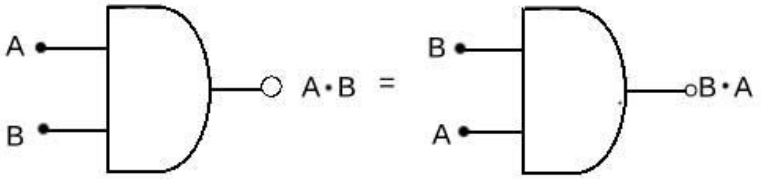


A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

=

B	A	B+A
0	0	0
0	1	1
1	0	1
1	1	1

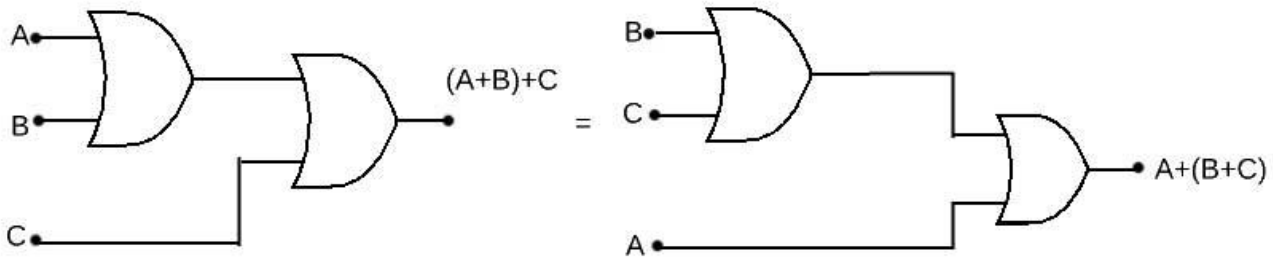
Law 2:- $A \cdot B = B \cdot A$
This law states that A and B is same as that of B and A.



A	B	A•B
0	0	0
0	1	0
1	0	0
1	1	1

B	A	B•A
0	0	0
0	1	0
1	0	0
1	1	1

Law of association:-
Law 1:- (A+B)+C = A+(B+C)
A OR B ORed with C is same as A ORed with B OR C.



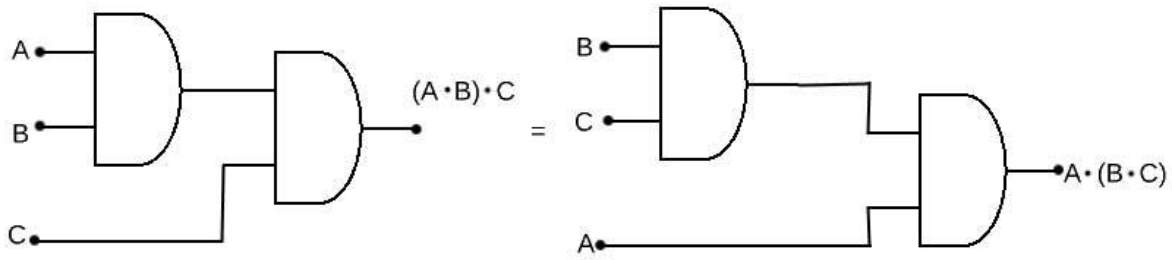
A	B	C	(A+B)+C
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

=

A	B	C	A+(B+C)
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Law 2:- $(A \cdot B) \cdot C = A \cdot (B \cdot C)$

A AND B ANDed with C is same as A ANDed with B AND C.



A	B	C	(A•B)•C
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

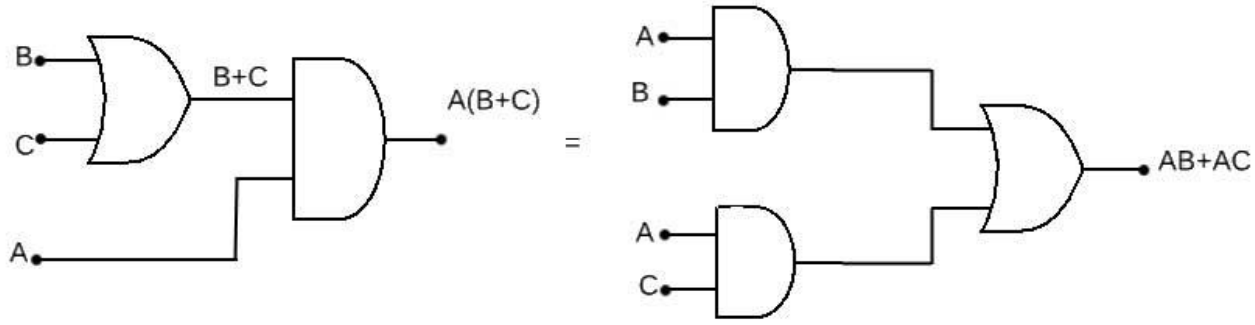
=

A	B	C	A•(B•C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Distributive laws:-

Law 1:- $A(B+C) = A \cdot B + A \cdot C$

States that ORing of several variables and ANDing the result with a single variable is equivalent to ANDing that single variable with each of the several variable and then ORing the producers.



