Name M.Yasir shah

ID 13172

Submitted to Engr. Mujtaba Ihsan

Department of Electrical Engineering
Assignment
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Course Details

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

Student Details

Name: M.yasir shah **Student ID:** 13172

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#01 (a) :- Discuss the darlington connection for multistage amplifiers.

Ans:- Darlington Connection:-

→ The main feature 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.

→ Provides high current gain than a single BJT.

→ The connection is made using two seperate transistors having current gains of β_1 and β_2.

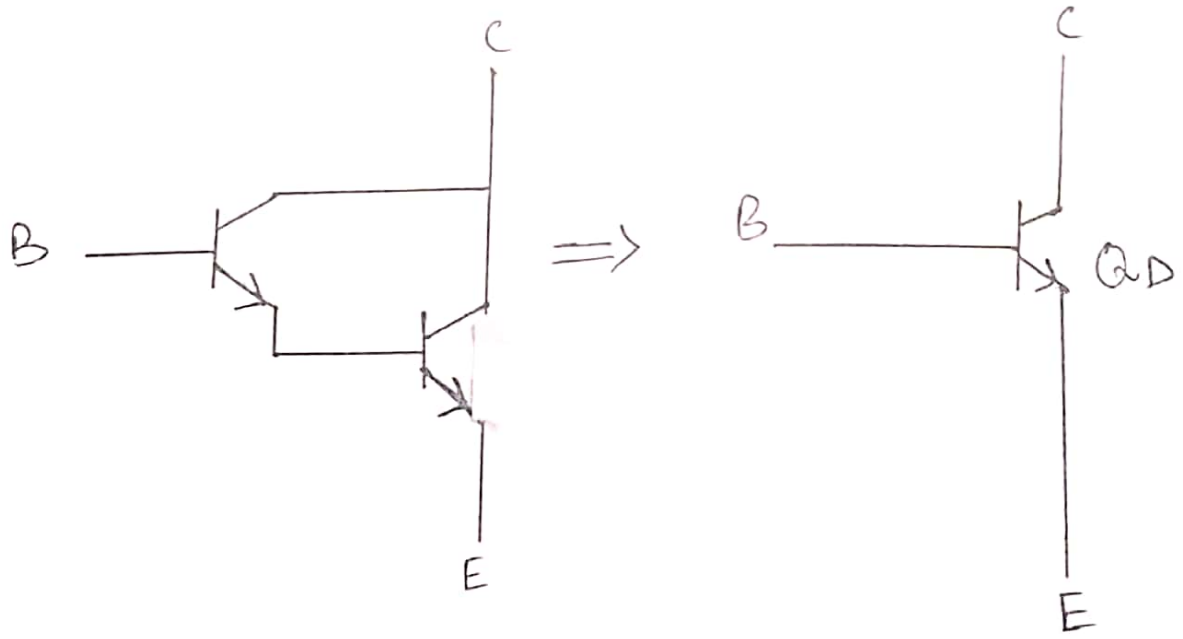
So the current gain.

$$\beta_D = \beta_1 \beta_2$$

If $\beta_1 = \beta_2 = \beta$

The Darlington connection provides a current gain of

$$\beta_D = \beta^2$$



Darlington transistor

Q#01 (b):

Solution:

