Proposal Form For Addition And Revision Of Courses

1. Proposing College / School: Samuel Ginn College of Engineering
   Department: Mechanical Engineering

2. Course Prefix and Number: MECH 4430

3. Effective Term: 12F

4. Course Title: Ground Vehicle Fundamentals
   Abbreviated Title (30 characters or less): Ground Vehicle Fundamentals

5. Requested Action:
   - [ ] Renumber a Course
   - [ ] Add a Course
   - [ ] Revise a Course

6. Course Credit:
   - Contact/Group Hours
   - Scheduled Type (e.g.: Lab, Lecture, Practicum, Directed Study)
   - Weekly or Per Term?
   - Credit Hours
   - Anticipated Enrollment

   Maximum Hours (Repeatability): 3

<table>
<thead>
<tr>
<th>Contact/Group Hours</th>
<th>Scheduled Type</th>
<th>Weekly or Per Term?</th>
<th>Credit Hours</th>
<th>Anticipated Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lecture</td>
<td>weekly</td>
<td>3</td>
<td>25</td>
</tr>
</tbody>
</table>

   Total Credit Hours: 3

7. Grading Type:
   - [ ] Regular (ABCDF)
   - [ ] Satisfactory/Unsatisfactory (S/U)
   - [ ] Audit

8. Prerequisites/Corequisites:
   Use “P:” to indicate a prerequisite, “C:” to indicate a corequisite, and “P/C:” to indicate a prerequisite with concurrency.
   P: ENGR 2100 or ENGR 2350 or MECH 2120

9. Restrictions: List specific restriction in space above.
   - [ ] College
   - [ ] Major
   - [ ] Standing
   - [ ] Degree

10. Course Description:
    (20 Words or Less: exactly as it should appear in the Bulletin)
    Engineering fundamentals of ground vehicles and typical subsystems, including: power (engine and electrical); drivetrain; braking, steering; suspension; ergonomics; and structure.

11. May Count Either: [ ] or [ ]
    (Indicate if this particular course cannot be counted for credit in addition to another)

12. Affected Program(s):
    (Respond “N/A” if not included in any program; attach memorandum if more space is required)

<table>
<thead>
<tr>
<th>Program Type</th>
<th>Program Title</th>
<th>Requirement or Elective?</th>
</tr>
</thead>
<tbody>
<tr>
<td>major</td>
<td>Bachelor of Mechanical Engineering</td>
<td>elective</td>
</tr>
<tr>
<td>minor</td>
<td>Automotive Engineering &amp; Manufacturing</td>
<td>required</td>
</tr>
</tbody>
</table>

13. Overlapping or Duplication of Other Units' Offerings:
    (If course is included in any other degree program, is used as an elective frequently by other unit(s), or is in an area similar to that covered by another college/school, attach correspondence with relevant unit)
   - [ ] Applicable
   - [ ] Not Applicable
14. Justification:

The previous version of MECH 4430 was called “Vehicle Design”. It was a project-based course in ground vehicle systems engineering, with some emphasis on structures. In order to achieve its outcome of a competent whole vehicle design, it required Mechanics of Materials as a prerequisite (to enable structural design) – a course usually taken late in the curriculum. Teaching experience showed that 4430 also required familiarity with automotive component domain knowledge, as an effective prerequisite, in order to produce a competent design project outcome.

Teaching experience shows that the students in 4430 are of two types:
1. Members of SAE student competitions teams (Formula SAE, Baja SAE), focusing on dedicated automotive studies.
2. General engineering population students.

These types are highly disparate. Setting 4430 at a level sufficiently fundamental to avoid going over the heads of the Type 2 students results in boring the Type 1 students. Setting the level to be sufficiently informative to the Type 1 students results in losing the Type 2 students. Students in the Automotive Engineering and Manufacturing Minor who are not on SAE competition teams tend to act more like Type 2 students than Type 1 students.

