# COURSE

# Applied Mechanics(I)-*STATICS*

- **Hours/week**：M3M4W2
- **Instructor**：Ming-Chuen Yip
- **Email**：**mcyip@pme.nthu.edu.tw**
- **Textbook**： Vector Mechanics for Engineers-*STATICS* (THIRD SI METRIC EDITION) by Beer & Johnston
- **Reference Book**：Engineering Mechanics- Statics by Hibbeler

  Engineering Mechanics- Statics by Riley & Sturges
- **Evaluations**：1st exam. 25% (chap.2-5)

  2nd exam. 25% (chap.6-8)

  Final exam. 35% (chap.2-10)

  Homework 10%

  Quiz 5%

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1. Introductions
2. Statics of particles
3. Rigid bodies：equivalent systems of forces
4. Equilibrium of rigid bodies
5. Distributed forces：centroids and centers of gravity
6. Analysis of structures
7. Forces in beams and cables
8. Friction
9. Distributed forces：moments of inertia
10. Method of virtual work

# 1. Introductions

1.1 What is Mechanics

1.2 Fundamental  Concepts and principles

1.3 Systems of Units

1.4 Method of Problem Solution

1.5 Numerical Accuracy

# 2. Statics of particles

2.1 Introduction
2.2 Force on a Particle. Resultant of Two Forces
2.3 Vectors
2.4 Addition of Vectors
2.5 Resultant of Several Concurrent Forces
2.6 Resolution of a Force into Components
2.7 Rectangular Components of a Force. Unit Vectors
2.8 Addition of Forces by Summing x and y Components
2.9 Equilibrium of a Particle
2.10 Newton’s First Law of Motion
2.11 Problems Involving the Equilibrium of a Particle Free-Body Diagrams

# 2. Statics of particles (cont)

2.12 Rectangular Components of a Force in Space

2.13 Forced Defined by Its Magnitude and Two Points on Its Line of Action

2.14 Addition of Concurrent Forces in Spaces

# 3. Rigid bodies  equivalent systems of forces

3.1 Introduction

3.2 External and Internal Forces

3.3 Principle of Transmissibility. Equilibrium Forces

3.4 Vector Product of Two Vectors

3.5 Vector Product Expressed in Terms of Rectangular Components

3.6 Moment of a Force about a Point

3.7 Varignon's Theorem

3.8 Rectangular Components of the Moment of a Force

3.9 Scalar Product of Two Vectors

3.10 Mixed Triple Product of Three Vectors

3.11 Moment of a Force about a Given Axial

3.12 Moment of a Couple

# 3. Rigid bodies  equivalent systems of forces (cont)

3.13 Equivalent Couples

3.14 Additions of Couples

3.15 Couples Can Be Represented by Vectors

3.16 Resolution of a Given Force into a Forces at O and a Couple

3.17 Reduction of a System of Forces to One Force and One Couple

3.18 Equivalent Systems of Forces

3.19 Equipollent Systems of Vectors

3.20 Further Reduction of a System of Forces

3.21 Reduction of a System of Forces to a Wrench

# 4. Equilibrium of rigid bodies

4.1 Introduction

4.2 Free-Body Diagrams

4.3 Reactions at Supports and Connections for a Two-Dimensional
Structure

4.4 Equilibrium of a Rigid Body in Two Dimensions

4.5 Statically indeterminate Reactions. Partial Constraints

4.6 Equilibrium of a Two-Force Body

4.7 Equilibrium of a Three-Force Body

4.8 Equilibrium of a Rigid Body in Three Dimensions

4.9 Reactions at Supports and Connections for a Three-Dimensional
Structure

# 5. Distributed forces
# Centroids and Centers of gravity

5.1 Introduction

5.2 Center of Gravity of a Two-Dimensional Body

5.3 Centroids of Areas and Lines

5.4 First Moments of Areas and Lines

5.5 Composite Plates and Wires

5.6 Determination of Centroids by Integration

5.7 Theorems of Pappus-Guldinus

5.8 Distributed Loads on Beams

5.9 Forces on Submerged Surfaces

5.10 Center of Gravity of a Three-Dimensional Body. Centroid of a Volume

5.11 Composite Bodies

5.12 Determination of Centroids of Volume by Integration

# 6. Analysis of structures

6.1 Introduction
6.2 Definition of a Truss
6.3 Simple Trusses
6.4 Analysis of Trusses by the Methods of Joints
6.5 Joints under Special Loading Condition
6.6 Space Trusses
6.7 Analysis of Trusses by the Methods of Sections
6.8 Trusses Made of Several Simple Trusses
6.9 Structures Containing Multiforce Members
6.10 Analysis of a Frame
6.11 Frames Which Cease to Be Rigid When Detached from Their Supports
6.12 Machines

# 7. Forces in beams and cables

7.1 Introduction
7.2 Internal Forces in Members
7.3 Various Types of Loading and Support
7.4 Shear and Bending Moment of in a Beam
7.5 Shear and Bending Moment Diagrams
7.6 Relations among Load , Shear , and Bending Moment
7.7 Cables with Concentrated Loads
7.8 Cables with Distributed Loads
7.9 Parabolic Cable
7.10 Catenary

# 8. Friction

8.1 Introduction
8.2 The Laws of Dry Friction. Coefficients of Friction
8.3 Angles of Friction
8.4 Problems Involving Dry Friction
8.5 Wedges
8.6 Square-Threaded Screws
8.7 Journal Bearings. Axle Friction
8.8 Thrust Bearings. Disk Friction
8.9 Wheel Friction. Rolling Resistance
8.10 Belt Friction

# 9. Distributed forces  moments of inertia

9.1 Introduction

9.2 Second Moment , or Moment of Inertia , of an Area

9.3 Determination of the Moment of Inertia of an Area by Integration

9.4 Polar Moment of Inertia

9.5 Radius of Gyration of an Area

9.6 Parallel-Axis Theorem

9.7 Moments of Inertia of Composite Areas

9.8 Product of Inertia

9.9 Principal Axes and Principal Moments of Inertia

9.10 Mohr’s Circle for Moments and Products of Inertia

9.11 Moment of Inertia of a Mass

9.12 Parallel-Axis Theorem

# 9. Distributed forces  moments of inertia (cont)

9.13 Moments of Inertia of Thin Plates

9.14 Determination of the Moment of Inertia of a Three-Dimensional

Body by Integration

9.15 Moments of Inertia of Composite Bodies

9.16 Moment of Inertia of a Body with Respect to an Arbitrary Axis

Through O. Mass Products of Inertia

9.17 Ellipsoid of Inertia. Principal Axes of Inertia

9.18 Determination of the Principal Axes and Principal Moments of

Inertia of a Body of Arbitrary Shape

# 10.Method of virtual work

10.1 Introduction
10.2 Work of a Force
10.3 Principle of Virtual Work
10.4 Applications of the Principle of Virtual Work
10.5 Real Machines. Mechanical Efficiency
10.6 Work of a Force during a Finite Displacement
10.7 Potential Energy
10.8 Potential Energy and Equilibrium
10.9 Stability of Equilibrium