17.04.2017

CSE-224

Electrical Devices and Circuits

Final exam:

chapter- 9, 10, 11, 13, 14, $\boxed{\text{opamp}}$

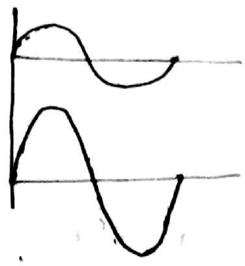
from midterm: chapter-8 (lecture-3),
chapter-6 (lecture-2),

chapter: 9

9.1

Faithful amplification:

The process of rising the strength of a weak signal without changing its general shape is known as faithful amplification.



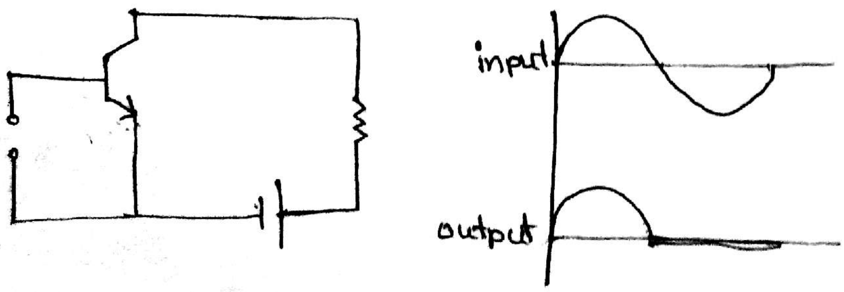
Condition must be fullfilled:

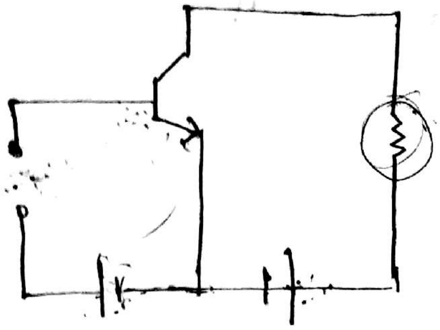
(i) proper zero signal collector current.

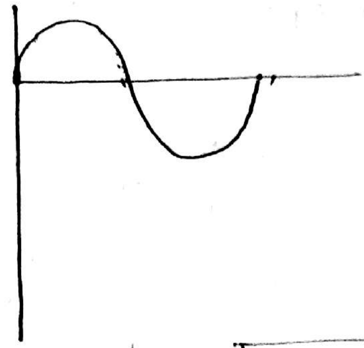
(ii) minimum proper base-emitter voltage.

(iii) minimum proper collector-emitter voltage.

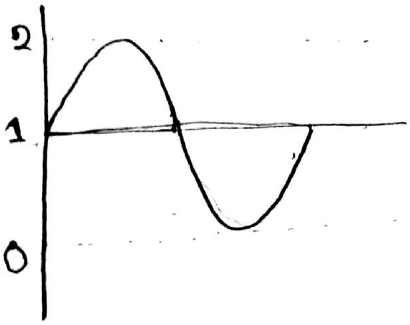
(i) proper zero signal collector current:

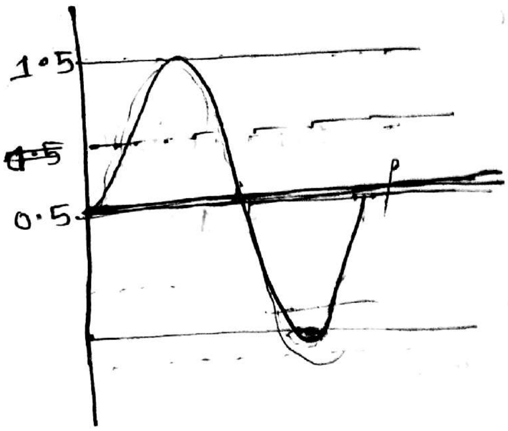




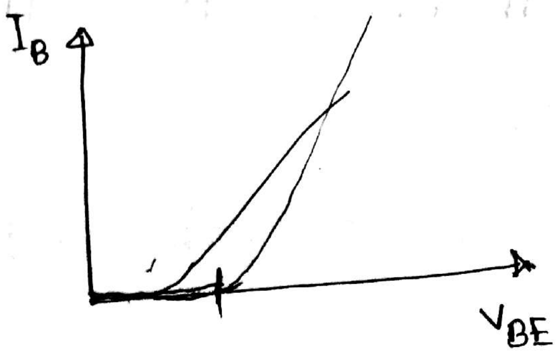


$\boxed{i_C = i_c + I_C}$



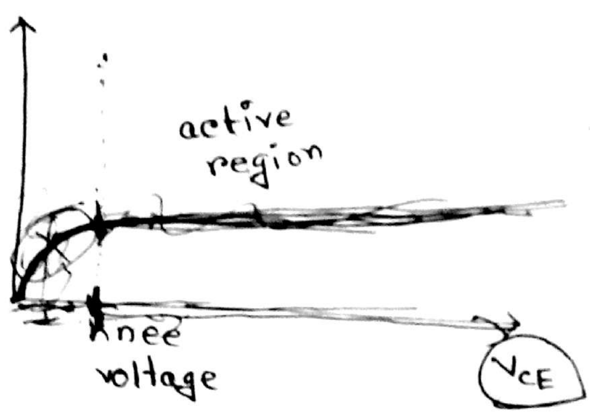


(ii) minimum proper base-emitter voltage:



0·7V – Si
0·3V – Ge

(iii) proper minimum collector-emitter current :



Ge – 0.5 V

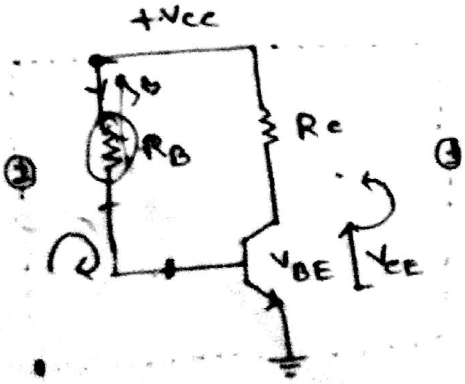
Si – 1 V

9.2

The proper flow of zero signal $\boxed{\text{collector current}}$ and maintaining proper $\boxed{\text{collector-emitter voltage}}$ is called Transistor biaising.

9.8

Base resistor method:



circuit analysis:

$I_B = \frac{I_c}{\beta}$

Now using KVL,

$$-V_{cc} + I_B R_B + V_{BE} = 0$$

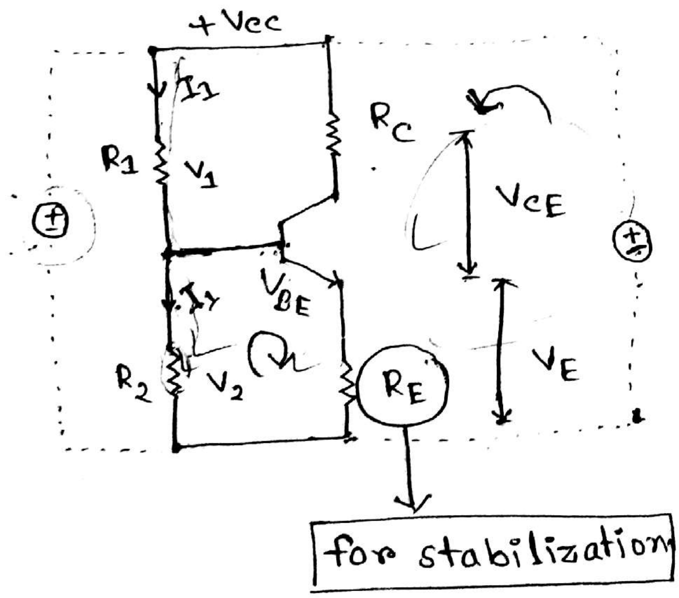
$$\text{or, } I_B R_B + V_{BE} = V_{cc}$$

$$\therefore I_B = \frac{V_{cc} - V_{BE}}{R_B}$$

$$\text{or, } R_B = \frac{V_{cc} - V_{BE}}{I_B}$$

9.12

Voltage divider bias method:



circuit analysis: (I_c)

(i) $$I_1 = \frac{V_{cc}}{R_1 + R_2}$$

voltage across R_2,

$$V_2 = \frac{V_{cc}}{R_1 + R_2} \times R_2$$

Now, using KVL –

$$V_2 = V_{BE} + V_E$$

$$\text{or, } V_2 = V_{BE} + I_E R_E$$

$$I_E = \frac{V_2 - V_{BE}}{R_E}$$

$$\because I_E \approx I_c$$

$$\therefore I_C = \frac{V_2 - V_{BE}}{R_E}$$

(ii) V_{CE}

using KVL.

