ELECTRONICS DEVICES AND CIRCUITS

SECTION - D

SOME SPECIAL DEVICES

OBJECTIVE

TUNNEL DIODE

TUNNEL DIODES

- was first introduced by ***Leo Esaki*** in 1958.
- is fabricated by doping the semiconductor materials that will form the p-*n* junction at a level one hundred to several thousand times that of a typical semiconductor diode.
- The tunnel diode has a region in its ***voltage current characteristic*** where the current decreases with increased forward voltage, known as its ***negative resistance region*****.** This characteristic makes the tunnel diode useful in oscillators and as a microwave amplifier.
- widely known as ***Esaki diode.***

- are different from any diode in that it has a negative-resistance region.

Negative-resistance region:

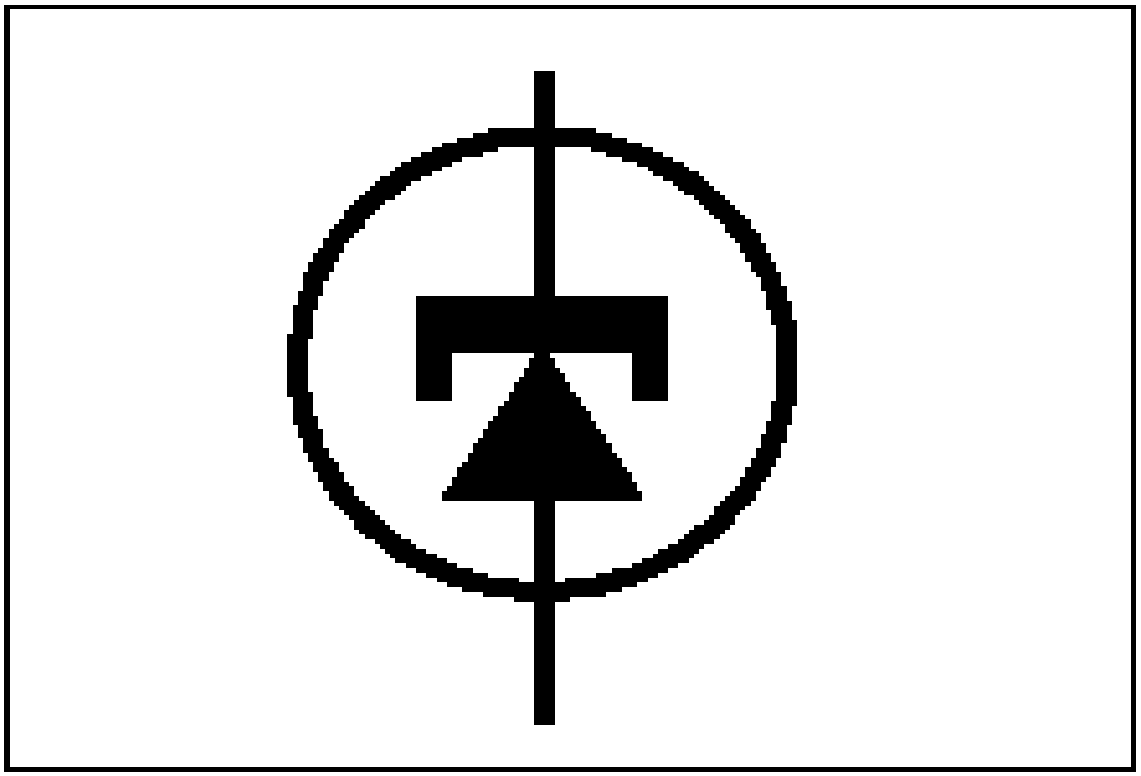
- An increase in terminal voltage results in a reduction in diode current.

