

Training Date : 21 March 2018

Title: Vehicle Plan and Design

Instructor: Dr. Hiroaki Morimura, Tokyo Institute of Technology

Summary:

For vehicle plan / design, advanced method; CAE, 1D-CAE, etc. are progressing rapidly. However, the production of excellent vehicle cannot be realized, if these methods are simply used as a black box. Understanding the basics of vehicle plan / design and utilizing new methods are important for engineers in all departments of automobiles and component manufacturers.

For vehicle plan / design, it is necessary to present targets for the vehicle in consideration of external anticipated factors. Vehicle plan / design realize the targets by replacing with vehicle performance and function. In other words, this vehicle plan / design will decompose / assign / lay-out vehicle performance & function of components of a vehicle. A combination table of those performance & function relationship has been presented from about 40 years ago at J-SAE.

This combination table is complicated. But it shows clearly that there are many difficult tasks that are difficult to harmonize for the one vehicle.

By clarifying the issues from this table, vehicle manufacturers and component manufacturers can recognize the tasks and solve the difficult problems. Some examples are indicated.

Also, the performance & functions of the vehicle are outlined to understand the plan / design jobs.

The recent design method are also explained to denote the direction of modeling the vehicle and the components.

Title: Body design

Instructor: Dr. Hiroaki Morimura, Tokyo Institute of Technology

Summary:

All components are installed in the vehicle body. A basic understanding of body design is important for engineers in all divisions of automobiles and component manufacturers. First, following will be explained: 1) role of the body and required performance/characteristics and design history; 2) load acting on the body; 3) the concept of body structure and stiffness/strength of the body; 4) Lightweight of body; 5) Modeling of body.

And another principal roles of body are described in this textbook. But collision phenomena and passenger safety will be explained in another textbook.

In this session, weight reduction of the car body and stiffness/strength of the body are explained in detail, as those are important.

As the vehicle body is consisted of a thin-walled structure, it is difficult to obtain lightweight body with sufficient rigidity. Simple car model samples are demonstrated to

<p>understand the vehicle body structure in this session.</p> <p>And progressively, the outline of body design is explained with basic concept and simple modeling. And the latest design method is explained.</p>
<p>Title: “Combustion and Emission” & “Biofuel/ New Fuel and New Engine”</p>
<p>Instructor: Mr. Mitsuharu Oguma, National Institute of Advanced Industrial Science and Technology (NIAIST)</p>
<p>Summary:</p> <p>Relationship between combustion of gasoline/diesel engines and emission characteristics is explained with some examples. Then, emission after-treatment systems existing in the market are introduced.</p> <p>[Contents]</p> <ol style="list-style-type: none"> 1. Emissions from Engines 2. Emission Characteristics of Spark-Ignition Engines 3. Emission Characteristics of Diesel Engines 4. Exhaust-Gas After-treatment Systems <p>Situation of fuels for vehicles will be shown as an introduction, after that, natural gas vehicles, hybrid vehicles, electric vehicles and fuel cell vehicles will be explained.</p> <p>[Contents]</p> <ol style="list-style-type: none"> 1. Energy situation for vehicles 2. Natural Gas Vehicles 3. Biofuels 4. Hybrid Vehicles 5. Fuel Cell Vehicles 6. Sustainability of Mobility Energy
<p>Title: Electronics (Basic Control System)</p> <p>Development of System & Sensors for Preventive Safety</p>
<p>Instructor: Mr. Tetsuya Nakamura, DENSO CORPORATION</p>
<p>Summary:</p> <p>Control system is important item and technology of automobile.</p> <p>The outline of control engineering is described with easy mathematics.</p> <p>The terms and examples of control system are explained.</p> <p>And automotive electronics systems are explained.</p> <p>Sensing Technology is important basis of automotive electronics system.</p> <p>The process and design of automotive electronics systems are outlined.</p> <p>And the principle of Lidar and Radar are explained to focus the difference.</p> <p>And structures are displayed with dismantled components in this session.</p>

Title: Vehicle Handling Dynamics

Instructor: Dr. Sunao Chikamori, SAE Honorary Member

Summary:

Chapter 1. Tire Mechanics

The aims of this chapter are to obtain the basic knowledge of the cornering force, and to understand how this knowledge utilize to formulate the equation of vehicle motion.

