Content Electronics

1. Semiconductor Physics

1.1 Metals, Semiconductors, and Insulators

1.2 Direct and Indirect Semiconductors

1.3 Electrons and Holes

1.3.1 Effective Mass

1.4 Intrinsic Material

1.5 Extrinsic Material

1.6 The Fermi Level

1.6.1 Electron and Hole Concentrations at Equilibrium

1.7 Temperature Dependence of Carrier Concentrations

1.8 Compensation and Space Charge Neutrality

1.9 Current Components in Semiconductor

1.9.1 Drift current (Conductivity and Mobility)

1.9.2 Diffusion Current

1.9.3 Einstein Relationship

1.9.4 Total Current in a Semiconductor

1.10 Effects of Temperature and Doping on Mobility

1.11 The Potential Variation within a Graded Semiconductor

1.11.1 An Open-Circuited Step-graded Junction

Summary

2. P-N Junction Diode

2.1 Semiconductor Diode

2.1.1 No Applied Bias

2.1.2 Reverse Bias Condition

2.1.3 Forward Bias Condition

2.1.4 Ideal Diode

2.1.5 Diode Characteristics

2.1.6 Diode Equation

2.1.7 Breakdown Diodes

2.1.8 The Temperature Dependence of the *V-I* Characteristics

2.2 Diode Resistances

2.2.1 DC or Static Resistance

2.2.2 AC or Dynamic Resistance

2.3 Diode Capacitances

2.3.1 Space-Charge or Transition Capacitance

2.3.2 Diffusion Capacitance

2.4 Load Line Analysis

2.5 Series Diode Configurations with DC Inputs

2.6 Parallel and Series–Parallel Configurations

2.7 Rectifiers

2.7.1 Half-Wave Rectification

2.7.2 Full Wave Rectification

(i) Bridge Network

(ii)Center-Tapped transformer

2.8 Clippers

2.8.1 Series Clippers (Positive and Negative)

2.8.2 Parallel Clippers (Positive and Negative)

Summary

2.9 Clampers

Summary

2.10 Zener Diode

2.10.1 Case-I$\left(V_i \text{ and } R_L \text{ fixed}\right)$)

2.10.2 Case-II$\left(\text{fixed } V_i \text{ and variable } R_L\right)$

2.10.3 Case-III$\left(\text{fixed } R_L \text{ and variable } V_i\right)$

2.10.4 Zener as a Reference Levels

3. Bipolar Junction Transistors

3.1 Transistor Construction

3.2 Transistor Operation

3.3 Transistor Configurations

3.3.1 Common Base Configuration

3.3.2 Common Emitter Configuration

3.3.3 Common Collector Configuration

3.4 DC Biasing-BJTs

3.4.1 Introduction

3.4.2 Operating Point

3.5 Fixed -Bias Circuit

3.5.1 *Q*-point

3.5.2 Transistor Saturation

3.5.3 Load-Line Analysis

3.6 Emitter-Stabilized Bias Circuit

3.6.1 *Q*-point

3.6.2 Saturation Level

3.6.3 Load-Line Analysis

3.7 Voltage-Divider Bias

3.7.1 Q-point

3.7.2 Transistor Saturation

3.7.3 Load-Line Analysis

3.8 DC Bias with Voltage Feedback

3.8.1 Q-point

3.8.2 Saturation Conditions

3.8.3 Load-Line Analysis

4. Operational Amplifier

4.1 Characteristics of an Op-Amp

4.1.1 Input Offset Voltage

4.1.2 Input Offset Current

4.1.3 Input Bias Current

4.1.4 Differential Input Resistance

4.1.5 Common-mode Rejection Ratio (*CMRR*)

4.1.6 Supply Voltage Rejection Ratio

4.1.7 Large-signal Voltage Gain

4.1.8 Output Voltage Swing

4.1.9 Output Resistance

4.1.10 Transient Response

4.1.11 Slew Rate

4.1.12 Gain-Bandwidth Product

