Department of Electrical Engineering
Assignment
Date: 24/06/2020

Course Details

Course Title: Electronic Circuit Design **Module:** 04
Instructor: Engineer Mujtaba Ehsan **Total Marks:** 50

Student Details

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Q1.	(a)	**Discuss** the darlington connection for multistage amplifiers.	Marks 05+10
	(b)	The input of a certain regulator increases by 4.5 V. As a result, the output voltage increases by 0.062 V. The nominal output is 40 V. **Evaluate** the line regulation in both % and in %/V	CLO 2
Q2.		**Explain** Colpitts and Hartley oscillators.	Marks 10
			CLO 2
Q3.	(a)	**Describe** the idea behind class B amplifiers.	Marks 06+06
	(b)	**Explain the** types of voltage regulators and their purposes.	CLO 2
Q4.		**Explain** the working of Flash ADC.	Marks 05
			CLO 2
Q5.		**Differentiate** between the following:	Marks
	(a)	Low pass & high pass filters	04+04
	(b)	Active and passive filters	CLO 2

Q:-1 (b) The input of a certain regulator increases by 4.5 V. As a result, the output voltage increases by 0.062 V. The nominal output is 40 V. Evaluate the line regulation in both % and in %/V

Answer:

Line Regulation in % :

As we know that,

Line regulation=$\frac{0.062}{4.5} \times 100$

Line regulation= 1.378%

Line Regulation in %/V :

As we know that,

Line regulation =$\frac{\frac{0.062}{40}}{4.5} \times 100$

Line regulation= 0.344%/V

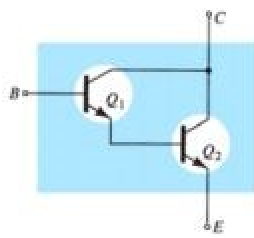
Q:-1 (a) Discuss the darlington connection for multistage amplifiers

Multistage Amplifier:

An amplifier formed by connecting several amplifiers in cascaded arrangement such that output of one amplifier becomes the input of other whose output becomes input of next and so on . The overall voltage gain of multistage amplifier is product of voltage gain of individual amplifier.

Darlington Pair:

A very popular connection of two bipolar junction transistors for operation as one "superbeta" transistor is the Darlington connection shown in Figure below The main feature of the Darlington connection is that the composite transistor acts as a single unit with a current gain that is the product of the current gains of the individual transistors. If the connection is made using two separate transistors having current gains of β1 and β2, the Darlington connection provides a current gain of βD = β1β



Use of Darlington amplifier:

The Darlington Pair offers a number of advantages. It is primarily used because it offers a particularly high current gain and this also reflects into a high input impedance for the overall Darlington circuit when compared to a single transistor.

Q2.		**Explain** Colpitts and Hartley oscillators.

Answer:

Colpitts Oscillator:

Oscillator is an amplifier with the positive feedback and it converts DC input signal into AC output waveform with certain variable frequency drive and certain shape of output waveform (like sine wave or square wave, etc) by using the positive feedback instead of input signal. Oscillators which utilizes the inductor L and capacitor C in their circuit are called as LC oscillator which is a type of linear oscillator.

LC oscillators can be designed by using different methods. The well known LC oscillators are Hartley oscillator and Colpitts oscillator. Among these two, the frequently used design is Colpitts Oscillator designed by and named after an American Engineer Edwin H Colpitts in 1918.