$$-V_{CC} + I_C R_C + V_{CE} + V_E = 0$$

or. $-V_{CC} + I_C R_C + V_{CE} + I_E R_E = 0$

or. $-V_{CC} + I_C R_C + V_{CE} + I_C R_E = 0 \quad [\because I_C = I_E]$

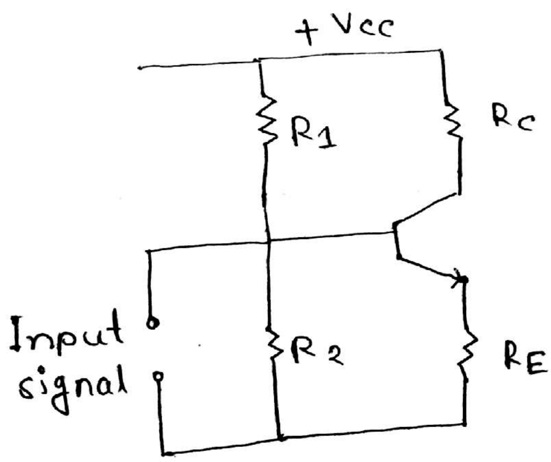
or. $\boxed{V_{CE} = V_{CC} - I_C (R_C + R_E)}$

Chapter- 10

Signal stage Transistor Amplifier:

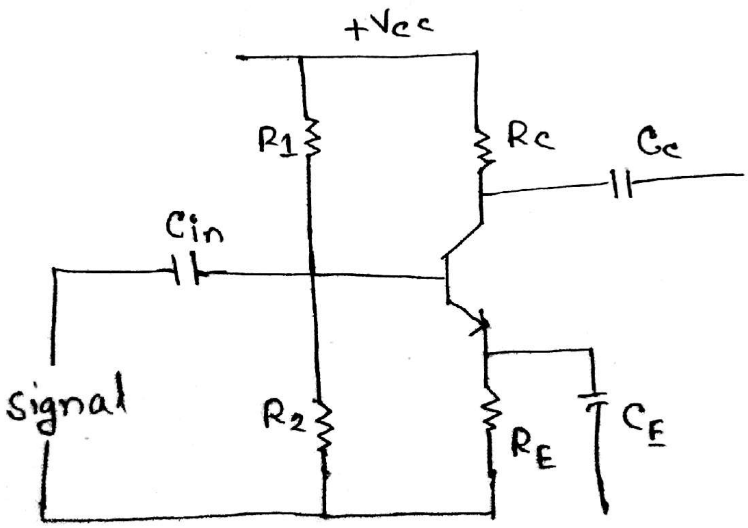
10·1

When only one transistor is used for amplifing a weak signal, the circuit is know as signal state transistor amplifier.



10·4

practical circuit of single stage:



(i) Baising circuit

(ii) Emitter bypass capacitor

(iii) Input capacitor

(iv) Coupling capacitor

* Base current : $i_B = I_B + i_b$

* Collector current : $i_C = I_C + i_c$

* Emitter current : $i_E = I_E + i_e$

24.07.2017

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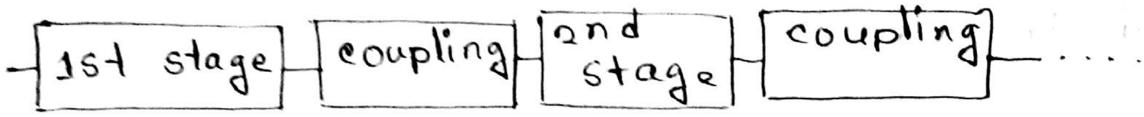
Electrical Devices and Circuits

chapter-11

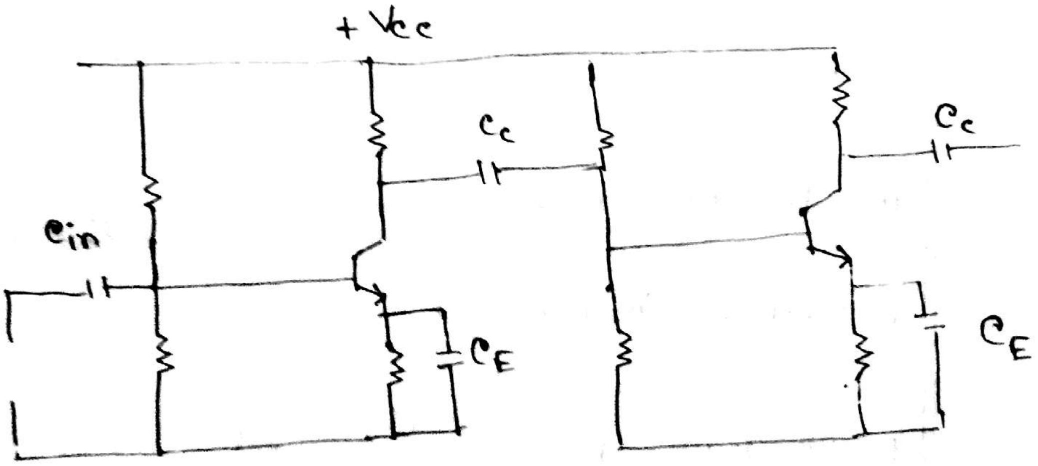
A transistor circuit containing more than one stage of amplification is known as "Multistage transistor amplifier."