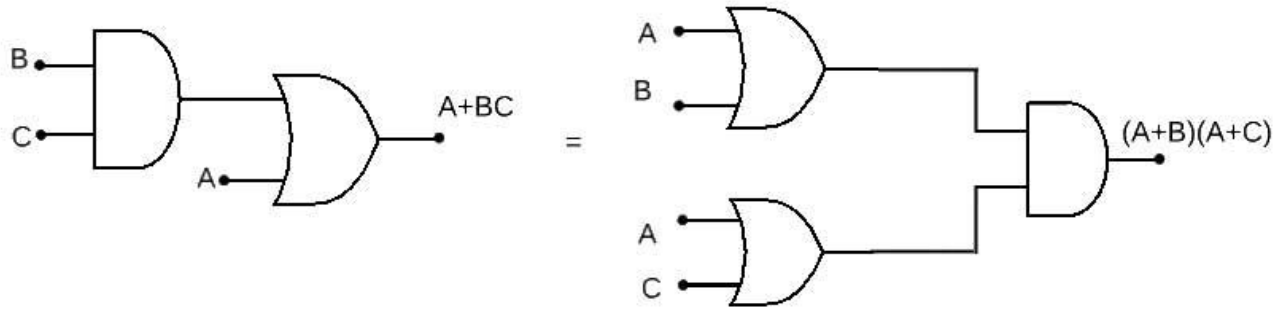
A	B	C	A(B+C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

=

A	B	C	AB+AC
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Law 2:- A+BC = (A+B) (A+C)

This law states that ANDing of several variables and ORing the result with a single variable is equivalent to ORing that single variable with each of the several variable and then ANDing the sums.



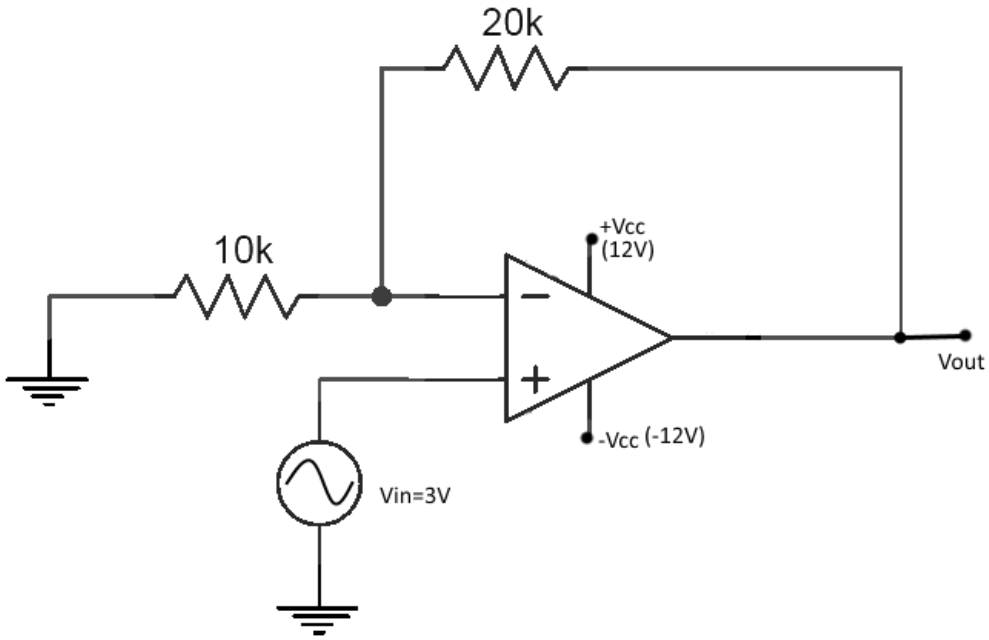
A	B	C	A(B+C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

=

A	B	C	(A+B)(A+C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

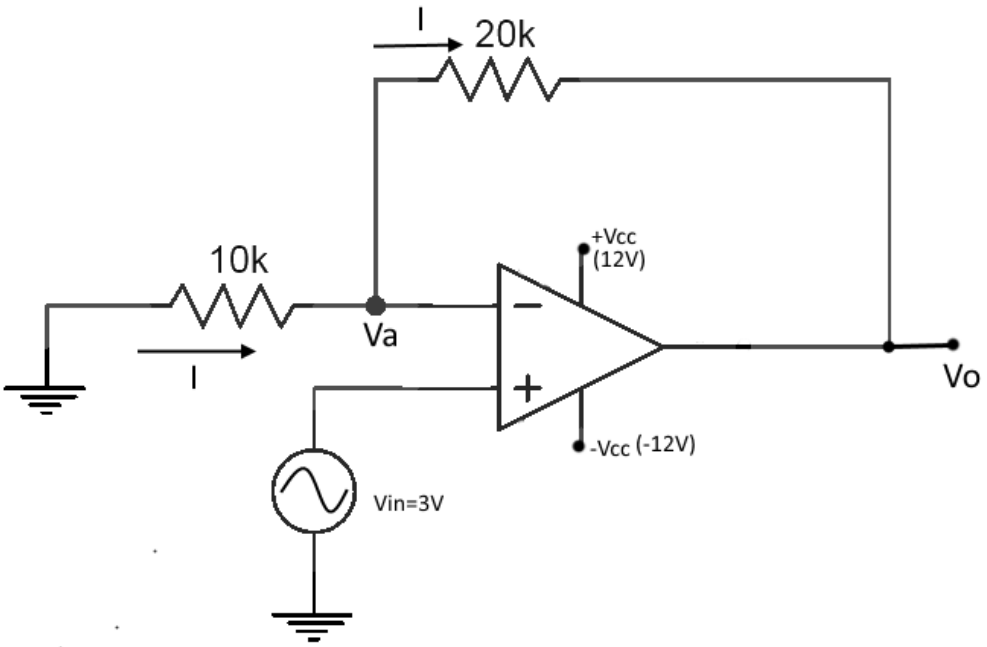
OR

4. (a) Calculate output voltage V_0 of Op-Amp circuit shown in figure. Draw UP and 0/P waveforms. [6M]



