Department of Electrical Engineering
Final Exam Summer 2020
Date: 28/09/2020

Course Details

Course Title:	Electronic Circuit Design	**Module:**	04
Instructor:		**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 05 CLO 2
Q3.	(a)	**Describe** the idea behind class B amplifiers.	Marks 05+05
	(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	03+03
	(b)	Active and passive filters	CLO 2
Q6.		A certain operational amplifier has a common mode gain of 0.6 and an open loop differential voltage gain of 400,000. **Evaluate** the CMRR & express it in decibels.	Marks 05 CLO 2
Q7.	(a)	**Explain** the concept behind negative feedback in operational amplifiers.	Marks 04 CLO 2

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QNo 1 (a)

Darlington Connection:-

The main ~~connection~~ 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 provide high current gain than a singhe BJT.

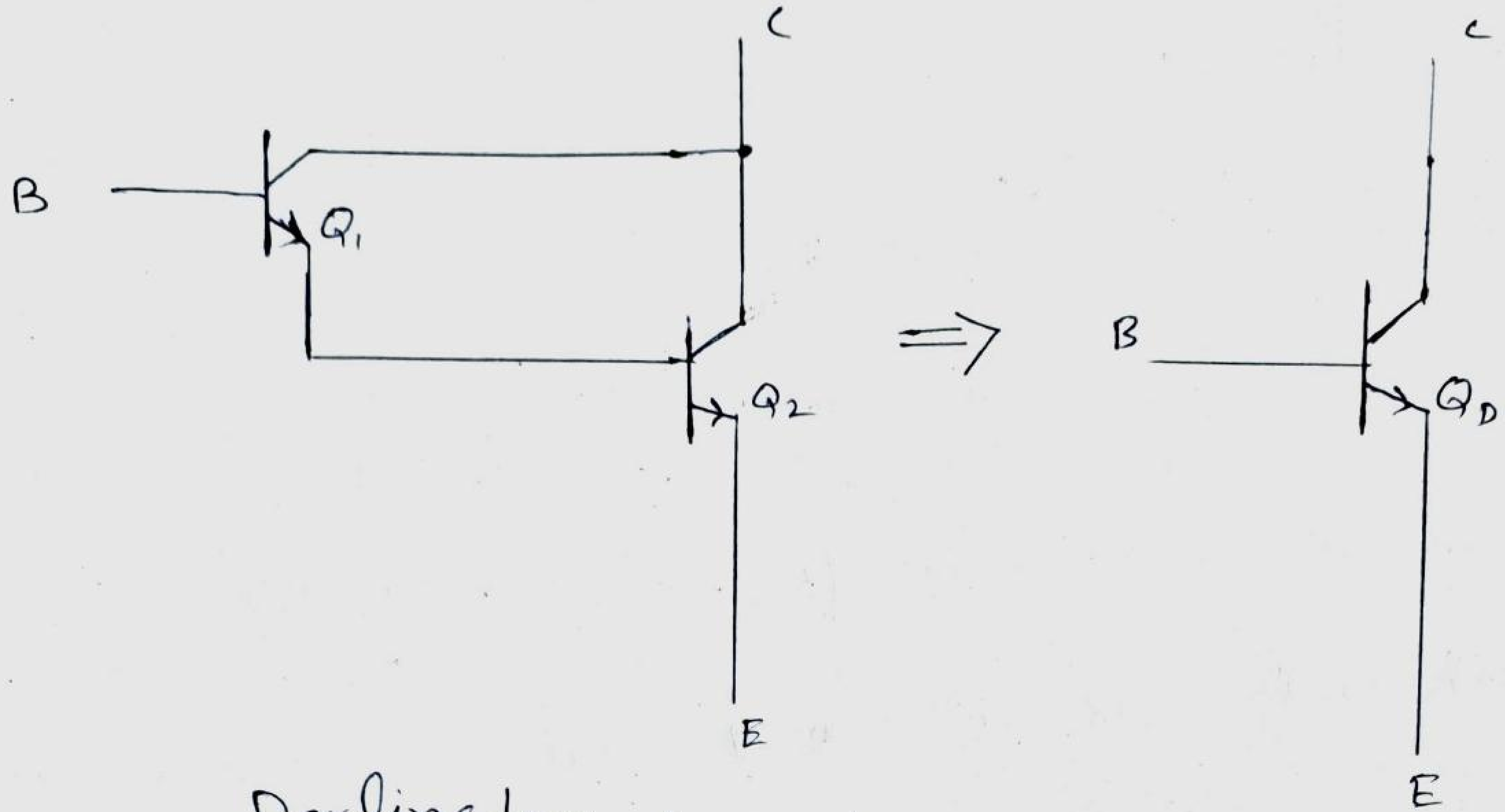
-> The connection is made using two separate transistor having currents gain of β_1 and β_2.