The solution proposed for serving these two types of student within one course is to drop the level from systems engineering to component engineering. By focusing on components (and their system-significant outcomes), the course fills a gap observed to be common to Type 2 students. An automotive component course can be valuable to the Type 1 students as well if they take it early enough in their academic careers that their competition team project work has not already given them a sort of street-level automotive component domain knowledge (which can be hard to overcome). This means that the Mechanics of Materials prerequisite must be relaxed to a lower level (i.e., earlier in the curriculum) subject such as Engineering Dynamics. This means that the course must de-emphasize design of the structure in favor of other automotive components.

The course content outline for the proposed version of 4430 (item 17 below) appears very similar to the content of the previous version. The difference is a matter of emphasis and focus. Some examples are as follows:

**Drivetrain**-
1. The previous version of the course addressed automotive differentials on a systems level, connecting vehicle handling requirements like yaw rate to component performance attributes like torque bias ratio. And then a few examples of different types of differentials were illustrated.
2. The proposed version of the course will address automotive differentials on a component level, proposing a geometry for an example differential, and developing techniques for deriving the torque bias ratio for that example.

**Suspension**-
1. The previous version of the course addressed suspension damping by connecting heave response to the effective damping coefficient.
2. The proposed version of the course will address design of the internals of an automotive damper (shock absorber) to achieve a desired damping coefficient function.

**Steering**-
1. The previous version of the course addressed steering by the relation of steering angle to vehicle path. And then a few examples of different steering components and their characteristics were illustrated.
2. The proposed version of the course will study the arrangement of the steering linkages and gearbox (rack) to determine Ackermann and steering
effort as functions of gearbox and linkage placement and design.

Structure:
1. The previous version of the course encouraged students to find and employ their own methodology for calculating the torsional rigidity of an automotive chassis of their own design (part of a major design project).
2. The proposed version of the course will conduct exercises in torsional rigidity calculation using packaged software and a defined geometry. Overall, the emphasis of the course will change from encouragement of discovery in pursuit of an open-ended class design project to defined exercises in automotive engineering – shifting from freestyle to school figures.

This is not to say that there is not great value in teaching a systems engineering approach to design of ground vehicles – quite the contrary. But after several years of teaching experience, the conclusion has been reached that the lessons of ground vehicle systems engineering fail to take root without sufficient engineering understanding of the underlying components. The current (and to date, only) instructor of this course firmly believes that SAE team students will benefit more from an earlier (in the curriculum) automotive component course, and that Minor students and general students will benefit more from such an automotive component course, than either student type can from a late-curriculum course in automotive systems design. This conclusion might not have obtained with the typical students of a generation or two ago. But it does now. Education in systems engineering for ground vehicles is more reliably left to the senior project courses, MECH 4440 and 4450, for which 4430 is a prerequisite.

As to the effect on the Minor, this should be most beneficial. The previous version of 4430 has gained a reputation for difficulty and obtuseness, principally because it has open-ended outcomes, and speaks a language (automotive engineering components) which most students do not know. The proposed content revision should make it much more practical for general students to find meaning in the course.

15. Resources:

No additional resources required

(Indicate whether existing resources such as library materials, classroom/laboratory space, and faculty appointments are adequate to support the proposed addition/revision; if additional resources are required, indicate how such needs will be met, referencing the appropriate level of authorization – i.e.: Dean – where necessary; if no additional resources or shifting of resources will be necessary, respond “Not Applicable”)

16. Student Learning Outcomes:

1. Quantify the relation of typical ground vehicle system configurations to system performance, to a level sufficient for ground vehicle preliminary design.
2. Integrate ground vehicle system configurations into an overall vehicle configuration and estimate several types of performance metric to a level sufficient for preliminary design.

