SNS COLLEGE OF TECHNOLOGY

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19ECB201-ANALOG ELECTRONIC CIRCUITS

II YEAR /III SEMESTER

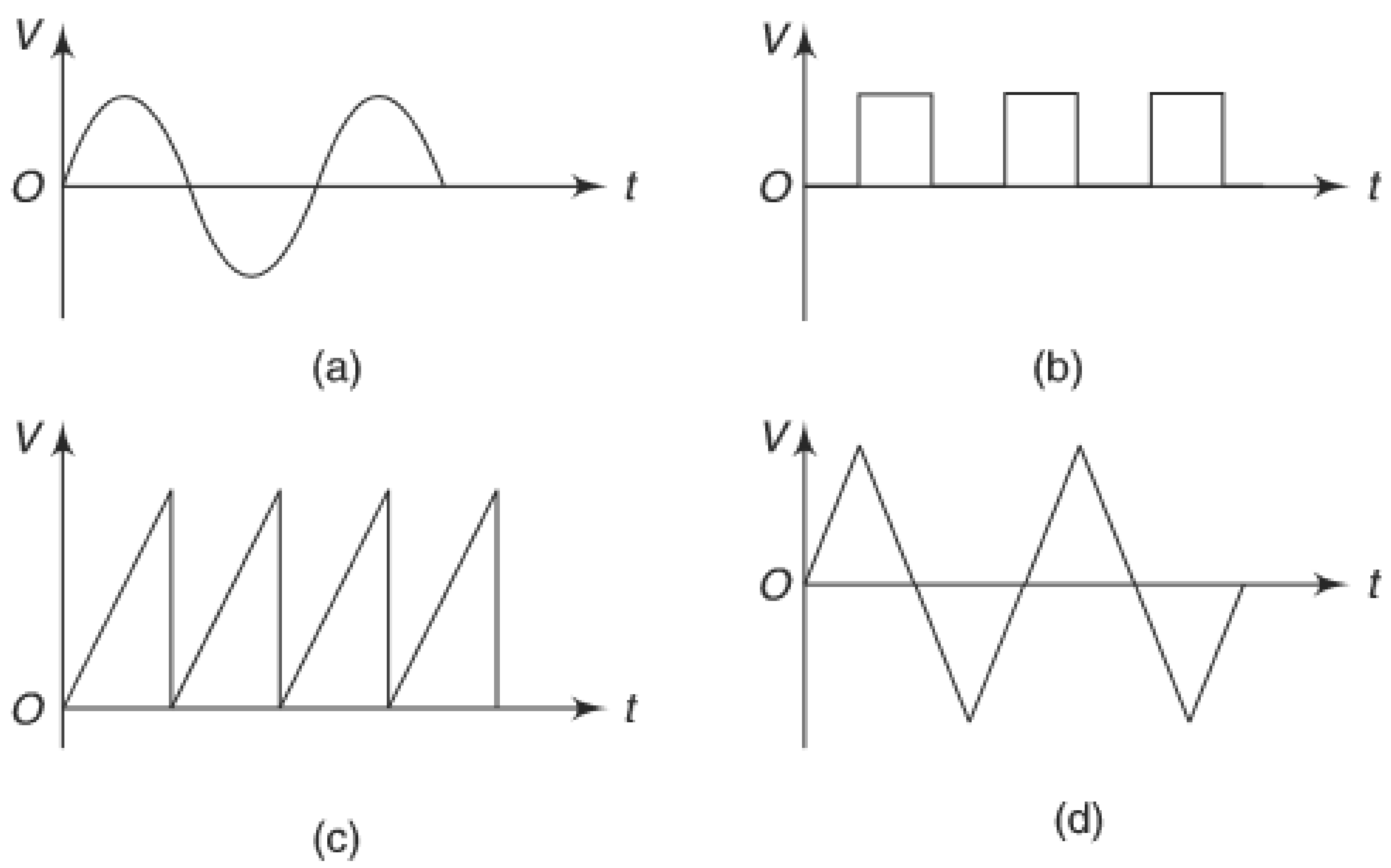
Unit 4- OSCILLATORS & MULTIVIBRATOR CIRCUITS