Chapter 2. Vehicle Equation of Motion

The equation of motion will be studied based on the vehicle fixed coordinate. And introducing several simplifications, a set of linearized equation in two degrees of freedom, lateral and yawing motion, can be obtained.

Chapter 3. Steady-State Cornering

By surveying the vehicle motion in steady-state cornering, the fundamental differences of steer characteristics can be understood. For example, there are three kinds of steer characteristics (US, NS, OS), and the steer characteristics is decided by the vehicle and tires specifications.

Chapter 4. Dynamic Response to Steer Input

By means of numerical simulation, the step and impulse responses to steer angle input are examined. The simulation makes clear that OS vehicle has the critical velocity, US vehicle has two kinds of damping mode (with or without oscillation), etc.

Chapter 5. Additional Rear Wheel Steer (4WS)

The equation of motion with new concept, additional rear wheel steer, is formulated to analyze the dynamic responses. Then the control algorithm to make the side-slip angle zero is introduced. The numerical simulation of the 4WS vehicle shows the several advantages on the dynamic responses (quick response, zero over-shoot, zero side-slip angle).

Chapter 6. Response of Driver-Vehicle System

The simulation of vehicle response with human driver. The driver is looking forward at the target path, and controlling the vehicle through the steer angle. The necessary requirements for stable traveling are explained.

Chapter 7. Direct Yaw-moment Control (DYC)

Target of this new technology is to stabilize the vehicle motion even in critical condition. The additional yaw moment is mainly produced by the tire longitudinal forces divided between outside and inside tire. The fundamental concept and merit of DYC are examined by the simulation based on the linear equation of motion.

Title: Impact Biomechanics and Crash Safety
Instructor: Dr. Yasuki Motozawa, Teikyo University
Summary:
<p>The crash safety is one of the vehicle technologies to prevent, or mitigate injuries sustained by the occupants and pedestrians during vehicle impacts based on the methodology of the dynamics, material mechanics and impact biomechanics. The purpose of the lecture is to make fundamental understanding the methods of the crash safety technology.</p> <p>The present lecture consists of six parts. The first part introduces the overview of the real-world traffic accidents. The second part discusses the impact biomechanics, addressing the historical background, human anatomy, injury mechanisms and human tolerance. The third part discusses the human mechanical response during impacts. By using a simple mechanical model, the fundamental mechanism of the human response and the strategy to mitigate the injuries are discussed. The fourth and fifth parts discuss the vehicle body structure and restraint system (seatbelts and airbags), respectively. These parts discuss the basic architectures and functions of those, and address the strategy to optimize the design of them based on the knowledge discussed in the previous parts. The final part covers the pedestrian protection, a contemporary social issue, requires different approach to the vehicle occupant protection.</p> <p>Unlike other lectures focusing on the regulative vehicle safety standards and the countermeasure to meet them, the present lecture is trying to address the theoretical and biomechanical approach to the crash safety, and this will be helpful for establishing safer vehicle design. After this lecture, attendees will be able to understand the vehicle safety standards from a theoretical point of view as well.</p>
Title: Power Transmission
Instructor: Dr. Yasukazu Sato, Yokohama National University, Japan
Summary:
<p>The most important function of a power transmission is to transmit an engine power to wheels efficiently. Understanding the driving performance is very useful to make sense of the engine power flow. In the introduction, some physical quantities closely related to the driving performance will be emphasized. Recently, various power transmissions are commercialized.</p> <p>For example, 8 and over step automatic transmissions, dual clutch transmissions, metal belt CVTs, and chain CVTs are commercialized. The mechanism and features of each transmissions will be presented in detail. Furthermore, important components of power transmission will be introduced.</p> <p>The drivetrain of Hybrid Electric Vehicle (HEV), and plug-in HEV improves the fuel efficiency of vehicle drastically. HEV drivetrain which integrates an electric motor with a conventional transmission (AT, CVT or DCT) and series parallel HEV are</p>

commercialized. The mechanism and actuation of several type HEV drivetrains, and function of EV will be introduced from the viewpoint of eco- and efficient- power transmission. The role of power transmission becomes more essential for not only conventional vehicle but future HEV and EV.

