



JOINT INSTITUTE  
交大密西根学院

## **VM458: Automotive Engineering (3 credits)**

*Fall Semester 2016*

### **Course Objective**

This course is intended to introduce the students the practice of engineering in the automotive field. Topics are focused on systems approach to automotive design, and include vehicle system, powertrain, driveline, chassis, braking, cooling system, as well as automotive component function, operating & design principles, and current trends. In addition, analytical approach to the engineering problem and performance analysis related to automobile engines which affect engine power, efficiency, emissions, design and operating characteristics will be discussed. The regularly scheduled lecture periods will include guest lecturers, if possible, from the automotive industry to introduce the students to the current state of select automotive technologies, including autonomous driving and driverless vehicle developments. A team-based project with oral presentation is required for students to research on the state-of-the-art automotive topics or emerging trends in the automotive segment.

### **Instructor**

Professor David L.S. Hung

Rm. 221, UM-SJTU JI Building

Phone: 3420-6730

Email: [dhung@sjtu.edu.cn](mailto:dhung@sjtu.edu.cn)

Office hours: Tuesday & Thursday 12:30 to 13:30; and 16:00 to 17:00

### **Teaching Assistants**

Mr. Fengnian Zhao

Email: [iclover@sjtu.edu.cn](mailto:iclover@sjtu.edu.cn)

Phone: 188-1755-3175

Office hours: Wednesday 16:00 – 18:00 (@ E-reading room, 2<sup>nd</sup> floor of the JI building)

Mr. Weihao Li

Email: [li.weihao@hotmail.com](mailto:li.weihao@hotmail.com)

Phone: 136-3668-0767

Office hour/location: Tuesday 14:00 – 15:00 (@ E-reading room, 2<sup>nd</sup> floor of the JI building)

### **Course Pre/Co-requisites:**

Prerequisite: Vm350 Design and Manufacturing II (or can be waived by instructor's approval)

**Course Textbook:**

R. Stone & J. Ball, "**Automotive Engineering Fundamentals**," Published by SAE (ISBN: 978-0-7680-0987-3), 2004.

**Course Location:**

Chen Rui Qiu Building, Room 106

**Course Schedule:**

Tuesday & Thursday: 10:00 to 11:40 (weekly)

- Lectures will be conducted between week 1 and week 12
- Final team project presentations will be held during week 13 (Exact schedule to be determined)
- Exam 2 will be held during the final exam week (week 14)

**Grading Criteria:**

Assignments	Percentage
Exam 1	20 %
Exam 2	20 %
In-class Assignments and Participation	15 %
Homework Assignments	10 %
Team Project Final Report (Team / Individual)	20 % (10% / 10%)
Team Project Presentation (Team / Individual)	15 % (5 % / 10 %)
<b>TOTAL</b>	<b>100 %</b>

**Team Project:**

A team project is required for this course. Each team will research and prepare a team project, and deliver to the entire class an oral presentation based on a topic which either a) is not already covered in the class, or b) covers in greater detail some specific aspect of a topic which is covered in class. The team project should draw technical materials from a variety of sources, including but not limited to, the course textbook (*Automotive Engineering Fundamentals*) and other textbooks or reference books, automotive industry trade and technical journals. Each team will make a **sub-topic introduction presentation** to the entire class during lecture, and a **final team presentation** will be scheduled near the end of the semester. The final report and presentation should briefly cover the background, current status, and the projected future developments of the topic or system selected. A discussion of the primary engineering and operating principles and design criteria and tradeoffs relating to the topic or system should be the core of the final presentation. The final report should be limited to between 20 and 30 pages (additional pages can be allowed for appendix). Each final team project presentation should be approximately 15-20 minutes. Each student is expected to present his/her contributions of the team project.

Students may form teams for their project as they wish, subject to the maximum group size of **four** students. Team membership must be submitted to the instructor no later than

Tuesday, Sept. 20<sup>th</sup>. Students who have not already formed a group before this date will be automatically assigned in the remaining groups randomly.

The selection of the main topic for each team will be based on a lottery draw during class on Thursday, Sept. 22<sup>nd</sup>, to determine the ranking of each team (i.e., the team with the highest ranking can select the topic from the main topic list first, then followed by the second ranked team, and so forth). All main topics will be assigned to each team by Tuesday, Sept. 27<sup>th</sup>. Based on the main topic assigned, each team must research about this main topic, and then submit two abstracts, one for each sub-topic, related to the main topic assigned (that is, two abstracts are due on Oct. 18<sup>th</sup>). Each abstract must be written between 100 and 200 words to describe the sub-topic. The final sub-topic for the team project will be decided by the instructor and be posted in CANVAS on or before Oct. 25<sup>th</sup>.

