# New Course Request

## Indiana University

**IUPUI Campus**

Check Appropriate Boxes:  
- Undergraduate credit [ ]  
- Graduate credit [x]  
- Professional credit [ ]

1. **School/Division**: School of Engineering and Technology  
2. **Academic Subject Code**: ME  
3. **Course Number**: 504 (must be cleared with University Enrollment Services)  
4. **Instructor**: S. Anwar

5. **Course Title**: Automotive Control  

   **Recommended Abbreviation (Optional)**

   (Limited to 32 Characters including spaces)

6. **First time this course is to be offered (Semester/Year)**: Fall 2006

7. **Credit Hours**: Fixed at 3 or Variable from to

8. **Is this course to be graded S-F (only)?** Yes [x] No [ ]

9. **Is variable title approval being requested?** Yes [x] No [ ]

10. **Course description (not to exceed 50 words) for Bulletin publication**: Basic Engine Operation; Lambda Control; Speed Control, Knock Control, Fuel Injection timing control, Ignition control of SI engine; Complete Vehicle Model; Driveline modeling, Automatic transmission control, Clutch phasing control; Wheel Model; Observers, Friction Coefficient estimators, Tire Contact Patch Force Estimators; Anti-Lock Brake control, Traction control, Yaw Stability control; Drive-By-Wire Systems.

11. **Lecture Contact Hours**: Fixed at 75 minutes or Variable from to

12. **Non-Lecture Contact Hours**: Fixed at 2 hours or Variable from to

13. **Estimated enrollment**: 20 of which 80 percent are expected to be graduate students.

14. **Frequency of scheduling**: 1/year  

15. **Justification for new course**: 1) Lack of a course in the Automotive Control Area 2) Student demand

16. **Are the necessary reading materials currently available in the appropriate library?** Yes [x]

17. **Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.**

18. **If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.**

19. **A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.**

Submitted by:  

**H. W. Ahearn**  
Department Chairman/Division Director  
Date 5-30-06

Approved by:  

**M. A. S. Tan**  
Dean  
Date 5/21/06

Dean of Graduate School (when required)  

**J. O. Parker**  
Date 8/30/06

University Enrollment Services  

Date

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.
**INSTRUCTIONS:** Please check the items below which describe the purpose of this request.

- [x] 1. New course with supporting documents
- 2. Add existing course
- 3. Expiration of a course
- 4. Change in course number
- 5. Change in course title
- 6. Change in course credit/type
- 7. Change in course attributes
- 8. Change in instructional hours
- 9. Change in course description
- 10. Change in course requirements
- 11. Change in semesters offered
- 12. Transfer from one department to another

**PROPOSED:**

<table>
<thead>
<tr>
<th>Subject Abbreviation</th>
<th>Subject Abbreviation</th>
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<tbody>
<tr>
<td>ME</td>
<td>ME</td>
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<table>
<thead>
<tr>
<th>Course Number</th>
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<tbody>
<tr>
<td>504</td>
<td>504</td>
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<table>
<thead>
<tr>
<th>Long Title</th>
<th>Short Title</th>
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<tbody>
<tr>
<td>Automotive Control</td>
<td>Automotive Control</td>
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**COURSE ATTRIBUTES:** Check all that apply:

- 1. Pass/Not Pass Only
- 2. Satisfactory/Unsatisfactory Only
- 3. Repeatable
- 4. Credit by Examination
- 5. Designator Required
- 6. Special Fees

**TERMS OFFERED**

- [x] Fall
- [ ] Summer
- [ ] Spring

**CAMPUS(ES) INVOLVED**

- Calumet
- Ft. Wayne
- N. Central
- Tech Statewide

**COURSES DESCRIPTION (INCLUDE REQUISITES):**

Basic Engine Operation; Lambda Control, Speed Control, Knock Control, Fuel Injection timing control, Ignition control of SI engines; Driveline modeling, Automatic transmission control, Clutch phasing control; Wheel Model, Complete Vehicle Model; Observers, Friction Coefficient estimators, Tire contact latch force estimators; Anti-lock Brake control, Traction control, Yaw Stability control; Drive-By-Wire Systems. ECE 382 or ME 482 or equivalent (Control System Analysis & Design) and any high-level programming languages, or consent from instructor. Senior or graduate standing.

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**Cross-Listed Courses**

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**OFFICE OF THE REGISTRAR**
ME 504
AUTOMOTIVE CONTROL
Syllabus

(3 Credit hours, Fall 2006)

Instructor: Dr. Sohel Anwar, Assistant Professor, Mechanical Engineering Dept., IUPUI. Office: SL 260N, Tel. 274-7640, Fax 274-9744, email: soanwar@iupui.edu.

Office Hrs: MW 1:30 - 2:45 PM


Prereq.: ECE 382 or ME 482 or equivalent, and any high-level programming languages.

