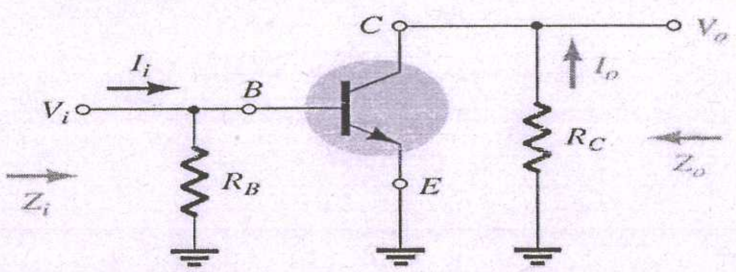
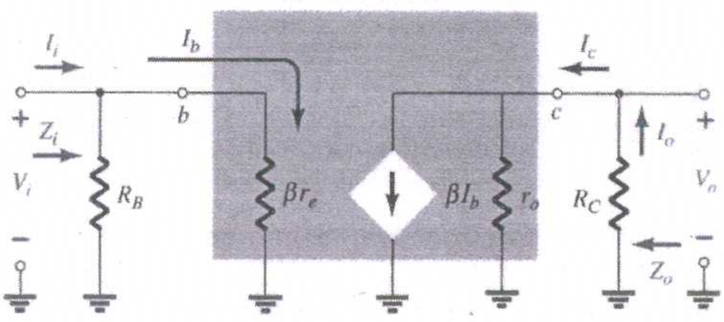
Scheme of valuation

(Scoring indicators)

Revision: 2015	**Course code and title : 3044ELECTRONIC DEVICES AND CIRCUITS**			
Qst no:	**Scoring Indicator**	**Split up score**	**Sub total**	**Total**
	PART A			
1	When no signal is applied, a constant collector current and collector to emitter voltage will appear in the amplifier and this Ic and Vce will represent a point on the DC load line called Q point	2	2	2
2	Greater power output, no even harmonics, higher efficiency, effect of power supply ripple noise eliminated	2	2	2
3	If the feedback voltage or current is out of phase with the input signal, it is called negative feedback	2	2	2
4	N channel enhancement mode MOSFET, P channel enhancement mode MOSFET, N channel depletion mode MOSFET, P channel depletion mode MOSFET	4X0.5	2	2
5	The input voltages at which the output switches from +Vsat and to –Vsat and vice versa are called UTP and LTP	2	2	2
II				
1		Diagram 3 + derivation3	6	6

2

re Model



Voltage Gain

$$A_v = \frac{V_O}{V_i}$$

$$V_O = -\beta I_b (R_C \parallel r_o)$$

$$V_i = I_b \beta r_e$$

$$A_v = \frac{-\beta I_b (R_C \parallel r_o)}{I_b \beta r_e}$$

$$= \frac{(R_C \parallel r_o)}{r_e}$$

$$\text{if } r_o = \infty\Omega \text{ or } \geq 10R_C \qquad A_v = \frac{R_C}{r_e}$$

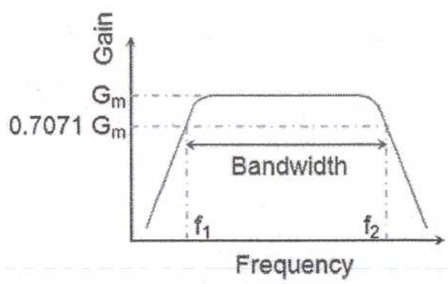


Figure 2 Frequency Response Curve of a RC Coupled Amplifier

It is the Plot of frequency versus gain of an amplifier. At low frequencies (frequencies less than lower cut-off frequency f_L) due to high capacitive reactance of the coupling capacitors and bypass capacitors, the gain is very low as the signals are not effectively coupled to the amplifier. As the frequency increases, (at mid frequencies) the capacitive reactance decrease and the capacitors are effectively short circuited. In this frequency range (between lower cut off frequency f_L and upper cut-off frequency f_H),all the signals are coupled to the amplifier and also from the amplifier to the output. The gain is maximum and constant in the mid frequency range. After upper cut off frequency f_H, the high frequency parasitic capacitance and the inter electrode capacitances of the transistor become dominant and these capacitances effectively short circuits the transistor leads decreasing the gain. The frequency at which gain is 3 dB down the maximum gain is called cut off frequency. The difference between f_H and f_L is called the bandwidth.

Diagram 2

+

Description 4

6

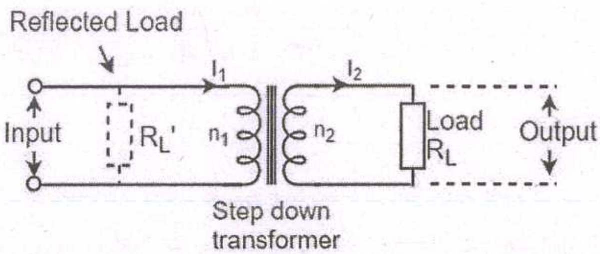
3

Voltage amplifier	Current amplifier
Low current gain	High current gain
Very high collector load	Very low collector load
Low input voltage requirement	High input voltage requirement
Low power output	high power output
Less power dissipation capacity	high power dissipation capacity
High output impedance	low output impedance
RC coupling is used	transformer coupling is used
Doesn’t need cooling arrangement	need cooling arrangement

6X1=6

4

Power transferred from the power amplifier to the load (loudspanker) will be maximum only if the amplifier output impedance equals to the load impedance, otherwise lesser power will be transferred and the rest of the power will be lost in the transistor. Hence to transfer maximum power to the load, it is necessary the output impudence of the amplifier should be equal to the load impedance and is possible with the use of a transformer.



transformer equation is

$V_1/V_2=I_2/I_1= N_1/N_2$

From figure

$R_L' = V_1/I_1$and $R_L=V_2/I_2$

$R_L'/ R_L = V_1I_2/V_2I_1=(N_1/N_2)2$

$R_L= R_L'*(N_1/N_2)2$

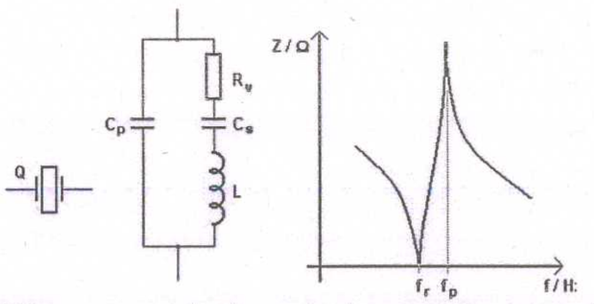
Hence any impedance R_L can be matched with the amplifier output impedance R_L' by varying the turns ration N1/N2.