4.1.13 The Ideal Op-Amp

4.1.14 Equivalent Circuit of an Op-Amp

4.1.15 Ideal Voltage Transfer Curve

4.2 Open-Loop Op-Amp Configurations

4.2.1 The Differential Amplifier

4.2.2 The inverting Amplifier

4.2.3 The Non-inverting Amplifier

4.3 An Op-Amp with Negative Feedback

4.3.1 Block Diagram Representation of Feedback Configurations

4.4 Voltage-Series Feedback Amplifier

4.4.1 Negative Feedback

4.4.2 Closed-Loop Voltage Gain

4.4.3 Difference Input Voltage Ideally Zero

4.4.4 Input Resistance with Feedback

4.4.5 Output Resistance with Feedback

4.4.6 Bandwidth with Feedback

4.4.7 Total Output Offset Voltage with Feedback

4.4.8 Voltage Follower

4.5 Voltage-Shunt Feedback Amplifier

4.5.1 Closed-Loop Voltage Gain

4.5.2 Inverting Input Terminal at Virtual Ground

4.5.3 Input Resistance with Feedback

4.5.4 Output Resistance with Feedback

4.5.5 Bandwidth with Feedback

4.5.6 Total Output Offset Voltage with Feedback

4.5.7 Current-to-Voltage Converter

4.6 Differential Amplifiers

4.6.1 Differential Amplifier with One Op-Amp

4.6.2 Differential Amplifier with Two Op-Amps

4.7 The Practical Op-Amp

4.8 Summing, Scaling and Averaging Amplifier

4.8.1 Inverting Configuration

4.8.2 Non-inverting Configuration

4.8.3 Differential Configuration

4.9 The Integrator

4.10 The Differentiator

4.11 Active Filters

4.11.1 First-Order Low-Pass Filter

4.11.2 Second-Order Low-Pass Filter

4.11.3 First-Order High-Pass Filter

4.11.4 Second-Order High-Pass Filter

4.11.5 Band-Pass Filter

4.11.6 All-Pass Filter

4.12 Oscillators

5. Digital Electronics

5.1 Number System

5.1.1 Decimal Number System

5.1.2 Binary Number System

5.1.3 Octal Number System

5.1.4 Hexadecimal Number System

5.2 Logic Gates

5.2.1 The Inverter

5.2.2 The AND Gate

5.2.3 The OR Gate

5.2.4 The NAND Gate

5.2.5 The NOR Gate

5.2.6 OR Gate (Positive Logic and Negative Logic)

5.2.7 AND Gate (Positive Logic and Negative Logic)

5.3 Logic Expressions

5.3.1 NOT

5.3.2 AND

5.3.3 OR

5.3.4 NAND

5.3.5 NOR

5.4 Rules for Boolean algebra

5.4.1 Demorgan's Theorems

5.5 Boolean Expressions for Gate Networks

5.5.1 Sum-of-Product Form

5.5.2 Product-of-Sums Form

5.6 Simplification of Boolean Expressions

5.6.1 Boolean algebra techniques

5.6.2 The Karnaugh Map

5.7 Universal Gates

Content-Solid State physics

1. Crystal Structure

1.1 Space Lattice

1.2 Basis

1.3 Bravais Space Lattice

1.4 Miller Indices in Crystal Lattice

1.5 Density of Crystal

1.5.1 Packing Fraction

2. *X*-Ray diffraction

2.1 Structure Factor

2.2 Braggs Law

2.3 Methods of X-ray Diffraction

3. Einstein and Debye Theory of Specific Heat

3.1 Classical Theory

3.2 Einstein Theory of Specific Heat

3.3 Debye Theory of Specific Heat

4. Free Electron Theory of Metals

4.1 Fermi Energy

4.2 Electron Specific Heat

4.3 Density of States

5. Origin of Energy Bands

5.1 Concept Effective Mass and Holes

6. Elementary Ideas about Dia-, Para- and Ferromagnetism

6.1 Diamagnetism

6.2 Paramagnetism

6.3 Ferromagnetism