Topic 1 : Mechanism for start of oscillation and stabilization of amplitude

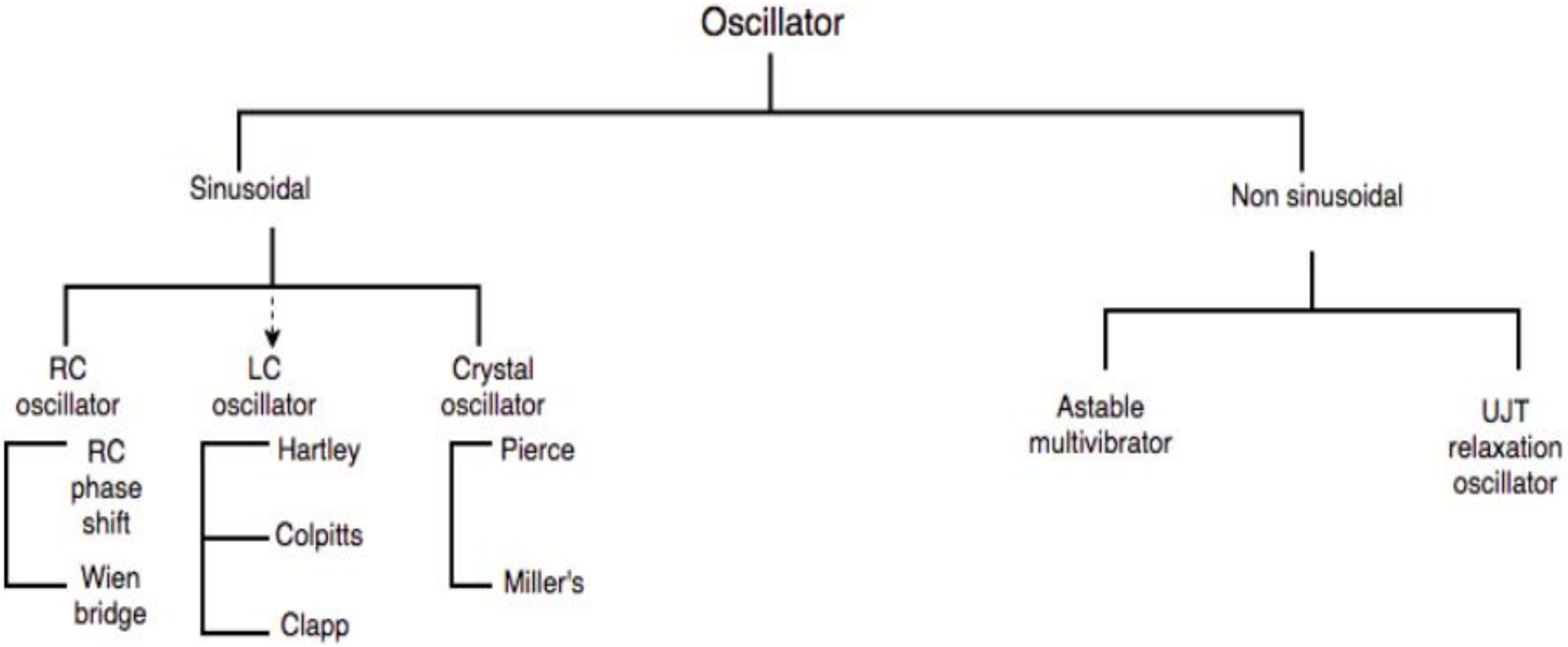
Classification of oscillators

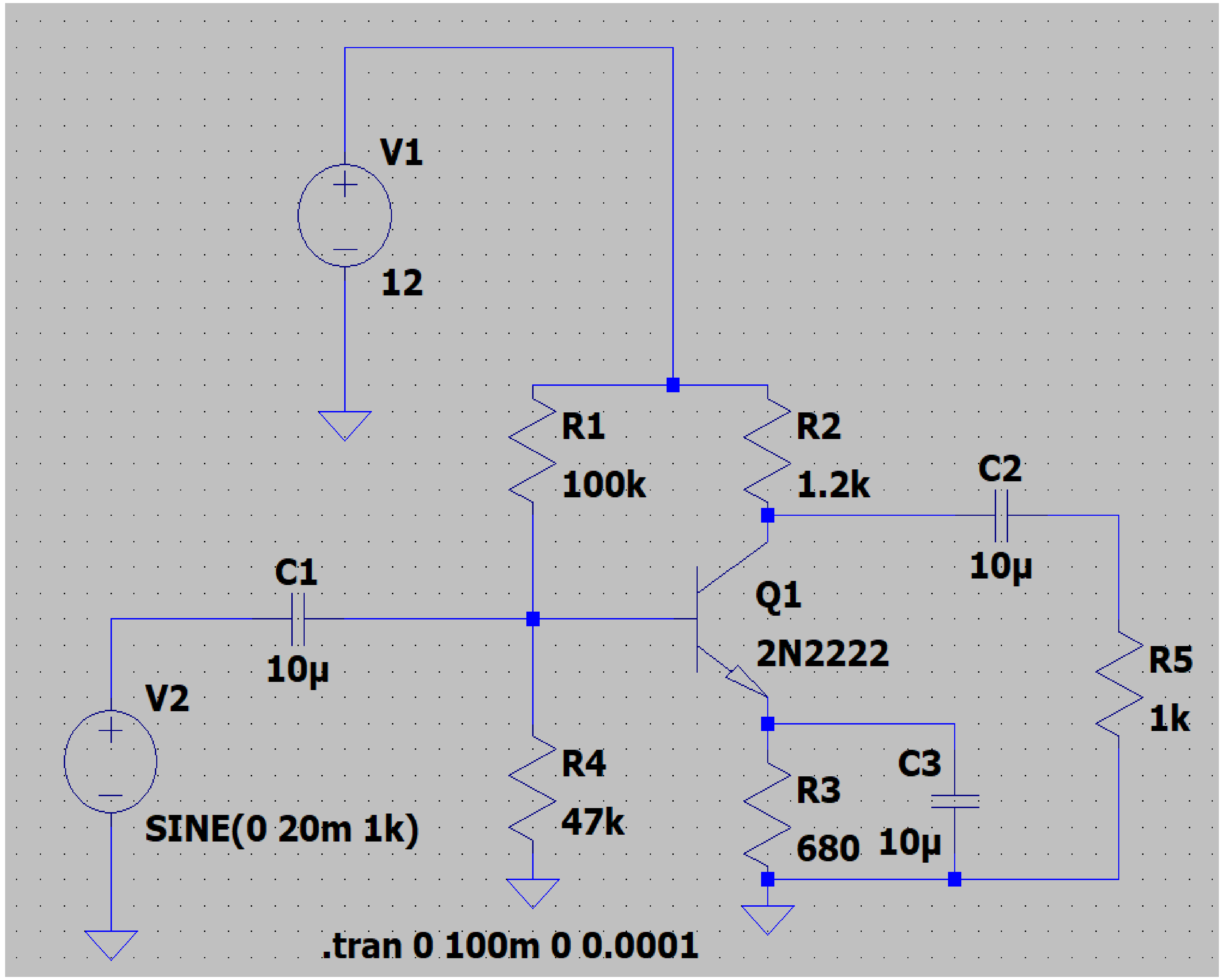
According to the waveform generated

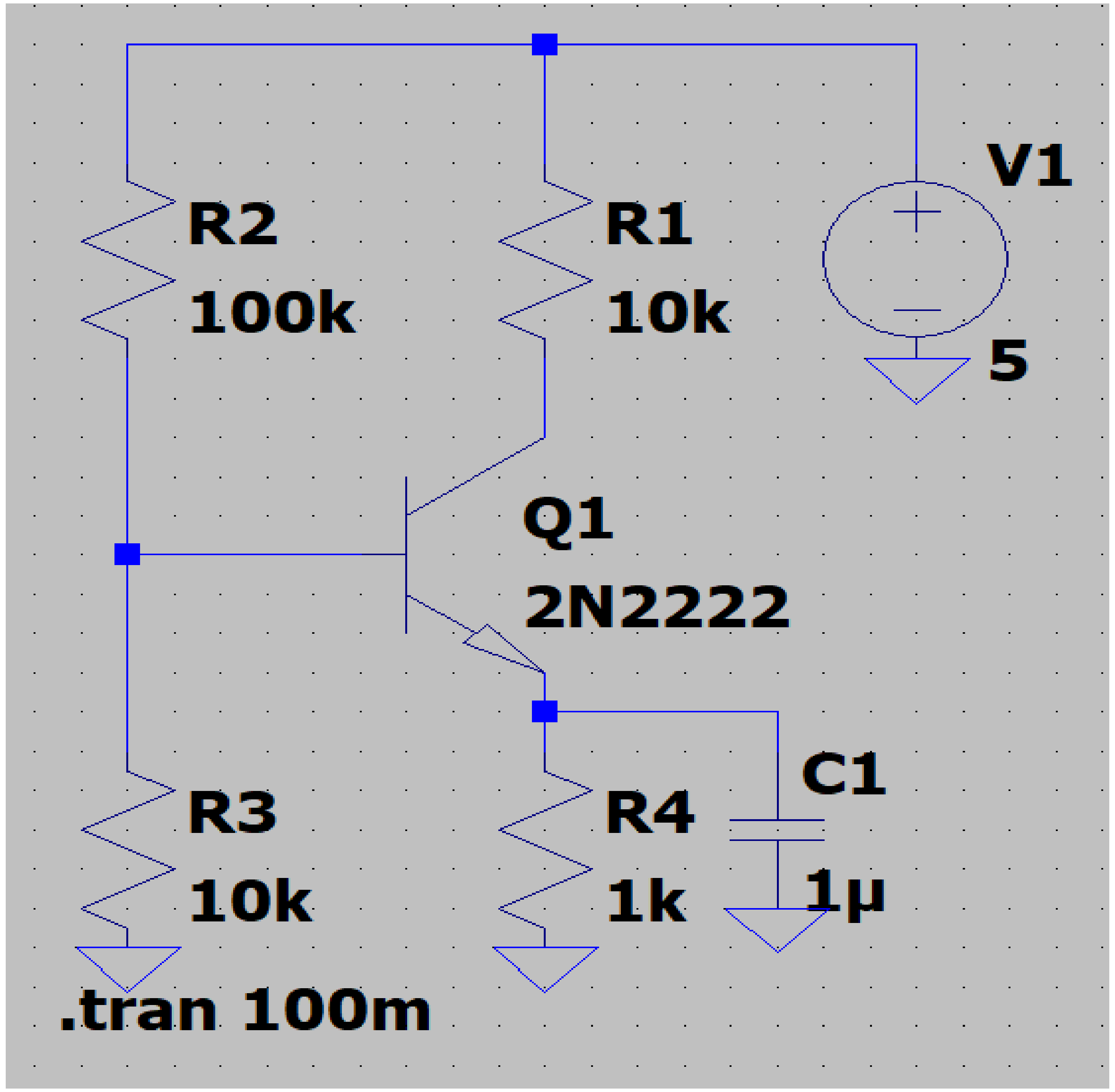
- Harmonic oscillator
- Relaxation oscillator