$$\text{Line reg} = 0.062/45 \times 100\%$$

$$= 1.3777\%$$

$$\text{Line reg} = 0.062/40 \times 100\%$$

$$= 0.155\%/V.$$

Q # 02:-

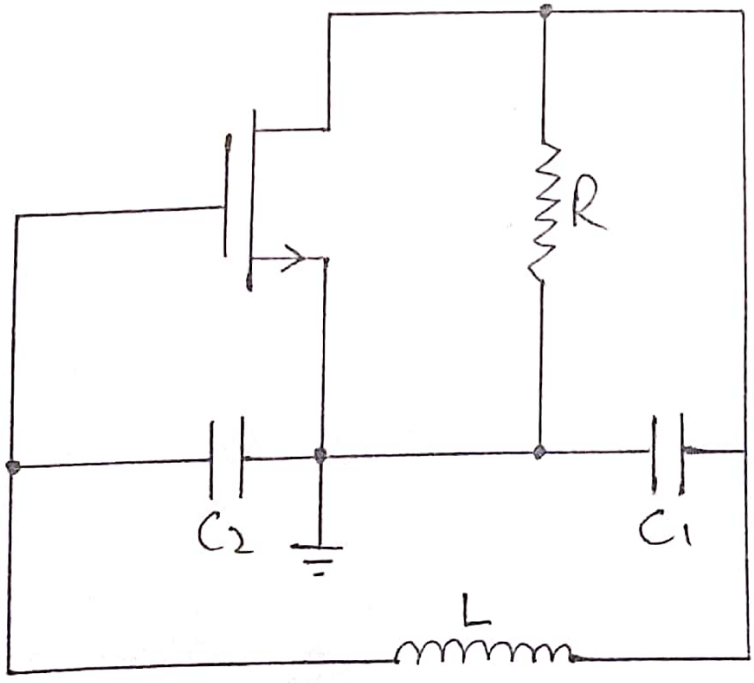
Colpitts Oscillator

-> The colpitts oscillator is a type of oscillator that uses an LC circuit in the feedback loop.

-> The feedback network is made up of a pair of tapped capacitors (C_1 and C_2) and an inductor L to produce a feedback necessary for oscillations.

-> The output voltage is developed across C_1.

-> The feedback voltage is developed across C_2.



Hartley Oscillator

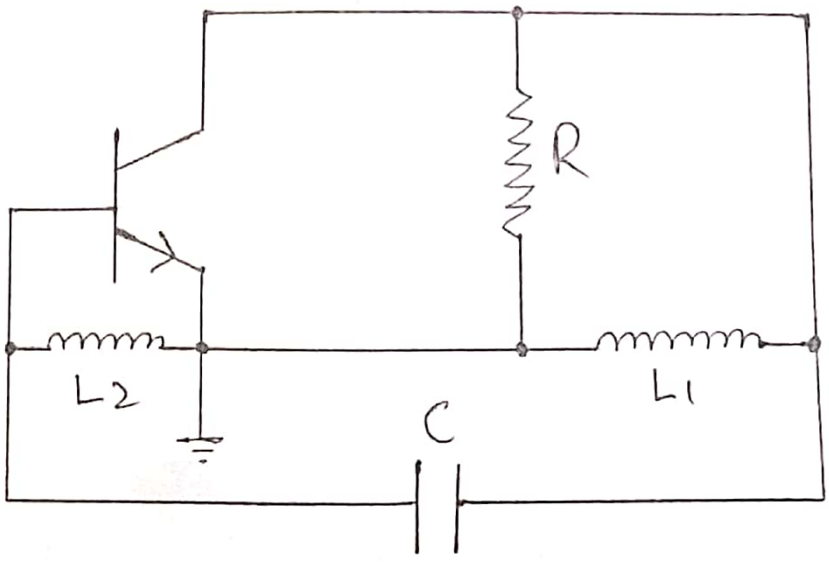
-> The Hartley oscillator is almost identical to the Colpitts oscillator.

-> The primary difference is that the feedback network of the Hartley oscillator uses tapped inductors (L_1 and L_2) and a single capacitor C.

-> The analysis of Hartley oscillator is identical to that Colpitts oscillator.

-> The frequency of oscillation

$$\omega_0 = \frac{1}{\sqrt{(L_1 + L_2)C}}$$



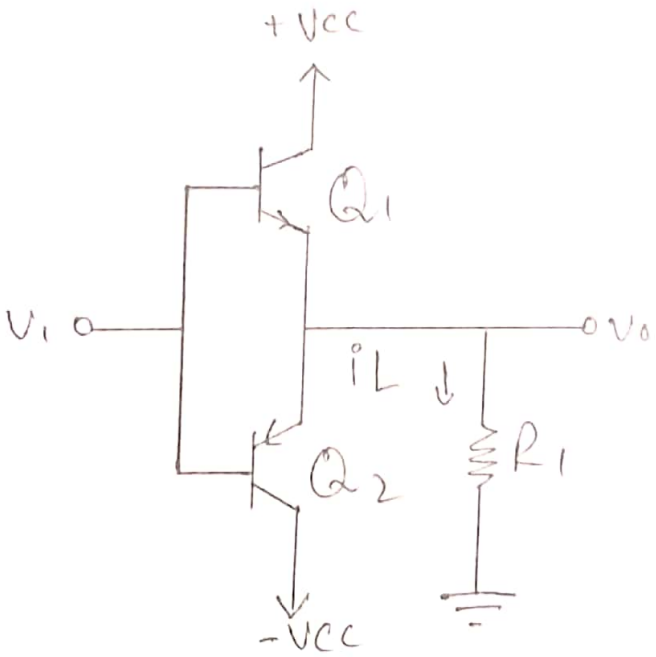
Q#03(a):- Describe the idea behind class B amplifiers.