(State in measurable terms (reflective of course level) what students should be able to do when they have completed this course)

17. Course Content Outline:

Week 1: Internal combustion powerplants
Week 2: Combustible fuel systems
Week 3: Heat rejection
Week 4: Electric powerplants
Week 5: Battery systems
Week 6: Transmission & Driveline
Week 7: Braking systems
Week 8: Aerodynamics
Week 9: Ground wheel performance
Week 10: Steering systems  
Week 11: Suspension systems  
Week 12: Wheelset design  
Week 13: Ergonomics  
Week 14: Structure  
Week 15: Mass Properties

(Provide a comprehensive, week-by-week breakdown of course content, including assignment due dates)

18. Assignments / Projects:

<table>
<thead>
<tr>
<th>Homework: weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm exams: 1</td>
</tr>
<tr>
<td>Final Exam</td>
</tr>
</tbody>
</table>

(List all quizzes, projects, reports, activities and other components of the course grade -- including a brief description of each assignment that clarifies its contribution to the course's learning objectives)

19. Rubric and Grading Scale:

<table>
<thead>
<tr>
<th>Homework - 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm - 25%</td>
</tr>
<tr>
<td>Final - 50%</td>
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<tr>
<td>90% to 100% - A</td>
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<tr>
<td>80% to 90% - B</td>
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<tr>
<td>70% to 80% - C</td>
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<tr>
<td>60% to 70% - D</td>
</tr>
<tr>
<td>Below 60% - F</td>
</tr>
</tbody>
</table>

(List all components of the course grade -- including attendance and/or participation if relevant -- with point totals for each; indicate point totals and ranges or percentages for grading scale; for S/U grading, detail performance expectations for a passing grade)

20. Justification for Graduate Credit:  

| N/A |

(Include a brief statement explaining how the course meets graduate educational standards (i.e.: rigorous standards for evaluation, development of critical thinking and analytical skills, etc.))

(Included below are standard statements regarding course policies. If necessary, a statement may be altered to reflect the academic policies of individual faculty members and/or the academic unit or department, provided that there is no conflict with the Tiger Cub, Faculty Handbook, or any existing university policy.)

POLICY STATEMENTS

Attendance: Although attendance is not required, students are expected to attend all classes, and will be held responsible for any content covered in the event of an absence.

Excused Absences: Students are granted excused absences from class for the following reasons: illness of the student or serious illness of a member of the student's immediate family, the death of a member of the student's immediate family, trips for student organizations sponsored by an academic unit, trips for university classes, trips for participation in intercollegiate athletic events, subpoena for a court appearance, and religious holidays. Students who wish to have an excused absence from class for any other reason must contact the instructor in advance of the absence to request permission. The instructor will weigh the merits of the request, and render a decision. When feasible, the student must notify the instructor prior to the occurrence of any excused absences, but in no case shall such notification occur more than one week after the absence. Appropriate documentation for all excused absences is required. Please see the Tiger Cub for more information on excused absences.

Make-Up Policy: Arrangement to make up a missed major examination (e.g.: hour exams, mid-term exams) due to properly authorized excused absences must be initiated by the student within one week of the end of the period of the excused absence(s). Except in unusual circumstances, such as the continued absence of the student or the advent of university holidays, a make-up exam will take place within two weeks of the date that the student notifies the instructor of its intention to make up the exam. Except in extraordinary circumstances, no make-up exams will be arranged during the last three days before the final exam period begins.

Academic Honesty Policy: All portions of the Auburn University student academic honesty code (Title XII) found in the Tiger Cub will apply to university courses. All academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Disability Accommodations: Students who need special accommodations in class, as provided for by the Americans With Disabilities Act, should arrange for a confidential meeting with the instructor during office hours (first week of classes, or as soon as possible if accommodations are needed immediately). The student must bring a copy of their Accommodation Letter and an Instructor Verification Form to the meeting. If the student does not have these forms, they should make an appointment with the Program for Students with Disabilities, 1288 Haley Center, 844-2096 (V/T).
<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department Chair / Head</td>
<td>Jeffrey C. Suhling</td>
<td></td>
</tr>
<tr>
<td>College / School Chair</td>
<td>Nels Madsen</td>
<td></td>
</tr>
<tr>
<td>College / School Dean</td>
<td>Nels Madsen</td>
<td></td>
</tr>
<tr>
<td>Dean of the Graduate School</td>
<td>(for Graduate Courses)</td>
<td></td>
</tr>
<tr>
<td>Assoc. Provost for Undergraduate Studies</td>
<td>(for Undergraduate Courses)</td>
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</tr>
</tbody>
</table>

