Submit originals and one copy and electronic copy to Governance/Faculty Senate Office. See http://www.uaf.edu/uafgov/faculty/cd for a complete description of the rules governing curriculum & course changes.

### Change Course (Major) and Drop Course Proposal

#### Submitted By:
- **Department**: Mechanical Engineering
- **College/School**: College of Engineering and Mines
- **Prepared by**: Sarah Hall
- **Phone**: x7136
- **Email Contact**: fymech@uaf.edu
- **Faculty Contact**: Dr. Chuen-Sen Lin

#### 1. Course Identification:
- **Dept**: ME
- **Course #**: F602
- **No. of Credits**: 3.0

#### 2. Action Desired:
- **Change Course**: X
- **If Change, indicate below what change**: 
- **Drop Course**: []

#### 3. Course Format

**Note**: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school’s curriculum council. Furthermore, any core course compressed to less than six weeks must be approved by the core review committee.

**Course Format**:
- (check one)
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6 weeks to full semester

**Other Format** (specify):
- Mode of delivery (specify lecture, field trips, labs, etc)
- lecture

#### 4. Course Classifications

(undergraduate courses only. Use approved criteria found on page 10 & 17 of the manual. If justification is needed, attach on separate sheet.)

**H = Humanities**

<table>
<thead>
<tr>
<th>N = Natural Science</th>
<th>S = Social Sciences</th>
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<tbody>
<tr>
<td>Yes</td>
<td>X</td>
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</table>

**Will this course be used to fulfill a requirement for the baccalaureate core?**
- Yes X No

**If Yes, check which core requirements it could be used to fulfill:**
- 0 = Oral Intensive, Format 6
- W = Writing Intensive, Format 7
- Natural Science, Format 8

#### 5. Course Repeatability

**Is this course repeatable for credit?**
- Yes X No

**Justification**: Indicate why the course can be repeated (for example, the course follows a different theme each time).

**How many times may the course be repeated for credit?**

---

**COURSE TITLE**: Advanced Mechanical System Design

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>TITLE</th>
<th>DESCRIPTION</th>
<th>CREDITS (Including credit distribution)</th>
</tr>
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<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>CROSS-LISTED</th>
<th>Dept.</th>
<th>(Requires approval of both departments and deans involved. Add lines at end of form for such signatures.)</th>
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<table>
<thead>
<tr>
<th>STACKED (400/600)</th>
<th>Dept.</th>
<th>Course #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ME</td>
<td>402/602</td>
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</table>

**Other (please)**: Course contents
If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course?

6. CURRENT CATALOG DESCRIPTION AS IT APPEARS IN THE CATALOG: including dept., number, title and credits

ME F602 Advanced Mechanical System Design
3 Credits
Advanced synthesis and analysis of two- and three-dimensional multi-body mechanical systems of rigid and elastic elements. Floating frame of reference formulation. Finite element formulation. Large deformation problems and computer-aided applications. Special fees apply. Prerequisites: ME F302; ME F408; or permission of instructor. (3+0)

7. COMPLETE CATALOG DESCRIPTION AS IT WILL APPEAR WITH THESE CHANGES: (Underline new wording strike through old wording and use complete catalog format including dept., number, title, credits and cross-listed and stacked.) PLEASE SUBMIT NEW COURSE SYLLABUS. For stacked courses the syllabus must clearly indicate differences in required work and evaluation for students at different levels.

ME F402/F602 Advanced Mechanical System Design
3 Credits
Advanced synthesis and analysis of two- and three-dimensional multi-body mechanical systems of rigid and elastic elements. Rigid body system formulation and deformable body system formulation. Floating frame of reference formulation. Finite element formulation. Large deformation problems and computer-aided applications. Application of CAE software for rigid body and large deformable body systems. Special fees apply. Prerequisites: ME F302; ME F408; or permission of instructor. (3+0)

8. IS THIS COURSE CURRENTLY CROSS-LISTED?

YES/NO
N
O

(Requires written notification of each department and dean involved. Attach a copy of written notification.)

