

New Course EFD Template



College of Engineering

Engineering Faculty Document No.:

EFD#04-26

April 30, 2025

TO: The Engineering Faculty

FROM: The Faculty of the School of Mechanical Engineering

RE: New graduate course – ME 51601, Mechanics Innovation Using TRIZ

The Faculty of the School of Mechanical Engineering has approved the following new graduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM (IF ALREADY OFFERED WITH TEMPORARY NUMBER):

ME 59700, Innovation and Problem Solving

Fall 2017 (7 actual end total), Spring 2018 (23 actual end total), Spring 2019 (15 actual end total),

3 total credits; Lecture

Preq:None

TO:

ME 51601 Mechanics Innovation Using TRIZ

Fall, Spring, or Summer

3 total credits; Lecture

Prereq: ME 26300 Introduction to Mechanical Engineering, Design, Innovation and Entrepreneurship; or Engineering drawing, basic notions of modeling and design in engineering

Description: Introduction to the principles and practical applications of the TRIZ (Theory of Inventive Problem Solving) method for innovation in mechanics. TRIZ provides a systematic approach to innovation and problem-solving by analyzing patterns of invention and identifying solutions to engineering challenges. Topics cover knowledge and application of TRIZ tools and techniques to generate creative solutions, improve product functionality, and resolve design conflicts in mechanical systems. CAD simulation is expected.

RATIONALE:

This course was offered four times between Fall 2017 and Spring 2019. The typical enrollment is 25 when offered residually and online. It will be offered again in Fall 2025. The faculty feel strongly that this course is an important element for a ME graduate level curriculum while, at the same time, offering an opportunity to senior UG to gain experience and skills with problem solving. The faculty believe that the topics covered in this new

course are central to the needs of mechanical engineering graduates. Details of this new course are outlined in the appended material below.

A handwritten signature in black ink, appearing to read "Edm Spoll". The signature is fluid and cursive, with the first name "Edm" and the last name "Spoll" clearly distinguishable.

Head/Director of the School of Mechanical Engineering

Link to Curriculog entry: <https://purdue.curriculog.com/proposal:33314/form>

ME 5XX: Mechanics Innovation Using TRIZ

3 units

Instructors

- Prof. Shirley J Dyke
 - Email: sdyke@purdue.edu
- Dr. Christian E. Silva
 - Email: cesilva@purdue.edu

Course Description

This course introduces students to the principles and practical applications of the TRIZ (Theory of Inventive Problem Solving) method for innovation in mechanics. TRIZ provides a systematic approach to innovation and problem-solving by analyzing patterns of invention and identifying solutions to engineering challenges. Students will learn how to apply TRIZ tools and techniques to generate creative solutions, improve product functionality, and resolve design conflicts in mechanical systems.

Course Learning Outcomes

By the end of the course, students will have a comprehensive understanding of how to integrate TRIZ into the innovation process and a toolkit for addressing complex engineering and mechanics challenges in innovative ways.

Learning Objectives:

1. Understand the fundamental concepts and philosophy of the TRIZ method.
2. Analyze and resolve design contradictions using systematic approaches.
3. Apply inventive principles and patterns of evolution to mechanics innovation challenges.
4. Develop function models and identify root causes of design issues.
5. Use TRIZ tools to create innovative, efficient, and cost-effective mechanics solutions.

Prerequisites

- Basic knowledge of mechanical design
- Understanding of engineering problem solving

Required Text and Materials

Required Text

- [*Innovation on Demand*](#) by Victor Fey and Eugene Rivin (2007). Third edition (any edition can be used, but must check problems and units)

Additional Tools/Technologies

- Use of CAD software will be expected to complete the project component of the course. Any version software packages such as AutoCAD or SolidWorks will be suitable for this activity. Please go to <https://it.purdue.edu/shopping/software/student.php> to look and download accessible software

- In the case of a standalone innovation, a prototype will be required to complete/pass this course. Use of machine shop/3D printer is suggested when available. Otherwise, paper and cardboard prototypes will also be acceptable.
- In the case of a solution to a specific design problem, or design modification, a demonstrable prototype in any of the forms described above will be required as a proof of concept.