11.2

(i) bypass capacitor

(ii) Coupling capacitor

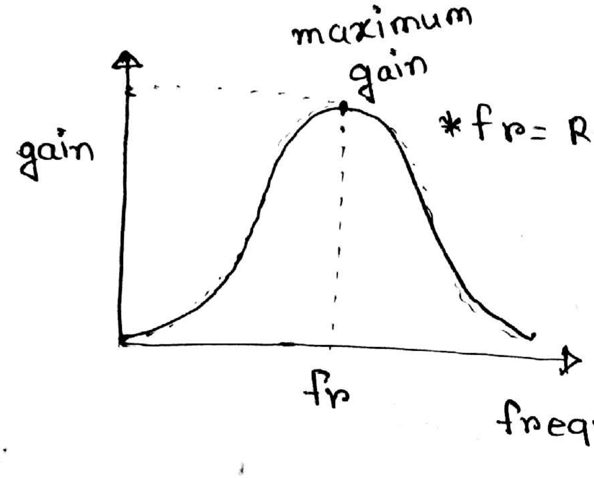


11.3

(i) Gain: The ratio of the output to the input of the amplifier is called Gain of amplifier.

$$\boxed{G = G_1 \times G_2 \times G_3 \times \cdots\cdots}$$

(ii) Frequency Response:



* fr = Resonant frequency

(iii) Decibel Gain: The common logarithm of power gain is called bel power gain.

$$\text{power gain} = \log \frac{P_{out}}{P_{in}} \text{ bel}$$

1 bel = 10 dB

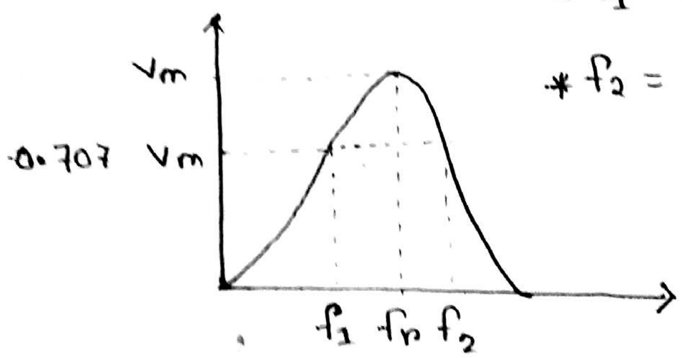
$$\therefore \text{Power gain} = \boxed{10 \log_{10} \frac{P_{out}}{P_{in}} \text{ (dB)}}$$

$$\boxed{\text{voltage gain} = 20 \log_{10} \frac{V_{out}}{V_{in}}}$$ ***

$$\boxed{\text{current gain} = 20 \log_{10} \frac{I_{out}}{I_{in}}}$$

(iv) Band width: The range of frequency over which the voltage gain is equal to or greater than 70.7% of the maximum gain is called Bandwidth.