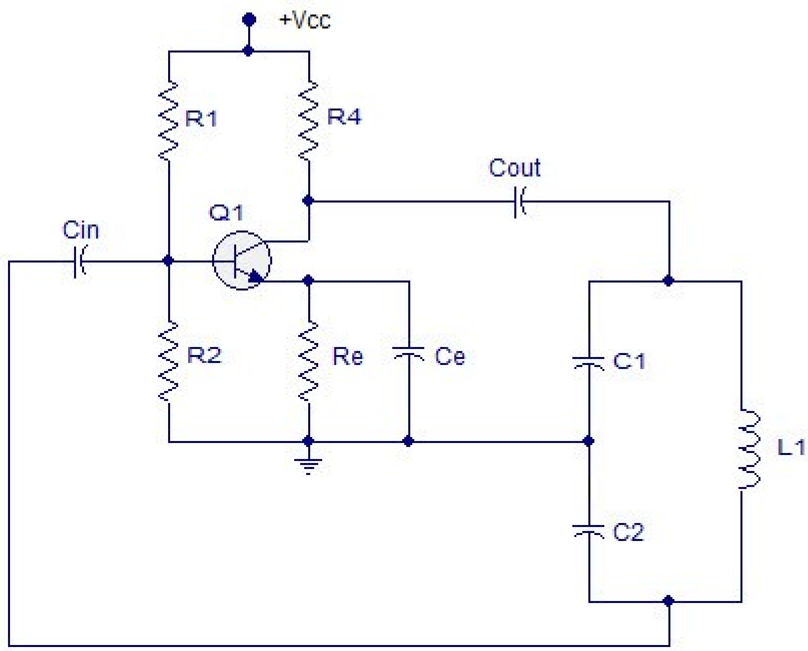
Colpitts Oscillator Theory

It consists of a tank circuit which is an LC resonance sub circuit made of two series capacitors connected in parallel to an inductor and frequency of oscillations can be determined by using the values of these capacitors and inductor of the tank circuit.

This oscillator is almost similar to Hartley oscillator in all aspects; hence, it is termed as electrical dual of Hartley oscillator and is designed for the generation of high frequency sinusoidal oscillations with the radio frequencies typically ranging from 10 KHz to 300MHz. The major difference between these two oscillators is that it uses tapped capacitance, whereas the Hartley oscillator uses tapped inductance.

Colpitts Oscillator Circuit

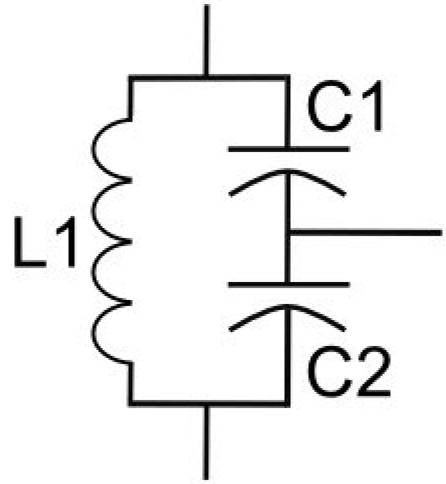
Every other oscillator circuit which generates sinusoidal waveforms utilizes the LC resonant circuit except a few electronic circuits such RC oscillators, Wien-Robinson oscillator and a few crystal oscillators which don't require additional inductances for this purpose.



It can be realized by using gain device such as Bipolar Junction Transistor(BJT), operational amplifier and field effect transistor(FET) as similar in other LC oscillators also. The capacitors C1 & C2 forms potential divider and this tapped capacitance in the tank circuit can be used as the source for feedback and this setup can be used to provide better frequency stability compared to the Hartley oscillator in which tapped inductance is used for feedback setup.

Colpitts Oscillator Working

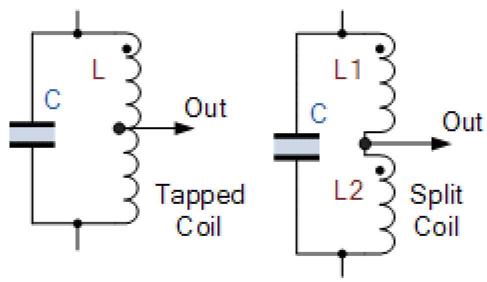
Whenever power supply is switched on, the capacitors C1 and C2 shown in the above circuit start charging and after the capacitors get fully charged, the capacitors starts discharging through the inductor L1 in the circuit causing damped harmonic oscillations in the tank circuit.



