

# TKB213102

## Anatomi dan Fisiologi

### Anatomy and Physiology

#### BASIC INFORMATION

<b>Course Credit</b>	3 / 150 minutes per Week
<b>Course Type</b>	<b>Required</b>
<b>Course Classification</b>	<b>Engineering Topics</b>
<b>Prerequisites</b>	

#### STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

Fundamental and Engineering

Knowledge (a)

Data and Experiments (d)

Learning Outcomes

LO1 Students are able to understand organization and functions of human body as a single unit. (Mahasiswa untuk memahami organisasi dan fungsi tubuh manusia sebagai satu kesatuan.)

#### COURSE DESCRIPTION

This course discusses organization and functions of human body as a single unit.

Mata kuliah ini bertujuan untuk memberikan uraian organisasi dan fungsi tubuh manusia sebagai satu kesatuan.

#### TOPICS

1. Cell Structure and Biochemical Reactions
2. Cellular Homeostasis and Membrane Potential
3. The Action Potential
4. Cellular Transport and Communication
5. Pharmacokinetics
6. Tissue Mechanics
7. Cardiovascular System I: The Heart
8. Cardiovascular System II: The Vasculature
9. The Respiratory System
10. The Central Nervous System

## REFERENCES

- [1] Physiology, Biophysics, and Biomedical Engineering. Editor: A. W. Wood, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2012
- [2] Chappell, Michael, Payne, Stephen. Physiology for Engineers Applying Engineering Methods to Physiological Systems, Springer, 2016

# TKU213101

## Optimization Methods

### Teknik Optimisasi

#### 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>	Single- and Multi-Variable Calculus; Linear Algebra

#### STUDENT AND LEARNING OUTCOMES

##### Covered Student Outcomes

Development of Engineering Solution (KP.2)      Engineering Design (KP.3)

##### Learning Outcomes

- LO1** Students are able to understand and solve unconstrained optimization problems.
- LO2** Students are able to understand and solve linear programming problems.
- LO3** Students are able to understand and solve nonlinear constrained optimization problems.

#### COURSE DESCRIPTION

This course deals with analytical methods to solve optimization problems which very often appear in engineering. It studies the unconstrained optimization, linear programming, and nonlinear constrained optimization problems.

#### TOPICS

##### **PART I : MATHEMATICAL REVIEW**

##### **1. Methods of Proof and Some Notation**

- 1.1 Methods of Proof
- 1.2 Notation

##### **2. Vector Spaces and Matrices**

- 2.1 Vector and Matrix

- 2.2 Rank of a Matrix
- 2.3 Linear Equations
- 2.4 Inner Products and Norms

### **3. Transformations**

- 3.1 Linear Transformations
- 3.2 Eigenvalues and Eigenvectors
- 3.3 Orthogonal Projections
- 3.4 Quadratic Forms
- 3.5 Matrix Norms

### **4. Concepts from Geometry**

- 4.1 Line Segments
- 4.2 Hyperplanes and Linear Varieties
- 4.3 Convex Sets
- 4.4 Neighbourhoods
- 4.5 Polytopes and Polyhedra

### **5. Elements of Calculus**

- 5.1 Sequences and Limits
- 5.2 Differentiability
- 5.3 The Derivative Matrix
- 5.4 Differentiation Rules
- 5.5 Level Sets and Gradients
- 5.6 Taylor Series

## **PART II : UNCONSTRAINED OPTIMIZATION**

### **6. Basics of Set-Constrained and Unconstrained Optimization**

- 6.1 Introduction
- 6.2 Conditions for Local Minimizers

### **7. One-Dimensional Search Methods**

- 7.1 Introduction
- 7.2 Golden Section Search
- 7.3 Fibonacci Method
- 7.4 Bisection Method
- 7.5 Newton's Method
- 7.6 Secant Method
- 7.7 Bracketing

## 7.8 Line Search in Multidimensional Optimization

### **8. Gradient Methods**

#### 8.1 Introduction

#### 8.2 The Method of Steepest Descent

#### 8.3 Analysis of Gradient Methods

### **9. Newton's Method**

#### 9.1 Introduction

#### 9.2 Analysis of Newton's Method

#### 9.3 Levenberg-Marquardt Modification

#### 9.4 Newton's Method for Nonlinear Least Squares

### **10. Conjugate Direction Methods**

#### 10.1 Introduction

#### 10.2 The Conjugate Direction Algorithm

#### 10.3 The Conjugate Gradient Algorithm

#### 10.4 The Conjugate Gradient Algorithm for Non-quadratic Problems

### **11. Quasi-Newton Methods**

#### 11.1 Introduction

#### 11.2 Approximating the Inverse Hessian

#### 11.3 The Rank One Correction Formula

#### 11.4 The DFP Algorithm

#### 11.5 The BFGS Algorithm

## **PART III : LINEAR PROGRAMMING**

### **12. Introduction to Linear Programming**

#### 12.1 Brief History of Linear Programming

#### 12.2 Simple Examples of Linear Programs

#### 12.3 Two-Dimensional Linear Programs

#### 12.4 Convex Polyhedra and Linear Programming

#### 12.5 Standard Form Linear Programs

#### 12.6 Basic Solutions

#### 12.7 Properties of Basic Solutions

#### 12.8 Geometric View of Linear Programs

### **13. Simplex Method**

#### 13.1 Solving Linear Equations Using Row Operations

- 13.2 The Canonical Augmented Matrix
- 13.3 Updating the Augmented Matrix
- 13.4 The Simplex Algorithm
- 13.5 Matrix Form of the Simplex Method
- 13.6 Two-Phase Simplex Method
- 13.7 Revised Simplex Method

#### **14. Duality**

- 14.1 Dual Linear Programs
- 14.2 Properties of Dual Problems

### **PART IV : NONLINEAR CONSTRAINED OPTIMIZATION**

#### **15. Problems with Equality Constraints**

- 15.1 Introduction
- 15.2 Problem Formulation
- 15.3 Tangent and Normal Spaces
- 15.4 Lagrange Condition
- 15.5 Second-Order Conditions
- 15.6 Minimizing Quadratics Subject to Linear Constraints

#### **16. Problems with Inequality Constraints**

- 16.1 Karush-Kuhn-Tucker Condition
- 16.2 Second-Order Conditions

#### **17. Convex Optimization Problems**

- 17.1 Introduction
- 17.2 Convex Functions
- 17.3 Convex Optimization Problems
- 17.4 Semi-definite Programming

#### **18. Algorithms for Constrained Optimization**

- 18.1 Introduction
- 18.2 Projections
- 18.3 Projected Gradient Methods with Linear Constraints
- 18.4 Lagrangian Algorithms
- 18.5 Penalty Methods

## **REFERENCES**

[1] Edwin K. P. Chong, Stanislaw H. Zak., 2013., An Introduction to Optimization, 4th Edition