9. GRADING SYSTEM:

LETTER: X
PASS/FAIL: 

10. ESTIMATED IMPACT

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

N/A

11. LIBRARY COLLECTIONS

Have you contacted the library collection development officer (ffklj@uaf.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.
12. IMPACTS ON PROGRAMS/DEPTS:
What programs/departments will be affected by this proposed action?
Include information on the Programs/Departments contacted (e.g., email, memo)

Mechanical Engineering only

13. POSITIVE AND NEGATIVE IMPACTS
Please specify positive and negative impacts on other courses, programs and departments resulting from the proposed action.

N/A

JUSTIFICATION FOR ACTION REQUESTED
The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. If you ask for a change in # of credits, explain why; are you increasing the amount of material covered in the course? If you drop a prerequisite, is it because the material is covered elsewhere? If course is changing to stacked (400/600), explain higher level of effort and performance required on part of students earning graduate credit. Use as much space as needed to fully justify the proposed change and explain what has been done to ensure that the quality of the course is not compromised as a result.

1. The job market has shown an increasing need of graduates with Computer Aided Engineering backgrounds.
2. Part of the course materials is appropriate for undergraduate students with a good background in dynamics of machinery and vibrations.
3. The textbook selected for this course was originally developed for two one-year graduate courses. The course content after modification covers enough materials for a first graduate course.
4. The addition of CAE software teaching helps students to better understand the physical meaning of the teaching materials and learn more about multi-body system modeling and simulation.

APPROVALS:

[Signatures and dates]

Signature, Chair, Program/Department of: Mechanical Engineering

Signature, Chair, College/School Curriculum Council for:

Signature, Dean, College/School of:

Signature of Provost (if applicable)

Offerings above the level of approved programs must be approved in advance by the Provost.
**ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE.**

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<thead>
<tr>
<th>Signature, Chair, UAF Faculty Senate Curriculum Review Committee</th>
<th>Date</th>
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</thead>
</table>

**ADDITIONAL SIGNATURES: (If required)**

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<th>Signature, Chair, Program/Department of:</th>
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<table>
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<tr>
<th>Signature, Dean, College/School</th>
<th>Date</th>
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</thead>
</table>
ATTACH COMPLETE SYLLABUS (as part of this application).
Note: syllabus must follow the guidelines discussed in the Faculty Senate Guide
http://www.uaf.edu/uafgov/faculty/cd/syllabus.html.

The department and campus wide curriculum committees will review the syllabus to
ensure that each of the items listed below are included. If items are missing or
unclear, the proposed course change will be denied.

SYLLABUS CHECKLIST FOR ALL UAF COURSES
During the first week of class, instructors will distribute a course syllabus.
Although modifications may be made throughout the semester, this document will
contain the following information (as applicable to the discipline):

1. Course information:
   - Title, number, credits, prerequisites, location, meeting time
     (make sure that contact hours are in line with credits).

2. Instructor (and if applicable, Teaching Assistant) information:
   - Name, office location, office hours, telephone, email
     address.

3. Course readings/materials:
   - Course textbook title, author, edition/publisher.
   - Supplementary readings (indicate whether required or recommended)
   - any supplies required.

4. Course description:
   - Content of the course and how it fits into the broader curriculum;
   - Expected proficiencies required to undertake the course, if applicable.
   - Inclusion of catalog description is strongly recommended, and
   - Description in syllabus must be consistent with catalog course
description.

5. Course Goals (general) and Student Learning Outcomes (more specific)

6. Instructional methods:
   - Describe the teaching techniques (e.g.: lecture, case study, small group
discussion, private instruction, studio instruction, values clarification,
games, journal writing, use of Blackboard, audio/video conferencing, etc.).

7. Course calendar:
   - A schedule of class topics and assignments must be included. Be specific
     so that it is clear that the instructor has thought this through and will
     not be making it up on the fly (e.g. it is not adequate to say “lab”.
     Instead, give each lab a title that describes its content). You may call
     the outline Tentative or Work in Progress to allow for modifications during
     the semester.