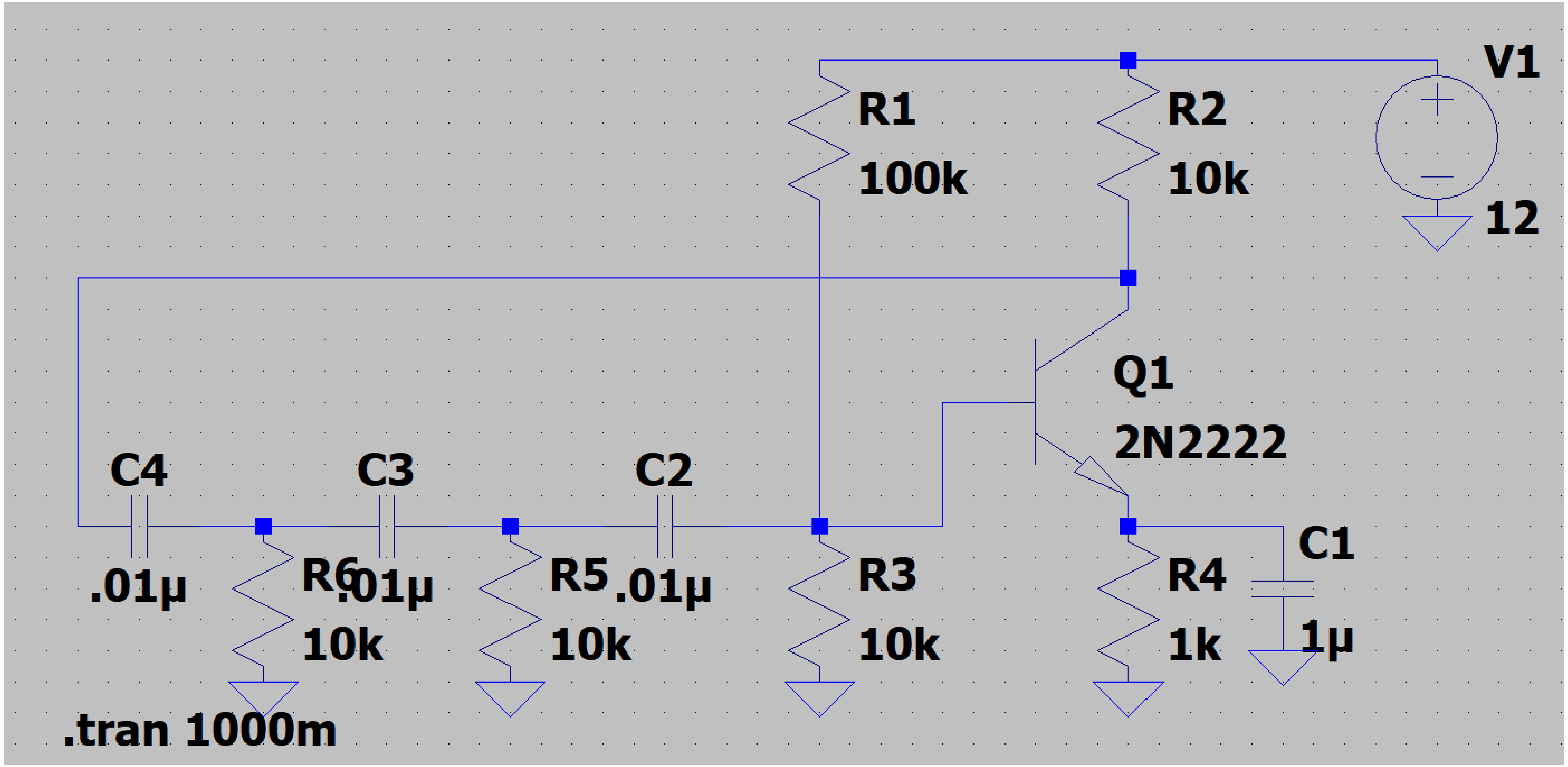


Classification of oscillator



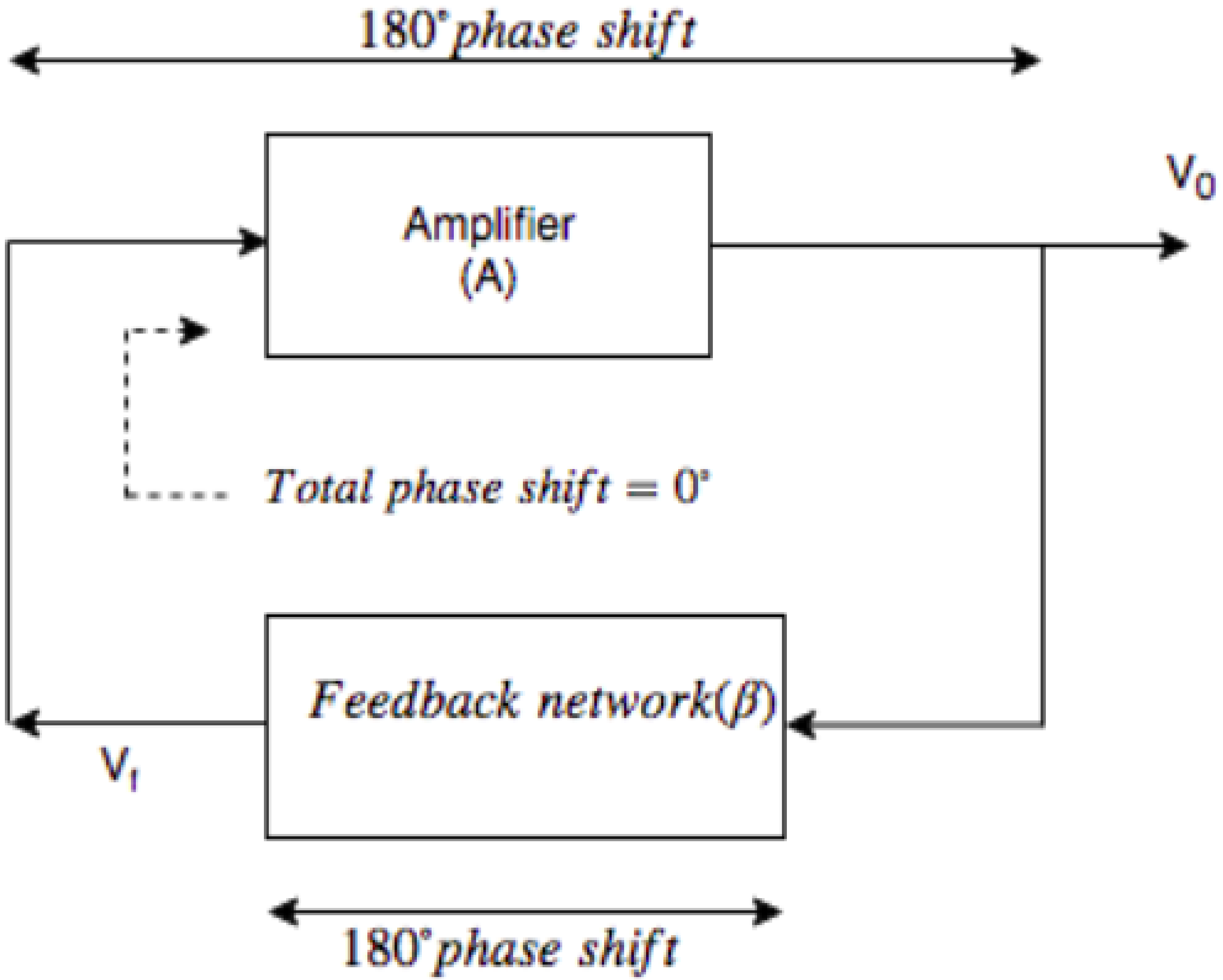

V1
12
R1
100k
R2
1.2k
C2
10µ
C1
10µ
Q1
2N2222
V2
SINE(0 20m 1k)
R4
47k
R3
680
C3
10µ
R5
1k
.tran 0 100m 0 0.0001


R2
100k
R1
10k
V1
5
Q1
2N2222
R3
10k
R4
1k
C1
1µ
.tran 100m



V1
12
R1
100k
R2
10k
Q1
2N2222
C4
.01µ
C3
.01µ
C2
.01µ
R6
10k
R5
10k
R3
10k
R4
1k
C1
1µ
.tran 1000m

Block diagram of sinusoidal oscillator



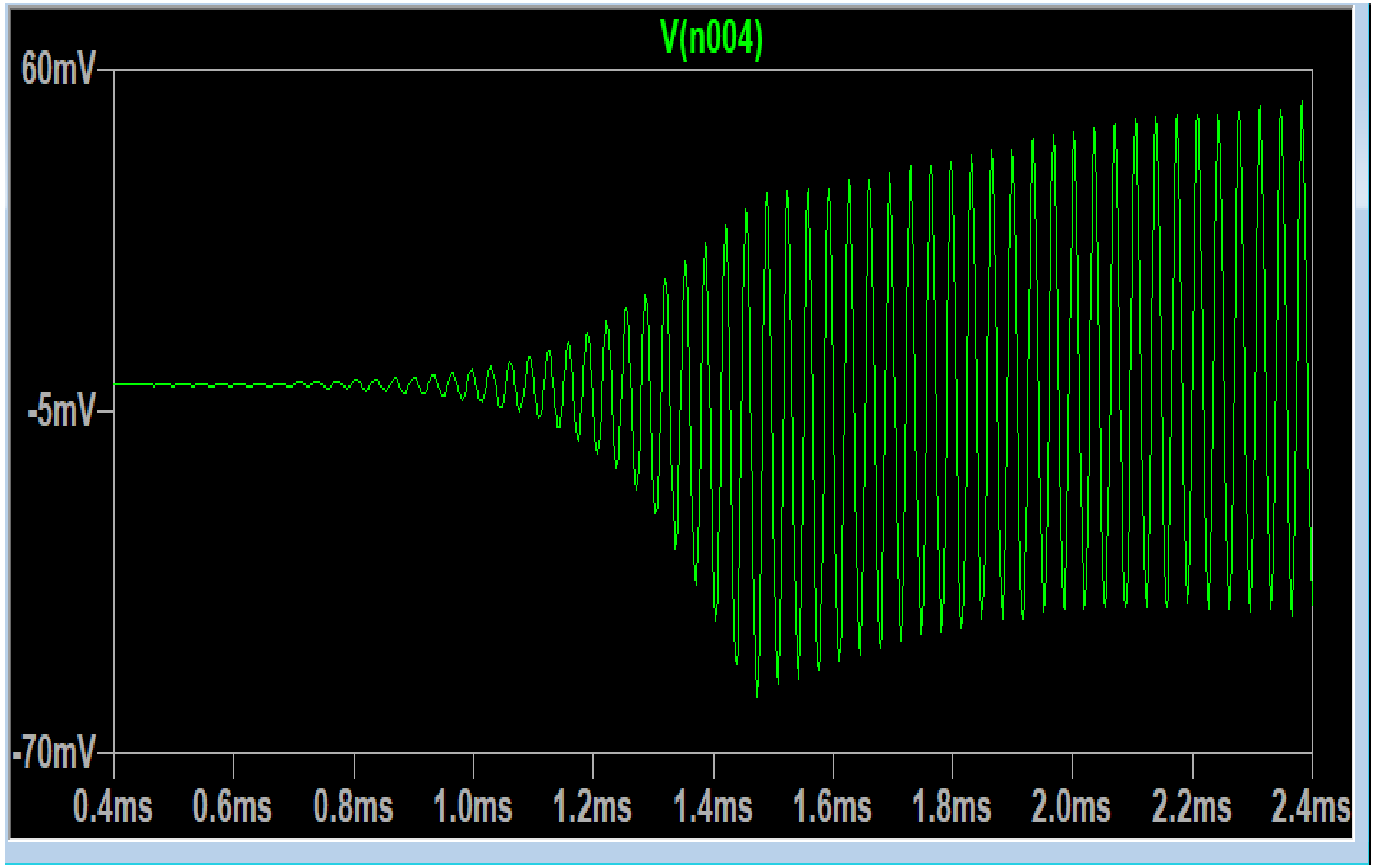
Classification of oscillators

According to frequency generated

- Audio Frequency Oscillator: Upto 20kHz
- Radio Frequency Oscillator: 20 kHz to 30 MHz
- Very High Frequency Oscillator: 30 MHz to 300 MHz
- Ultra High Frequency Oscillator: 300 MHz to 3 GHz
- Microwave Frequency Oscillator: Above 3 GHz