Description 3 + derivation 3 =6

<table>
<tr><td>5</td><td>

BJT	FET
Current conduction due to holes and electrons	Holes in p channel and electrons in n channel
Low input impedance	High input impedance
Current controlled device	Voltage controlled device
Noise is high	Low noise
Gain if BJT is characterised by current gain	Gain is characterised by trans conductance
High power consumption	Low power consumption

</td><td>1X6=6</td></tr>
<tr><td>6</td><td>



When a crystal of quartz is properly cut and mounted, it can be made to distort in an electric field by applying a voltage to an electrode near or on the crystal. This property is known as electrostriction or inverse piezoelectricity. When the field is removed, the quartz generates an electric field as it returns to its previous shape, and this can generate a voltage. The result is that a quartz crystal behaves like an RLC circuit, composed of an inductor, capacitor and resistor, with a precise resonant frequency. Usually, quartz crystal oscillators are highly stable, consist of good quality factor(Q), they are small in size, and are economically related. The equivalent electrical circuit also describes the crystal action of the crystal. Just look at the equivalent electrical circuit diagram shown in the above. The basic components used in the circuit, inductance L represents crystal mass, capacitance C2 represents compliance, and C1 is used to represent the capacitance that is formed because of crystal's mechanical moulding, resistance R represents the crystal's internal structure friction, The quartz crystal oscillator circuit diagram consists of two resonances such as series and parallel resonance, i.e., two resonant frequencies.

</td><td>Fig 2+explanation 4 = 6</td></tr>
<tr><td>7</td><td>

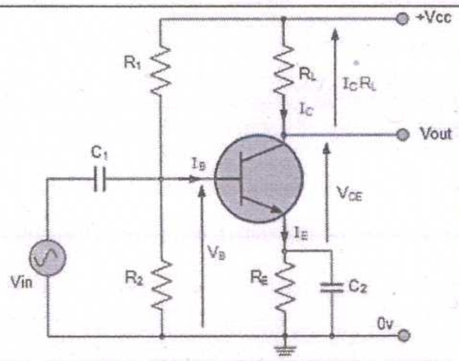
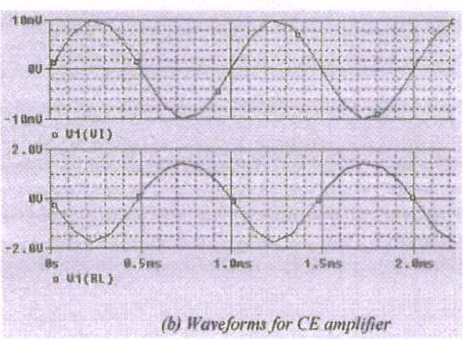
In order to achieve good integration, the following two conditions must be fulfilled.

1. The time constant RC o the circuit should be very large as compared to the time period of the input wave.
2. The value of R should be 10 or more times larger than X_C.

In order to achieve good differentiation, the following two conditions should be satisfied:

1. The time constant RC of the circuit should be much smaller than the time period of the input wave.
2. The value of X_C should be 10 or more times larger than R at the operating frequency.

</td><td>3+3=6</td></tr>
</table>

IIIa	  *(b) Waveforms for CE amplifier* circuit diagram shows the working of the common emitter amplifier circuit and it consists of voltage divider biasing, used to supply the base bias voltage as per the necessity. The voltage divider biasing has a potential divider with two resistors are connected in a way that the midpoint is used for supplying base bias voltage. There are different types of electronic components in the common emitter amplifier which are R1 resistor is used for the forward bias, the R2 resistor is used for the development of bias, the RL resistor is used at the output it is called as the load resistance. The RE resistor is used for the thermal stability. The C1 capacitor is used to separate the AC signals from the DC biasing voltage and the capacitor is known as the coupling capacitor. When a signal is applied across the emitter-base junction, the forward bias across this junction increases during the upper half cycle. This leads to increase the flow of electrons from the emitter to a collector through the base, hence increases the collector current. The increasing collector current makes more voltage drops across the collector load resistor RC. The negative half cycle decreases the forward bias voltage across the emitter-base junction. The decreasing collector-base voltage decreases the collector current in the whole collector resistor Rc. Thus, the amplified load resistor appears across the collector resistor. The common emitter amplifier circuit is shown below figure (a). From the voltage waveforms for the CE circuit shown in Fig. (b) It is seen that there is an 180-degree phase shift between the input and output waveforms. A transistor can work as amplifier, only if the dc/ac voltages and currents in the circuit are suitably fixed. The operating point or bias point or quiescent point(or simply Q-point) is the voltage or current which, when applied to a device, causes it to operate in a certain desired fashion.	Fig 4 + Exp 5	9	15
IIIb	**Need for BIAS STABILIZATION** After fixing the operating point suitably, it should remains there only. But there are two reasons for the operating point to shift. 1. The transistor parameters such as VBE & β changes from device to device 2. Transistor parameters are also temperature dependent. Since the collector current is Ic = β IB + (1+ β) Ico (β, IB and Ico are temperature dependent) • β of a transistor is strongly dependent on temperature. As temp. increases, β increases • The junction voltage VBE is also a function of temperature. As temperature increases, VBE decreases at the rate of 2.5mV/C	6		

