

# TKU212242

## Fundamentals of Electronics Elektronika Dasar

### BASIC INFORMATION

<b>Course Credit</b>	3 / 150 minutes per Week
<b>Course Type</b>	Required
<b>Course Classification</b>	Engineering Topics
<b>Prerequisites</b>	Electricity & Magnetism; DC Circuits; Differential Equations

### STUDENT AND LEARNING OUTCOMES

#### Covered Student Outcomes

Fundamental and Engineering Knowledge (KP.1)      Development of Engineering Solution (KP.2)

#### Learning Outcomes

- LO1** Students are able to understand the characteristics of various non-linear components (diode, transistor and operational amplifier), and their implementation.
- LO2** Students are able to apply the basic information about characteristics of linear and non-linear components for analyzing the behaviour of electronic circuits.
- LO3** Students are able to design electronic circuits for certain purposes.

### COURSE DESCRIPTION

Fundamentals of Electronics course introduces the students to the world of electronics. Using the knowledge and understanding from Electricity & Magnetism, and DC Circuits courses as the foundations, this course discusses the characteristics of various non-linear electronic components, which can be used to implement various electronic circuits such as rectifiers, amplifiers, logic gates and filters. Students are required to take both Electricity & Magnetism, DC Circuits and Differential Equations courses before taking this course.

### TOPICS

#### 1. Analysis of Linear Circuits (Review)

- 1.1 Kirchhoff's Laws
- 1.2 Thevenin's and Norton's Theorem

#### 2. Analysis of Nonlinear Circuits

- 2.1 Introduction to Nonlinear Components
- 2.2 Analytical Solution
- 2.3 Graphical Analysis
- 2.4 Piecewise Linear Analysis
- 2.5 Incremental Analysis (Linearization)

### **3. Semiconductor Diodes**

- 3.1 PN Junction
- 3.2 Covalent Bonding
- 3.3 Diode Characteristic
- 3.4 Diode Approximation
- 3.5 Half-Wave and Full-Wave Rectifier Circuits
- 3.6 Rectifier Circuits with RC Filter

### **4. Dependent Sources and Amplifiers**

- 4.1 Circuit with Dependent Sources
- 4.2 Large-Signal Analysis
- 4.3 Small-Signal Analysis
- 4.4 Signal Amplification
- 4.5 Input and Output Impedance
- 4.6 Characteristic of Ideal Amplifier

### **5. Bipolar Junction Transistor (BJT)**

- 5.1 Transistor Construction
- 5.2 Operation Principle
- 5.3 Basic Configuration
- 5.4 Biasing (Large-Signal Analysis)
- 5.5 Small-Signal Model of BJT
- 5.6 BJT Amplifier

### **6. Metal Oxide Semiconductor Field Effect Transistor (MOSFET)**

- 6.1 MOSFET Construction
- 6.2 Operation Principle and Characteristic
- 6.3 Basic Configuration \*)
- 6.4 Biasing (Large-Signal Analysis) \*)
- 6.5 Small-Signal Model of MOSFET \*)
- 6.6 MOSFET Amplifier \*)

### **7. Introduction to Digital Circuits**

- 7.1 Logic Gates
- 7.2 Power Dissipation in Logic Gates \*)
- 7.3 CMOS Logic \*)

### **8. Operational Amplifier Basic and Analysis**

- 8.1 Basic Characteristics
- 8.2 Ideal Operational Amplifier
- 8.3 Open-Loop and Closed-Loop Response
- 8.4 Analysis of Operational Amplifier Circuit

## **9. Operational Amplifier Circuits**

9.1 Basic Operational Amplifier Circuits

9.2 Instrumentation Amplifier

## **10. Non-ideal Characteristics of Operational Amplifier**

10.1 Non-ideal Characteristics

10.2 Negative Feedback vs Positive Feedback Operational Amplifier Circuit

10.3 Application of Positive Feedback Operational Amplifier Circuit

## **11. Filters**

11.1 Filtering Concept

11.2 Transfer Function and Types of Filter

11.3 Passive and Active Filters

11.4 First-Order Filter and its Design Technique

11.5 Second-Order Filter and its Design Technique

11.6 Cascaded-Filters

## **12. Oscillator (Operational Amplifier Based) \*)**

12.1 Square Wave Generator (Relaxation Oscillator)

12.2 Triangular Wave Generator

12.3 Positive Feedback and Oscillation (Barkhausen Criterion)

12.4 Sine Wave Generator

## **13. Power Supply and Regulator \*)**

13.1 Series

13.2 Shunt

13.3 Switching

## **REFERENCES**

- [1] Boylestad, R.L., Electronic Devices and Circuit Theory, 1999, Prentice Hall Int'l Inc, New Jersey.
- [2] Sedra, A. S. & Smith, K. C., Microelectronics Circuits, 2011, 6th edition, Oxford Series in Electrical and Computer Engineering.
- [3] Behzad Razavi, B., Fundamentals of Microelectronics, 2014, John Wiley & Sons, Inc., New York.
- [4] Agarwal, A. & Lang, J.H., Foundations of Analog and Digital Electronic Circuits, 2005, Elsevier Inc., San Francisco