

Lesson Plan

(Mechanical Engineering)

Lesson: Dependent Motion of a Multiple Particle System (Course: ME 215  
Engineering Dynamics)

Timeframe: 2 hrs

Materials needed: Course Note, pen or pencil, scratch papers and a calculator.

Note: a laptop with internet access (optional) in a group.

Objectives:

*Basic:*

1. To draw free-body diagram correctly when friction force exists.
2. To establish the Equations of Motion using Newton's 2nd Law.
3. To demonstrate the ability of solving system equations algebraically.

*Advanced:*

1. To use math: solving physical problems in Engineering Dynamics.
2. To break down a complex problem into several simpler ones.
3. To stretch thinking by using theory to solve real world mechanic problems.

Background: Engineering Dynamics can be viewed as the branches of Mechanics. It is a continued course of Statics, students should learn how to use mathematical knowledge to solve time-dependant mechanics problems.

Introduction to Lesson: Dependent motion is an important topic concerning the system motion. Students have learned some preliminary knowledge of the motion of individual particles. They have to continue learning how to solve complex problems if more than an individual particle being integrated into a system.

Procedure [Time needed, include additional steps if needed]:

*Pre-Class Individual Space Activities and Resources:*

Steps	Purpose	Estimated Time	Learning Objective
Step 1: Read the textbook related to dependent motion in chapter 3.	Familiarize with the course content in advance.	30 mins	Define problems, locate the unknowns.
Step 2: Read my Power Point slides posted on BlackBoard with the streamlined course content and solve some concept quizzes.	Approach to the topic of dependent motion	20 mins	To gain preparatory knowledge of identifying the problems
Step 3: Find a problem in the previous session of lesson. This problem is about a single particle in motion.	Allows students to build the foundation of Newton's 2nd law for single particle in motion.	10 mins	To build foundation to deal with single motion case.
Step 4: Try to solve a multi-variable system equations using algebraic algorithms to find correct answers	Familiarize the math technique to be used in dependent motion analysis.	30 mins	To Analyze physical problems by using math tools and develop quantitative thinking skills.

Step 5: To search online and try to find a practical problem e.g. air train motion, collision of cars etc. to do the dependent motion analysis.	To connect the course knowledge with real-world problems and understand how to use the knowledge for practical case analysis.	30 min	To apply theory learned in class for real-world problem solving.
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**In-Class Group Space Activities and Resources:**

Steps	Purpose	Estimated Time	Learning Objective
Step 1: In the opening minutes, I would allow students to ask questions about dependent motion.	Relate the simple motion to dependent motion and familiarize with the topic.	10 min	To Define Problems Illustrate the outline and content.
Step 2: Discuss and share the examples for dependent motion.	Explain the theory, illustrate the analysis method, formulate the equations of motion	50 min	To Interpretate Theory, Develop the equations of motion.
Step 3: Practice the problem solving strategies. Show students the geometric constraints in a pulley system and two blocks connected by a un-stretchable cable.	Sketch the free body diagram; Define the position coordinates; Draw the external forces	30 min	To Illustrate mathematical method and correlated to physical model.

<p><b>Step 4:</b> show mathematical techniques, Solve system equations using algebraic approaches. Give hand-outs with examples and some review materials on math.</p>	<p>To manipulate the equations mathematically. To find answer correctly.</p>	<p>20 min</p>	<p>To Evaluate problem mathematically and accurately</p>
<p><b>Step 5:</b> Check the answers and discuss on the impact of the results. How it may be used for real-world problem solving.</p> <p>Summarize the content of the class. What do we learn? The importance of the course content.</p>	<p>To evaluate the learning outcomes, To explore and stretch thinking To assess the learning outcomes.</p>	<p>5 min. 5 min</p>	<p>To encourage students to stretch thinking for solving complex problem. To assess the knowledge retained</p>

**Closure/Evaluation:**

**Analysis:** To provide a set of hand-outs to students with streamlined survey to evaluate the content of course.

**Post-Class Individual Space Activities:** To use computer or other online resources to explore dependent motion cases in real world. For example. Launch rockets, air craft motion. (The fuel and the bodies, dependent and relative motion cases)

**Connections to Future Lesson Plan(s):** A future topic is on work-energy of motion. The dependent motion will provide the foundation for analyzing the mechanical energy to work or work to energy conversions.