Mechanism for Start of Oscillations

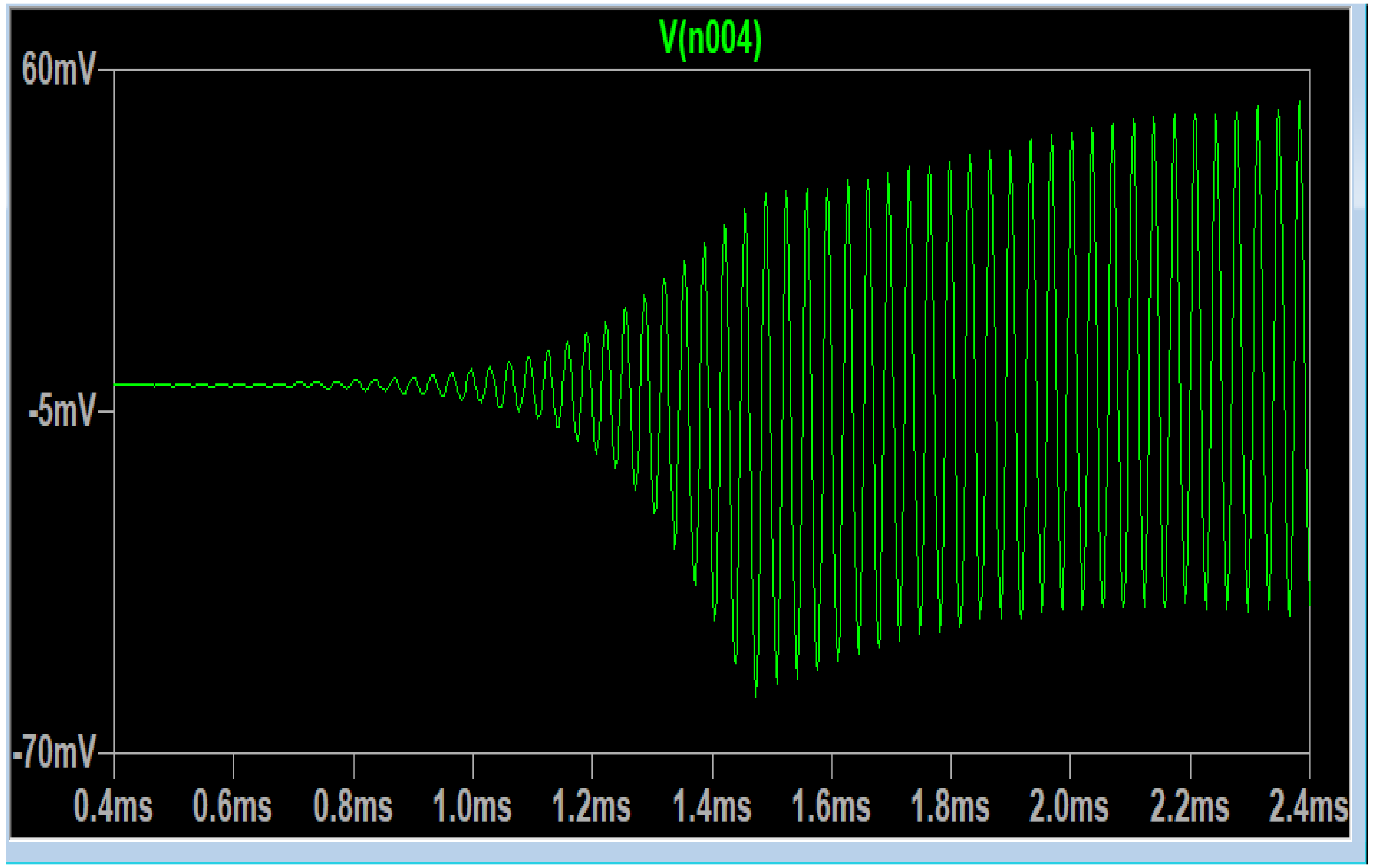
IDEATE



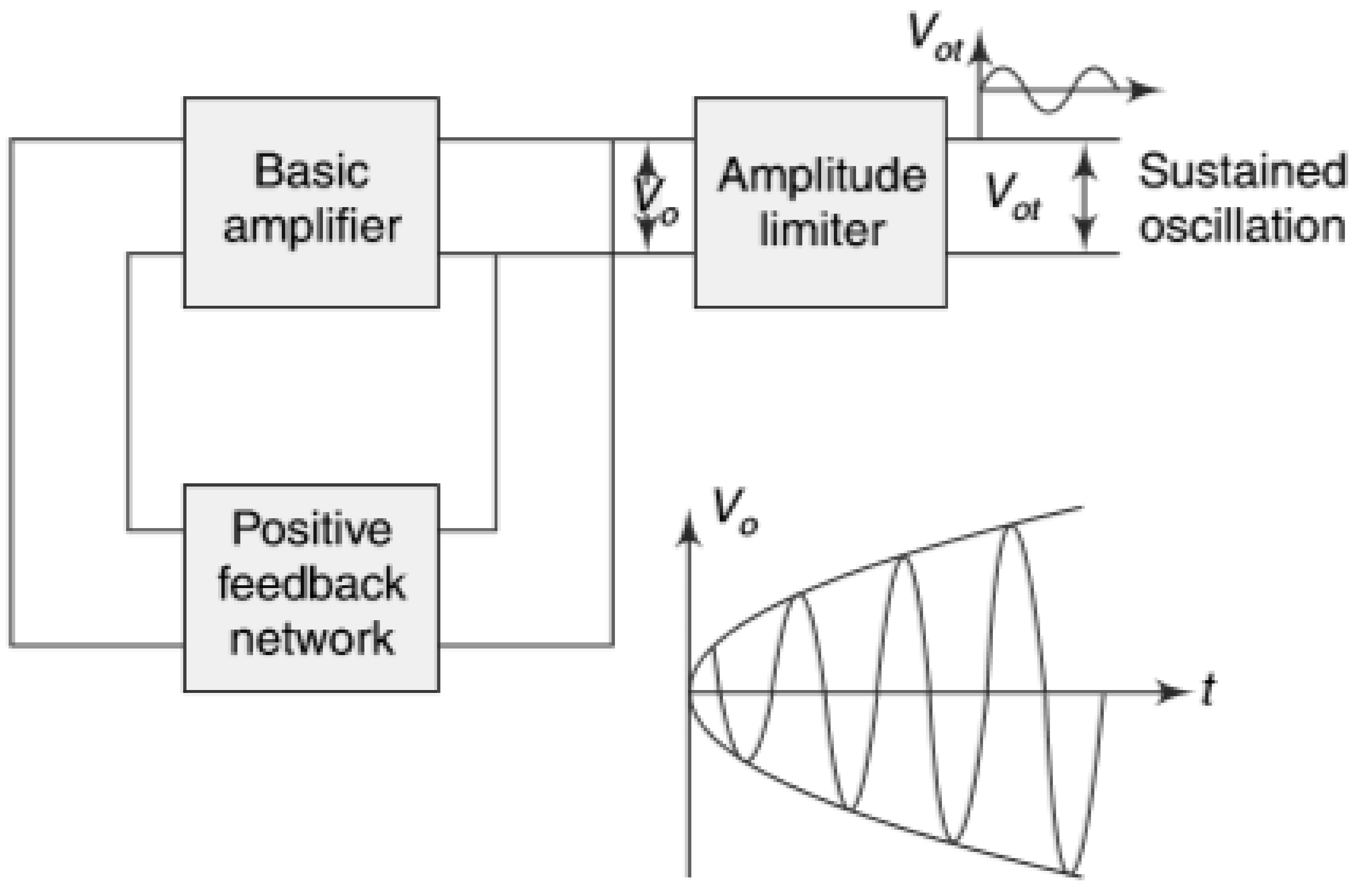
Barkhausen Criterion

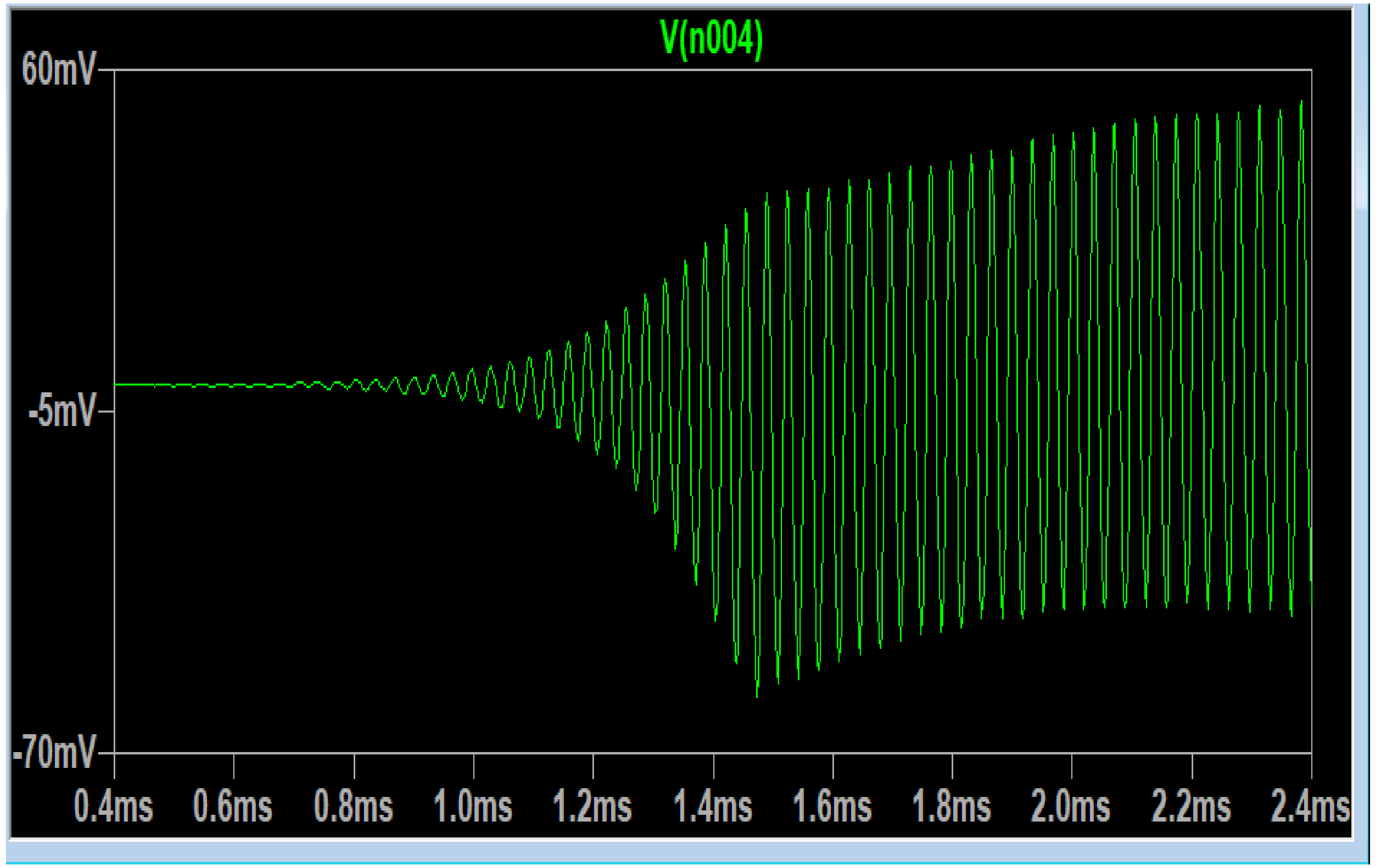
The essential conditions for maintaining oscillations are:

1. $|A\beta| = 1$, i.e. the magnitude of loop gain must be unity.
2. The total phase shift around the closed loop is zero or 360 degrees.



