



CURRICULUM PROPOSAL FORM 1999-2000

**NON-GENERAL EDUCATION PROCESS A**

\*DEADLINES: Deadline dates for 1999/2000 submissions: Regular proposals: October 22, 1999 to be implemented in Fall 2000; Short-Term proposals: December 10, 1999 to be implemented in Fall, 2000; Regular proposals February 18, 2000 to be implemented in Spring 2001; March 24, 2000 for short-term courses to be implemented in Spring 2001

PROPOSAL TITLE: Advanced Dynamics (0910.553)

SPONSOR(S): Jennifer Kadlowec

DEPARTMENT: Mechanical Engineering

COLLEGE: Engineering

IF LAS CHECK ONE:  History/Humanities  Math/Science  Social/Behavioral Sciences

Check one:  Undergraduate  Graduate

THE ATTACHED **NON-GEN-ED** PROPOSAL IS BEST DESCRIBED BY THE ITEM(S) CHECKED.

New non-gen-ed course

Short-term non-gen-ed course

Minor curricular changes (fewer than three) to:

existing non-gen-ed course

non-gen-ed degree requirements

major

minor, specialization, concentration, track certificate program

DEPARTMENT

(Signature indicates approval) Ravi Kish Rameshchandra 2/24/00

Dept. Curriculum Chair/Date

T.R. Chandrasekhar 2/24/2000

Dept. Chairperson/Date

ACADEMIC DEAN

Approved  Not Approved  Comments:

Dean's Signature/Date J. P. [Signature] 2/24/00

**COLLEGE CURRICULUM COMMITTEE**

Date of open hearing (if necessary) 3/20/01 Approved  Not Approved

Comments:

Signature of College Chair/Date: [Signature] 6/15/01

**UNIVERSITY CURRICULUM COMMITTEE**

Date Received/Processed 6/04/01

Comments:

Curriculum Chair Signature: [Signature] Date Announced At Senate 6/04/01

**EXECUTIVE VICE PRESIDENT/PROVOST**

Approved  Not Approved  If no, reasons are as follows:

Student Credit Hours: \_\_\_\_\_ Faculty Load Hours: \_\_\_\_\_ Equalized Credit Hours: \_\_\_\_\_

Official Copy & Approval Sheet Filed (Date): \_\_\_\_\_ Executive VP/Provost Signature/Date: [Signature] 6/15/01

**REGISTRAR**

Date Approved Course Description Required \_\_\_\_\_

Hegis Taxonomy & Course Number Assigned \_\_\_\_\_

Registrar Signature/Date: [Signature] 6/26/01

**NOTIFICATION FORWARD**

<input checked="" type="checkbox"/> Senate Curriculum Committee Chairperson	<input checked="" type="checkbox"/> Academic Dean(s)	<u>8/22/01</u>
<input checked="" type="checkbox"/> Department Chairpersons	<input checked="" type="checkbox"/> Registrar	<u>Sponsor(s)</u>

## Course Proposal

### 1. Details:

- a) **Course Title:** Advanced Dynamics (0910.553)  
b) **Sponsor:** Dr. Jennifer Kadlowec and College of Engineering Curriculum Committee  
c) **Credit Hours:** 3 credit hours  
d) **Course Level:** Graduate  
e) **Curricular Effect:** Elective course for graduate level mechanical engineering students  
f) **Prerequisites:** Engineering Analysis II or equivalent, dynamics, vibrations  
g) **Suggested Time/Scale of Implementation** Fall or spring semesters  
One section  
h) **Resources:** Faculty: Existing faculty is in place to teach this course  
Library: No library acquisitions will be required  
Equipment: No laboratory equipment will be required  
Computers: Computer laboratory access will be required and additional software may be acquired.

### 2. Rationale:

The proposed course is an additional engineering elective that would supplement the Engineering Curriculum Proposal approved by the College Senate in December 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February 1995.

This course is an important elective for students who want to focus on mechanical systems. Analytical dynamics introduces students to the concept of 3-D particle and rigid body dynamics and its applications in mechanical engineering. Analytical dynamics develops the foundation for the study of rigid body dynamic and vibration systems. This course requires students to be knowledgeable in physics, mathematics and mechanics and is an extension of undergraduate coursework in this area.

### 3. Essence of the Course:

#### a) Objectives:

Upon completion of the course, the students will be able to

1. Formulate and solve problems involving the kinematics and dynamics of particles in two and three dimensions.
2. Formulate and solve problems using general vectorial development for dynamics of single particles and systems of particles.

3. Use Lagrange's equations to formulate the equations of motion for particles and rigid bodies.
4. Formulate and solve problems of three-dimensional rotational dynamics of one or more rigid bodies.
5. Apply computer software to solve differential equations of motion for three dimensional dynamics/vibrations problems.
6. Use the course material in a project to computational solve nonlinear equations of motion and to use commercial multibody dynamics software.

**b) Topical Outline:**

The topics to be covered are listed below. The instructor will supply the students with a syllabus during the first week of classes. The instructor will assess any technology advances in the subject matter prior to the course and make topic changes deemed to be appropriate to maintain the level and currency of instruction.

Kinematics of a particle

- Position, velocity and acceleration (linear and angular)
- Rigid body motion about a fixed point
- Motion in a moving/rotating coordinate system

Dynamics of a particle and system of particles

- Work and energy
- Conservative forces
- Linear impulse and momentum
- Angular impulse and momentum

Lagrange's equations

- Degrees of freedom
- Generalized coordinates
- Generalized forces
- Constraints
- Virtual work
- Lagrange multipliers

Kinematics and dynamics of rigid body motion

- Degrees of freedom
- Moments of inertia
- Matrix and dyadic notation
- Translation and rotation of axes
- Euler angles

Equations of motion  
D'Alembert's principle

Vibration theory  
One and two degree of freedom systems  
Free and forced vibrations

Advanced topics  
Kane's equations  
Computational techniques for solving nonlinear equations of motion

**c) Evaluation and Grading Procedure of Students:**

Student grades will be determined on the basis of examinations, homework and/or projects, computer projects and reports. A course syllabus with stated method of arriving at the final grade, e.g., number of exams, projects, homework, percentage of grade, will be distributed to the students during the first week of classes.

**d) Course Evaluation:**

The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty.

**4. Results of Consultations:**

The proposed course is an additional elective that would supplement the Engineering Curriculum Proposal approved by the Faculty Senate in December 1994. Consultations with Dr. Guerra in the Chemistry/Physics department indicates that this course would complement Classical Mechanics in the sense that this course will focus heavily on 3-D rigid body dynamics rather than particle dynamics.

**Catalog Description:****Analytical Dynamics** (0910.553)

Prerequisites: Engineering Analysis II or equivalent, Dynamics, Vibrations

This course is an advanced introduction to three-dimensional motion of particles and rigid bodies. Students study modern analytical rigid body dynamics equation formulation and computational solution techniques applied to mechanical systems and multibody systems. Students will formulate Newton/Euler and Lagrangian equations for applications to engineering systems, use Hamiltonian's principle, study kinematics of motion using generalized coordinates, speeds and forces, determine inertia properties and perform computational simulations.