TKB213101

Biomedical Electronics

Elektronika Biomedis

BASIC INFORMATION

Course Credit	2 / 100 minutes per Week
Course Type	Required
Course Classification	Engineering Topics
Prerequisites	DC Circuits Analysis; Fundamentals of Electronics

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 apply the small-signal analysis technique for analyzing the behaviour of various amplifier circuits.

LO2 Students are able to understand the characteristics of amplifier circuits as a function of frequency.

LO3 Students are able to understand the concept of biological electricity and design electronic models of biological signal.

COURSE DESCRIPTION

This course discusses biological electrical phenomena, analysis of biological electric signals for clinical purposes, design of electronic models for systems producing biological signal, and design of simulations producing biological signal.

TOPICS

1. Dependent Sources and Amplifiers (Review)

1.1 Circuit with Dependent Sources

1.2 Small-Signal Analysis

1.3 Signal Amplification

1.4 Input and Output Impedance

1.5 Multi-Stage Amplifier

2. MOS Amplifier

2.1 Biasing - DC Analysis (Review)

2.2 Basic Amplifier Topology

2.3 Advanced Amplifier Topology

3. BJT Amplifier

3.1 Biasing - DC Analysis (Review)

3.2 Basic Amplifier Topology

3.3 Advanced Amplifier Topology

4. Differential Amplifier

4.1 Common-Mode and Differential Signal

4.2 BJT Differential Pair

4.3 MOS Differential Pair

4.4 Common-Mode Rejection

4.5 Differential Pair with Active Load

5. Current Mirror

5.1 Biasing Stability and Current Source Implementation

5.2 Basic of Current Mirror

5.3 Cascoded Current Mirror

5.4 Active Current Mirror

6. Output Stage and Power Amplifier

6.1 General Considerations

6.2 Classification of Output Amplifier

7. Operational Amplifier

7.1 Two-Stage Operational Amplifier Circuit

7.2 Folded-Cascode Operational Amplifier Circuit

7.3 Operational Amplifier Circuit Example : the 741 Op-Amp

7.4 DC Analysis of Operational Amplifier Circuit

7.5 Small-Signal Analysis of Operational Amplifier Circuit

7.6 Amplification, Frequency Response and Slew Rate of Operational Amplifier

7.7 Modern Technique of Operational Amplifier Design *)

8. Frequency Response

8.1 Transfer Function and Bode Plot (Review)

8.2 Frequency Response of CS and CE Amplifiers

8.3 Effect of Internal Capacitance

8.4 High-Frequency Model of BJT and MOS Transistor

8.5 High-Frequency Response of CS and CE Amplifiers

8.6 High-Frequency Response of CG, CB and Cascode Amplifiers

8.7 High-Frequency Response of Source and Emitter Follower Amplifiers

8.8 High-Frequency Response of Differential Amplifier

8.9 Multi-Stage Amplifier

9. Oscillator (Transistor Based) *)

9.1 Barkhausen Criterion and Positive Feedback

9.2 Ring-Oscillators

9.3 RC Oscillators

9.4 LC Oscillators

9.5 Crystal Oscillators

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.