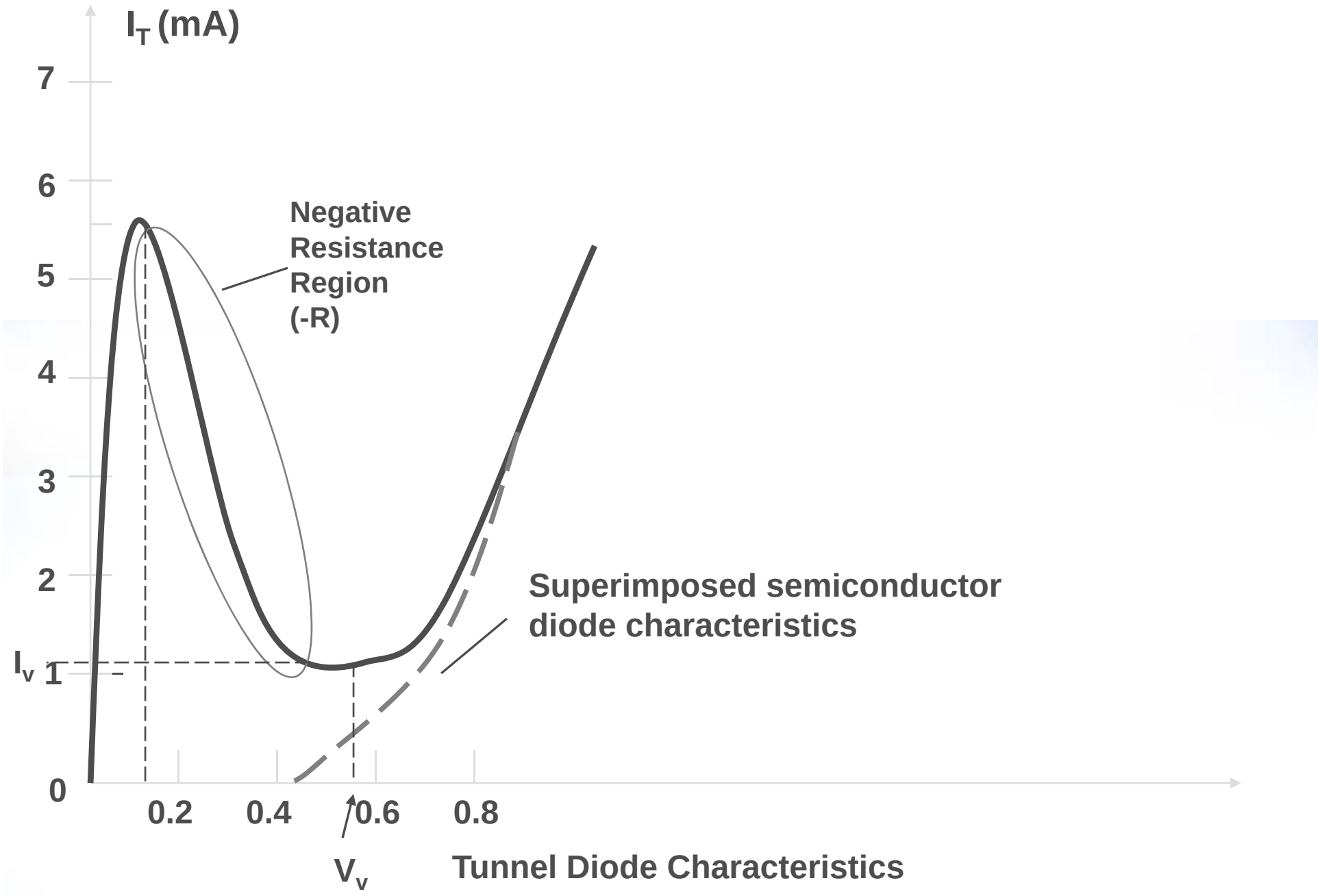
The semiconductor materials most frequently used in the manufacture of tunnel diodes:

- Germanium – it is typically 10:1
- Gallium Arsenide – it is closer 20:1

The ratio I_p/I_v is very important for computer applications.