<table>
<tr><td></td><td>

- IB also increases
- The Ico is a strong function of temperature that doubles for every 100C rise in temperature

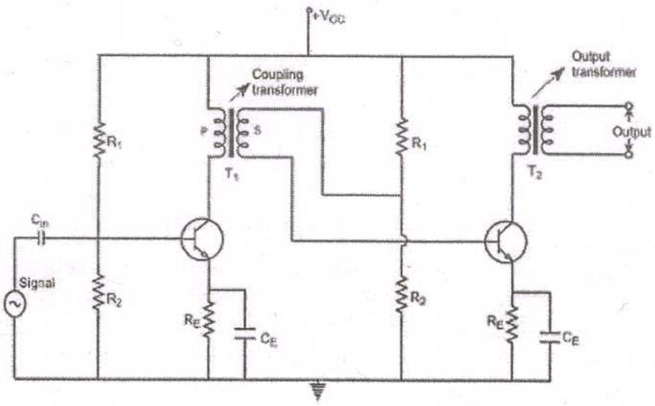
The net result of this increase in β, IB and Ico is that, Ic increases, shifting the operating point in the upward direction. This causes distortion in the output i.e. Q-point is not stable against temperature variation.

</td><td></td><td></td><td></td></tr>
<tr><td>IV a</td><td>

The amplifier circuit in which, the previous stage is connected to the next stage using a coupling transformer, is called as Transformer coupled amplifier.

The coupling transformer T_1 is used to feed the output of 1st stage to the input of 2nd stage. The collector load is replaced by the primary winding of the transformer. The secondary winding is connected between the potential divider and the base of 2nd stage, which provides the input to the 2nd stage. Instead of coupling capacitor like in RC coupled amplifier, a transformer is used for coupling any two stages, in the transformer coupled amplifier circuit.

The figure below shows the circuit diagram of transformer coupled amplifier.



The potential divider network R_1 and R_2 and the resistor R_e together form the biasing and stabilization network. The emitter by-pass capacitor C_e offers a low reactance path to the signal. The resistor R_L is used as a load impedance. The input capacitor C_{in} present at the initial stage of the amplifier couples AC signal to the base of the transistor. The capacitor C_C is the coupling capacitor that connects two stages and prevents DC interference between the stages and controls the shift of operating point.

Operation of Transformer Coupled Amplifier

When an AC signal is applied to the input of the base of the first transistor then it gets amplified by the transistor and appears at the collector to which the primary of the transformer is connected.

The transformer which is used as a coupling device in this circuit has the property of impedance changing, which means the low resistance of a stage (or load) can be reflected as a high load resistance to the previous stage. Hence the voltage at the primary is transferred according to the turns ratio of the secondary winding of the transformer.

</td><td>Fig 4 + explana tion 5 =9</td><td></td><td>15</td></tr>
</table>

This transformer coupling provides good impedance matching between the stages of amplifier. The transformer coupled amplifier is generally used for power amplification.

IVb

RC coupled amplifier applications

Public address systems as pre-amplifiers.

They have excellent audio fidelity over a wide range of frequency.

Widely used as Voltage amplifiers

Audio and music players

Transformer coupled amplifier applications

The transformer coupled amplifier is commonly used for amplification of RF (radio frequency) signal.

It is mostly used for impedance matching between the individual stages.

It is used to transfer power to the low impedance load such as loudspeakers.

In order to match the impedance, a step down transformer of proper turn ratio is used.

The transformer coupling is generally used when the load is small.

It is mostly used for power amplification.

Direct coupled amplifier applications

It is used in linear integrated circuits.

It is used to amplify low frequency signals.

It is used in bioelectric measurements.

It is used in analog computation.

It is used in power supply voltage regulators.

It is used in TV receivers.

It is used in regulator circuits.

3X2=6

Va

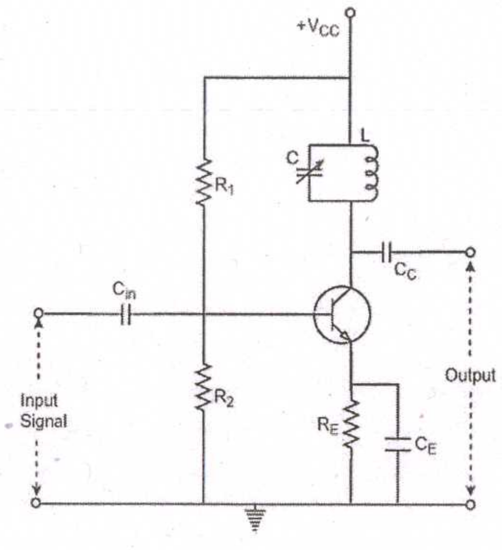


Fig 4 + explanation 5 =9

An amplifier circuit with a single tuner section being at the collector of the amplifier circuit is called as Single tuner amplifier circuit. A simple transistor amplifier circuit consisting of a parallel tuned circuit in its collector load, makes a single tuned amplifier circuit. The values of capacitance and inductance of the tuned circuit are selected such that its resonant frequency is equal to the frequency to be amplified. The output can be obtained from the coupling capacitor C_C as shown above or from a secondary winding placed at L. **Operation**

The high frequency signal that has to be amplified is applied at the input of the amplifier. The resonant frequency of the parallel tuned circuit is made equal to the frequency of the signal applied by altering the capacitance value of the capacitor C, in the tuned circuit.

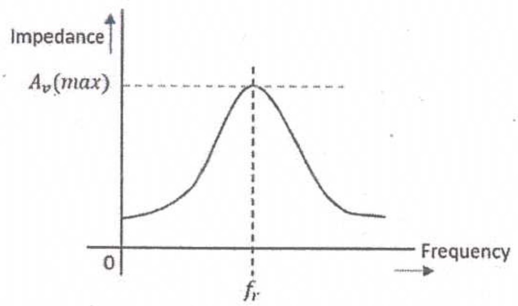
At this stage, the tuned circuit offers high impedance to the signal frequency, which helps to offer high output across the tuned circuit. As high impedance is offered only for the tuned frequency, all the other frequencies which get lower impedance are rejected by the tuned circuit. Hence the tuned amplifier selects and amplifies the desired frequency signal.