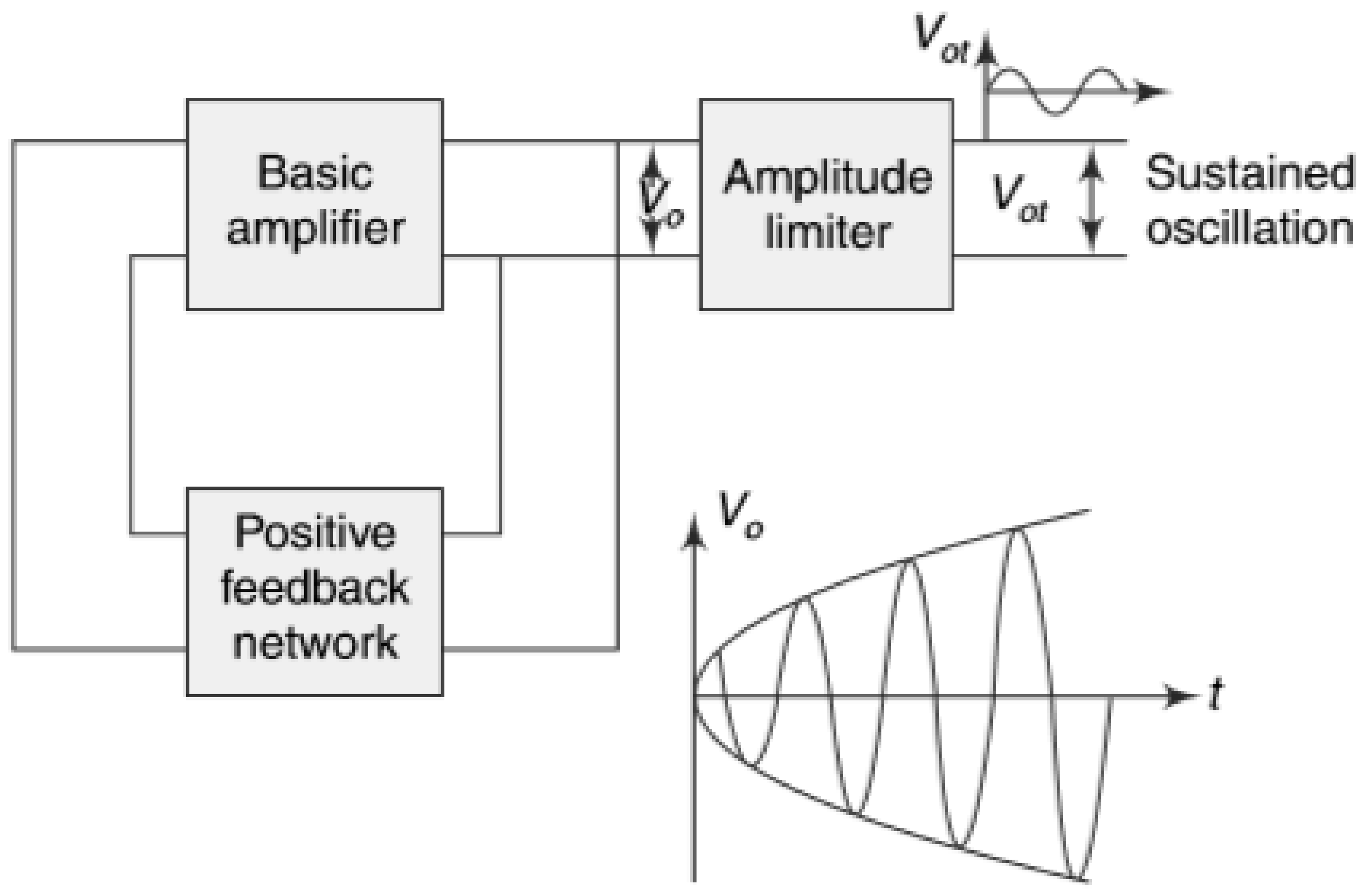
Amplitude Stability of Oscillators



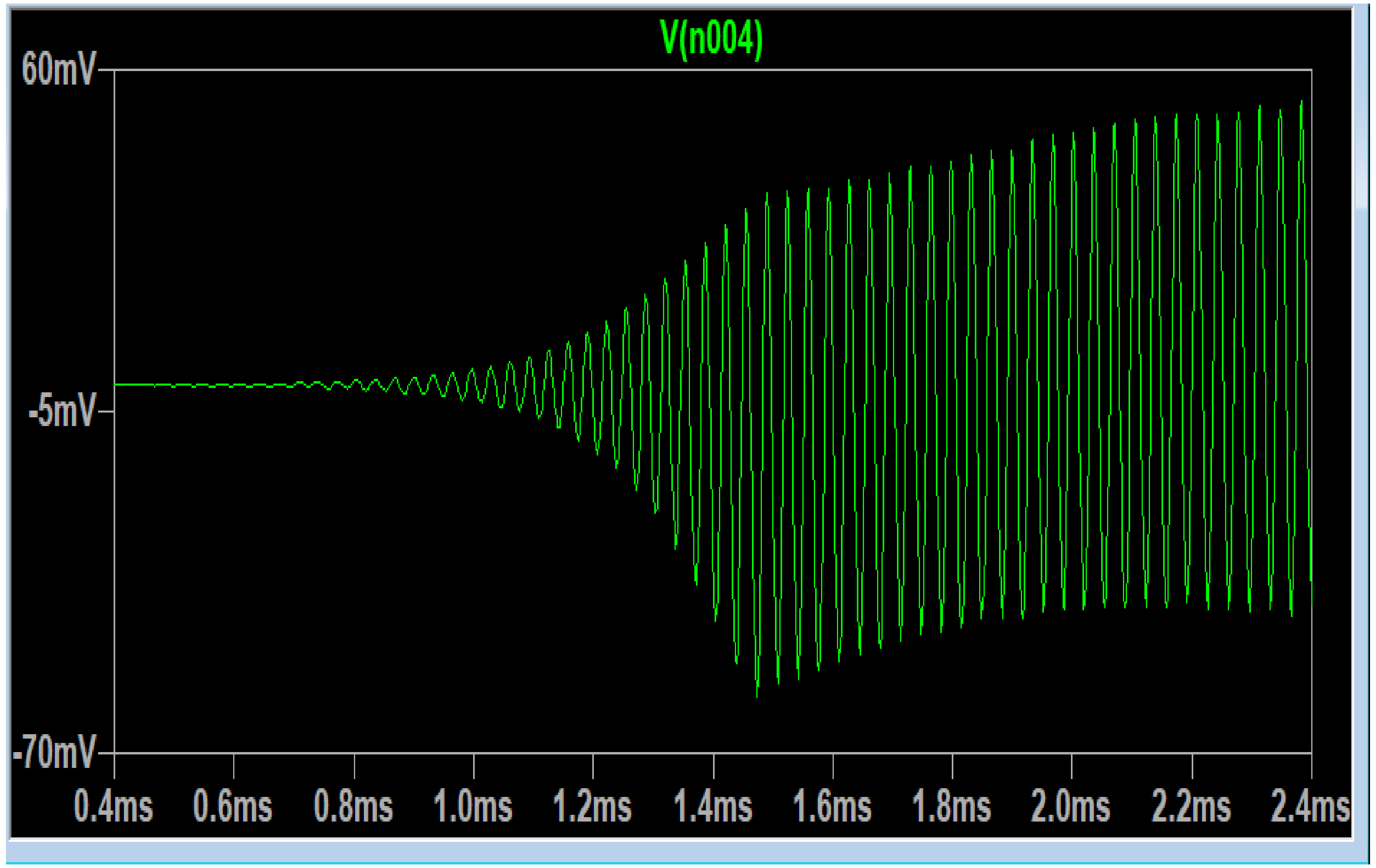


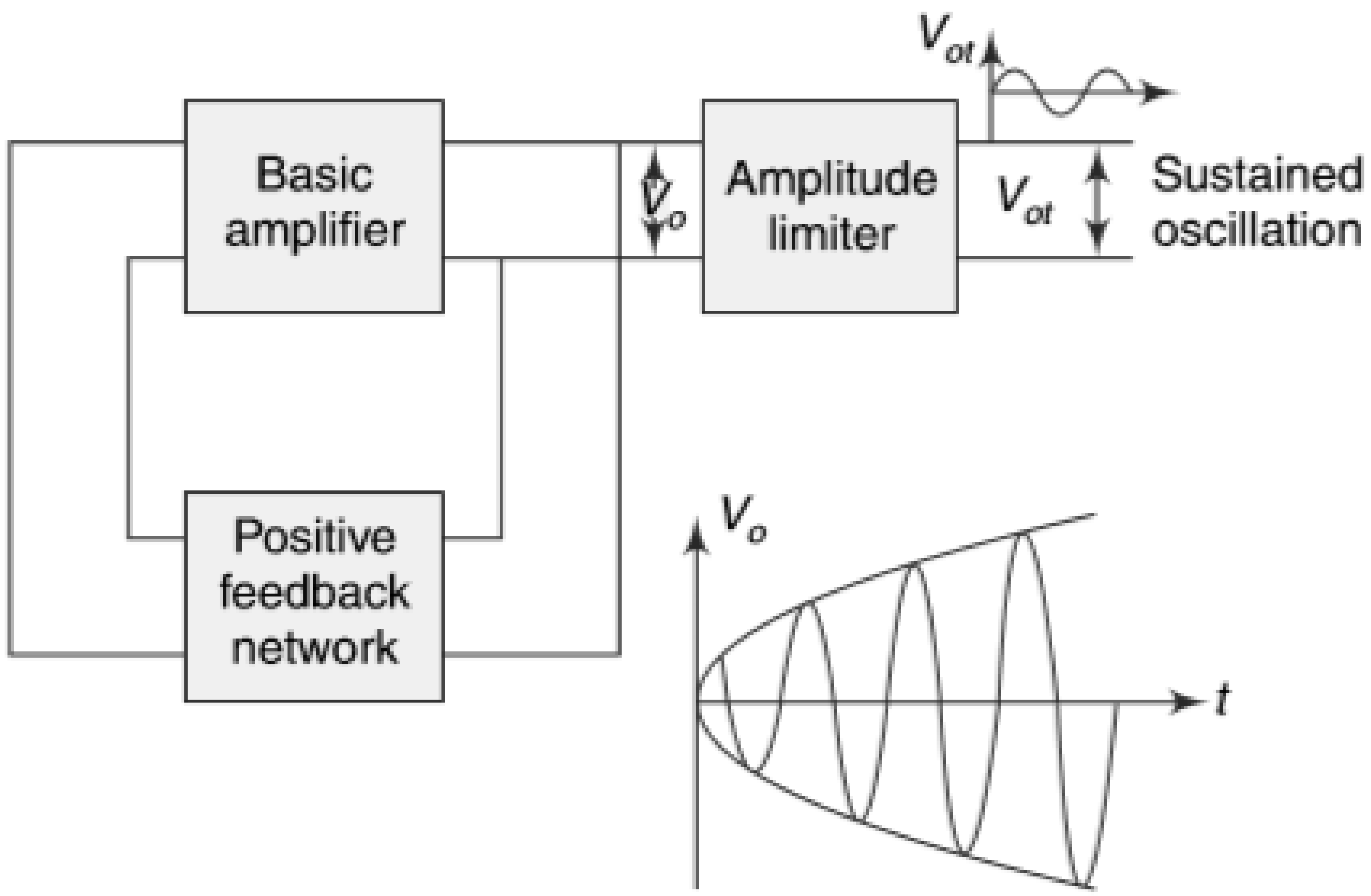
General Form of an Oscillator

- ❖Basic Amplifier
- ❖Amplitude Limiter
- ❖Positive feedback network



Why Positive Feedback in Oscillators?