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.

→ The small current gain:-

$$A_i = I_o / I_i$$

Since $V_{\pi 1} = I_i r_{\pi 1}$

Therefore

$$g_{m1} V_{\pi 1} = g_{m1} r_{\pi 1} I_i = \beta_1 I$$

then

$$V_{\pi 2} = (I_i + \beta_1 I_i) r_{\pi 2}$$

The o/p current is:-

$$I_o = g_{m1} V_{\pi 1} + g_{m2} V_{\pi 2} = \beta_1 I_i + \beta_2 (1 + \beta_1) I_i$$

The overall gain is :-

$$A_i = I_o / I_i = \beta_1 + \beta_2(1+\beta_1) \cong \beta_1 \beta_2$$

The overall small-signal current gain = The product of the individual current gains.

→ The input resistance :-

$$V_i = V_{\pi 1} + V_{\pi 2} = I_i r_{\pi 1} + I_i(1+\beta_1) r_{\pi 2}$$

So, The i/p resistance is

$$R_i = r_{\pi 1} + (1+\beta_1) r_{\pi 2}$$

The base of Q2 is connected to emitter of Q1, which means that the i/p resistance to Q2 is multiplied by factor $(1+\beta_1)$ as we saw in circuits with emitter resistor.

$$r_\pi = \beta_1 V_T / I_{CQ_1} \quad \text{and} \quad I_{CQ_1} \cong I_{CQ_2} / \beta_2$$

$$r_{\pi 1} = \beta_1 \left(\beta_2 V_T / I_{CQ_2} \right) = \beta_1 r_{\pi 2}$$

$$R_i \cong 2 \beta_1 r_{\pi 2}$$

The i/p resistance tends to be large because of β multiplication

Q No 1 (b)

Sol:-

i) Line Reg = $\frac{0.062}{4.5} \times 100\%$

$= 1.37\%$

ii) Line Regulation in %/V $\Rightarrow$

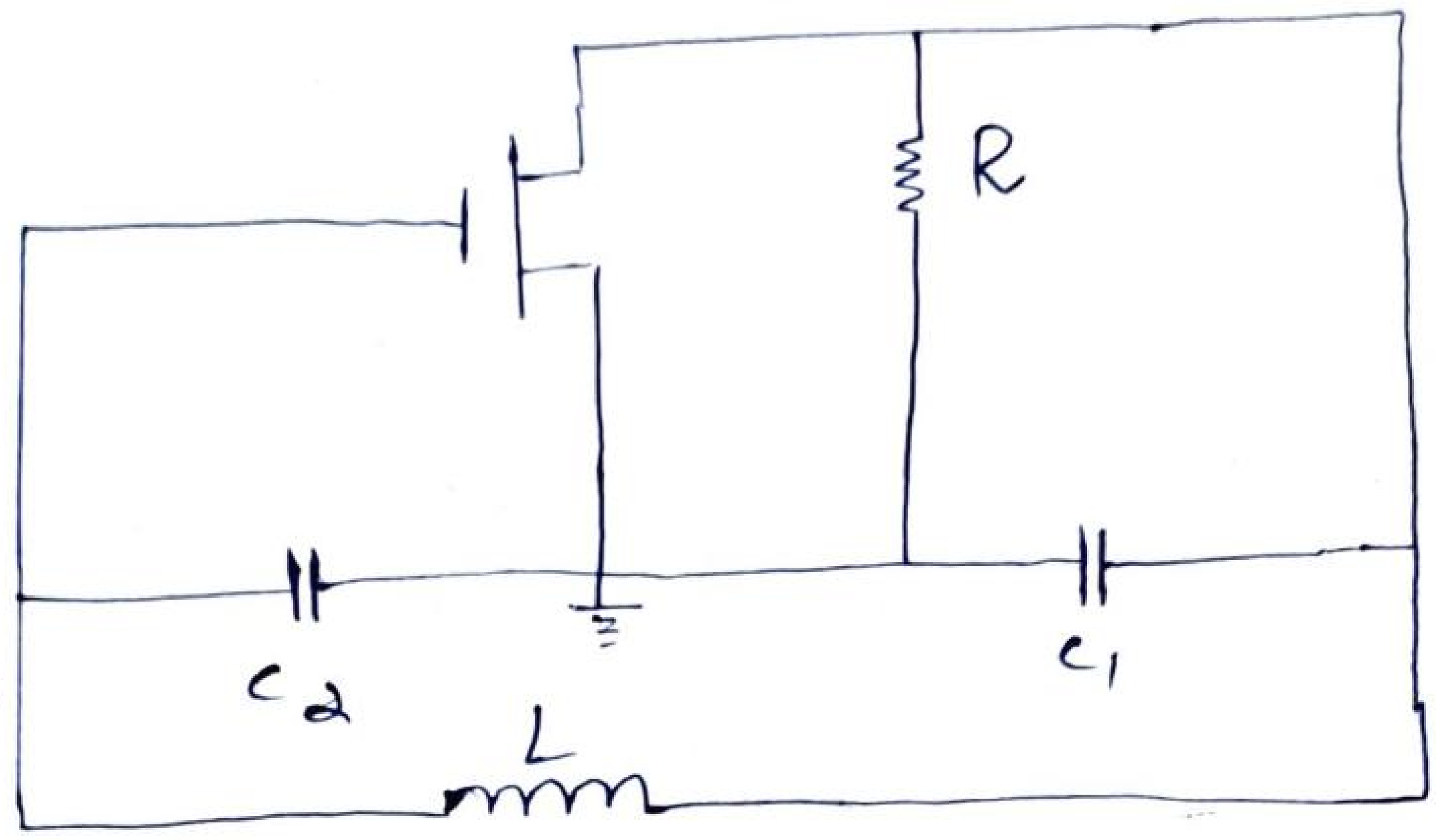
$= \frac{\frac{0.062}{40} \times 100\%}{4.5}$