**Contact Person:** Peter Jones  
**E-Mail Address:** jonesp1@auburn.edu  
**Telephone:** 4-3368  
**Fax:**
Course Number: MECH 4430
Semester: FALL, 2012
Course Title: Ground Vehicle Fundamentals
Credit Hours: 3 (LEC 3)
Prerequisites: ENGR 2100, or ENGR 2350, or MECH 2120

Lecture Schedule
TR 8:00 a.m.-9:15 p.m., 27 Lowder

Instructor
Dr. Peter D. Jones, Mechanical Engineering, Wiggins 3418G, (334) 844-3368, jonesp1@auburn.edu, Office Hours TR 9:30 a.m.-11:00 a.m.

Course Outcomes
1. Quantify the relation of typical ground vehicle system configurations to system performance, to a level sufficient for ground vehicle preliminary design.
2. Integrate ground vehicle system configurations into an overall vehicle configuration and estimate several types of performance metric to a level sufficient for preliminary design.

Website
http://www.eng.auburn.edu/~pjones/mech4430.htm
Note that this is NOT a Blackboard or Canvas site.

Textbook

Supplementary material will be posted to the course website.

Deliverables
Reading
Textbook readings are to be completed before the class in which they are discussed. The text is somewhat incomplete in many areas, and so supplemental material will be made available.

Homework
Homework exercises approximately weekly. Completed exercises are expected to be clean, complete, and professional in appearance.

Examinations
Midterm - 75 min. Closed book and notes, with the exception of one side of one 8½ x 11 inch sheet, any font or margins.

Final - 150 min. Comprehensive. Closed book and notes, with the exception of both sides of one 8½ x 11 inch sheet, any font or margins.
Grading Weights
Homework Exercises 25%
Midterm Examination 25%
Final Examination 50%
Total (max possible) 100%

Grading Scale
Total (achieved) Grade will be at least
90% A
80% B
70% C
60% D
50% F

Tentative Schedule
Readings are to be completed before class
Homework assignments are listed by due date

<table>
<thead>
<tr>
<th>Tuesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Aug</td>
<td></td>
</tr>
<tr>
<td>Subject: Introduction</td>
<td></td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.1</td>
<td></td>
</tr>
<tr>
<td>21 Aug</td>
<td>23 Aug</td>
</tr>
<tr>
<td>Subject: Internal combustion engines</td>
<td>Subject: Internal combustion engines</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.2 (ex §10)</td>
<td>Reading: Stone &amp; Ball Chap.3 (ex §2,7,8)</td>
</tr>
<tr>
<td>28 Aug</td>
<td>30 Aug</td>
</tr>
<tr>
<td>Subject: Internal combustion engines</td>
<td>Subject: Fuel systems</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.4 (ex §2,6)</td>
<td>Homework: Internal combustion engines</td>
</tr>
<tr>
<td>4 Sep</td>
<td>6 Sep</td>
</tr>
<tr>
<td>Subject: Heat rejection</td>
<td>Subject: Heat rejection</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.5 (ex §4,5)</td>
<td></td>
</tr>
<tr>
<td>11 Sep</td>
<td>13 Sep</td>
</tr>
<tr>
<td>Subject: Electric motors</td>
<td>Subject: Batteries</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.12</td>
<td>Homework: Heat Rejection</td>
</tr>
<tr>
<td>18 Sep</td>
<td>20 Sep</td>
</tr>
<tr>
<td>Subject: Power transmission</td>
<td>Subject: Mechanical driveline</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.6</td>
<td>Homework: Electrical propulsion</td>
</tr>
<tr>
<td>25 Sep</td>
<td>27 Sep</td>
</tr>
<tr>
<td>Subject: Aerodynamics</td>
<td>Subject: Midterm Examination</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.10,11</td>
<td></td>
</tr>
<tr>
<td>2 Oct</td>
<td>4 Oct</td>
</tr>
<tr>
<td>Subject: Braking systems</td>
<td>Subject: Braking systems</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.9 (ex §8)</td>
<td>Homework: Drivetrain</td>
</tr>
<tr>
<td>9 Oct</td>
<td>11 Oct</td>
</tr>
<tr>
<td>Subject: Tires</td>
<td>Subject: Tires</td>
</tr>
<tr>
<td>Reading: Stone &amp; Ball Chap.9 §8</td>
<td>Homework: Brakes</td>
</tr>
<tr>
<td>Date</td>
<td>Subject: Steering</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>16 Oct</td>
<td>Reading: Stone &amp; Ball Chap.7</td>
</tr>
<tr>
<td>23 Oct</td>
<td>Subject: Suspension</td>
</tr>
<tr>
<td></td>
<td>Reading: Stone &amp; Ball Chap.8</td>
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<tr>
<td>30 Oct</td>
<td>Subject: Wheelset design</td>
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<td></td>
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<tr>
<td>6 Nov</td>
<td>Subject: Ergonomics</td>
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<td></td>
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<tr>
<td>13 Nov</td>
<td>Subject: Structure</td>
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<td></td>
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<tr>
<td>27 Nov</td>
<td>Subject: Mass properties</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4 Dec</td>
<td>Final Examination (8:00 a.m. – 10:30 a.m.)</td>
</tr>
</tbody>
</table>