Recommended Texts (Optional, use as References)

- *TRIZ. Theory of Inventive Problems* by Wladimir Petrov
- *ABC TRIZ* by Michael E. Orloff

Grading

This course will be graded based on the following criteria:

Assessment Type	Description	% of Final Grade
Project Throughout	A project assignment focused on the application of TRIZ principles, tools and methodologies to solve a complex, real-world problem. Deep understanding of the material covered in the course needs to be demonstrated. Phase 1: Problem Definition and Analysis (10 %) Deliverables: Clear problem statement, ID of elements and functions, functional analysis, ID of stumbling blocks. Phase 2: System Conflict ID and Resolution (20%) Deliverables: List of system conflicts, contradiction matrix with a few entries per conflict, proposed resolutions Phase 3: Ideality Analysis Deliverables: Final solution proposal and analysis of ideality Phase 4: Application of TRIZ Laws of Tech Evolution (20%) Deliverables: Analysis of current state of evolution of proposed solution and prediction/recommendations on where it goes. Phase 5: Implementation Plan and Final Report Deliverables: Plan, report, and 15' presentation	40%
Quizzes Monthly	Quiz 1: Introduction, product development, and basic tools Quiz 2: System contradictions and problem solving (40 principles) Quiz 3: Advanced tools and system evolution	30%
Homework assignments Bi-weekly	HW 1: (ME) bicycle drivetrain, engine efficiency, mechanical watch, hydraulic leak, wind turbine HW 2: (CE) bridge, taller building, sewage system, road construction project, evolution of skyscrapers HW 3: (ChemE) distillation column, chemical reactor temperature, water purification, use of by products, catalysts, oil refinery HW 4: (IE) assembly line, production increase, packaging machine, slow operation, 3D printing, inventory HW 5: (EE) smartphone battery, heat generation in circuit, solar panel, semiconductors, power grid HW 6: (AAE) jet engine, aircraft weight, satellite, vibration during launch, evolution of aircraft wings	30%

Grading Scale

Your course grade will be based on the following grading scale:

This class is graded according to a set curve. I am interested in seeing that you demonstrate what you have learned through your project and class participation. Final grades will be distributed through an assessment among students based on the assignments outlined above. According to these points, the following grades will be distributed as follows:

- A: Demonstrates good mastery of the material in the course
- B: Demonstrates strong ability to apply the material with a few small gaps
- C: Demonstrates very little ability to apply the course material
- D: Demonstrates very low ability to apply the course material and does not meet course requirements.
- F: Demonstrates unsatisfactory ability to apply the course material and does not meet course requirements.

Estimated Effort

- 10 hours/week

Course Content and Activities

Section	Module	Assmt.
1 – Course Introduction	1. Overview of TRIZ and its origins	HW1
	2. Key concepts: system conflicts, contradictions, and innovation	PH1
	3. Introduction to TRIZ terminology and philosophy	
2 – Resolving System Conflicts	4. Types of engineering contradictions (technical vs. physical)	HW2
	5. Contradiction matrix and inventive principles	Q1
	6. Practical examples of contradiction resolution	PH2
3 – Substances and Fields. The Object-Tool-Energy Triad	7. Defining and modeling substance-field (Su-Field) systems	HW3
	8. Identifying and resolving deficiencies in Su-Field models	PH3
	9. Standards in typical field transformations	
4 – Inventive Problem Solving (ARIZ)	10. Introduction to ARIZ: Structure and purpose	HW4
	11. Step-by-step walkthrough of ARIZ	Q2
	12. Strategies for breaking down complex problems using ARIZ	PH4
5 – Laws of Technological System Evolution (LTSE)	13. Overview of LTSE and their relevance to innovation	HW5
	14. Identifying evolutionary potential in technological systems	Q3
	15. Applications of LTSE in forecasting and design	
6 – Guiding Technology Evolution	16. Strategic use of LTSE to guide innovation	HW6
	17. Linking system evolution to market and functional needs	PH5
	18. Combining TRIZ with other innovation methods (e.g., QFD, DFMA)	

Course Help

To get help with course content, comment in the Brightspace *Questions and Answers* discussion forum. By commenting in this discussion forum, the course team will be able to respond to your question more quickly.