$= 0.034\ \%/V$

QNo(2)

Answer:-

Colpits oscillator:-



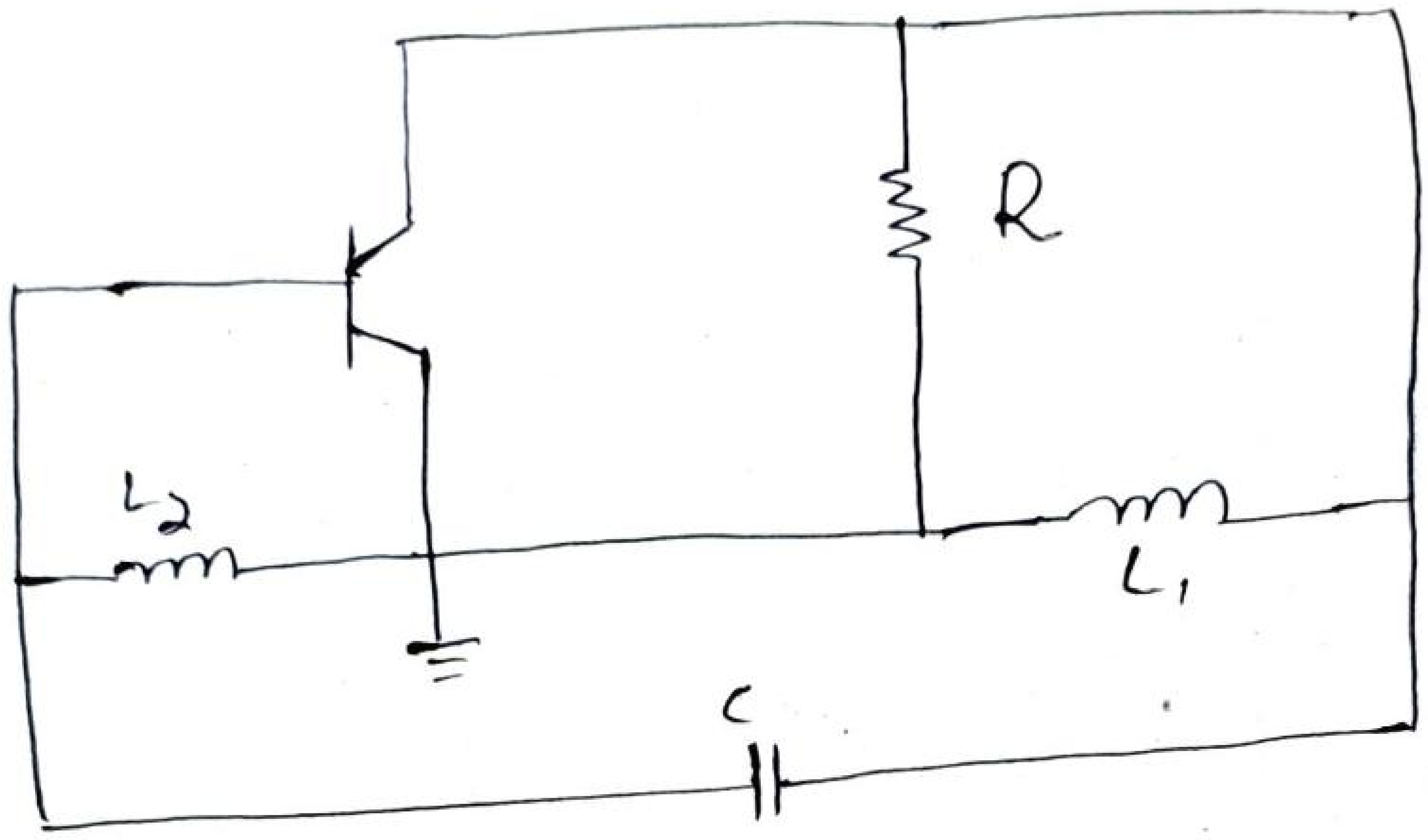
-> The colpitts oscillator is a type of ossillator that uses an LC circuit in feed-back loop.