Given:-

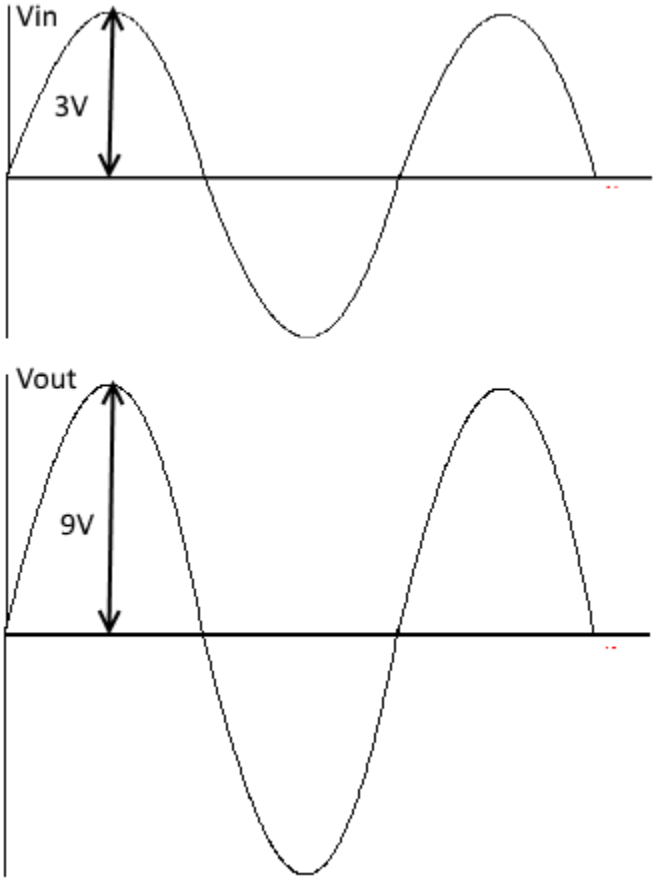
Redrawing above circuit



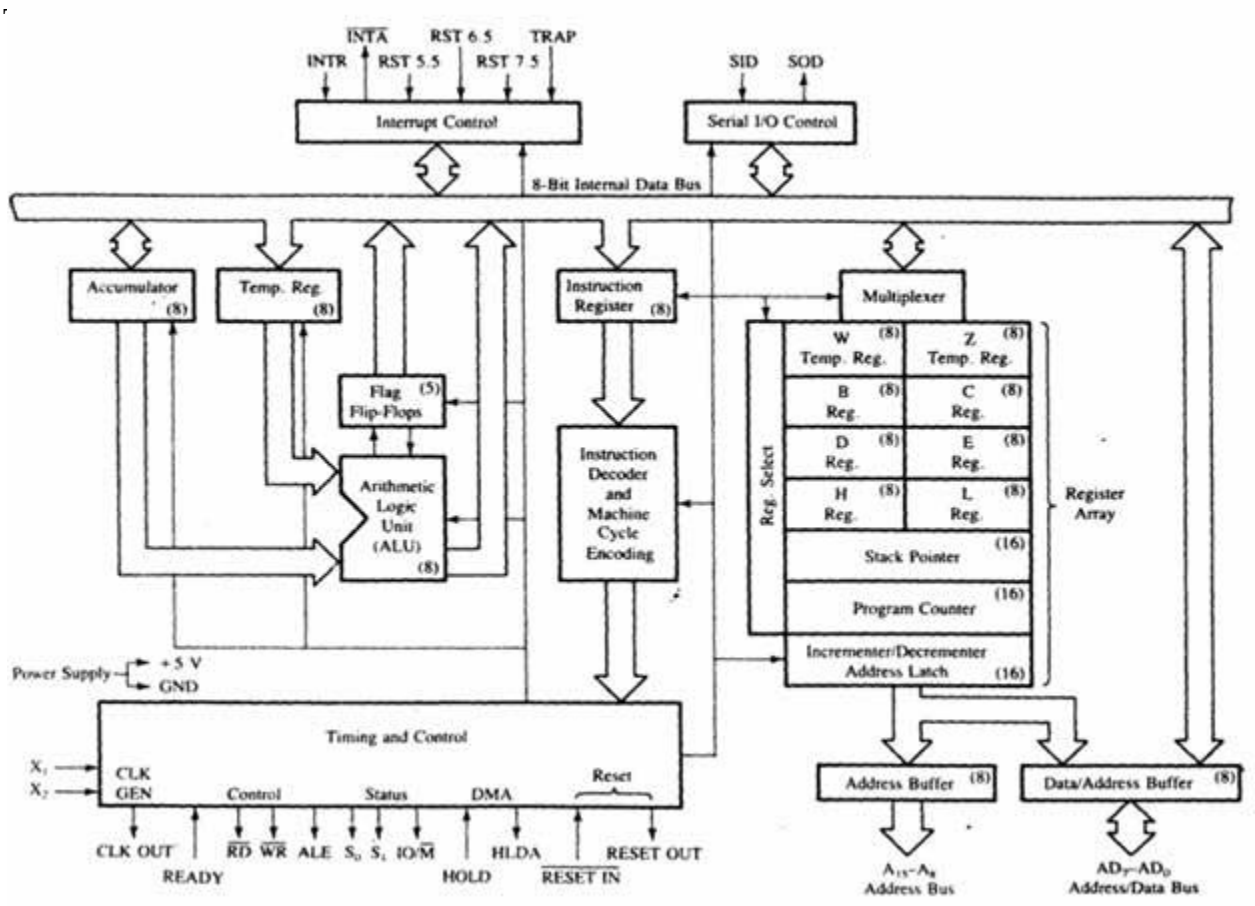
Applying kvl at V_a

But according to virtual ground concept, $V_a=V_{in}$

$\therefore V_o = 3V_{in}$



(b) Draw and explain the block diagram of microprocessor. [6]



Accumulator:- It is a 8-bit register which is used to perform airthmetical and logical operation. It stores the output of any operation. It also works as registers for i/o accesses.

Temporary Resistor:- It is a 8-bit register which is used to hold the data on which the acumulator is computing operation. It is also called as operand register because it provides operands to ALU.

Registers:- These are general purposes registers. Microprocessor consists 6 general purpose registers of 8-bit each named as B,C,D,E,H and L. Each carries the 8-bits data. These registers can also be used to carry the 16 bits data by making the pair of 2 registers. The valid register pairs available are BC,DE and HL.

ALU:- ALU performs the arithmetic operations and logical operation.