Frequency Response

The parallel resonance occurs at resonant frequency f_r when the circuit has a high Q. the resonant frequency f_r is given by

$$F = \frac{1}{2\pi\sqrt{LC}}$$

The following graph shows the frequency response of a single tuned amplifier circuit.



At resonant frequency f_r the impedance of parallel tuned circuit is very high and is purely resistive. The voltage across R_L is therefore maximum, when the circuit is tuned to resonant frequency. Hence the voltage gain is maximum at resonant frequency and drops off above and below it. The higher the Q, the narrower will the curve be.

On the basis of the mode of operation, i.e., the portion of the input cycle during which collector current flows, the power amplifiers may be classified as follows.

Vb **Class A Power amplifier** – When the collector current flows at all times during the full cycle of signal, the power amplifier is known as **class A power amplifier**. class A amplifiers to 25% in normal configuration and 50% in a transformer coupled configuration.

Class B Power amplifier – When the collector current flows only during the positive half cycle of the input signal, the power amplifier is known as **class** B power amplifier. Such amplifiers have an efficiency around 60%

Class AB Power amplifier – When the collector current flows more than a half cycle of the input signal, the power amplifier is known as **class AB** power amplifier.class AB is a combination of class A and class B type of amplifiers. As class A has the problem of low efficiency and class B has 6 distortion problem, this class AB is emerged to eliminate these two problems, by utilizing the advantages of both the classes.

Class C Power amplifier – When the collector current flows for less than half cycle of the input signal, the power amplifier is known as class C power amplifier. Distortion is high and practical use requires a tuned circuit as load. Efficiency can reach 80% in radio-frequency applications.

VI a

Class B Push-Pull Amplifier

Though the efficiency of class B power amplifier is higher than class A, as only one half cycle of the input is used, the distortion is high. Also, the input power is not completely utilized. In order to compensate these problems, the push-pull configuration is introduced in class B amplifier.

Construction

The circuit of a push-pull class B power amplifier consists of two identical transistors T_1 and T_2 whose bases are connected to the secondary of the center-tapped input transformer T_{r1}. The emitters are shorted and the collectors are given the V_{CC} supply through the primary of the output transformer T_{r2}.

The circuit arrangement of class B push-pull amplifier, is same as that of class A push-pull amplifier except that the transistors are biased at cut off, instead of using the biasing resistors. The figure below gives the detailing of the construction of a push-pull class B power amplifier.

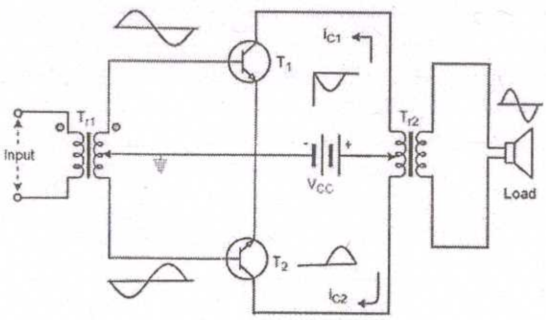


Fig 4 + explanation 5 =9

Operation

The circuit of class B push-pull amplifier shown in the above figure clears that both the transformers are center-tapped. When no signal is applied at the input, the transistors T_1 and T_2 are in cut off condition and hence no collector currents flow. As no current is drawn from V_{CC}, no power is wasted.

When input signal is given, it is applied to the input transformer T_{r1} which splits the signal into two signals that are 180^o out of phase with each other. These two signals are given to the two identical transistors T_1 and T_2. For the positive half cycle, the base of the transistor T_1 becomes positive and collector current flows. At the same time, the transistor T_2 has negative half cycle, which throws the transistor T_2 into cutoff condition and hence no collector current flows. The waveform is produced as shown in the following figure.

For the next half cycle, the transistor T_1 gets into cut off condition and the transistor T_2 gets into conduction, to contribute the output. Hence for both the cycles, each transistor conducts alternately. The output transformer T_{r3} serves to join the two currents producing an almost undistorted output waveform.

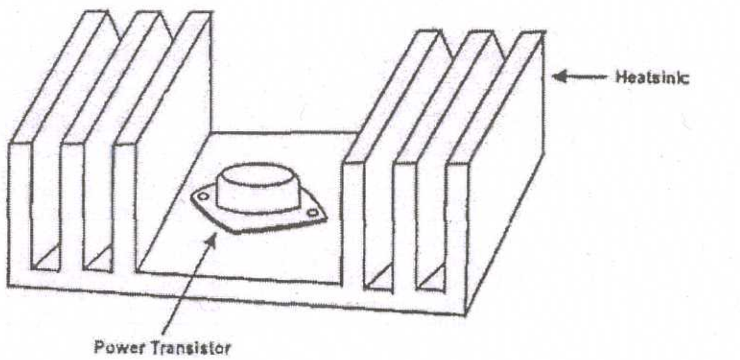
VI b

Power dissipation at junction causes the junction temperature to rise, and this in turn increases the collector current which causes further increase in power dissipation. If the phenomenon continues then it may result in permanent damage of the transistor. This is known as thermal runaway.
In power transistor or large signal transistors, the power to be dissipated at the collector causes junction temperature to rise to a high level.
It is possible to increase the power handling capacity of the transistor if a device that can cause rapid conduction of heat away from the junction is used. Such a device is called a heat sink.
A heat sink is a mechanical device. It is connected to the case of the semiconductor device. So it is providing a path for the heat transfer.
The heat flows through the heat sink and is radiated to surrounding air. If a heat sink is not used then all the heat has to he transferred from a transistor case to surrounding air causing case temperature to increase.
If the power handled by the transistor is higher, then the case temperature will be higher. The temperature of the two types of power transistor is

Germanium: 100°C to 110°C

Silicon : 150°C to 200°C

6



Heat sinks increase the power rating (ie. power handling capacity) of a transistor by getting rid of the heat developed quickly.