Thus, an AC voltage is produced across C1 & C2 by the oscillatory current in the tank circuit. While these capacitors get fully discharged, the electrostatic energy stored in the capacitors get transferred in the form of magnetic flux to the inductor and thus inductor gets charged.

The Hartley Oscillator

The Hartley Oscillator design uses two inductive coils in series with a parallel capacitor to form its resonance tank circuit producing sinusoidal oscillations



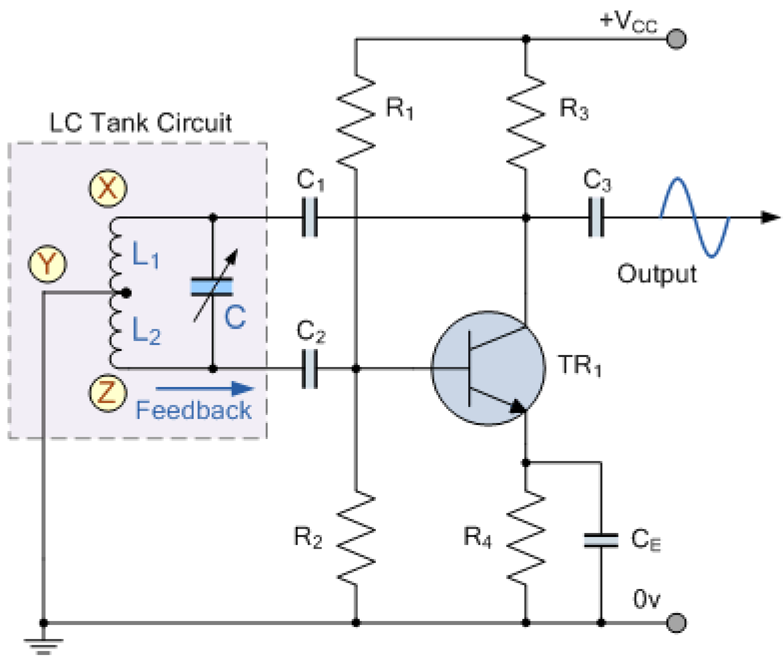
In the Hartley Oscillator the tuned LC circuit is connected between the collector and the base of a transistor amplifier. As far as the oscillatory voltage is concerned, the emitter is connected to a tapping point on the tuned circuit coil.

The feedback part of the tuned LC tank circuit is taken from the centre tap of the inductor coil or even two separate coils in series which are in parallel with a variable capacitor, C as shown.

The Hartley circuit is often referred to as a split-inductance oscillator because coil L is centre-tapped. In effect, inductance L acts like two separate coils in very close proximity with the current flowing through coil section XY induces a signal into coil section YZ below.

An Hartley Oscillator circuit can be made from any configuration that uses either a single tapped coil (similar to an autotransformer) or a pair of series connected coils in parallel with a single capacitor as shown below.

Basic Hartley Oscillator Design



When the circuit is oscillating, the voltage at point X (collector), relative to point Y (emitter), is 180o out-of-phase with the voltage at point Z (base) relative to point Y. At the frequency of oscillation, the impedance of the Collector load is resistive and an increase in Base voltage causes a decrease in the Collector voltage.

Thus there is a 180o phase change in the voltage between the Base and Collector and this along with the original 180o phase shift in the feedback loop provides the correct phase relationship of positive feedback for oscillations to be maintained.

The amount of feedback depends upon the position of the “tapping point” of the inductor. If this is moved nearer to the collector the amount of feedback is increased, but the output taken between the Collector and earth is reduced and vice versa. Resistors, R1 and R2 provide the usual stabilizing DC bias for the transistor in the normal manner while the capacitors act as DC-blocking capacitors.

Q:-3(a) Describe the idea behind class B amplifiers.