**Accessibility**

Students who need special accommodations in class, as provided for by the Americans With Disabilities Act, should arrange for a confidential meeting with the instructor during office hours in the first week of classes (or as soon as possible if accommodations are needed immediately). The student must bring a copy of their Accommodation Letter and an Instructor Verification Form to the meeting. If the student does not have these forms, they should make an appointment with the Office of Accessibility, 1288 Haley Center, 844-2096 (V/TT).

**Attendance**

Although attendance is not required, students are expected to attend all classes, and will be held responsible for any content covered in the event of an absence.

**Behavior**

Professional behavior is expected of all course participants.

**Contingency**

If normal class and/or lab activities are disrupted due to illness, emergency, or crisis situation, the syllabus and other course plans and assignments may be modified to allow completion of the course. If this occurs, an addendum to your syllabus and/or course assignments will replace the original materials.

**Evacuation**

Should an unsafe environment develop in any class meeting room, design space, or shop facility, all class participants must proceed immediately outdoors, or to a designated safe area. Dismissal by the instructor is not necessary (i.e., establish safety first – address attendance afterward).
**Excused Absences**
Students are granted excused absences from class for the following reasons: illness of the student or serious illness of a member of the student's immediate family, the death of a member of the student's immediate family, trips for student organizations sponsored by an academic unit, trips for university classes, trips for participation in intercollegiate athletic events, subpoena for a court appearance, and religious holidays. Students who wish to have an excused absence from class for any other reason must contact the instructor in advance of the absence to request permission. The instructor will weigh the merits of the request, and render a decision. When feasible, the student must notify the instructor prior to the occurrence of any excused absences, but in no case shall such notification occur more than one week after the absence. Appropriate documentation for all excused absences is required. Please see the Tiger Cub for more information on excused absences.

**Honesty**
All portions of the Auburn University Student Academic Honesty Code, as found in the *Tiger Cub* and defined in the SGA Code of Laws, Title XII, will apply in this class. The honesty code may be viewed at:


**Make-Up Policy**
Arrangement to make up a missed major examination (e.g.: hour exams, mid-term exams) due to properly authorized excused absences must be initiated by the student within one week of the end of the period of the excused absence(s). Except in unusual circumstances, such as the continued absence of the student or the advent of university holidays, a make-up exam will take place within two weeks of the date that the student initiates arrangements for it. Except in extraordinary circumstances, no make-up exams will be arranged during the last three days before the final exam period begins.

**Religious Holidays**
Students requesting absence or delay of due dates in order to observe religious holidays must do so in writing to the instructor no less than two weeks prior to the beginning of the anticipated observance.