To get help with course content, contact your course team using one of the following methods:

1. Check the discussion forum to see if your question has already been answered.
2. Comment in the discussion forums. By commenting in these discussion forums, the course team will be able to respond to your question more quickly.
3. Email the instructor for your question. The instructor will try to respond to your email within 48 hours.

NOTE: When emailing the instructor, please start your subject line with "[ME XXX]" and the topic (e.g., "ME XXX Assignment 2 Question").

Discussion Guidelines

Please follow the Discussion Guidelines when contributing to discussions in this course. Here are a few of the key points you should remember:

- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular or slang language. This could possibly lead to misinterpretation.
- Do not hesitate to ask for feedback.
- Be concise and to the point.
- Think and edit before you push the "Send" button.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under *University Policies*.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available in our course Brightspace under *University Policies*.

The Purdue Honor Pledge

"As a Boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."

Accessibility Support

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

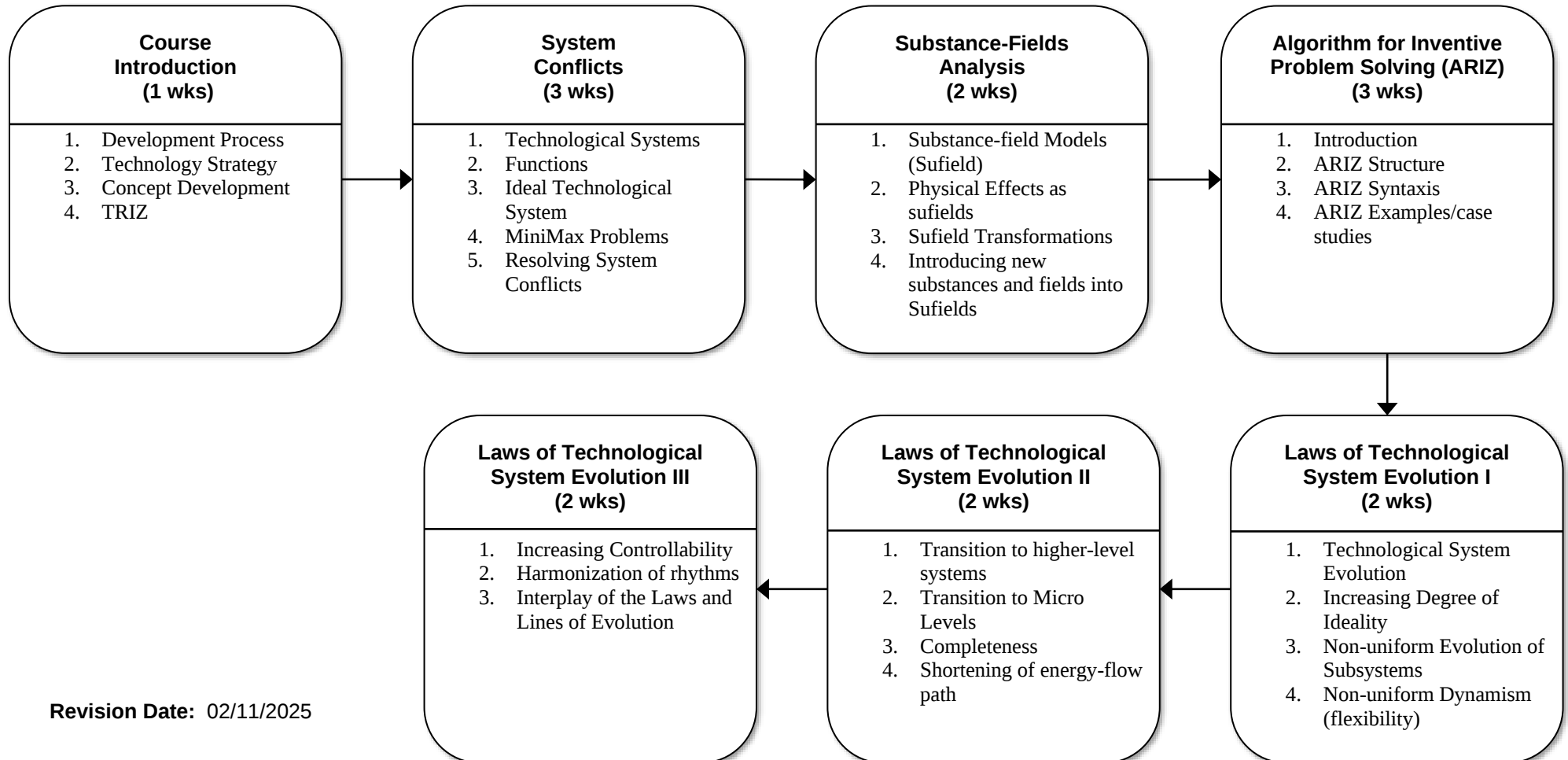
Disclaimer

This syllabus is subject to change.

ME _5XX____
MECHANICS INNOVATION USING TRIZ

Course Outcomes

1. Understand the fundamental concepts and philosophy of the TRIZ method.
2. Analyze and resolve design contradictions using systematic approaches.
3. Apply inventive principles and patterns of evolution to mechanical innovation/design challenges.
4. Develop function models and identify root causes of design issues.
5. Use TRIZ tools to create innovative, efficient, and cost-effective mechanics solutions.