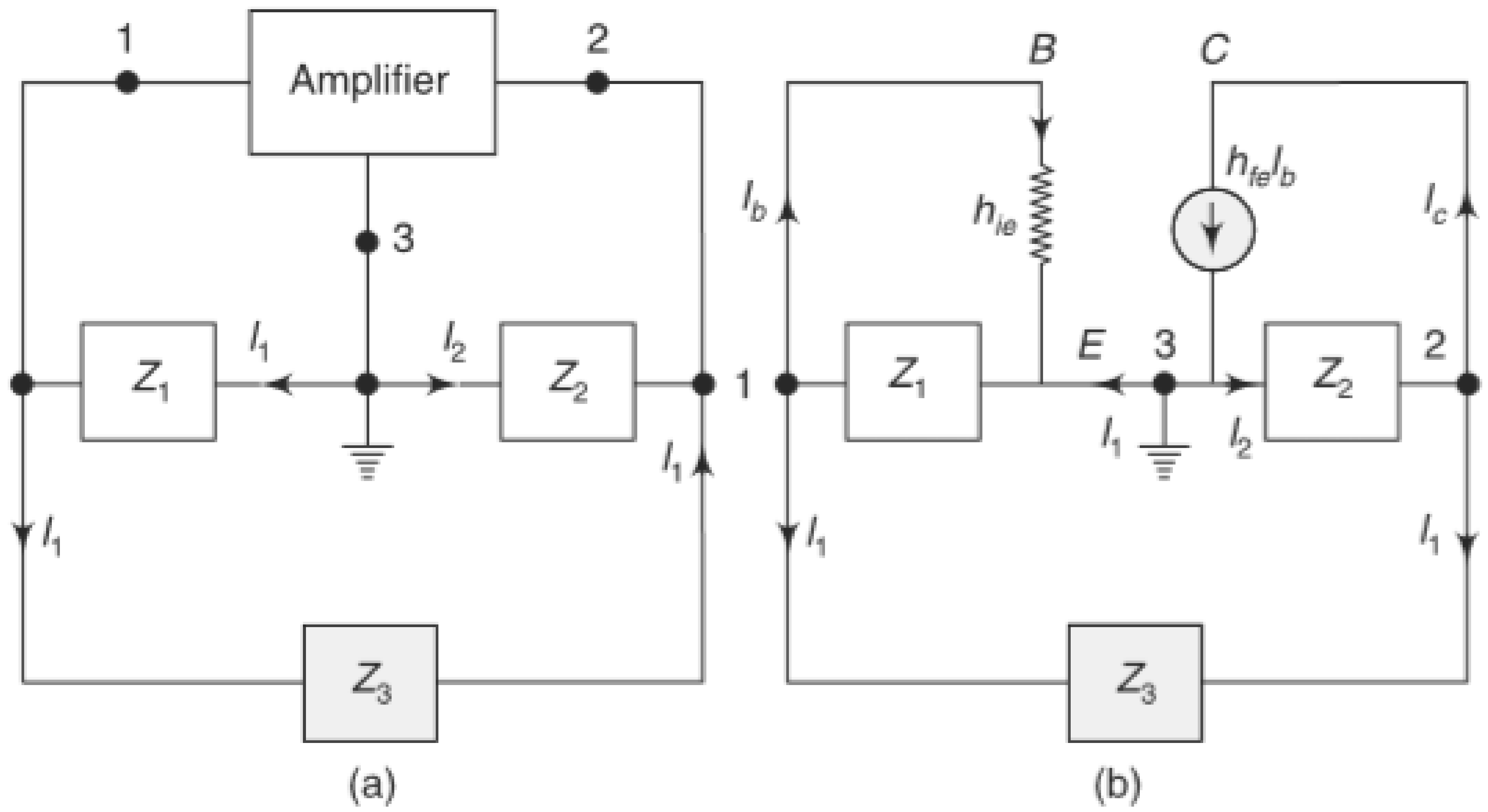


Equivalent Circuit

Load Impedance

$$\frac{1}{Z'} = \frac{1}{Z_1} + \frac{1}{h_{ie}}$$

$$Z' = \frac{Z_1 h_{ie}}{Z_1 + h_{ie}}$$

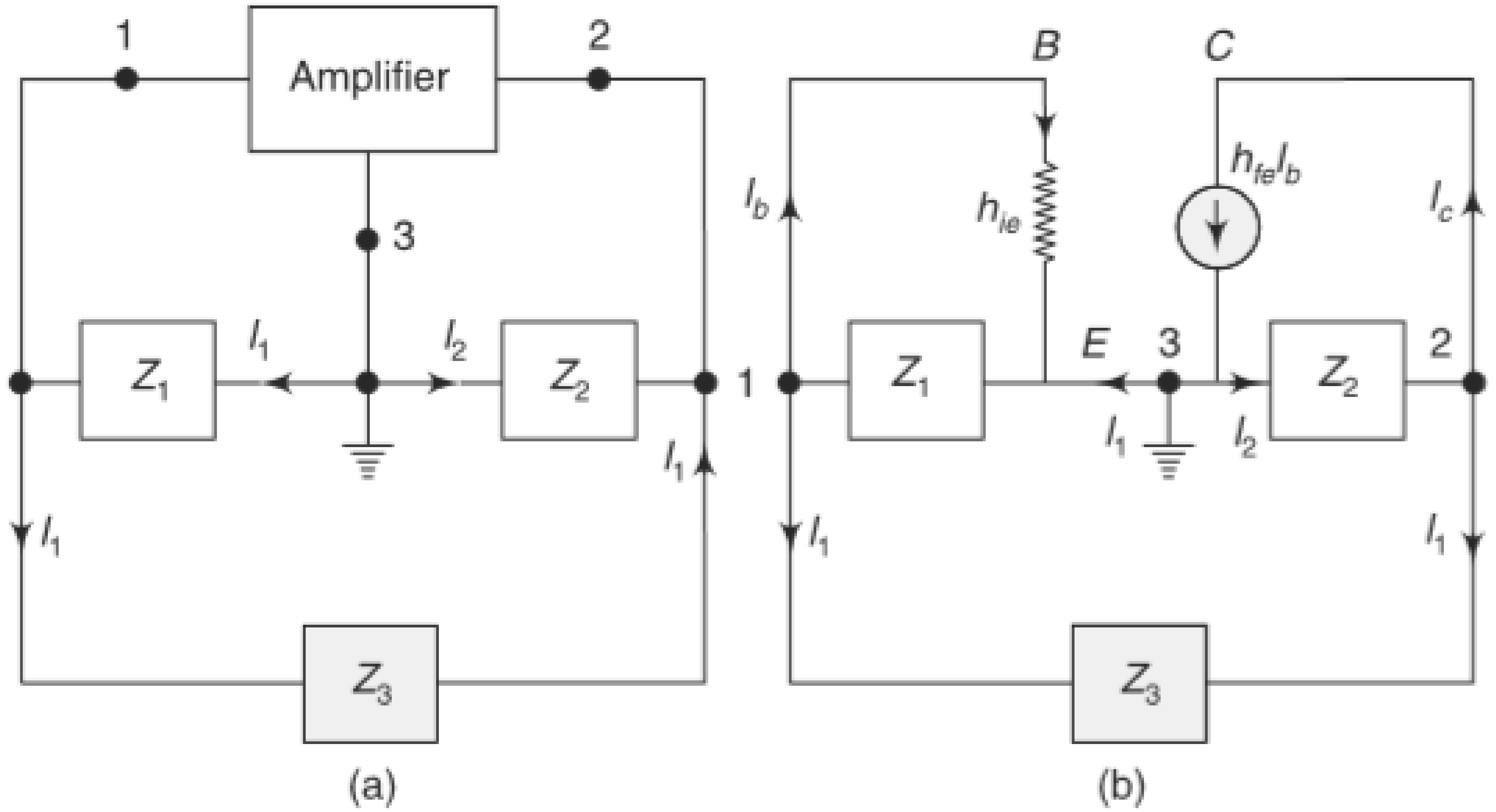


Calculation of Load Impedance

$$\frac{1}{Z_L} = \frac{1}{Z_2} + \frac{1}{Z' + Z_3}$$

Derive

$$Z_L = \frac{Z_2[h_{ie}(Z_1 + Z_3) + Z_1 Z_3]}{h_{ie}(Z_1 + Z_2 + Z_3) + Z_1 Z_2 + Z_1 Z_3}$$

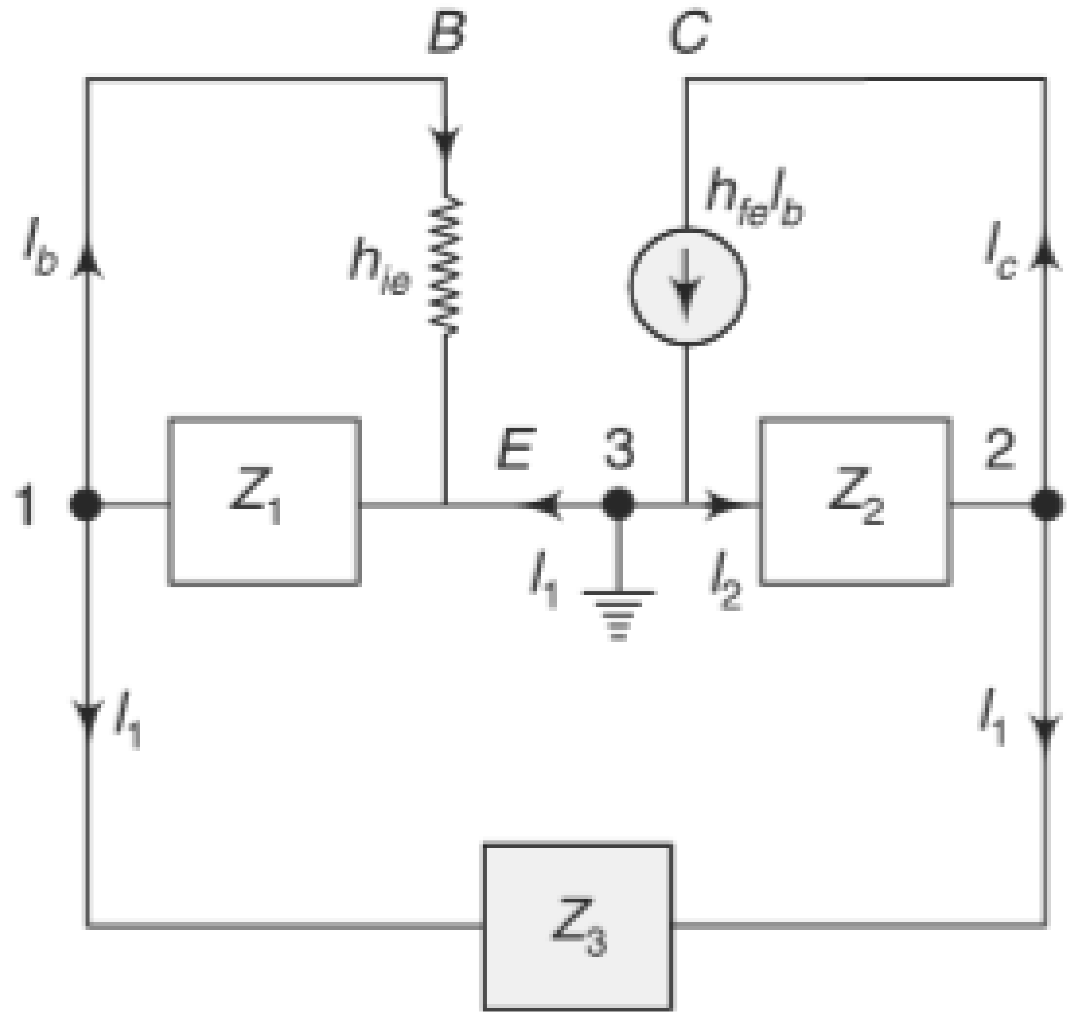


Load Impedance

$$= \frac{1}{Z_2} + \frac{1}{\dfrac{Z_1 h_{ie}}{Z_1 + h_{ie}} + Z_3}$$

