SNS COLLEGE OF TECHNOLOGY

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COIMBATORE-35
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EET202 / ANALOG ELECTRONICS
II YEAR / III SEMESTER

UNIT-I: PN JUNCTION DEVICE

DIFFUSION AND TRANSITION CAPACITANCE

TOPIC OUTLINE

- ✓ Introduction
- ✓ Capacitance
- ✓ Types of capacitance in PN Junc diode
- ✓ Diffusion capacitance
- ✓ Transition capacitance

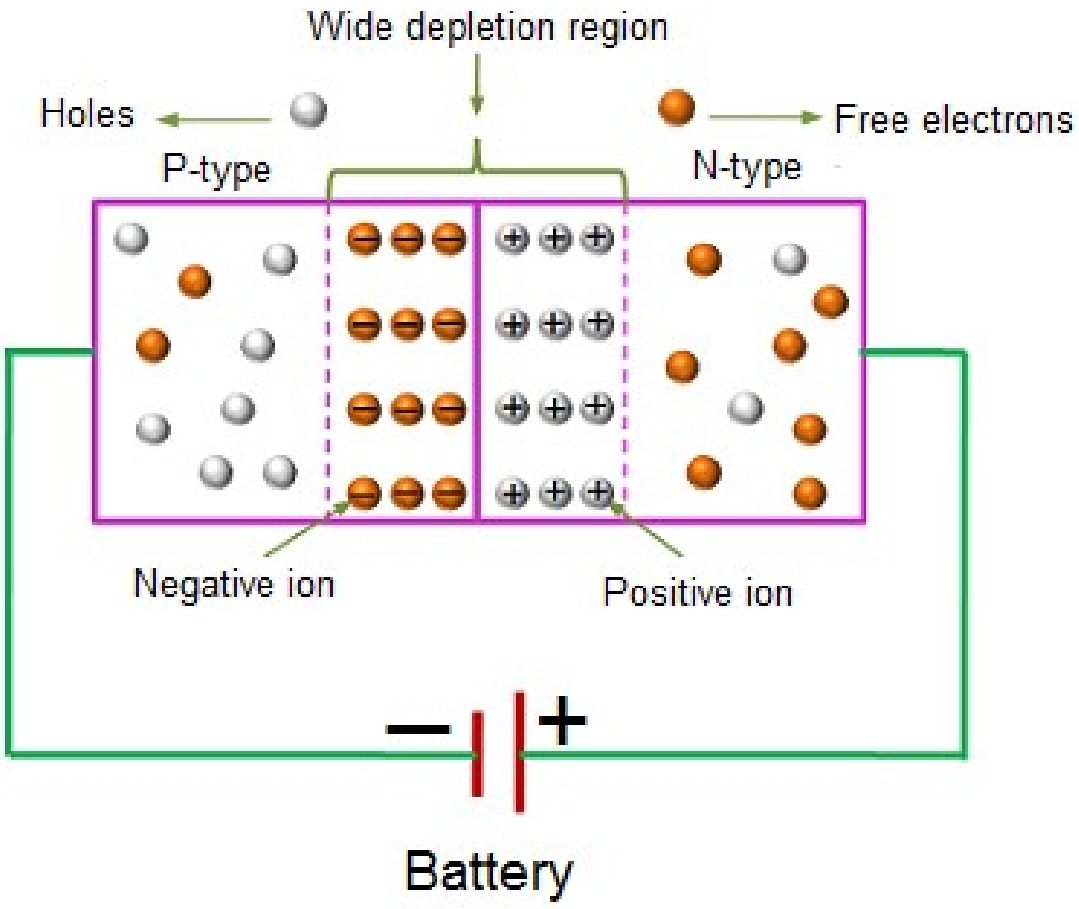
Capacitance

In a p-n junction diode, two types of capacitance take place. They are,

Transition capacitance (CT)

Diffusion capacitance (CD)

Transition capacitance (CT)



Reverse bias

Contd…

In a forward biased diode, the transition capacitance exist. However, th transition capacitance is very small compared to the diffusion capacitance.

Hence The amount of capacitance changed with increase in voltage is called transition capacitance.

The transition capacitance is also known as depletion region capacitanc junction capacitance or barrier capacitance.

Transition capacitance is denoted as CT. e, transition capacitance is neglected in forward biased diode.