Flag Register:-It consists of 5 flip flop which changes its status according to the result stored in an accumulator. It is also known as status registers. It is connected to the ALU.
There are five flip-flops- Sign(S), zero(z), Auxiliary carry(AC), Parity(P), Carry(C) with bit position as-

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z		AC		P		CY

All of the three flip flop set and reset according to the stored result in the accumulator.

Instruction registers(IR):- It is a 8-bit register. When an instruction is fetched from memory then it is stored in this register.

Instruction Decoder:- Instruction decoder identifies the instructions. It takes the informations from instruction register and decodes the instruction to be performed.

Program Counter:- It is a 16 bit register used as memory pointer. It stores the memory address of the next instruction to be executed. So we can say that this register is used to sequencing the program. Generally the memory have 16 bit addresses so that it has 16 bit memory. The program counter is set to 0000H.

Stack Pointer:- It is also a 16 bit register used as memory pointer. It points to the memory location called stack. Generally stack is a reserved portion of memory where information can be stores or taken back together.

Timing and Control Unit:- It provides timing and control signal to the microprocessor to perform the various operation. It controls all external and internal circuits. It operates with reference to clock signal.It synchronizes all the data transfers.

It has three control signal:
1.ALE- Arithmetic Latch Enable, It provides control signal to synchronize the components of microprocessor.
2.RD- This is active low used for reading operation.
3.WR-This is active low used for writing operation.

It has three status signal used in microprocessor S1, S2 and IO/M which change their status according to the operation as below

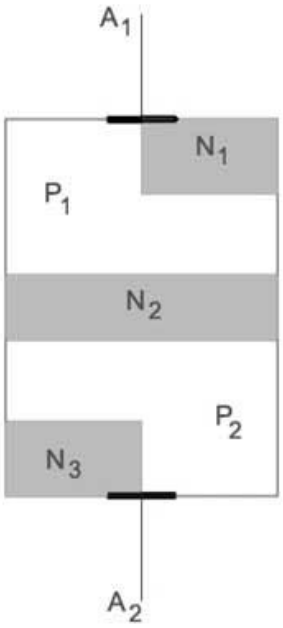
IO/M(Active Law)	S1	S2	Data Bus Status (Output)
0	0	0	Halt
0	0	1	Memory WRITE
0	1	0	Memory READ
1	0	1	IO WRITE
1	1	0	IO READ
0	1	1	Opcode fetch
1	1	1	Interrupt acknowledge

Serial Input Output Control:-There are two pins in this unit. This unit is used for serial data communication.

Interrupt Unit:- There are 6 interrupt pins in this unit. Generally an external hardware is connected to these pins. These pins provide interrupt signal sent by external hardware to microprocessor and microprocessor sends acknowledgement for receiving the interrupt signal. Generally INTA is used for acknowledgement.

5. (a) Draw construction of DIAC and explain working with V-I characteristics. [6M]

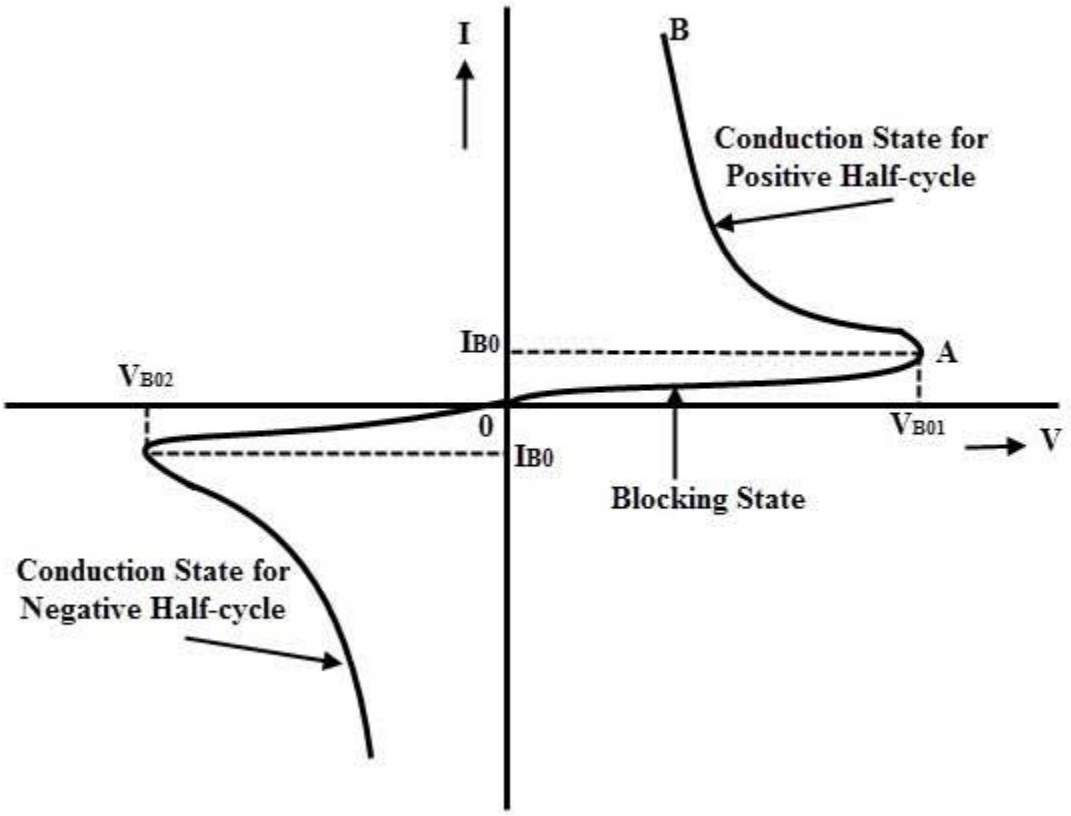
DIAC Construction



It is a device which consists of four layers and two terminals. The construction is almost same as that of the transistor. But there are certain points which deviate from the construction from the transistor. The differentiating points are-
1. There is no base terminal in the diac.
2. The three regions have almost the same level of doping.
3. It gives symmetrical switching characteristics for either polarity of voltages.