It is in the form of a sheet of metal. Since the power dissipation within a transistor is mainly due to power dissipated at collector junction, the collector (connected to the case of the transistor) is bolted on to metal sheet for faster radiation of heat.

In this case, to prevent the collector from shorting to metal sheet, a thin mica washer is used between the two. Fig shows a heat sink. The heat now radiate more quickly because of increased surface area.

Sometimes the transistor is connected to a large heat sink with fins causing more efficient removal of heat from the transistor.

When heat flows out of a transistor, it passes through the case transistor and into the heat sink, which then radiates the heat into the surrounding air.

VIIa

Negative feedback in an amplifier is the method of feeding a portion of the amplified output to the input but in opposite phase. The phase opposition occurs as the amplifier provides 180° phase shift whereas the feedback network doesn't.

There are two main types of negative feedback circuits. They are –

- Negative Voltage Feedback
- Negative Current Feedback

Negative Voltage Feedback

In this method, the voltage feedback to the input of amplifier is proportional to the output voltage. This is further classified into two types –

- Voltage-series feedback
- Voltage-shunt feedback

Negative Current Feedback

In this method, the voltage feedback to the input of amplifier is proportional to the output current. This is further classified into two types.

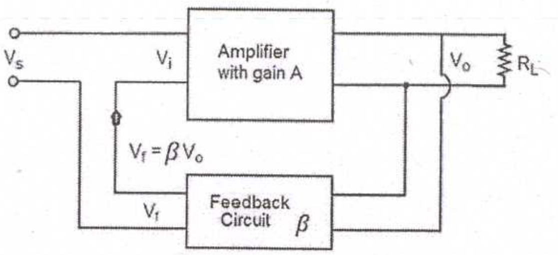
- Current-series feedback
- Current-shunt feedback

Let us have a brief idea on all of them.

Voltage-Series Feedback

In the voltage series feedback circuit, a fraction of the output voltage is applied in series with the input voltage through the feedback circuit. This is also known as **shunt-driven series-fed** feedback, i.e., a parallel-series circuit.

The following figure shows the block diagram of voltage series feedback, by which it is evident that the feedback circuit is placed in shunt with the output but in series with the input.



As the feedback circuit is connected in shunt with the output, the output impedance is decreased and due to the series connection with the input, the input impedance is increased.

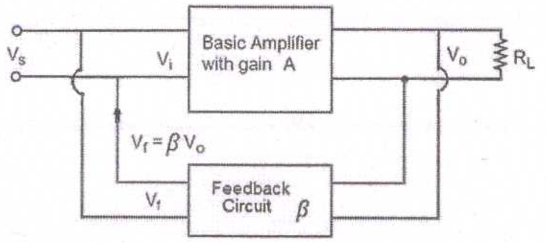
Voltage-Shunt Feedback

In the voltage shunt feedback circuit, a fraction of the output voltage is applied in parallel with the input voltage through the feedback network. This is also known as **shunt-driven shunt-fed** feedback i.e., a parallel-parallel proto type.

The below figure shows the block diagram of voltage shunt feedback, by

Explanation 1 marks + 4x2marks = 9

which it is evident that the feedback circuit is placed in shunt with the output and also with the input.

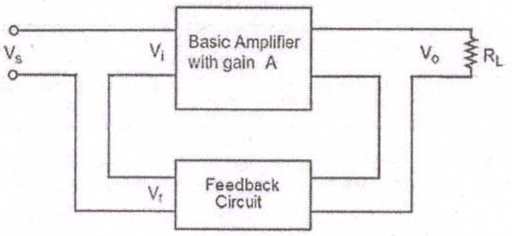


As the feedback circuit is connected in shunt with the output and the input as well, both the output impedance and the input impedance are decreased.

Current-Series Feedback

In the current series feedback circuit, a fraction of the output voltage is applied in series with the input voltage through the feedback circuit. This is also known as **series-driven series-fed** feedback i.e., a series-series circuit.

The following figure shows the block diagram of current series feedback, by which it is evident that the feedback circuit is placed in series with the output and also with the input.

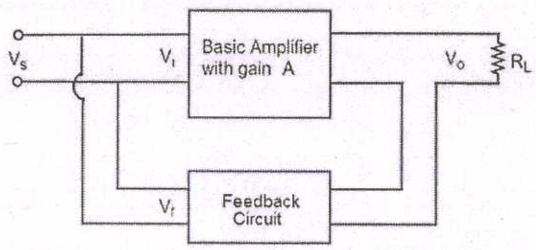


As the feedback circuit is connected in series with the output and the input as well, both the output impedance and the input impedance are increased.