A Tunnel Diode




I_T (mA)
7
6
5
4
3
2
1
0
I_v
Negative
Resistance
Region
(-R)
Superimposed semiconductor
diode characteristics
0.2
0.4
0.6
0.8
V_v
Tunnel Diode Characteristics

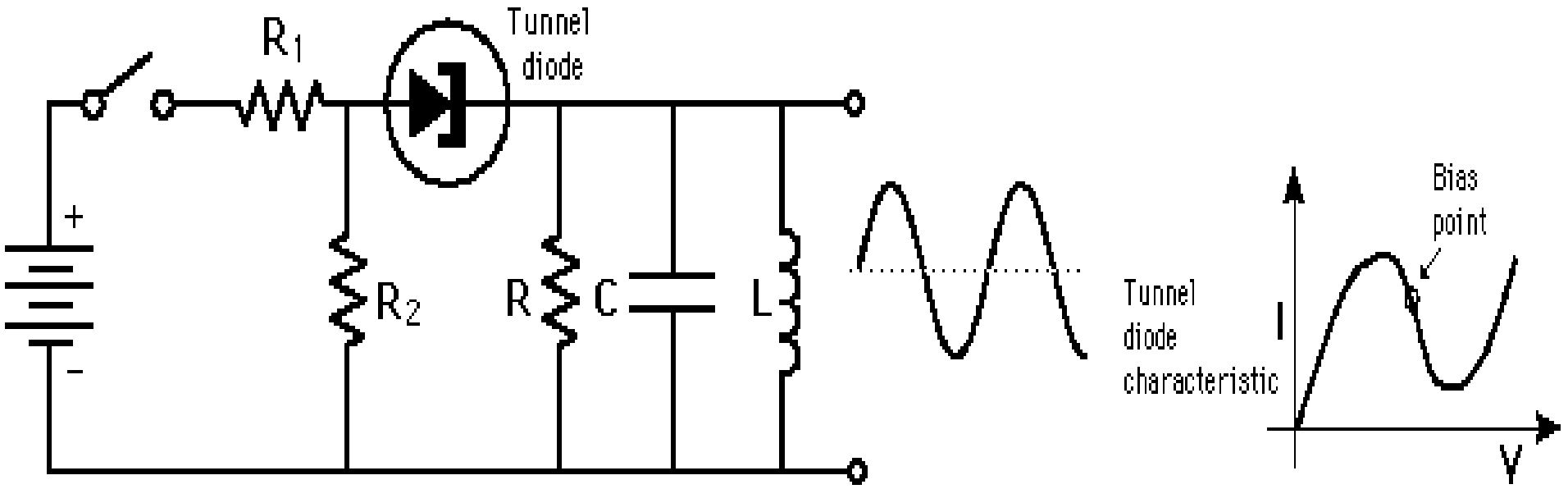
❖ The peak current, I_p, of a tunnel diode can vary from a few microamperes to several hundred amperes. The peak voltage, however, is limited to about 600 mV. For this reason, a simple VOM with an internal dc battery potential of 1.5V can severely damaged a tunnel diode if applied improperly.

Simplicity, linearity, low power drain, and reliability

- Ensure tunnel diodes' continued life and application.

❖ The availability of a negative resistance region can be put to good use in the design of oscillators, switching networks, pulse generators, and amplifiers.

Tunnel diode oscillator



The **negative resistance region** of the tunnel diode makes oscillator action possible. The choice of network elements is designed to establish a load line such as shown in the fig. When the power is turned on, the terminal voltage of the supply will build up from 0V to a final value of E volts.

Sinusoidal Oscillator

- A tunnel diode can also be used to generate a *sinusoidal voltage* using simply a dc supply and a few passive elements.

The closing of the switch will result in a sinusoidal voltage that will decrease in amplitude with time.

Sinusoidal Oscillator

- Depending on the elements employed, the time period can be from one almost instantaneous to one measurable in minutes using typical parameter values.

- This damping of the oscillator with time is due to the dissipative characteristics of the resistive elements.