V-I Characteristics of DIAC

The figure below shows the V-I characteristics of DIAC which indicates the current flow through the diac with respect to the voltage across it.



i) As long as the voltage across the diac is within its breakover limits that is from –VBO to +VBO, the resistance offered by the diac is very high. So a small leakage current flows through the device for applying positive voltage which is less than +VBO and negative voltage less than –VBO as shown in figure. The region OA in the portion of the characteristics is the blocking region.
ii) Under these conditions diac operates as an open switch. The voltages +VBO and –VBO are the breakdown voltages which are generally in the range of 30 to 50 volts.
iii) Once the positive or negative applied voltage is more than the respective breakdown voltages that means at point A in the above figure the diac begins to conduct and the voltage drop across the device becomes few volts.
iv) The portion AB represents the conduction of diac. This conduction continuous until the device current falls below its holding current level. From the figure it is noted that the holding current and breakover voltage values are identical for reverse and forward region of operation.
v) The first and third quadrant characteristics represent the forward and reverse bias conditions of the diac.

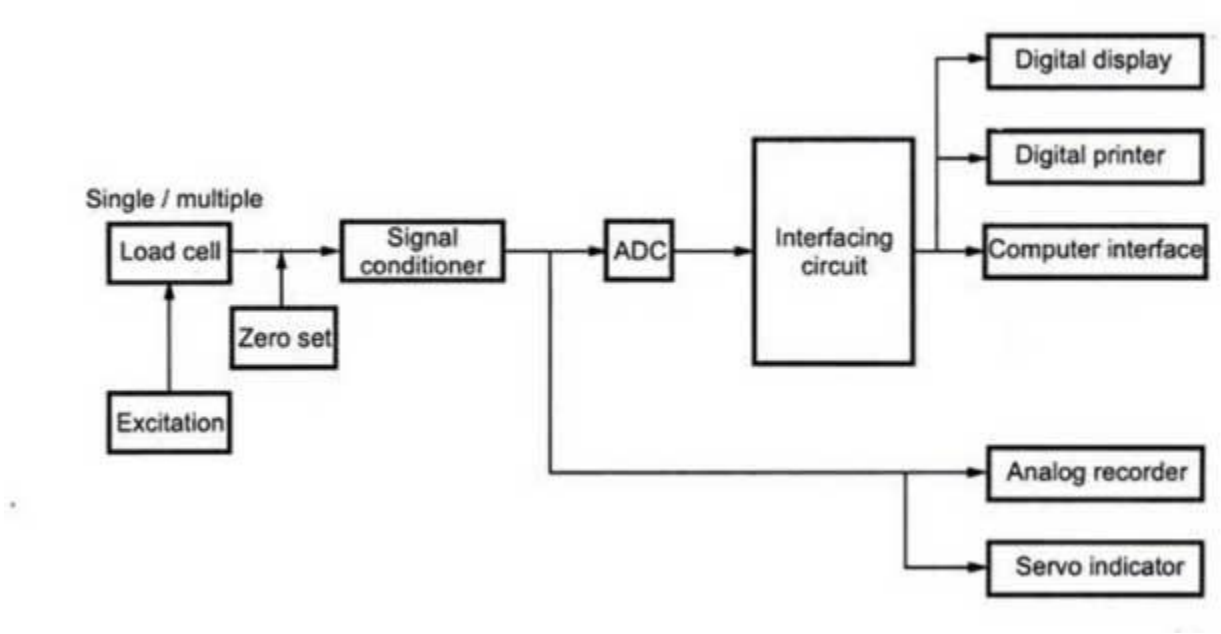
(b) What is electronic weighing machine ? With the help of neat block diagram Explain its working. [7M]

Electronic weighing machine:-

It is a standard method of determining weight in many industrial applications.

Many of the weighing problems in the industrial process as well as in general. Weighing are solved by in corporating an electronic system.

Some of the main features of electronic weighing machine
i) Compact and small in size
ii) Easy to operate
iii) high resolution
iv) high stability and ruggedness



Block diagram of electronic weighing system

Fig. shows the schematic block diagram of electronic weighing system. It consists of load cell, suitable signal conditioner, analog to digital converter, and output recorders/indicators giving both the analog and digital outputs.

The load cells (which may be up to 4 or 8 cells) convert the weight data into electrical signal which is amplified to give an output of 0 to 5V or 20 mA. This signal can be used as input for analog recorder or servo indicator to print or indicate weight. But to get digital readouts or printing it is necessary to convert analog signal into digital signal. Analog to digital converter is used for this purpose. Interfacing circuit provides the necessary interface for different printing and indicating devices.

OR

6. (a) Define transducer What are the selection criteria for a good transducer ? [7M]

Definition:- A device that converts variations in a physical quantity, such as pressure or brightness, into an electrical signal, or vice versa.

A transducer is an electronic device that converts energy from one form to another. Common examples include microphones, loudspeakers, thermometers, position and pressure sensors, and antenna.

The following factor are to considered while selecting a transducer
i) Operating principle:- The transducers are selected on the basis of operating principle it may be resistive, inductive, capacitive, optical etc.
ii) Operating range : The range of transducer should be appropriate for measurement to get a good resolution.
iii) Accuracy : The accuracy should be as high as possible or as per the measurement.
iv) Range : The transducer can give good result within its specified range, so select transducer as per the operating range.
v) Sensitivity : The transducer should be more sensitive to produce the output or sensitivity should be as per requirement.
vi) Loading effect : The transducer's input impedance should be high and output impedance should be low to avoid loading effect.
vii)Errors : The error produced by the transducer should be low as possible.
viii)Environmental compatibility : The transducer should maintain input and output characteristic for the selected environmental condition.

