

Advanced Vehicle Technology

I. Course Code: 0300068 S

Class Hours: 48 Credit: 3

II. Applicable Major: Mechanical Engineering, Power Machinery and Engineering,
Aeronautical and Astronautical Science and Technology

III. Pre-requisite Courses: Automotive Structure, Vehicle Dynamics, Internal Combustion
Engine Science

IV. Objectives:

This course aimed to meet the rapid vehicle and power machinery technology development, expand the academic horizons for graduate students, and lay a solid foundation for research and work in the future. The topics will introduce a large number of relevant examples combining research experience, which can greatly stimulate interest and enthusiasm of graduate students in the scientific research as well as improve their innovative capacity. This course includes two modules: Advanced Vehicle Technology and Advanced Power Machinery Technology.

Vehicle Technology module introduces the latest achievements of vehicle technology and development trends in the future, new challenges for vehicle system dynamics, electric vehicles, intelligent vehicles, vehicle test and simulation technology, vehicle structure and lightweight technology, vehicle product development system.

Power Machinery Technology module introduces automotive engine new technologies, power machinery engineering development trend, combustion and emission of internal combustion engine, turbocharging technology of internal combustion engine, etc.

Technical Seminar module includes automotive technology innovation for low carbonization, informationization, and intellectualization. The new possibilities for automotive technology and products development in the era of big data, cloud computing, and AI will also be discussed.

V. Teaching method:

Classroom lectures, class discussion, case discussions, paper analysis

VI. Contents of teaching:

Vehicle Technology:

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| 1 Latest Developments on Vehicle Technology | 3 class hours |
| 1.1 New goal of automotive energy and safety | |
| 1.2 Automobile electronic technology and application | |
| 1.3 Automobile new material and application | |
| 1.4 Vehicle theory system and new development | |
| 2 Electric Vehicle Technologies | 3 class hours |
| 2.1 Overview of electric vehicles | |
| 2.2 Battery electric vehicles | |
| 2.3 Hybrid electric vehicles | |

2.4 Fuel cell engine electric vehicles	
2.5 Motors for EVs	
2.6 Power battery for EVs	
2.7 Controllers for EVs	
3 Intelligent Vehicle Technologies	3 class hours
3.1 Overview of intelligent vehicles	
3.2 Environmental perception	
3.3 Localization and navigation	
3.4 Path planning	
3.5 Motion control	
3.6 Integrated design for intelligent vehicles	
3.7 Intelligent connected vehicles	
4 Vehicle System Dynamics	6 class hours
4.1 Overview of vehicle system dynamics	
4.2 Tire mechanics and models	
4.3 Vehicle dynamics modeling and simulation	
4.4 Vehicle dynamics synthetic evaluation technology	
4.5 Chassis tuning technology	
4.6 New challenges for electric vehicle dynamics	
4.7 New challenges for intelligent vehicle dynamics	
5 Automobile structural optimization and lightweight technology	3 class hours
5.1 Automobile structure optimization	
5.2 High strength steel	
5.3 Aluminum/magnesium alloys	
5.4 CFRP/GFRP	
5.5 Manufacturing technology for lightweight materials	
5.6 Test Technology for lightweight materials	
6 Automobile Product Development System	3 class hours
6.1 Concept of product development system	
6.2 Different targets for development system	
6.3 Product development system for concept design phase	
6.4 Product development system for design and validation phase	
Power Machinery Technology:	
7 New Technologies and Future Prospects with Automotive Engines	3 class hours
7.1 Gasoline engine downsizing	
7.2 Diesel engine new combustion process	
7.3 Advanced fuel injection technology	
7.4 New engine working cycles	

7.5 Flex fuel engine	
8 Combustion and emission of internal combustion engine	3 class hours
8.1 Introduction to combustion and emission	
8.2 Powertrain and control system developments	
8.3 Powertrain and control trend technology	
9 Structure strength under high load and high temperature	3 class hours
9.1 Introduction to engine structure technology	
9.2 High temperature structure strength technology developments	
9.3 Structure strength trend technology	
10 Turbocharging advanced technology in vehicle power system	3 class hours
10.1 Introduction to turbocharging technology in vehicle power system	
10.2 Turbocharging system development and application in new power technology	
10.3 Turbocharger trend technology in vehicle power technology	
Technical Seminar:	
11 Automotive Technology Innovation for Low Carbonization	3 class hours
12 Automotive Technology Innovation for Informationization	3 class hours
13 Automotive Technology Innovation for Intellectualization	3 class hours
14 New possibilities with Big Data, Cloud Computing, and AI	6 class hours

VII. Grading:

Total Score 100%: Usually grading 40%, Course reports 60%.

VIII. Reference:

- [1] Thomas D. Gillespie. Fundamentals of Vehicle Dynamics. Society of Automotive Engineers Inc, 1992.
 - [2] Giancarlo Genta, Lorenzo Morello, Francesco Cavallino. The Motor Car- Past, Present and Future. Springer, 2014.
 - [3] P. K. Mallick. Materials, design and manufacturing for lightweight vehicles. Woodhead Publishing Limited, 2010.
 - [4] Xu Wang. Vehicle noise and vibration refinement. Woodhead Publishing Limited, 2010.
 - [5] Shushan Bai, Joel M. Maguire, Huei Peng. Dynamic Analysis and Control System Design of Automatic Transmissions. Society of Automotive Engineers Inc, 2011.
 - [6] Kevin Hoag, Brian Dondlinger. Vehicular Engine Design. Springer, 2016.
 - [7] James M. Morgan, Jeffrey K. Liker. The Toyota Product Development System: Integrating People, Process and Technology. Productivity Press, 2006.
 - [8] J. Heywood. Internal combustion engine Fundamentals of Turbocharging, 1988
 - [9] Nicholas C. Baines. Fundamentals of Turbocharging. Concepts NREC Press, 2005.
- IX. Syllabus writer: Xiaokai Chen, Hong Zhang