Class B power 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.

-> Class B designs show high efficiency but poor linearity around the cross over region (due to the time it takes to turn one device off and the other device on, which translates into extreme crossover distortion).

→ Class B designs restricted to low power applications, e.g battery operated equipment, such as communication audio.



Class B output stage

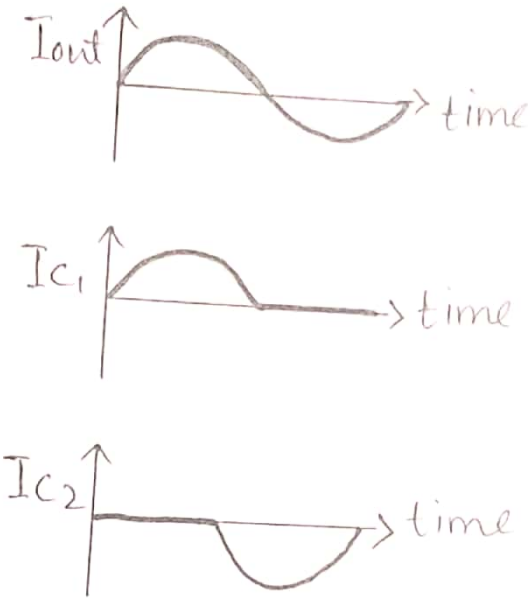
→ Q1 and Q2 form two unbiased emitter followers.

* Q1 only conducts when the input is positive.
* Q2 only conducts when the input is negative.

→ When input is zero, neither conducts.

→ i.e The quiescent power dissipation is zero.

Class B current waveforms:



Efficiency / Power Dissipation:

-> Peak efficiency of the class B output stage is 78.5%.

-> Remember, there are two output devices so the power dissipation is shared between them.

-> Class B amplifiers are used in low cost designs or design where sound quality is not that important.

Q#03(b): Explain types of voltage regulators and their purposes.

-> There are two types of voltage regulators.

-> Linear voltage regulator.

-> Switching voltage regulator.

Linear regulator:

-> 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.

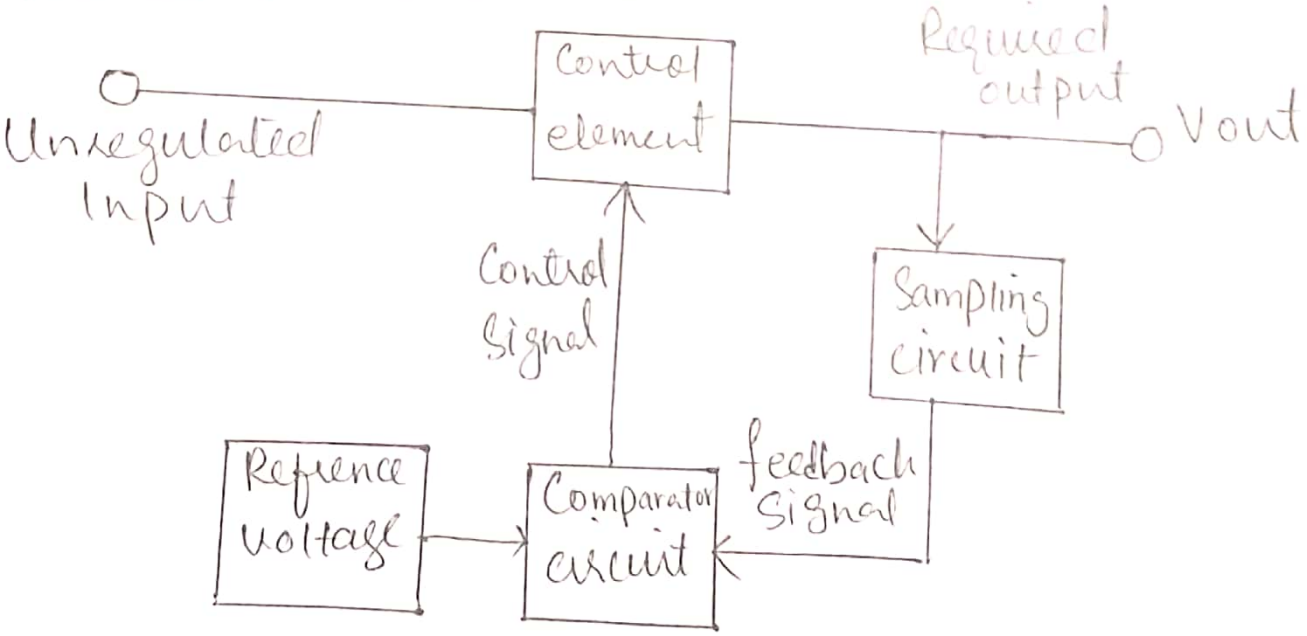
-> There are two types of Linear voltage regulator:

(i) Series

(ii) Shunt.

Series voltage regulator:

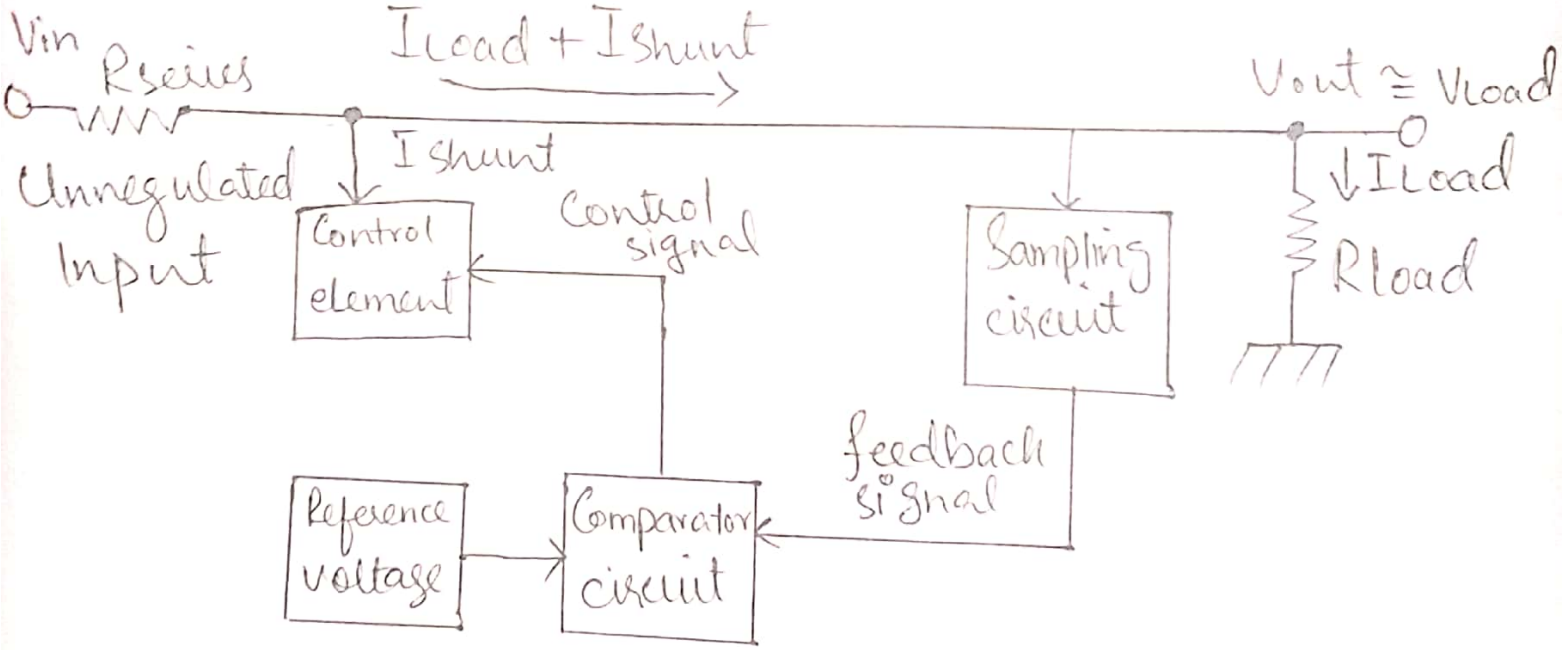
A series regulator uses a variable element placed in series with the load. By changing the resistance of that series element, the voltage dropped across it can be changed, and the voltage across the load remain constant.