(b) Draw and explain the block diagram of basic instrumentation system. [6M]

Instrumentation system can be classified into two types viz. Analog and Digital.
1. Analog instrumentation system

Fig. Analog Instrumentation System

i) The Primary Element/Transducer
The input receives the quantity whose value is to be measured and is converted into its proportional incremental electrical signal such as voltage, current, resistance change, inductance or even capacitance.Thus, the changed variable contains the information of the measured variable. Such a functional element or device is called a transducer.

ii)The Secondary Element/Signal Processing Unit
The output of the transducer is provided to the input of the signal processing unit. This unit amplifies the weak transducer output and is filtered and modified to a form that is acceptable by

the output unit. Thus this unit may have devices like: amplifiers, filters, analog to digital converters, and so on.

iii) The Final Element/Output Unit
The output from the signal processing unit is fed to the input of the output unit. The output unit measures the signal and indicates the value to the reader. The indication may be either through: an indicating instrument, a CRO, digital computer, and so on.

2. Digital Instrumentation System

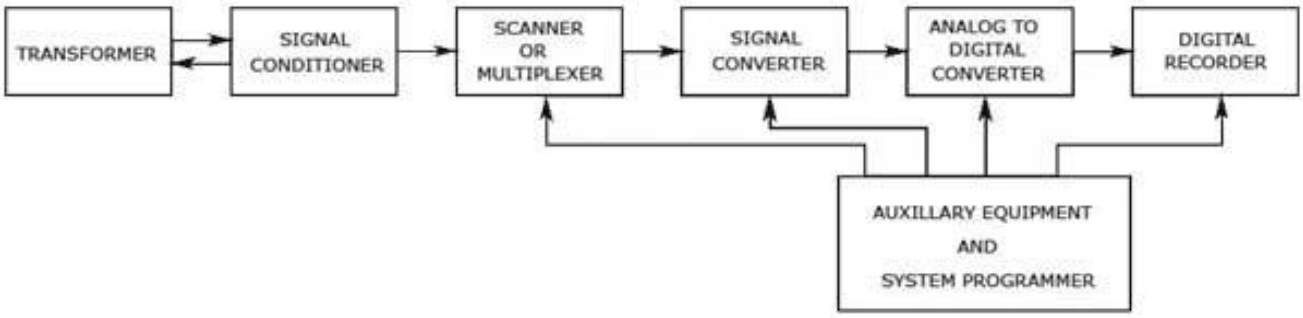


Fig. Digital Instrumentation System

i) Transducer
All the physical input parameters like temperature, pressure, displacement, velocity, acceleration and so on will be converted into its proportionate electrical signal.

ii) Signal Conditioning Unit
This working of this unit is exactly the same as that of a signal processing unit in an analog instrumentation system. It includes all the balancing circuits ad calibrating elements along with it.

iii) Scanner/Multiplexer
Multiple analog signals are received by this device and are sequentially provided on to a measuring instrument.

iv) Signal Converter
It is used to convert an analog signal to a form that is acceptable by the analog to digital converter.

v) Analog to (A-D) Digital Converter
The analog signal is converted into its proportional digital signal. The output of an A-D converter is given to a digital display.

vi) Auxiliary Equipment
All the system programming and digital data processing functions are carried out by this unit. The auxiliary equipment may be a single computer or may be a collection of individual instruments. Some of its basic functions include linearizing and limit comparison.

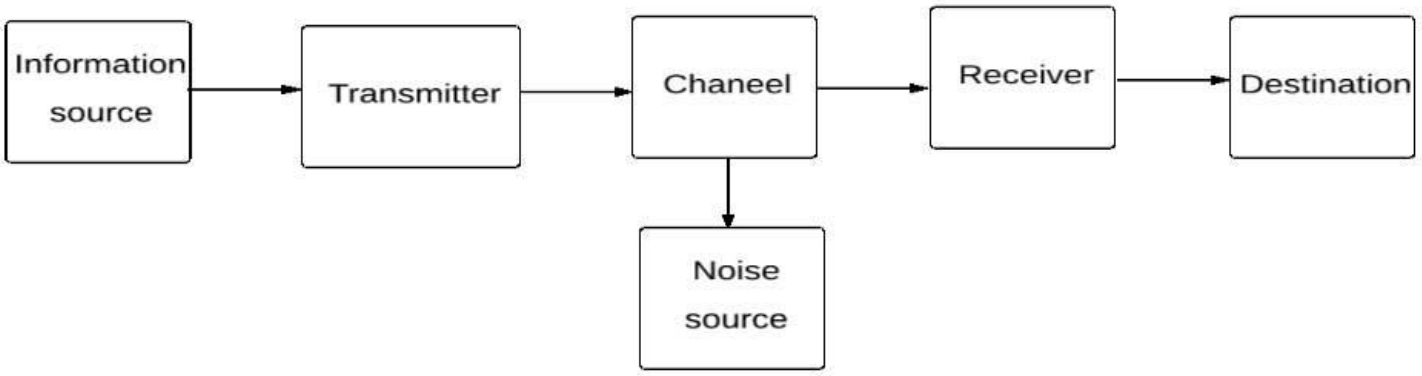
vii) Digital Recorder
It is mostly a CRO or a computer.

7. (a) What is electronic communication ? Explain the elements of communication system with the help of neat block diagram. [7M]

Communication is the process of establishing connection or link between two point for information exchange. In other words communication is simply the basic process of exchanging information.

The electronics equipments which are used for communication purpose, are called communication equipments. Different communication equipments when assembled together form a communication system.

Typical example of communication system are line telephony and line telegraphy, radio telephony and radio telegraphy, radio broadcasting, point-to-point communication and mobile communication, computer communication, radar communication, television broadcasting, radio telemetry, radio aids to navigation, radio aids to aircraft landing etc.



1. Information source :-
(i) The objective of any communication system is to convey information from one point to the other. The information comes from the information source, which originates it.
(ii) The information source converts this information into physical quantity.