Title: Electric Vehicle Development (Status and Future Review)

Instructor: Mr. Hidetoshi Kadota, Nissan Motor Corp.

Summary:

In this lecture, I explain the latest EV development status and its perspective. Although the benefits brought by the car society growth, it has become increasingly influential to the global environment such as air pollution, energy supply, traffic congestion, and traffic accidents. An effective countermeasure against these negative impact is the development of two technologies, electrification and intelligence of the vehicle. The synergistic effect of these two technologies will increase EV's social importance and will expand the global market.

Traditional cars simply provided value as a means of transportation, whereas EV will be incorporated to the social system that makes effective use of electricity resources even when vehicles are not being used for transportation.

Training Date : 23 March 2018

**Title: Overview of production Engineering/ Assembly
(Including machining of Powertrain unit)**

Instructor: Shinichi Inoue, Toyota Motor Corp.

Summary:

Many do not have clear idea regarding “Production Engineering” at their first sight. Since the “Production Engineering” is not apparent but profound technology of production fundamentals.

“Production Engineering” is inevitable where there is a product – not only automobiles. “Production Engineering” plays crucial and important roles: 1) Develop processes which enable production of high-quality products in QCD (quality, cost & delivery)-secured manner to realize product design elaborated by R&D, and provide them to manufacturing site. 2) Develop new fundamental engineering technologies, processing methods and production system.

This course will guide you to the “Production Engineering” for automobiles showing each process, workflows and the latest samples of Production Engineering development with explanation of Toyota Production System.

Power Train Unit Assembly (Including Machining), Body Assembly and Final Assembly are the main assembly processes in Production Engineering. This course will introduce the process overview, processing methods, conveyance methods and quality assurance methods.

Furthermore, the lecturer shows the latest Digital Engineering which is an inevitable tool in manufacturing and process planning with grounded examples.

Title: Iron and steel material and processes

Instructor: Dr. Shinichiro Fujikawa, Nissan Motor Corp.

Summary:

The ratio of light-weight metal such as Aluminum and Titanium and non-metal materials such as plastics and CFRP as automotive materials has been increased year by year to lighten the weight of a car for environmental needs. However, the ratio of iron steel metal has been still high for some reasons, rich resources, high strength and stiffness, high heat-resistance, and low cost.

This lecture tells some advantages of iron and steel material as automotive materials and explains steel making processes to be formed into sheet metal, pipe, and bulk materials and also automotive body and parts making processes such as sheet metal forming, pipe component forming, and forging.

It also discusses recent high strength materials development, such as high tensile strength steel and hot stamping, and future issues.

Title: Digital engineering for sheet metal forming, forging, and heat treatment processes

Instructor: Dr. Shinichiro Fujikawa, Nissan Motor Corp.

Summary:

The metal forming and heat treatment processes for automotive industries have been greatly progresses. The digital engineering such as CAD/CAM/CAE and image processing has remarkably contributed to the progress of these processes, not only for the short development term, but also for the optimization of the production quality, cost, and delivery.

This lecture demonstrates the features of digital engineering processes for sheet metal forming, forging, and heat treatment processes and also explains the real contribution of CAD/CAM, simulation techniques, and reverse engineering to the production processes.

And, this lecture explains the significance of IOT technologies for future automotive industries.

Title: Materials and Digital Processes (Non-ferrous metal, Non-metal materials)

Instructor: Mr. Hidenori Kurahashi, Honda Motor Corp.

Summary:

In this lecture, explain introduction of the material which corresponds to weight saving required by recent Electric Vehicle and Hybrid EV about manufacturing technologies.

Nonferrous metal materials for iron are aluminum mainly.

The plain lecture is about material characteristics, production equipment and processing technologies about a body and an engine with aluminum materials.

Within the case to which modern technologies was applied is introduced.

Non-metal materials for vehicles as there are resin materials(C-FRP etc.).

The resin material kind and process are introduced about the instrument panel and the bumper. A coating method, a process and the factory construction are introduced about painting of body at Movie.

At the end, it's also explained about a way of thinking of the recycling by which necessity will increase from now on.