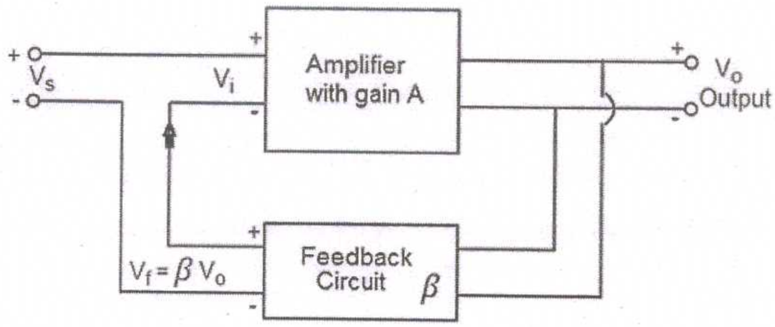
Current-Shunt Feedback

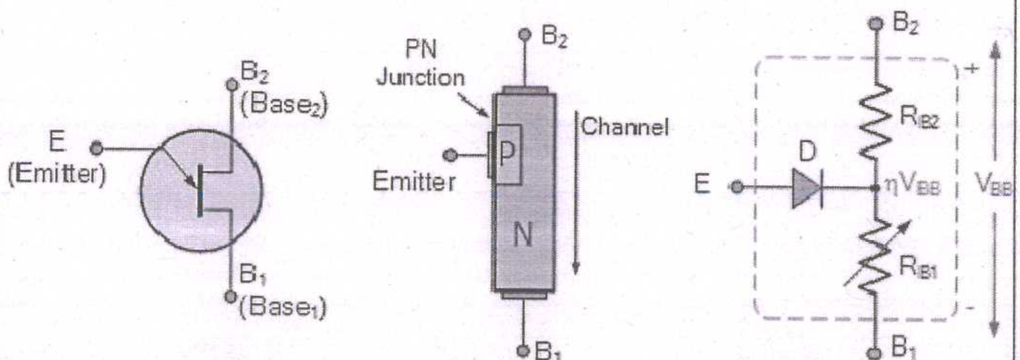
In the current shunt feedback circuit, a fraction of the output voltage is applied in series with the input voltage through the feedback circuit. This is also known as series-driven shunt-fed feedback i.e., a series-parallel circuit.

The below figure shows the block diagram of current shunt feedback, by which it is evident that the feedback circuit is placed in series with the output but in parallel with the input.



As the feedback circuit is connected in series with the output, the output impedance is increased and due to the parallel connection with the input, the input impedance is decreased.

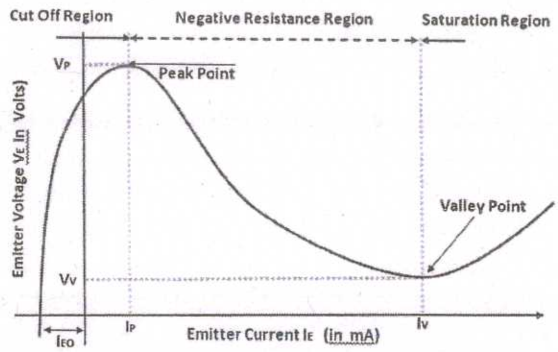
	Let us now tabulate the amplifier characteristics that get affected by different types of negative feedbacks.			
VIIb	A feedback amplifier generally consists of two parts. They are the amplifier and the feedback circuit. The feedback circuit usually consists of resistors. The concept of feedback amplifier can be understood from the following figure.  From the above figure, the gain of the amplifier is represented as A. the gain of the amplifier is the ratio of output voltage V_o to the input voltage V_i. the feedback network extracts a voltage $V_f = \beta V_o$ from the output V_o of the amplifier. This voltage is added for positive feedback and subtracted for negative feedback, from the signal voltage V_s. Now, $$V_i = V_s - V_f = V_s - \beta V_o$$ The quantity $\beta = V_f/V_o$ is called as feedback ratio or feedback fraction. Let us consider the case of negative feedback. The output V_o must be equal to the input voltage $(V_s - \beta V_o)$ multiplied by the gain A of the amplifier. Hence, $$(V_s - \beta V_o)A = V_o$$ $$AV_s - A\beta V_o = V_o$$ $$AV_s = V_o(1 + A\beta)$$ $$\frac{V_o}{V_s} = \frac{A}{1 + A\beta}$$	Fig 2+derivation 4 =6		

VIIIa	UJT consists of a single solid piece of N-type semiconductor material forming the main current carrying channel with its two outer connections marked as *Base 2* (B_2) and *Base 1* (B_1). The third connection, confusingly marked as the *Emitter* (E) is located along the channel. The emitter terminal is represented by an arrow pointing from the P-type emitter to the N-type base. The Emitter rectifying p-n junction of the unijunction transistor is formed by fusing the P-type material into the N-type silicon channel. The Emitter junction is positioned along the channel so that it is closer to terminal B_2 than B_1. An arrow is used in the UJT symbol which points towards the base indicating that the Emitter terminal is positive and the silicon bar is negative material. Below shows the symbol, construction, and equivalent circuit of the UJT.  UJT Symbol — Construction — Simplified Equivalent Circuit from the equivalent circuit above, that the N-type channel basically consists of two resistors R_{B2} and R_{B1} in series with an equivalent (ideal) diode, D representing the p-n junction connected to their center point. This Emitter p-n junction is fixed in position along the ohmic channel during manufacture and can therefore not be changed. Resistance R_{B1} is given between the Emitter, E and terminal B_1, while resistance R_{B2} is given between the Emitter, E and terminal B_2. As the physical position of the p-n junction is closer to terminal B_2 than B_1 the resistive value of R_{B2} will be less than R_{B1}. The total resistance of the silicon bar (its Ohmic resistance) will be dependent upon the semiconductors actual doping level as well as the physical dimensions of the N-type silicon channel but can be represented by R_{BB}. These two series resistances produce a voltage divider network between the two base terminals of the unijunction transistor and since this channel stretches from B_2 to B_1, when a voltage is applied across the device, the potential at any point along the channel will be in proportion to its position between terminals B_2 and B_1. The level of the voltage gradient therefore depends upon the amount of supply voltage. When used in a circuit, terminal B_1 is connected to ground and the Emitter serves as the input to the device. Suppose a voltage V_{BB} is applied across the UJT between B_2 and B_1 so that B_2 is biased positive relative to B_1. With zero	Dig 4 + Exp 5 = 9		

Emitter input applied, the voltage developed across R_{B1} (the lower resistance) of the resistive voltage divider can be calculated as: Unijunction Transistor R_{B1} Voltage

$$V_{RB1} = \frac{R_{B1}}{R_{B1} + R_{B2}} \times V_{BB}$$

For a unijunction transistor, the resistive ratio of R_{B1} to R_{BB} shown above is called the **intrinsic stand-off ratio** and is given the Greek symbol: **η** (eta). Typical standard values of η range from 0.5 to 0.8 for most common UJT's.