* f_1 = Lower cutt off frequency
* f_2 = Higher cut off frequency



Fall in voltage gain $= 20 \log_{10} 100 - 20 \log_{10} 70.7$

$= 20 \log_{10} \frac{100}{70.7}$

$= 20 \log_{10} 1.4142$

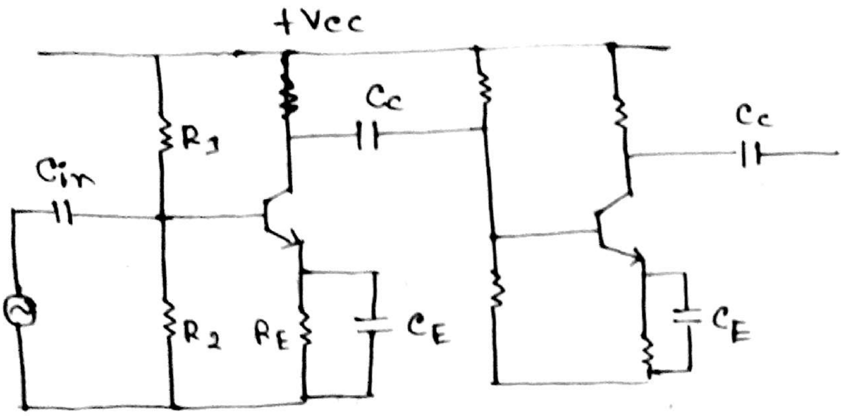
$= 3 dB$

$\boxed{\text{3 dB frequency / Half power frequency}}$

11.5

* RC means resistance capacitor

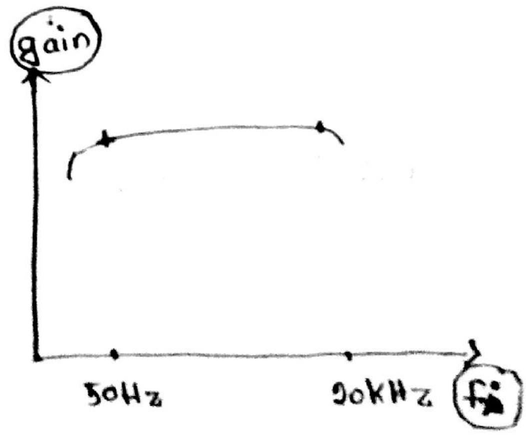
RC coupled transistor amplifier:



Operation:

(i) effective load resistance. (ii) loading effect.

Frequency response:



(i) All lower frequency < 50 Hz

→ C_c Quite high $\left[X_c = \frac{1}{\omega c} = \frac{1}{2\pi f c}\right]$

→ C_E cannot shunt

(ii) At Higher frequency > 20kHz

→ C_c is very small

→ C_E Base current ↑, β↓

(iii) Mid frequency (50 Hz to 20kHz)

RC couplect:

Advantages:

(i) It has excellent frequency response.

(ii) It has lower cost.

(iii) circuit is very impact.

Disadvantages:

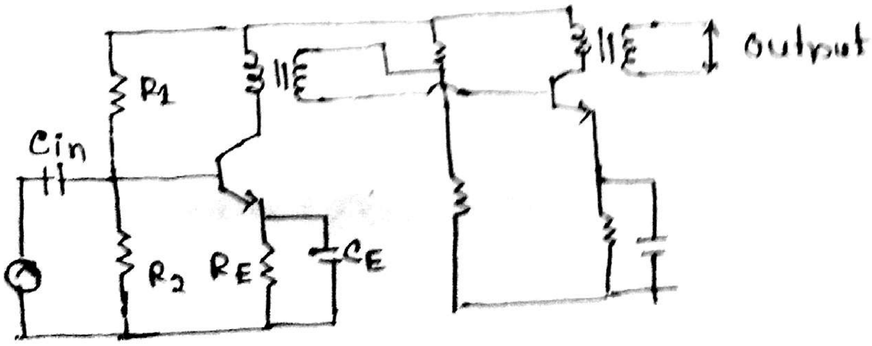
(i) Low voltage and power gain.

(ii) Noisy with age

(iii) Impedance matching is poor.

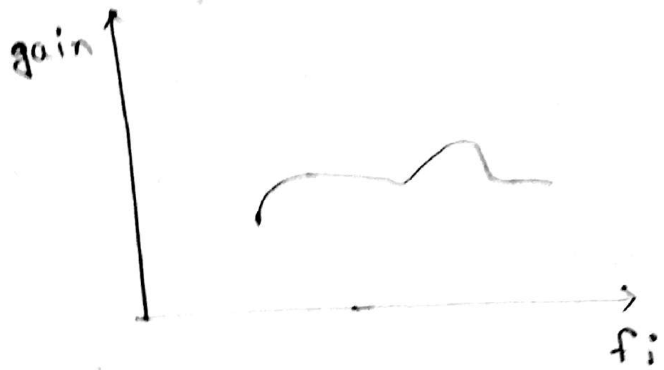
11.6

Transformer couplect transistor amplifier:



operation:

frequency response:



advantage:

(i) no signal power is lost

(ii) Excellent impedance matching

(iii) Higher gain

disadvantage:

(i) poor freqvency response

(ii) Bulky and expensive

(iii) Frequency distortion is higher.