$$= \frac{1}{Z_2} + \frac{Z_1 + h_{ie}}{Z_1 h_{ie} + Z_1 Z_3 + h_{ie} Z_3}$$

$$= \frac{1}{Z_2} + \frac{Z_1 + h_{ie}}{h_{ie}(Z_1 + Z_3) + Z_1 Z_3}$$

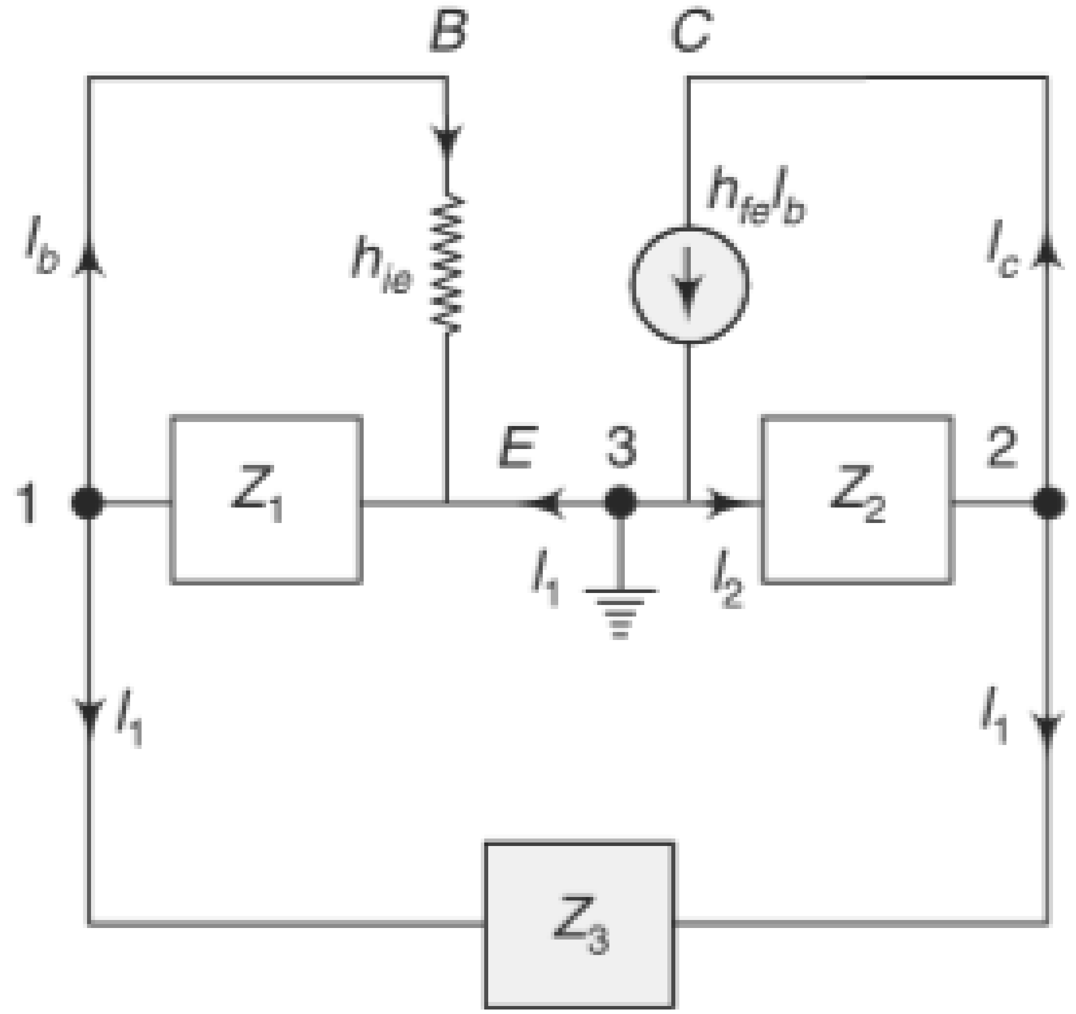


Load Impedance

$$= \frac{h_{ie}(Z_1 + Z_3) + Z_1 Z_3 + Z_2(Z_1 + h_{ie})}{Z_2\,[h_{ie}(Z_1 + Z_3) + Z_1 Z_3]}$$

$$= \frac{h_{ie}(Z_1 + Z_2 + Z_3) + Z_1 Z_2 + Z_1 Z_3}{Z_2\,[h_{ie}(Z_1 + Z_3) + Z_1 Z_3]}$$

$$Z_L = \frac{Z_2[h_{ie}(Z_1 + Z_3) + Z_1 Z_3]}{h_{ie}(Z_1 + Z_2 + Z_3) + Z_1 Z_2 + Z_1 Z_3}$$