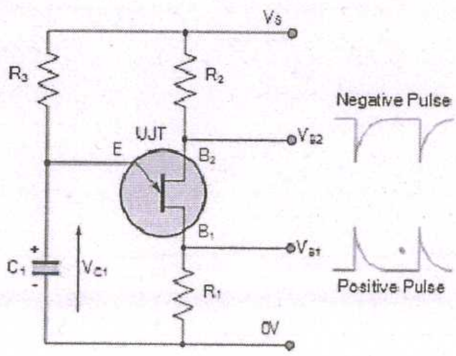


If a small positive input voltage which is less than the voltage developed across resistance, R_{B1} (ηV_{BB}) is now applied to the Emitter input terminal, the diode p-n junction is reverse biased, thus offering a very high impedance and the device does not conduct. The UJT is switched "OFF" and zero current flows.

However, when the Emitter input voltage is increased and becomes greater than V_{RB1} (or $\eta V_{BB} + 0.7V$, where 0.7V equals the p-n junction diode volt drop) the p-n junction becomes forward biased and the unijunction transistor begins to conduct. The result is that Emitter current, ηI_E now flows from the Emitter into the Base region.

The effect of the additional Emitter current flowing into the Base reduces the resistive portion of the channel between the Emitter junction and the B_1 terminal. This reduction in the value of R_{B1} resistance to a very low value means that the Emitter junction becomes even more forward biased resulting in a larger current flow. The effect of this results in a negative resistance at the Emitter terminal

VIIIb Unijunction Transistor Relaxation Oscillator



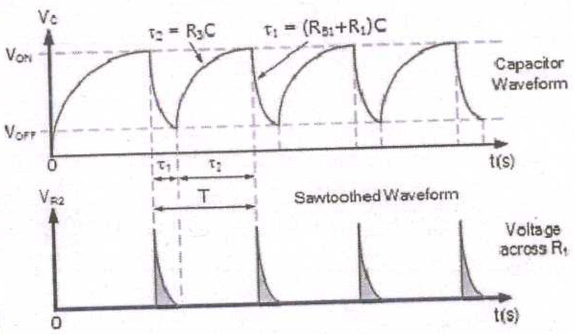
When a voltage (Vs) is firstly applied, the unijunction transistor is "OFF" and the capacitor C1 is fully discharged but begins to charge up exponentially through resistor R3. As the Emitter of the UJT is connected to the capacitor, when the charging voltage Vc across the capacitor becomes greater than the diode volt drop value, the p-n junction behaves as a normal diode and becomes forward biased triggering the UJT into conduction. The unijunction transistor is "ON". At this point the Emitter to B1 impedance collapses as the Emitter goes into a low impedance saturated state with the flow of Emitter current through R1 taking place.

Fig 3+ explanation 3 =6

As the ohmic value of resistor R1 is very low, the capacitor discharges rapidly through the UJT and a fast rising voltage pulse appears across R1. Also, because the capacitor discharges more quickly through the UJT than it does charging up through resistor R3, the discharging time is a lot less than the charging time as the capacitor discharges through the low resistance UJT.

When the voltage across the capacitor decreases below the holding point of the p-n junction (V_{OFF}), the UJT turns "OFF" and no current flows into the Emitter junction so once again the capacitor charges up through resistor R3 and this charging and discharging process between V_{ON} and V_{OFF} is constantly repeated while there is a supply voltage, Vs applied.

UJT Oscillator Waveforms

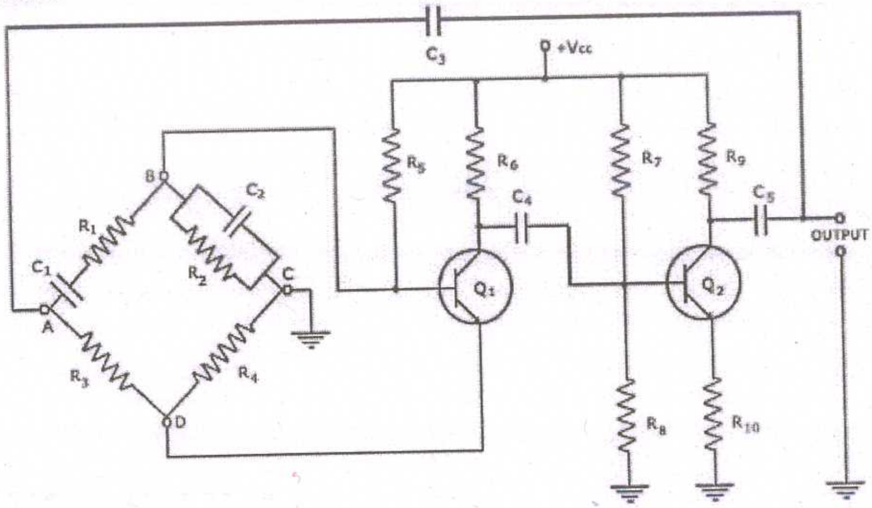


Then we can see that the unijunction oscillator continually switches "ON" and "OFF" without any feedback. The frequency of operation of the oscillator is directly affected by the value of the charging resistance R3, in series with the capacitor C1 and the value of η. The output pulse shape generated from the Base1 (B1) terminal is that of a sawtooth waveform and to regulate the time period, you only have to change the ohmic value of resistance, R3 since it sets the RC time constant for charging the capacitor.

The time period, T of the sawtoothed waveform will be given as the charging time plus the discharging time of the capacitor. As the discharge time, τ_1 is generally very short in comparison to the larger RC charging time, τ_2 the time period of oscillation is more or less equivalent to $T \cong \tau_2$. The frequency of oscillation is therefore given by $f = 1/T$.

IX a

It is a two stage amplifier with **RC bridge circuit** and the circuit has the lead lag networks. The lags at the phase shift are increasing the frequency and the leads are decreasing the frequency. In additional by adding the Wien Bridge oscillator at a particular frequency it becomes sensitive. At this frequency the Wien Bridge is balance the phase shift of 0°. The following diagram shows the circuit diagram of the Wienbridge oscillator. The diagram shows R1 is series with the C1, R3, R4 and R2 are parallel with the C2 to from the four arms.