math

13.1 - 13.8

14.3 - 14.6

CSE-224

Electronic Devices and Circuits

Chapter-13

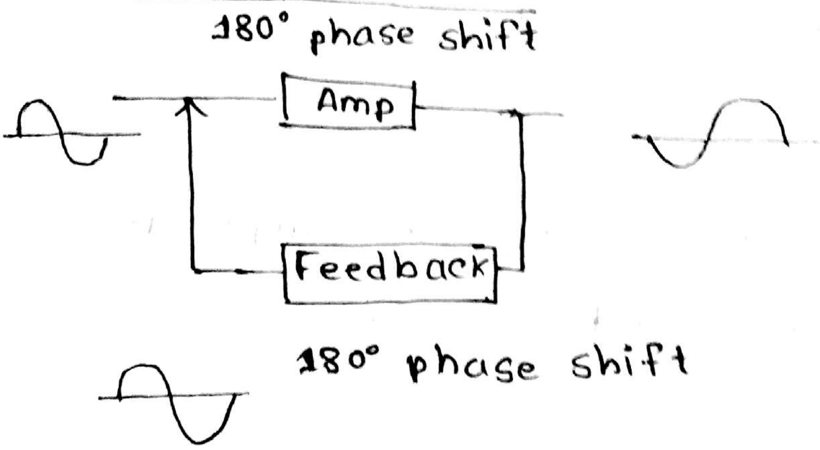
[13.1
13.2
13.3

Negative feedback:

13.1

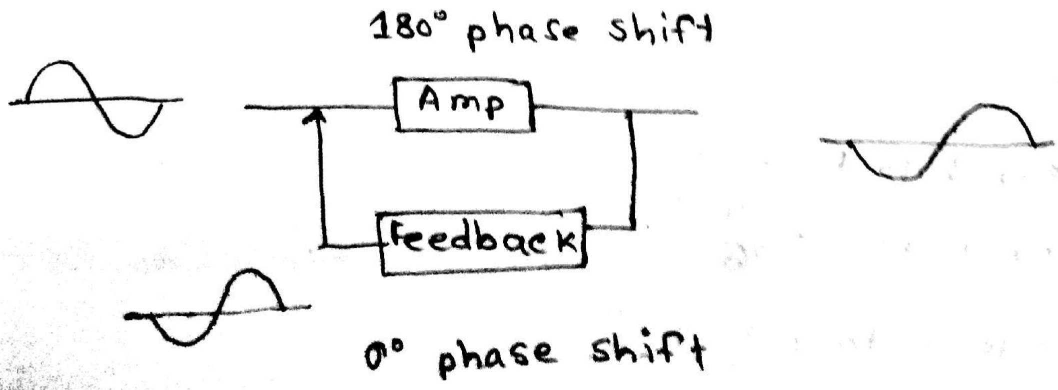
The process of injecting a function of output of energy by some device is called feedback.

(i) positive feedback:

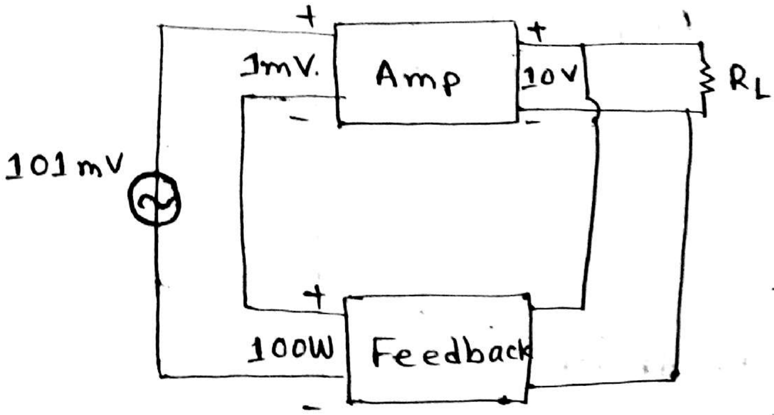


Common emitter

(ii) Negative feedback:



13·2



Gain of amplifier without feedback,

$$A_v = \frac{10V}{1mV} = 10,000$$

Gain of amplifier with feedback, $A_{vf} = \frac{10V}{101\ mV}$

$= 100$

Fraction of output, $m_v = \frac{100\ mV}{10\ V}$

$= 0 \cdot 01$

13·3

Gain of negative feedback:

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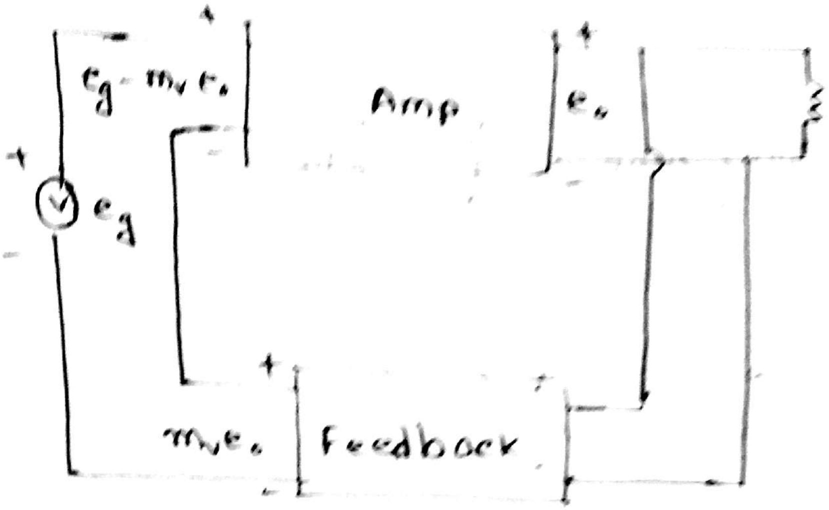


Now,

Actual input to amplifier $= e_g - m_v e_o$

now, $A_v = \dfrac{e_o}{e_g - m_v e_o}$

or, $(e_g - m_v e_o) A_v = e_o$

or, $A_v e_g - A_v m_v e_o = e_o$

or, $e_o (1 + A_v m_v) = A_v e_g$

or, $\dfrac{e_o}{e_g} = \dfrac{A_v}{1 + A_v m_v}$

$$\therefore \boxed{A_{vf} = \frac{A_v}{1 + A_v m_v}} \quad ***$$

Chapter-14

Oscillator

14·1
14·2
14·3
14·10
14·11

14·1

Oscillator:

An electronic devices that genarates sinusoidal oscillation of desired frequency is called "Oscillator".

Advantages:

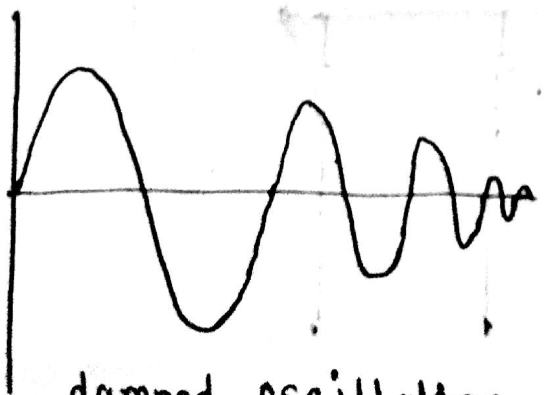
i) Non notating device

* Alternator

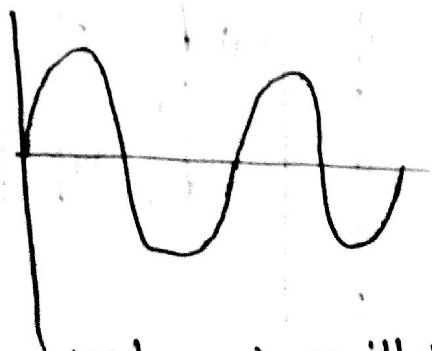
ii) Quite silent

iii) Range higher (from small to higher)