Catalog Description: Basic engine operation; Lambda control, Speed control, Knock control, Fuel injection timing control, Ignition control of SI engines; Driveline modeling, Automatic transmission control, Clutch phasing control; Wheel model, Complete vehicle model; Observers, Friction coefficient estimators, Tire contact patch force estimators; Anti-lock brake control, Traction control, Yaw stability control, Drive-By-Wire systems.

Homework: Homework problems will be assigned approximately once every 10 days in order for you to understand course materials covered in the lectures. Late due will not be accepted.

Projects: A final project will be assigned. The project includes a formal report and a presentation of the work.

Exams: One in-class midterm and a final exam will be given. The final will be comprehensive with emphasis on the materials which are not covered in the midterms. No make-up exams are allowed.

Academic Misconduct: Any cheating in the exams will result in a grade of “F” automatically.
Refer to the section on “Academic Misconduct” outlined in the IUPUI Code of Student Rights, Responsibilities, and Conduct for details.
http://www.iupui.edu/code/CSR_0106.pdf

Grading: Homework 20%, Final Project 25%, Midterm Exam 25%, Final Exam 30%.
Grading Scale

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A+</td>
<td>95-100</td>
</tr>
<tr>
<td>A</td>
<td>90-94.99</td>
</tr>
<tr>
<td>A-</td>
<td>87-89.99</td>
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<tr>
<td>B+</td>
<td>84-86.99</td>
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<tr>
<td>B</td>
<td>81-83.99</td>
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<tr>
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<td>C+</td>
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<tr>
<td>C-</td>
<td>65-69.99</td>
</tr>
<tr>
<td>F</td>
<td>0-64.99</td>
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**Americans with Disabilities Act:**
If you need any special accommodations due to a disability, please contact Adaptive Educational Services at (317)-274-3241. The office is located in CA 001E.

**Course Content:**
This course will cover the fundamentals of automotive control systems that are present in today's cars. It will also briefly review automotive control technologies of the future cars and their impact in our society. Basic engine functions will be illustrated (Four Stroke Cycle, Air-Fuel Ratio, Combustion, and Energy conversion). Various aspects of engine control system such as Speed Control, Knock Control, Fuel Injection timing control, Ignition control of SI engines will be explained. Fundamentals of modeling and control of automatic transmission for automobiles will be covered (automatic gear shifting and clutch phasing control). Vehicle dynamics modeling including Wheel Model will be illustrated. Vehicle parameter and state estimation methods will be briefly explained. Vehicle dynamics control such as Anti-Lock Brake control and Yaw Stability control will also be covered. Advanced topics such as Brake-By-Wire and Steer-By-Wire systems will briefly be described. Modeling of automotive control systems in MATLAB/SIMULINK environment will extensively be used in this course.

**Course Objectives:**
*Upon successful completion of the course, students should be able to:*

i. Define current state of automotive control systems and their impact in our society.


iii. Solve various aspects of engine control system: Speed Control; Knock Control; Fuel Injection timing control; Ignition control of SI engines.

iv. Perform Automatic Transmission Control: Automatic transmission modeling; Automatic Transmission control for gear shifting; Clutch phasing control.

v. Perform vehicle dynamics modeling: Wheel Model; and Vehicle Model.
vi. Calculate various vehicle parameter and perform state estimation methods: Observers; Friction Coefficient estimators; Tire Contact Patch Force estimators.

vii. Perform vehicle dynamics control: Anti-Lock Brake control; Yaw Stability control.

viii. Define advanced automotive control techniques: Brake-By-Wire; and Steer-By-Wire.

ix. Perform modeling of automotive control systems in MATLAB/SIMULINK environment.

x. Evaluate and test automotive control system performance using computer-aided tools (MATLAB/SIMULINK).

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### ME 504 Automotive Control Course Outline

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Topics</th>
<th>Week(s)</th>
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</table>
| 1        | Introduction  
Why control systems for automobiles? Background on automotive control systems | 0.5 |
| 2        | Engines and Their Working Principle  
Basic Engine Operation: Four Stroke Cycle, Air-Fuel Ratio, Combustion, Energy conversion | 1.0 |
| 3        | Engine Control System  
Lambda Control; Speed Control; Knock Control; Fuel Injection timing control; Ignition control of SI engines | 2.0 |
| 4        | Automatic Transmission Control  
Transmission modeling and control; Automatic transmission control for gear shifting; Clutch phasing control | 2.5 |
| 5        | Midterm Exam | |
| 6        | Vehicle Dynamics Modeling  
Wheel Model; Complete Vehicle Model | 2.5 |
| 8        | Vehicle Parameter and State Estimation  
Observers, Friction Coefficient estimators; Tire Contact Patch Force estimators | 2.0 |
| 9        | Vehicle Dynamics Control  
Anti-Lock Brake control; Yaw Stability control; | 2.5 |
| 10       | Advanced Topics  
Brake-By-Wire; Steer-By-Wire | 1.0 |
| 11       | Final exam | |