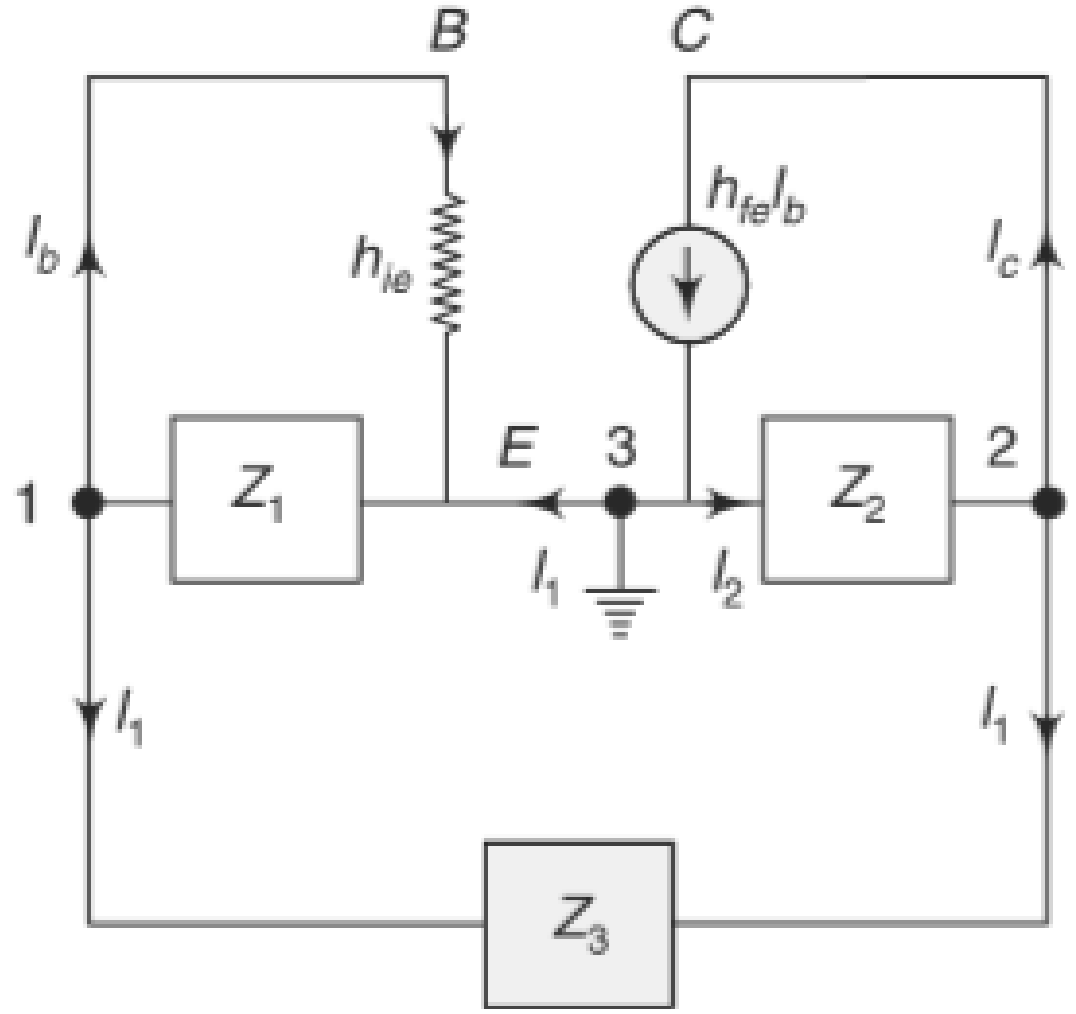


Voltage Gain Without Feedback

$$A_{ve} = -\frac{h_{fe} Z_L}{h_{ie}}$$

$$V_0 = -I_1 (Z' + Z_3) = -I_1\left(\frac{Z_1 h_{ie}}{Z_1 + h_{ie}} + Z_3\right)$$

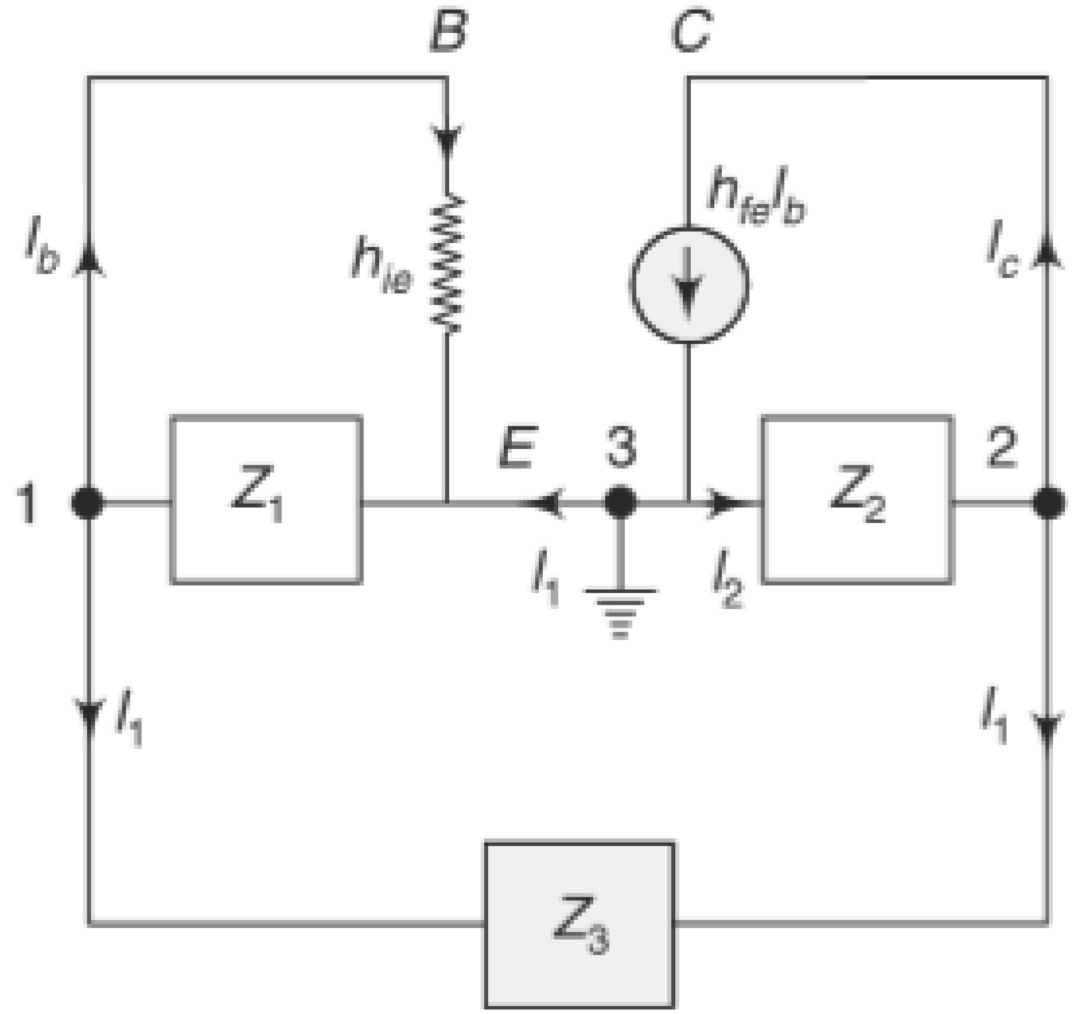
$$= -I_1\left(\frac{h_{ie}(Z_1 + Z_3) + Z_1 Z_3}{Z_1 + h_{ie}}\right)$$



Feedback Factor

$$\beta = \frac{V_{fb}}{V_o} = I_1\left(\frac{Z_1\, h_{ie}}{Z_1 + h_{ie}}\right)\left[\frac{Z_1 + h_{ie}}{h_{ie}\,(Z_1 + Z_3) + Z_1\, Z_3}\right]\cdot\frac{1}{I_1}$$

$$\beta = \frac{Z_1\, h_{ie}}{h_{ie}(Z_1 + Z_3) + Z_1\, Z_3}$$



Assessment 1 (Answer)

Derive the Equation of oscillator

Hints

$$A_{ve}\,\beta = 1$$

Answer

$$h_{ie}(Z_1 + Z_2 + Z_3) + Z_1 Z_2 (1 + h_{fe}) + Z_1 Z_3 = 0$$

References

Electronic Devices and Circuits By Salivahanan

Thank You