Answer:

Class B amplifier:

Class B amplifier is a type of power amplifier where the active device (transistor) conducts only for one half cycle of the input signal. That means the conduction angle is 180° for a Class B amplifier. Since the active device is switched off for half the input cycle, the active device dissipates less power and hence the efficiency is improved. Theoretical maximum efficiency of Class B power amplifier is 78.5%

Uses of class B amplifier:

The class B amplifiers are the positive and negative halves of the signals, that are allocated to the different parts of the circuits and the output device switched ON and OFF continuously. The basic class B amplifiers are used in two complementary transistors which are FET and bipolar.

Class B amplifiers as a high efficiency amplifier:

The Class B Amplifier has the big advantage over their Class A amplifier cousins in that no current flows through the transistors when they are in their quiescent state (ie, with no input signal), therefore no power is dissipated in the output transistors or transformer when there is no signal present unlike Class

Advantages of class B Amplifier:

- Very low standing bias current. Negligible power consumption without signal.
- Can be used for much more powerful outputs than class A
- More efficient than Class A.

Disadvantages of class B Amplifier:

- Creates Crossover distortion.
- Supply current changes with signal, stabilized supply may be needed.
- More distortion than Class A.

Q:-3(b) Explain the types of voltage regulators and their purposes.

Answer:

Voltage Regulator:

Voltage regulator, any electrical or electronic device that maintains the voltage of a power source within acceptable limits. The voltage regulator is needed to keep voltages within the prescribed range that can be tolerated by the electrical equipment using that voltage

Types of Voltage Regulators:

Basically, there are two types of Voltage regulators: Linear voltage regulator and Switching voltage regulator.

Linear:

Linear regulator acts as a voltage divider. In the Ohmic region, it uses FET. The resistance of the voltage regulator varies with load resulting in constant output voltage.

Advantages of a linear voltage regulator:

- Gives a low output ripple voltage
- Fast response time to load or line changes
- Low electromagnetic interference and less noise

Disadvantages of the linear voltage regulator:

- Efficiency is very low
- Requires large space – heatsink is needed
- Voltage above the input cannot be increased
- There are two types of linear voltage regulators:

Then there are the two sub types of linear voltage regulators:

- Series
- Shunt.

Switching:

A switching regulator rapidly switches a series device on and off. The switch's duty cycle sets the amount of charge transferred to the load. This is controlled by a feedback mechanism similar to that of a linear regulator. Switching regulators are efficient because the series element is either fully conducting or switched off because it dissipates almost no power. Switching regulators are able to generate output voltages that are higher than the input voltage or of opposite polarity, unlike linear regulators.

Advantages:

- High efficiency
- Low heat generation
- Boost/buck/negative voltage operation possible

Disadvantages:

- More external parts required
- Complicated design
- Increased noise

There are three sub types of switching voltage regulators:

- Step up,
- Step down
- Inverter voltage regulators.

Q4.		**Explain** the working of Flash ADC.

Answer:

A flash ADC (also known as a direct-conversion ADC) is a type of analog-to-digital converter that uses a linear voltage ladder with a comparator at each "rung" of the ladder to compare the input voltage to successive reference voltages.

Working of a flash ADC:

flash ADC is used to convert analog to digital comparator compares two voltages value and give output high one or low zero in this comparator the inverting terminal value is higher than non-inverting plus terminal so the output is low zero this comparator the inverting terminal value is lower than non-inverting plus terminal so the output is high one flash ADC is simple and fast but the precision of flash ADC is less flash ADC is useful in large bandwidth application it simply consists of resistors comparator priority encoder voltage regulator etc each resistor having same value as use advantage of flash ADC is that for high resolution it requires large number of comparators also it consume large power and it is bigger in size and bid flash ADC consists of two to the power and resistors and two to the power n minus one comparators means if it is three bit / a DC then 2 to the power 3 equal to 8 resistors and 2 to the power 3 minus 1 equal 7 comparators are required and if it is for bid flash ADC then 2 to the power 4 equal 16 resistors and 2 to the power 4 minus 1 equal 15 comparators are required and if it is 8-bit flash ADC then 2 to the power 8 equal 256 resistors and 2 to the power 8 minus 1 equal 255 comparators are required the input voltage V in is applied to non-inverting plus terminal of comparator and reference voltage is applied to inverting terminal of comparator the process is parallel so it is fast and also called parallel ADC sample-and-hold is not required in this method of ADC let eight volt is applied to be referenced by a voltage regulator so the voltage drop is shown seven volt six volt five volt 4 volt three volt 2 volt and 1 volt the comparators compares the reference voltage V Rev and input voltage V in LED 2.5 volt is applied to be in the comparator compare the voltage values if voltage value is lower than output of that comparator set to zero and it goes to lower comparator and if voltage value is lower than output of that comparator set to zero and it goes to lower comparator if voltage value is greater than output of that comparator set to 1 here the 2.5 is greater than 2 so the comparator value is set to 1 and the priority encoder gives the binary output

Q5.		**Differentiate** between the following:
	(a)	Low pass & high pass filters
	(b)	Active and passive filters

(a) Low pass & high pass filters:

High Pass Filter:

A high-pass filter (HPF) attenuates content below a cutoff frequency, allowing higher frequencies to pass through the filter.

Function:

A high-pass filter (HPF) is an electronic filter that passes signals with a frequency higher than a certain cutoff frequency and attenuates signals with frequencies lower than the cutoff frequencyion:

Use:

High pass filters are used in audio system as part of an audio crossover to direct high frequencies to a tweeter while attenuating bass signals which could interfere with, or damage, the speaker

Calculation of High pass filter:

The frequency range "below" this cut-off point ƒc is generally known as the Stop Band while the frequency range "above" this cut-off point is generally known as the Pass Band. The cut-off frequency, corner frequency or -3dB point of a high pass filter can be found using the standard formula of: $f_c = 1/(2\pi RC)$.

Low Pass Filter

A low-pass filter (LPF) attenuates content above a cutoff frequency, allowing lower frequencies to pass through the filter

Function:

A low-pass filter (LPF) is a filter that passes signals with a frequency lower than a selected cutoff frequency and attenuates signals with frequencies higher than the cutoff frequency.

Use:

A low-pass filter can be used very effectively to mimic the sensation that one signal is further away from the listener than another (unfiltered) signal. This technique can be used very quickly, and easily to establish spatial contrast between two signals, especially if they're separated in the stereo field

Calculation of a low pass filter:

The cut-off frequency or -3dB point, can be found using the standard formula, $f_c = 1/(2\pi RC)$. The phase angle of the output signal at ƒc and is -45o for a Low Pass Filter.

(b) Active and passive filters:

Electronic filters are circuits which perform signal processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones or both.

Passive filters:

Contains passive components (R, L, C), they do not depend upon an external power supply and/or they do not contain active components such as transistors or battery. The simplest passive filters, RC and RL filters, include only one reactive element, except HYBRIED LC Filter which is characterized by inductance and capacitance integrated in one element.

Active filters:

Are implemented using a combination of passive and active (amplifying) components, and require an outside power source. Operational filters are frequently used in active filter designs. These can have high Q Factor, and can achieve resonance without the use of inductors. However, their upper frequency limit is limited by the bandwidth of the amplifiers. The most common types of active filters are classified into four such as 1.Butterworth 2.Chebyshev 3.Bessel 4.Elliptical

The difference between Active and Passive Filters:

1. Passive filters consume the energy of the signal, but no power gain is available; while active filters have a power gain.

2. Active filters require an external power supply, while passive filters operate only on the signal input.

3. Only passive filters use inductors.

4. Only active filters use elements kike op-amps and transistors, which are active elements.

5. Theoretically, passive filters have no frequency limitations while, active filters have limitations due to active elements.

6. Passive filters have a better stability and can withstand large currents.

7. Passive filters are relatively cheaper than active filters.