The important dates for the team project are listed below. These dates are subject to change, and if so, the change will be announced in class and posted on CANVAS.

- Sept. 20<sup>th</sup> : Project teams formed
- Sept. 22<sup>nd</sup> : Ranking of main topic selection determined during class
- Sept. 27<sup>th</sup> : Main topic for each team assigned
- Oct. 18<sup>th</sup> : Two abstracts of sub-topic selections due in class
- Oct. 25<sup>th</sup> : Team project sub-topic approval announced on Canvas
- Nov. 3<sup>rd</sup> : Team project sub-topic introduction presentations in class
- Dec. 1<sup>st</sup>, 6<sup>th</sup>, & 8<sup>th</sup> : Team project final presentations in class
- Dec. 13<sup>th</sup>: Due date for final team project report (1-hardcopy). Electronic copies of the final report and team PPT presentations are due online via Canvas.

The following are the **main topics** for the team projects. The expected deliverables include 1) a comprehensive team project report, and 2) a team oral presentation to present the team's finding on the topic.

1. Driverless, self-driving, or autonomous vehicles (Sub-topics: Google car, vehicle safety, vehicle-driver interaction, etc)
2. "Big Data" on automotive and vehicle applications (Sub-topics: onboard diagnostics, real time driving data communication, etc)
3. Fuel economy, emissions & greenhouse gas reduction from vehicles (Sub-topics: CO<sub>2</sub> emission reduction, engine after-treatments, diesel particulate filters, global emission regulations and standards, drive cycle analysis)
4. New battery (energy storage) technology for electric vehicles (Sub-topics: Li-Ion Battery, fuel cell energy storage technology)
5. Heavy Duty Truck (Commercial Vehicle) Technology (Sub-topics: powertrain and drivetrain for use in commercial trucks, emission control, waste heat recovery)
6. Advanced powertrain and combustion technology (Sub-topics: gasoline direct compression ignition (GDCI), homogeneous charge compression ignition (HCCI), combustion systems with multiple fuels such as diesel and natural gas)
7. Automotive fuels and lubricants (Sub-topics: alcohol-based fuels, bio-diesel, hydrogen fuel, natural gas, advanced lubricants, automotive fuel processing technology)

8. New energy vehicle development (Sub-topics: electric, hybrids, plug-in hybrid, fuel cell vehicles, Government's policy for subsidy, infrastructure for charging stations, etc)
9. Novel automotive manufacturing and assembly processes (Sub-topics: 3D printing for automotive applications)
10. Advanced vehicle safety (active or passive) systems (Sub-topics: safety related to autonomous vehicles, airbag technologies, collision avoidance, vehicle stability)
11. Vehicle-to-Vehicle (V2V) and wireless communication systems for automobiles (Sub-topics: in-vehicle CAN bus communication network, new sensors)
12. Automotive/Motorcycle sports and car racing (Sub-topics: formula cars and racing motorcycles)
13. Advanced powertrain, drivetrain, and transmissions (Sub-topics: e-supercharger, dual clutch transmission, AMT, continuously variable transmission)
14. Novel and smart materials for use in automobiles (Sub-topics: light-weight alloys for vehicle body)
15. Vehicle exterior design and interior design/comfort (Sub-topics: vehicle aerodynamics, spoiler technology, cockpit design, interior comfort, in-vehicle climate control, etc)
16. Other topic: Be specific about the title with some details

***Internet Resources:***

This course uses the CANVAS, an online learning management system. It provides a place for the instructors and TA to give electronic versions of all course handouts, extra reading material, lecture notes, etc. The course instructors will also use the CANVAS to convey urgent messages to the entire course. For this reason you should remember to check CANVAS (or your email) regularly for any course updates.

***Academic Integrity and Honor Policy:***

Student surveys show that the overwhelming majority of JI students is proud of the Honor Code and supports it fully. It is seen as an asset of the JI, a real positive feature distinguishing the JI both from other institutions within SJTU and at other Chinese universities. The introduction of the Honor Code has enhanced the reputation of the JI while also teaching JI students about academic integrity. All students in the class are presumed to be decent and honorable, and all students in the class are bound by the Honor Code of the Joint Institute. The JI Honor Code is included in the undergraduate student handbook and also available at:

<http://umji.sjtu.edu.cn/academics/academic-integrity/honor-code/>

In short, the Honor Code prohibits students from representing work that is not the fruit of their own labors as their own. The specifics and application to concrete situations as well as the details of enforcement involving the student-comprised Honor Council and the Faculty of Discipline (FCD) make up the bulk of the Honor Code.