2. Transmitter :-
(i) The objective of the transmitter block is to collect the incoming message signal and modify it in a suitable fashion (if needed), such that, it can be transmitted via the chosen channel to the receiving point.
(ii) The functionality of the transmitter block is mainly decided by the type or nature of the channel chosen for communication.
(iii) Typically it consists of three sections i.e. transducer, modulator and amplifier.

(iv) Transducer converts energy from one form to other. It coverts actual input signals like sound, heat, pressure etc. into electrical form.
(v) Modulator is an arrangement used to convert low frequency input signal into high frequency signal suitable for transmission. The actual input signal also called as Base band signal which is a low frequency signal and cannot be transported to long distances. So it is mixed with a high frequency carrier signal which is suitable to send over long distances. This process is called as Modulation.
(vi) Amplifier provides the necessary amplification of the modulated signal for the transmission.

3. Channel :-
(i) Channel is the physical medium which connects the transmitter with that of the receiver
(ii) The physical medium includes copper wire, coaxial cable, fibre optic cable, wave guide and free space or atmosphere.

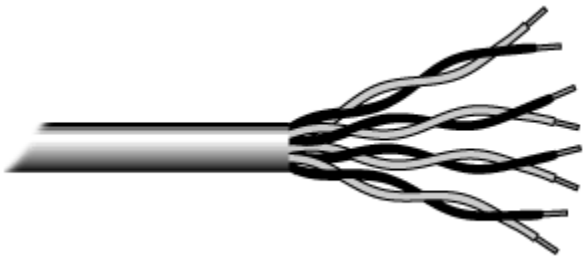
4. Receiver:-
(i) The receiver block receives the incoming modified version of the message signal from the channel and processes it to recreate the original (non-electrical) form of the message signal.
(ii) It also consists of three main parts amplifier, demodulator and transducer.
(iii) The amplifier is used to amplify the received signal weak signal.
(iv) The main block in receiver is demodulator. It is used to extract the original signal from the modulated wave. Its functionality is opposite to the modulator in transmitter.
(v) Finally the signal is converted into physical form using transducer.

5. Destination:-
(i) The destination is the final block in the communication system which receives the message signal and processes it to comprehend the information present in it.
(ii) Usually, humans will be the destination block.

(b)Explain different types of cables used in communication system with neat diagrams. [6M]

The following sections types of cables used in communication systems.
i) Twisted Pair Cable
ii) Coaxial Cable
iii)Fiber Optic Cable

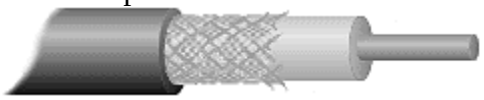
1. Twisted pair cable
Twisted pair cabling comes in two varieties: shielded and unshielded. Unshielded twisted pair (UTP) is the most popular and is generally the best option for networks.



Unshielded twisted pair

The cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices. The tighter the twisting, the higher the supported transmission rate and greater the cost per foot. It can provide bandwidth up to several megahertz.
Examples:- CAT1 (up to 1 Mbps), CAT2 (up to 4 Mbps)

2. Coaxial cable
Coaxial cabling has a single copper conductor at its center. A plastic layer provides insulation between the center conductor and a braided metal shield.
The metal shield helps to block any outside interference from fluorescent lights, motors, and other computers.



Coaxial cable

Although coaxial cabling is difficult to install, it is highly resistant to signal interference.
In addition, it can support greater cable lengths between network devices than twisted pair cable.
The two types of coaxial cabling are thick coaxial and thin coaxial.
Coaxial cables have 80X more transmission capacity than the twisted pair cables.
These are commonly used to deliver TV signals because of high bandwidth thay offer.
Examples:-75 ohm coaxial cable, 50 ohm coaxial cable.

3. Fiber Optic cable
Fiber optic cabling consists of a center glass core surrounded by several layers of protective materials.

Fibre optic cable

i) It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of electrical interference.
ii) It has also made it the standard for connecting networks between buildings, due to its immunity to the effects of moisture and lighting.
iii) They offer 26,000X more transmission capacity than the twisted pair cables.
iv) The cost is higher compared to twisted pair or coaxial cables.
v) There are two types of fiber optic cables- Singlemode and Multimode.
vi) Singlemode has small core and allows only one one mode of light to propagate while Multimode has larger core allows many modes of light at a time.

OR

8. (a) Draw neat block diagram of GSM system and explain its working. [6M]

GSM stands for Global System for Mobile communication.

In GSM, geographical area is divided into hexagonal cells whose side depends upon power of transmitter and load on transmitter (number of end user). At the center of cell, there is a base station consisting of a transceiver (combination of transmitter and receiver) and an antenna.