iv) High efficiency



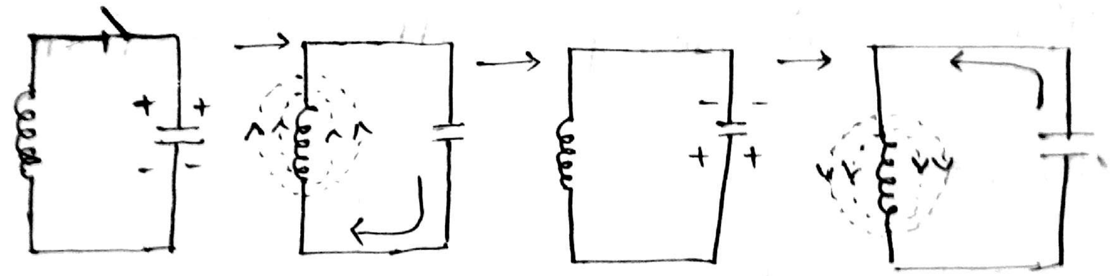
damped oscillation



undamped oscillation

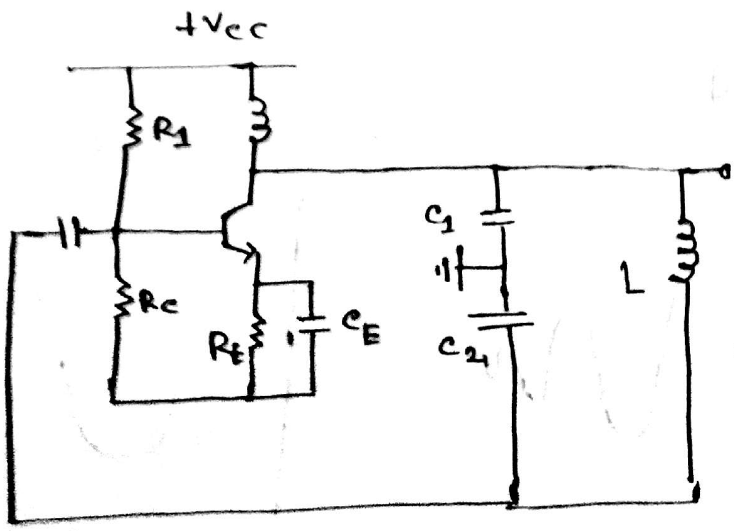
14.3

Oscillatory circuit: A circuit which produces electrical oscillations of any desired frequency is known as oscillatory circuit or tank circuit.



14.10

Colpitts Oscillator:



Operation:

$$f = \frac{1}{2\pi\sqrt{LC_T}}$$

$$C_T = \frac{C_1 C_2}{C_1 + C_2}$$

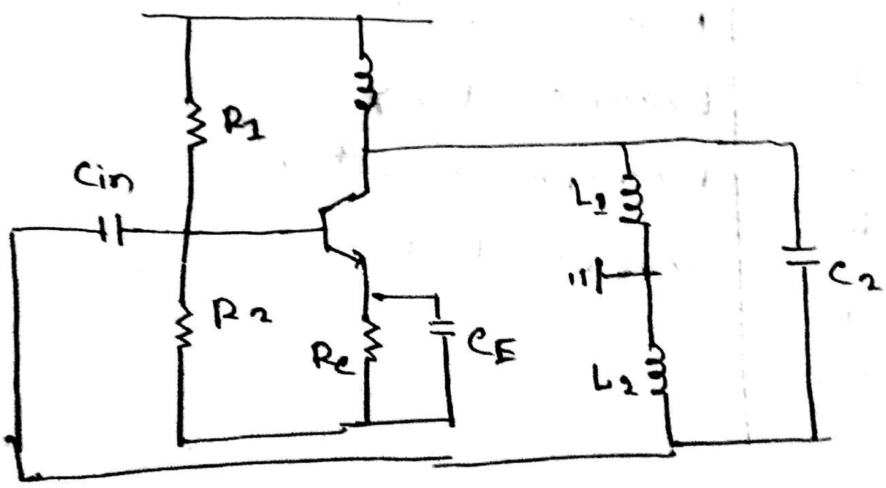
Feedback fraction:

$$m_v = \frac{V_f}{V_{out}} = \frac{X_{C_2}}{X_{C_1}} = \frac{C_1}{C_2}$$

$$\boxed{\therefore m_v = \frac{C_1}{C_2}}$$

14.11

Hartley oscillator:



09.08.2017

operation:

$$f = \frac{1}{2\pi\sqrt{L_T C}}$$

$$L_T = L_1 + L_2 + 2M$$

Feedback fraction:

$$m_v = \frac{V_f}{V_{out}}$$

$$= \frac{X_{L_2}}{X_{L_1}}$$

$$= \frac{L_2}{L_1}$$

$$\boxed{m_v = \frac{L_2}{L_1}}$$

Assignment

1. what is faithful amplification? describe all the criteria it needs to fullfill.
2. Describe voltage divider bais method
3. Describe Single stage transistor amplifier.
4. Describe transformer transistor amplifier
5. Describe Hartly oscillator

Example - 14.3
Example - 14.4
Example - 14.5
Example - 14.6
Example - 13.1
Example - 13.2
Example - 13.3
Example - 13.4

Example - 13.5
Example - 13.7
Example - 13.8 *
Example - 13.6.