You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work. Any violation of the above honor policies appropriate to each piece of course work will be reported to the Academic & Student

Affairs Office, and if guilt is established, penalties may be imposed. If violations are found and proven, there will be an automatic reduction of the final course grade by **ONE** full letter grade. More severe penalties may include, but are not limited to, expulsion from the University. If you have any questions about this course policy, please consult the course instructors.

***Guideline for Collaborative Group Work:***

This course requires students to work collaboratively and submit a class project as a team assignment. Therefore, students must follow the collaborative group work guidelines specified in **Section 5** of the **JI Honor Code (Rev 2016)**, which is excerpted as follows:

*“Assignments involving collaboration within a group (e.g., lab reports, project reports, collaborative course work) require that all members of the group whose name appears on the assignment are jointly and fully responsible for the entirety of the submitted work. If any section of the submission is found to violate the Honor Code, all group members whose name appears on the submission are equally and jointly liable for the violation. An exception is possible, at the instructor’s discretion, if part of the work is clearly delineated as originating only from specific group members.”*

***In-class Assignments and Participation:***

In-class assignments will be given at lectures periodically throughout the semester. These assignments are designed to reinforce the student’s knowledge of the materials covered in class and promote class attendance, discussion, and participation. Under normal circumstance, if you’re absent in the class when the assignments are given, you will NOT be able to make up for them.

**Course Lecture Schedule - 2016 Fall Semester (Subject to change/update)**

**Last updated on September 12<sup>th</sup>, 2016**

JI Week	Lecture	Date	Day	Lecture Content
1	1	9/13	Tuesday	Course Overview, Introduction to Automotive Engineering
		9/15	Thursday	No Lecture: Mid-Autumn Festival (University Holiday)
2	2	9/20	Tuesday	Vehicle System Overview and Historical Perspective, Auto Industry in China
	3	9/22	Thursday	Thermodynamics of Engine Cycles
3	4	9/27	Tuesday	Spark Ignition (Gasoline) Engines
	5	9/29	Thursday	Compression Ignition (Diesel) Engines
4		10/4	Tuesday	No Lecture: Week of October 1st National Holidays
		10/6	Thursday	No Lecture: Week of October 1st National Holidays
5	6	10/11	Tuesday	Vehicle Design and Manufacturing (Video format, plus in-class assignment about the video)
	7	10/13	Thursday	Lab Tour (Conducted at the SJTU Institute of Automotive Engineering Building)
6	8	10/18	Tuesday	Combustion Chemistry and Automotive Fuels
	9	10/20	Thursday	Automobile Emissions
7		10/25	Tuesday	Exam 1
	10	10/27	Thursday	Engine Boosting & Engine/Vehicle Modeling
8	11	11/1	Tuesday	Ignition, Intake Air & Valve Actuation Systems
	12	11/3	Thursday	<b>Topic Introduction Presentations (Team project topics to be presented by team leaders)</b>
	13	11/4	Friday	Fuel Injection Systems
9		11/8	Tuesday	Lecture to be moved to Friday, 11/4, from 16:00 to 17:50 (Location TBD)
		11/10	Thursday	Lecture to be moved to Friday, 11/18, from 16:00 to 17:50 (Location TBD)
10	14	11/15	Tuesday	Drivetrain Systems - Transmission
	15	11/17	Thursday	Drivetrain Systems - Steering & Suspension
	16	11/18	Friday	Vehicle Brake System and Vehicle Aerodynamics
11	17	11/22	Tuesday	In-vehicle Climate Control & Cooling Systems
	18	11/24	Thursday	New Energy Vehicle (Electric Vehicles, Hybrid Vehicles, Flex Fuel Vehicles)
12	19	11/29	Tuesday	Autonomous/Self-Driving Vehicle Technology
	20	12/1	Thursday	<b>Topic Presentations (Team project by entire team)</b>
13	21	12/6	Tuesday	<b>Topic Presentations (Team project by entire team)</b>
	22	12/8	Thursday	<b>Topic Presentations (Team project by entire team) / Final course review</b>
14				Exam 2 (Exam schedule to be announced)