8. Course policies:
   - Specify course rules, including your policies on attendance, tardiness,
class participation, make-up exams, and plagiarism/academic integrity.

9. Evaluation:
   - Specify how students will be evaluated, what factors will be
     included, their relative value, and
   - how they will be tabulated into grades (on a curve, absolute scores,
etc.)

10. Support Services:
    - Describe the student support services such as tutoring (local and/or
        regional) appropriate for the course.

11. Disabilities Services:
    The Office of Disability Services implements the Americans with Disabilities
    Act (ADA), and insures that UAF students have equal access to the campus and
course materials.
    - State that you will work with the Office of Disabilities Services (203
      WHIT, 474-7043) to provide reasonable accommodation to students with
      disabilities.”
Advanced Mechanical Systems Design

Instructor: Dr. Chuen-Sen Lin
Office: Duckering 333
Telephone: 474-5126
E-mail: ffcl@uaf.edu
Office hours: MF 12:00-1:00

Class Schedule:

Catalog description
Advanced analysis of two- and three-dimensional multi-body mechanical systems. Rigid body system formulation and deformable body system formulation. Application of CAE software for rigid body and large deformable body systems. Special fees apply. Prerequisites: ME F302; ME F408; or permission of instructor. (3+0)

Prerequisites: ME302 and ME408 or consent of the instructor

Disabilities Services:
The instructor will work with the Office of Disabilities Services (WHIT203, 474-7043) to provide reasonable accommodation to students with disabilities.

Textbook
"Dynamics of Multibody Systems,” Ahmed A. Shabana, Cambridge.

Supplementary readings:
Virtual.Lab Motion Tutorial Manual (Required)

References

Grading Policy

Homework (30%)
Project (40%)

One design and/or simulation project related to multibody dynamic systems. Graduate students are required to work on deformable multi-body system projects, which need knowledge in rigid body dynamics and continuum mechanics and/or FEM.
Undergraduate students are required to work on rigid multi-body system projects, which need knowledge in rigid body dynamics.

**Report (30%)**
- Project definition, solution details, verification, others

**Presentation (10%)**
- Organization, preparation, visual aids, prototype or computer animation (if needed), appearance

**Final Exam (Final: 30%)**
- If you miss the final for a medical or other legitimate reason, you must present a medical report or a legal document for justification. Otherwise a zero grade would be assigned to the final.

### Week 1
**Topic**
1. *Introduction*
   - Multibody systems, reference frames, particle mechanics, rigid body mechanics, deformable bodies, constrained motion, computer formulation and coordinate selection.
   - Introduction Virtual.Lab.

### Week 2-4
**Reference Kinematics**
- Rotation matrix, properties of the rotation matrix, successive rotations, velocity equations, accelerations and important identities, Rodriguez parameters, direction cosines, homogeneous transformation, relationships between different coordinate systems. Lab 1 to 6 (Virtual.Lab).

### Week 5-9
**Analytical Techniques**
- Generalized coordinates and kinematic constraints, degrees of freedom and generalized coordinate partitioning, virtual work and generalized forces, Lagrangian dynamics, applications to rigid body dynamics, Calculus of variations, Euler’s equation of several variables, equations of motion of rigid body systems, Newton-Euler equations. Vehicle dynamics example: Handling analysis for a simple vehicle.
  - Lab 7 to 11 (Virtual.Lab).

### Week 10-13
**Mechanics of Deformable Body**
- Kinematics of deformable bodies, strain components, physical interpretation of strains, rigid body motion, stress components, equations of equilibrium, constitutive equations, virtual work of the elastic forces. Lab 12 to 13 and Flexible Body Lab (Virtual.Lab).

### Week 14-15
**Project Discussion and Presentation**

### Course Objectives
To learn general methodology of the nonlinear dynamic analysis of multi-body systems and to implement multi-body dynamics on the high-speed digital computer.

To fulfill the ABET outcomes in (a) an ability to apply knowledge of mathematics, science, and engineering, (c) an ability to identify, formulate, and solve engineering problems, (g) an ability to communicate effectively, and (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practices.