-> The feedback network is made up of a pair of tapped capacitor (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 Osillator :-



-> 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.

QNo 3 (a)

Answer :-

Class B :-

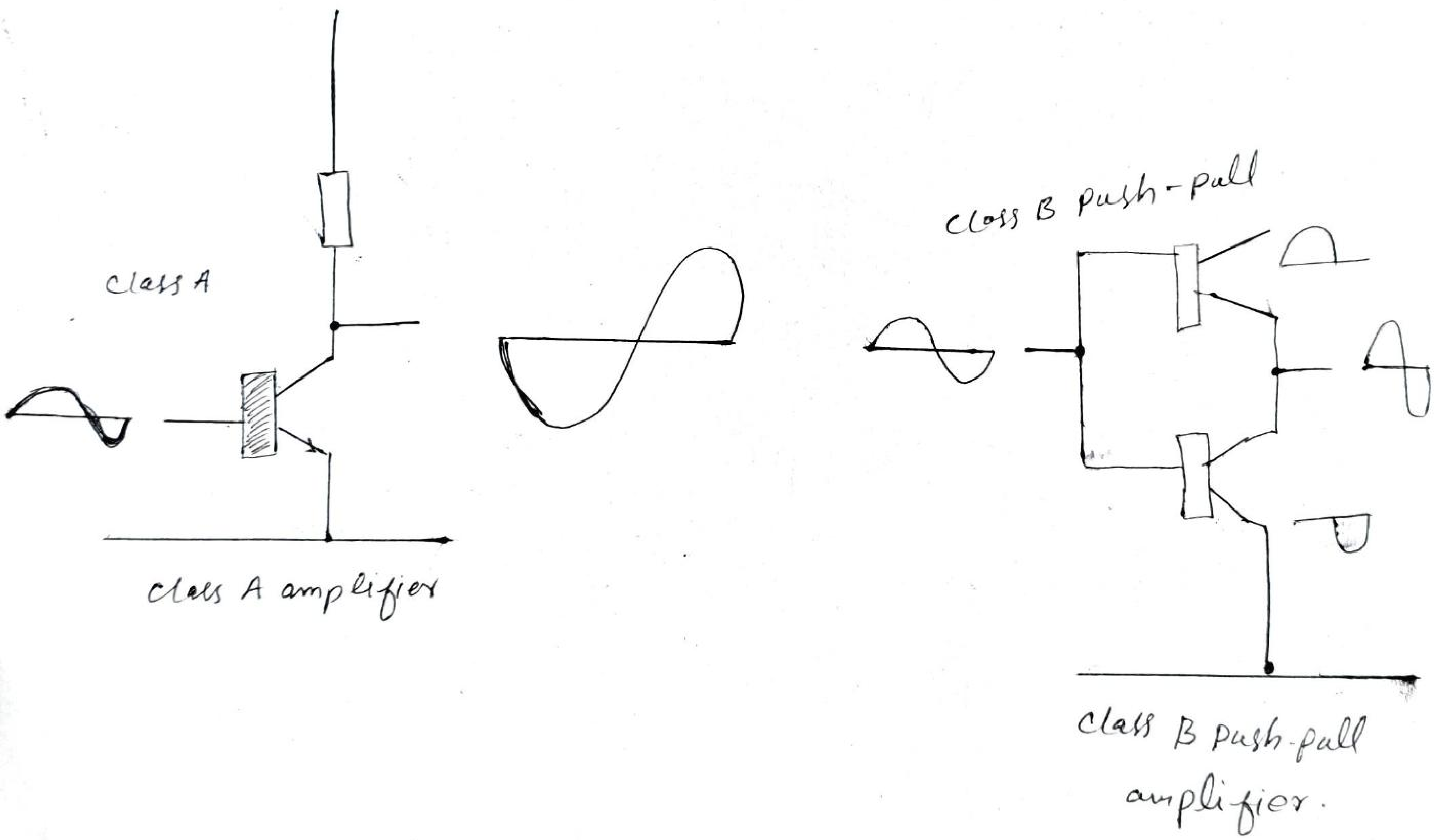
→ opposite of class A : both output device are never allowed to be on at the same time.