Wien Bridge Oscillator Circuit

From the above diagram we can see the two transistors are used for the phase shift of 360°and also for the positive feedback. The negative feedback is connected to the circuit of the output with a range of frequencies. This has been taken through the R4 resistor to from the temperature sensitive lamp and the resistor is directly proportional to the increasing current. If the output of the amplitude is increased then the more current is offered more negative feedback.

Wien Bridge Oscillator Operation

The circuit is in the oscillation mode and the base current of the first transistor is changed randomly because it is due to the difference in voltage of DC supply. The base current is applied to the collector terminal of the first transistor and the phase shift is about the 180°. The output of the first transistor is given to the base terminal of the second transistor Q2 with the help of the capacitor C4. Further, this process is amplified and from the second transistor of collector terminal the phase reversed signal is collected.

The output signal is connected to the phase with the help of the first transistor to the base terminal. The input point of the bridge circuit is from the point A to point C the feedback of this circuit is the output signal at the second transistor. The feedback signal is given to the resistor R4 which gives the negative feedback. In this same way the feedback signal is given to the base bias resistor R4 and it produces the positive feedback signal.

Fig 4 + Exp 5 =9

IX b

RC oscillator application

1. In audio signal generators
2. In function generators
3. In laboratory works
4. In audio applications like tone generator

LC oscillator application

2X3marks=6

1. RF generators
2. Radio and TV receivers and transmitters
3. High frequency heating

X a

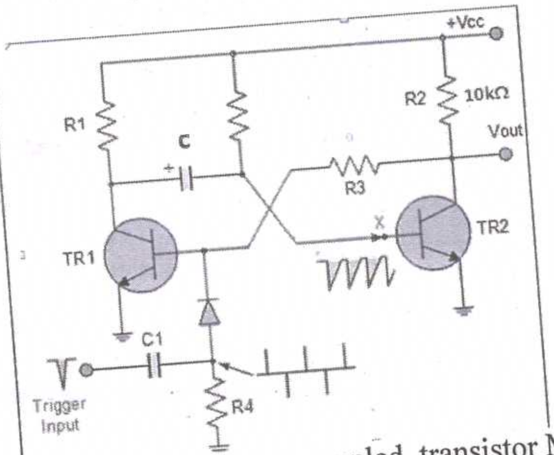
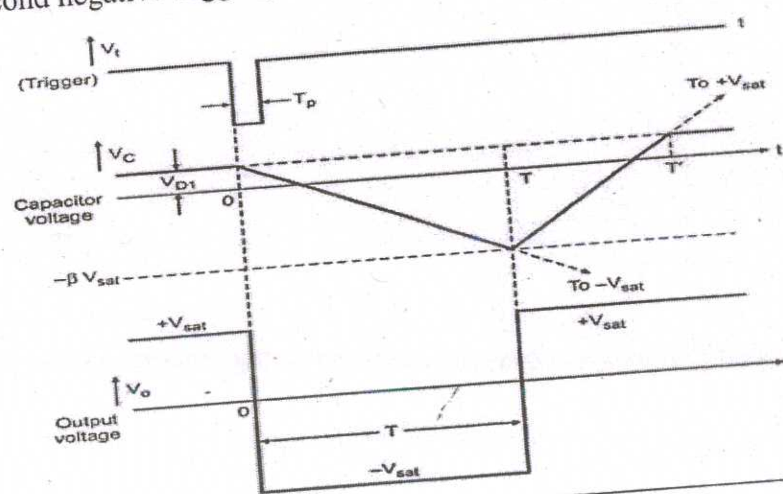


Fig 4 + explanation 5 =9

The basic collector-coupled transistor Monostable Multivibrator circuit and its associated waveforms are shown above. When power is firstly applied, the base of transistor TR2 is connected to Vcc via the biasing resistor, R_T thereby turning the transistor "fully-ON" and into saturation and at the same time turning TR1 "OFF" in the process. This then represents the circuits "Stable State" with zero output. The current flowing into the saturated base terminal of TR2 will therefore be equal to $Ib = (Vcc - 0.7)/R_T$.

If a negative trigger pulse is now applied at the input, the fast decaying edge of the pulse will pass straight through capacitor, C1 to the base of transistor, TR1 via the blocking diode turning it "ON". The collector of TR1 which was previously at Vcc drops quickly to below zero volts effectively giving capacitor C_T a reverse charge of -0.7v across its plates. This action results in transistor TR2 now having a minus base voltage at point X holding the transistor fully "OFF". This then represents the circuits second state, the "Unstable State" with an output voltage equal to Vcc.

Timing capacitor, C_T begins to discharge this -0.7v through the timing resistor R_T, attempting to charge up to the supply voltage Vcc. This negative voltage at the base of transistor TR2 begins to decrease gradually at a rate determined by the time constant of the $R_T C_T$ combination. As the base voltage of TR2 increases back up to Vcc, the transistor begins to conduct and doing so turns "OFF" again transistor TR1 which results in the monostable multivibrator automatically returning back to its original stable state awaiting a second negative trigger pulse to restart the process once again.



	Monostable Multivibrators can produce a very short pulse or a much longer rectangular shaped waveform whose leading edge rises in time with the externally applied trigger pulse and whose trailing edge is dependent upon the RC time constant of the feedback components used. This RC time constant may be varied with time to produce a series of pulses which have a controlled fixed time delay in relation to the original trigger pulse as shown below.			
Xb	Astable multivibrator 1. Used in square wave generator, voltage to frequency converter and in pulse synchronisation. 2. In digital voltmeter and SMPS 3. Used as an oscillator over a wide range of frequencies Monostable multivibrator 1. Used as adjustable pulse width generator 2. To generate uniform width pulses from variable width input pulse train 3. Used as a time delay unit Bistable multivibrator 1. Used a memory element or flip flop 2. In shift registers, countersetc. 3. Used a frequency divider	3X2 marks = 6		