Shunt voltage regulator:

A shunt regulator works by providing a path from the supply voltage to ground through a variable resistance. The current through the shunt regulator has diverted away

from the load and flows uselessly to the ground, making this form usually less efficient than series regulator. A shunt regulator can usually only sink (absorb) current.



Switching Regulator:

→ The switching regulator is a type of regulator circuit in which efficient transfer of power to the Load is greater than series and shunt regulators because the transistor is not always conducting.

→ The switching regulator passes voltage to the load in pulses, which is then filtered to provide a smooth dc voltage.

→ This type of regulator is ideal for high current applications.

→ Voltage regulation in a switching regulator is achieved by the on and off action limiting the amount of current flow based on the varying line and load conditions

→ With switching regulators, 90% efficiency can be achieved.

Purposes:

The purpose of linear regulator is that linear regulators respond quickly to changes in input voltage producing an output voltage that is mostly free of any ripple on the input.

→ The purpose of switching regulator is that a switching regulater is a circuit that uses a power switch, an inductor, and a diode to transfer energy from input to output.

The basic components of the switching circuit can be assanged to form a step down (buch) converter, a step up (boost) converter or an inverter (fly bach).

Q#04:- Explain working of Flash ADC.

-> As the analog input voltage exceeds the reference voltage at each comparator, the comparator outputs will sequentially saturate to a high state.

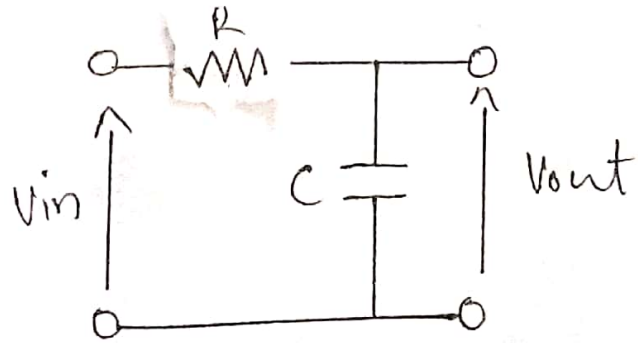
-> The priority encoder generates a binary number based on the highest-order active input, ignoring all other active inputs.

Q#05:- Differentiate between the following.

(a) Low pass and high pass filter.

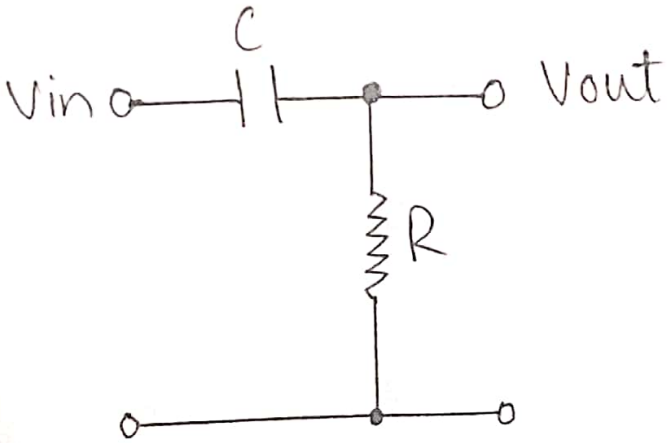
Low pass filter:

-> It is a circuit which allows the frequencies below cut off frequency to pass through it.
-> It consists of resistor followed by capacitor.
-> It is significant in removing aliasing effect.
-> Its operational frequency is lower than the cut off frequency.
-> In communication circuit use as anti aliasing filter.



High pass filter:

-> It is a circuit which allows the frequencies above cut off frequency to pass through it.
-> It consists of capacitor followed by a resistor.
-> It is significant when the distortion due to low frequency signal such as noise is to be removed.
-> Its operational frequency is higher than the cut off frequency.
-> In audio amplifiers, low noise amplifier etc.



(b) Active and passive filters

Active filter:

-> It is composed of active components like op-amp, transistor etc
-> It is High costly.
-> Its circuit is more complex.
-> Its weight is low.
-> Its Q factor is high
-> It required external power supply.
-> It is more sensitive.

Passive filter:

-> It is composed of Passive components like resistor, inductor and capacitor etc.

-> It's cost is comparatively low.

-> It is less complex than active filter.

-> Comparatively bulkier due to presence of inductors.

-> It's Q factor is very low in comparison to active filters.

-> It does not required external power supply.

-> It is comparatively less sensitive.