Contd…

The change of capacitance at the depletion region can be defined as the change in electric charge per change in voltage.

$$CT = dQ / dV$$

here,

CT = Transition capacitance

dQ = Change in electric charge

dV = Change in voltage

Contd…

e transition capacitance can be mathematically written as,

$$C_T = \varepsilon A / W$$

Where,

ε = Permittivity of the semiconductor

A = Area of plates or p-type and n-type regions

W = Width of depletion region

Diffusion capacitance (CD)

Diffusion capacitance occurs in a forward biased p-n junction diode. Diffusion capacitance is also sometimes referred as storage capacitance.

It is denoted as C_D.

In a forward biased diode, diffusion capacitance is much larger than the transition capacitance. Hence, diffusion capacitance is considered in forward biased diode.

Contd…

- In the similar way, if small electric current flows through the diode, only a small amount of charge is accumulated near the depletion layer.
- As a result, small diffusion capacitance occurs.
- When the width of depletion region decreases, the diffusion capacitance increases.
- The diffusion capacitance value will be in the range of nano farads (nF) to micro farads (μF)

Contd..

e formula for diffusion capacitance is

$$C_D = dQ / dV$$

here,

C_D = Diffusion capacitance

dQ = Change in number of minority carriers stored outside the depletion region

dV = Change in voltage applied across diode

MCQ

Diffusion capacitance is larger than transition capacitance.

a) True

b) False

c) Both are same

d) Depends on doping concentrations

ANSWER

Answer: b

Explanation: Diffusion capacitance occurs in a forward biased diode, transition capacitance is easy to see in reverse bias. C_D C_T for a forward bias junction. In reverse bias though, C_D may be neglected compared to C_T.

MCQ

2.For a diode the transition capacitance was 10pF. The depletion width changed fro
1µm to 10 µm. All other conditions remain unchanged. The new diode capacitan
is _____

a) 5pF
b) 1.414pF
c) 1pF
d) 10pF

ANSWER

Answer: c

Explanation: The equation of transition capacitance = ∈A/W

Where ∈ = permittivity of the material of diode, W = depletion width

A = area of cross section

Since depletion width increased 10 times and all other quantities are t

same, the capacitance decrease by 10 times.

MCQ

. A diode had a transition capacitance of 1pF and depletion width of 1 μ
The capacitance changes to 10 pF when the depletion width changes.
final depletion width is _____

a) 10 μm
b) 0.1 μm
c) 1 μm
d) 100 μm

ANSWER

Answer: b

Explanation: The equation of transition capacitance = ∈A/W

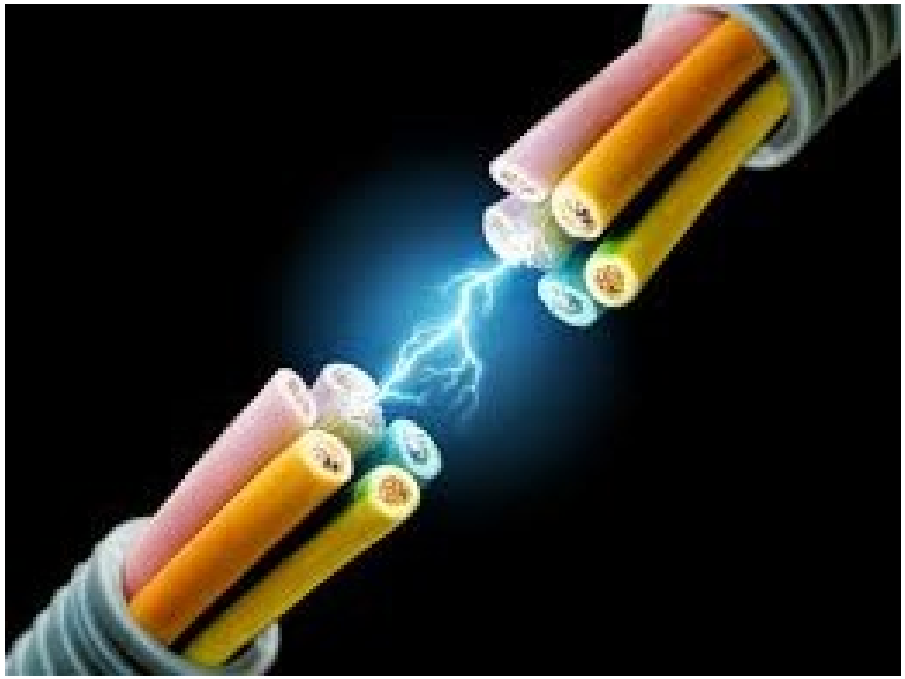
Where ∈ = permittivity of the material of diode, W = depletion width

A = area of cross section

Since depletion width and capacitance are inversely proportional

Depletion width decreases to 0.1 μm.

RECAP….



…THANK YOU