GSM Architecture :-

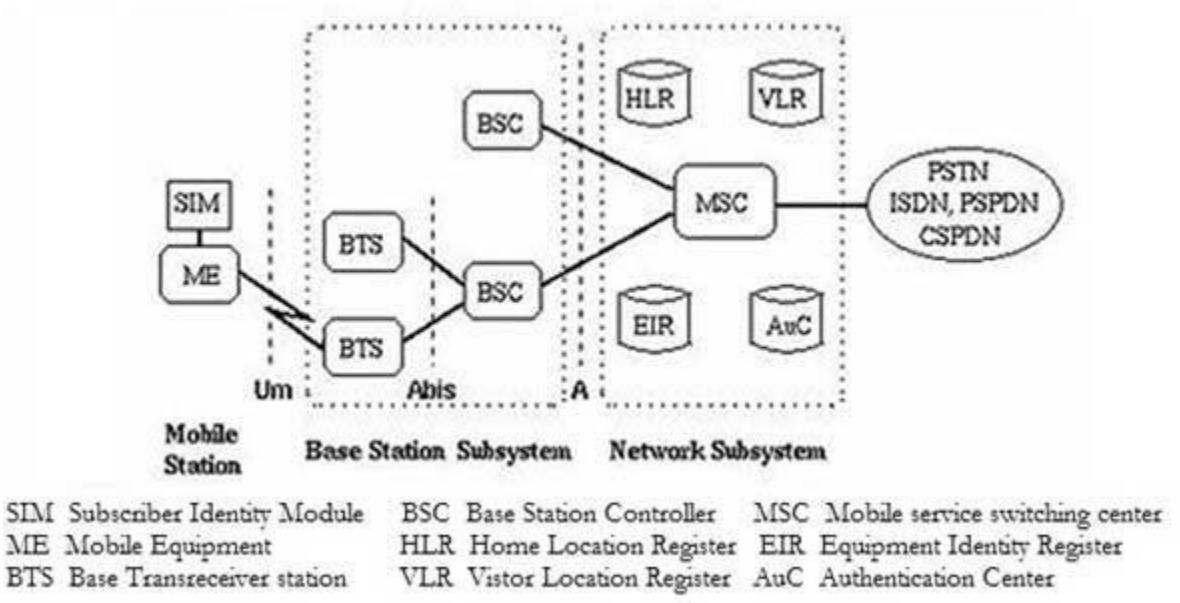


Fig. GSM Architecture

Function of Components :-

i) MS : It refers for mobile station. Simply, it means a mobile phone.
ii) BTS : It maintains the radio component with MS.
iii) BSC : Its function is to allocate necessary time slots between the BTS and MSC.
iv) HLR : It is the reference database for subscriber parameter ike subscriber's ID, location, authentication key etc.
v) VLR : It contains copy of most of the data stored in HLR which is temporary and exist only until subscriber is active.
vi) EIR : It is a database which contains a list of valid mobile equipment on the network.
vii) AuC : It perform authentication of subscriber.

Working:-

i) GSM is combination of TDMA (Time Division Multiple Access), FDMA (Frequency Division Multiple Access) and Frequency hopping.

ii) Initially, GSM use two frequency bands of 25 MHz width : 890 to 915 MHz frequency band for up-link and 935 to 960 MHz frequency for down-link. Later on, two 75 MHz band were added. 1710 to 1785 MHz for up-link and 1805 to 1880 MHz for down-link.

iii) up-link is the link from ground station to a satellite and down-link is the link from a satellite down to one or more ground stations or receivers. GSM divides the 25 MHz band into 124 channels each having 200 KHz width and remaining 200 KHz is left unused as a guard band to avoid interference.

(b) Define modulation index with reference to AM and FM. Write equations of modulation index. Draw AM waveform for 100% modulation case. [7M]

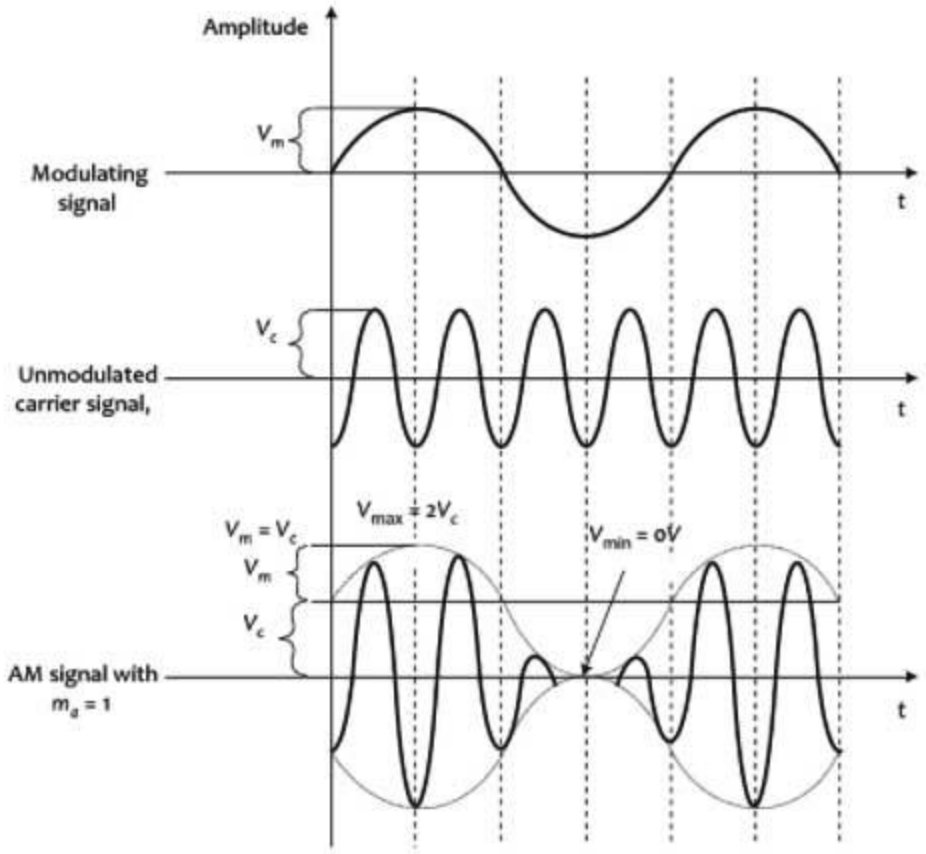
Modulation index (for AM) (M_a)
The ratio of maximum amplitude of modulating signal (V_m) and the maximum amplitude of carriers signal (V_c) is known as the modulation index for AM wave

$$M_a = \frac{V_m}{V_c}$$

And is also known as depth of modulation.

Modulation index (for FM) (M_f)
For a single to be sinusoidal modulating signal frequency modulation index (M_f) is defined as the ratio of peak frequency deviation (df) and modulatioon frequency (f_m)

Am waveform for 100% modulation:-


Amplitude
V_m
Modulating signal
t
V_c
Unmodulated carrier signal,
t
$V_{max} = 2V_c$
$V_{min} = 0V$
$V_m = V_c$
V_m
V_c
AM signal with $m_a = 1$
t