COURSE NUMBER: ME _5XX_____		COURSE TITLE: Mechanics Innovation using TRIZ	
REQUIRED COURSE OR ELECTIVE COURSE: Elective		TERMS OFFERED:	
TEXTBOOK/REQUIRED MATERIAL: <i>Innovation on Demand. New Product Development Using TRIZ by Victor Fey & Eugene Rivin</i>		PRE-REQUISITES: Engineering drawing, basic notions of modeling and design in engineering	
COORDINATING FACULTY: S.J. Dyke		COURSE OUTCOMES:	
COURSE DESCRIPTION: Introduction to the principles and practical applications of the TRIZ (Theory of Inventive Problem Solving) method for innovation in mechanics. TRIZ provides a systematic approach to innovation and problem-solving by analyzing patterns of invention and identifying solutions to engineering challenges. Topics cover knowledge and application of TRIZ tools and techniques to generate creative solutions, improve product functionality, and resolve design conflicts in mechanical systems. CAD simulation is expected.		1. Understand the fundamental concepts and philosophy of the TRIZ method. 2. Analyze and resolve design contradictions using systematic approaches. 3. Apply inventive principles and patterns of evolution to mechanical design challenges. 4. Develop function models and identify root causes of design issues. 5. Use TRIZ tools to create innovative, efficient, and cost-effective mechanical solutions.	
ASSESSMENTS TOOLS: 1. Five to six homework assignments. 2. Three concept/short problem quizzes. 3. One individual/group project with CAD/prototype implementation.		RELATED ME PROGRAM OUTCOMES: N/A	
PROFESSIONAL COMPONENT: 1. Engineering Topics: Engineering Science – 3 credits (100%)			
NATURE OF DESIGN CONTENT: N/A			
COMPUTER USAGE: SolidWorks, AutoCAD or similar software.			
COURSE STRUCTURE/SCHEDULE: 1. Lecture – 2 days per week at 75 minutes.			
PREPARED BY: Shirley J. Dyke, Christian E. Silva		REVISION DATE: Feb 11, 2025	