**Tennessee Tech University**

**ME 6710 – Dynamics of Machinery**

**Summer, 2017, Tuesdays/Thursdays, 8:00 – 10:00 AM**

**TTU /ORNL, 3 Credit hours**

## Instructor Information

Instructor’s Name: Stephen Canfield   
Office: 329 Brown Hall  
Telephone Number: (931)372-3254, (931) 267-2669 (cell)  
Email: SCanfield@tntech.edu

Office Hours TR 7:30-8:00 AM 10-11 AM

## Prerequisites (if applicable)

ME 4640 or Approval of Instructor.

## Texts and References

Applied Dynamics, Francis C. Moon, Wiley - VCH

## Course Description

Relative motion of two- and three-dimensional systems; dynamics of particles and machine elements; Lagrangian mechanics; energy methods, equations of motion and computer-aided solution methods, analysis and synthesis of linear and nonlinear mechanical dynamic systems; dynamics of mechanisms and machines.

## Course Objectives/Student Learning Outcomes

Students are expected to:

* Construct equations of motion for rigid body systems in 3D
* Construct equations of motion for multi-body systems using Newtonian and Lagrangian methods
* Apply Tools and techniques to evaluate equations of motion
* Develop algorithms and computer programs to simulate the dynamics of rigid body systems

## Major Teaching Methods

Lecture, Programming activities, in-class activities

## Special Instructional Platform/Materials

Supporting materials will be provided online. Majority of classes will be accessible remotely.

## Topics to Be Covered

## Consideration of Analytical Dynamics for Engineers, Introduction

Lecture notes, review

## Review basic principles

Chapter 1

## Kinematics

Frames of reference

Description of motion in 2d, 3 dof space

Rotation matrices, operations

Rules for differentiation

## Dynamics

## Newton-Euler Equations of Motion

* + - 1. Applications
      2. Phase Portraits
      3. Chapter 3, 8

## Analytical Methods:

## Virtual Work

## Lagranges Equation

## Lagrangian

* + - 1. Constraints and Lagrange Multipliers
      2. Hamiltonian, Cyclical coordinates
      3. Lagranges Equations with rigid bodies

c. Chapters 4. 8

## Multi-body dynamics (mechanisms)

## Numerical Integration

## Topics in dynamics

## 1. Mechanisms

2. Robotics

## 3. Mechatronic system dynamics

## Grading and Evaluation Procedures

Component Percentage Of course Average

Exam 1 25%

Exam 2 20%

Homework 25%

Programming Assignments 30%

## Grading Scale

| **Letter Grade** | **Grade Range** |
| --- | --- |
| A | 90-100 |
| B | 80-89.9 |
| C | 70-79.9 |
| D | 60-69.9 |
| F | Below 60 |

## Student Academic Misconduct Policy

Maintaining high standards of academic integrity in every class at Tennessee Tech is critical to the reputation of Tennessee Tech, its students, alumni, and the employers of Tennessee Tech graduates. The Student Academic Misconduct Policy describes the definitions of academic misconduct and policies and procedures for addressing Academic Misconduct at Tennessee Tech. For details, view the Tennessee Tech’s Policy 217 – Student Academic Misconduct at [Policy Central](https://tntech.policytech.com/dotNet/noAuth/login.aspx?ReturnUrl=%2fDefault.aspx%3fauto%3dfalse&auto=false&public=true).

## Attendance Policy

Class periods provide collective time to review, evaluate and summarize our learning and findings in course topics. Attendance is required to contribute to others in the course and to assess and guide your own learning. You are expected to attend and be ON TIME for all scheduled classes, except justified absences such as illness or emergency. If at all feasible, you are to contact one of the instructors about an expected absence before class. You can leave a voice-mail or e-mail message. Each unexcused absence will reduce your final grade by one point. Being late will reduce your bonus points by one-half of one point. Make-up tests or other compensatory work will be taken only when classes are missed for reasons accepted by the instructor.

## Class Participation

Class participation is similarly necessary to guide learning and provide input to other class members.

**Tennessee Tech University Student Email Policy**

The University sends official communications to all Tennessee Tech email addresses. All students receive a @students.tntech.edu email address. This address will receive notices about schedules, grade results, billing information, emergency alerts, important deadlines, a daily email newsletter, and all other official university information. It is your responsibility to read and manage this email.

See: <https://www.tntech.edu/its/emailinfo/studentemail>

Please add my email, ([SCanfield@tntech.edu](mailto:SCanfield@tntech.edu)), to your approved recipients list to ensure you will receive any correspondence in regards to this course.  Please note the instructor of this course is not responsible for missed email communication directed to your spam folder.

## Disability Accommodation

Students with a disability requiring accommodations should contact the Office of Disability Services (ODS). An Accommodation Request (AR) should be completed as soon as possible, preferably by the end of the first week of the course. The ODS is located in the Roaden University Center, Room 112; phone 372-6119. For details, view the Tennessee Tech’s Policy 340 – Services for Students with Disabilities at [Policy Central](https://tntech.policytech.com/dotNet/noAuth/login.aspx?ReturnUrl=%2fDefault.aspx%3fauto%3dfalse&auto=false&public=true).

## Course Schedule: Summer 2017

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| --- | --- | --- | --- | --- |
| **Week** | **First Day** | **Topic** | **Program** | **Online videos\*** |
| 1 | June 8 | Introduction to Analytical Dynamics for Engineers  Kinematics |  | Particle Kinematics |
| 2 | June 13, 16 | Rigid Body Kinematics |  | Rigid Body kinematics |
| 3 | June 20,22 | Newton-Euler Equations of Motion |  | Newtonian Dynamics |
| 4 | June 27,29 | Newton-Euler Equations of Motion, Examples  Programming Assignment #1 |  | Evaluating EOMs |
| 5 | July 4,6 | Numerical Integration, Algorithms, Methods | Programming assignment 1 |  |
| 6 | July 11, 13 | Analytical Methods | Exam 1 | Analytical dynamics |
| 7 | July 18,20 | Analytical Methods  Examples |  |  |
| 8 | July 25,27 | Applications in Multi-body Flexible Systems (E-Sail or other space tether)  Programming Assignmetn 2 |  |  |
| 9 | Aug 1, 3 | Applications in Robotics,  Dynamics of Mobile, Non Holonomic systems (mobile robots, vehicles) | Programming assignment 2 |  |
| 10 | Aug. 8, | Exam 2 | Exam 2 |  |

* Online course content at sites.tntech.edu/scanfield, under education page, ME 6710