→ Each output device is on for exactly one half of a complete sinusoidal signal cycle.

→ Class B designs show high efficiency but poor linearity around the cross-over region (due to the time it take 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 equipments, Such as communications audio.

Class A vs Class B.



Answer:-

Types of voltage regulator :-

There are two types of voltage regulators.

-> Linear voltage regulator.

-> Switching voltage regulator.

-> Linear voltage Regulator :-

Linear voltage Regulator act 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 :-

-> Gives low output ripple voltage.

-> Fast Response time to load or line changes.

-> Low electromagnetic interference and less noise.

Disadvantage :-

-> efficiency is very low.

-> Requires large space - heatsink is needed.

-> Voltage above the input cannot be increased.

Switching voltage Regulator :-

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

the input voltage or of opposite polarity unlike linear regularity.

Advantages :-

The main advantages of a switch power supply are efficiency, size and weight. It also a more complex design which is capable of handling higher power efficiency. switching voltage regulator can provide output, which is greater then or less then or that inverts the input voltage.

Disadvantages :-

-> Higher output ripple voltage.

-> Slower transient recovery time

-> EMI Produces very noisy output

-> very Expensive.

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.

flash ADC :- It consists of comparators, each one comparing the input signal to a unique reference voltage.

. The comparator outputs connect to the inputs of a priority encoder circuits which produces a binary out put.

-> Quantizing :- breaking down analog Value is a set of finite states.

Encoding :- assigning a digital word or number to each State and matching it to the input signal.

Advantages :-

-> simplest in term of operational Theory.

-> Most efficient in term of speed, very fast.

Disadvantages :-

-> Lower resolution

-> Expesive.

-> The number of comparator is doubled.
i.e for 8 bits, 256 comparators need.

Q No 5 :-

(a) i) Lowr pass filter :-

i) It is used for smoothing the image.

ii) It consist of resistor that followed by capacitor.

iii) It helps in removal of aliasing effect.

iv) It attenuates the high frequency. Low frequency is preserved in it.

v) It allows the freqency below cutt off frequency to pass through it.

ii) High pass filter :-

i) It is used for Sharpening the image.

ii) It attenuates the low freqquency. High frequency is preserved in it.

ii) It allows the frequencies above cuttoff frequency to pass through it.

iv) It consist of capacitor that is folled by a resistor.

It helps in removal of noise.

Q(5)
(b) (i) Active filter:-

-> Active filter composed of components like op-amp, transistor etc.

-> Cost is high.

-> Circuit is more complex.

-> weigh is low.

-> Q factor is high.

2) Passive filter:-

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

-> Cost is comparitively low.

-> Circuit is less complex then active filter.

-> weigh is comparatively bulkier due to presence of inductors.

-> Q factor is very low.

Sol:- Given that:

$A_{ol} = 400,000$

$A_{cm} = 0.6$

Required: CMRR = ?

$$CMRR = A_{ol}/A_{cm}$$

$$= 400,000/0.6$$

$$= 666,666.6$$

Expressed in decibels:

$$CMRR = 20 \log (666,666.1)$$

$$= 116.47 \text{ dB}.$$

QNo(7)

Answer:-

Negative feedback :-

→ "Negative ~~feebb~~ feedback is the process where by a portion of the output voltage of an amplifier is returned to the input with a phase angle that opposes (or subtracts from) the input signal."

→ Inverting (-) input effectively makes the feedback signal 180° out of phase with the input signal.