

## **IME: 4260 Automotive Structure, Ride and Safety**

Spring 2007

**Intended Audience:** Students who wish to become employed in the automotive/truck industry developing, producing, assembling or managing after sales concerns of the customer/producer/dealer

### **Catalog Description:**

Study and simulation of the body structures and control systems for the operator and occupants to travel in a safe comfortable environment free of annoying vibration. Associated systems include interior, Environmental control, structural stiffness and crush control features, stopping systems including ABS and Traction control and suspension systems. Emphasis on the evaluation of design, meeting government Performance requirements, life cycle testing, diagnosis of faults and adjustments of these systems.

### **Prerequisite by Topic:**

1. IME-122 Automobile in Society, The technological and sociological challenges of the automobile
2. Mathematics that includes the understanding of algebra, geometry and basic calculus
3. Physics that include the understanding of physical, thermal and electrical properties as well as manufacturing techniques used with these materials
4. Chemistry that include the understanding of chemical relationships used in production automotive components including electrical properties
5. Computers that include the use of software packages for simulation, problem solving and record keeping
6. Technical writing that includes the ability to measure, report scientific observations and performance results
7. Technical illustration that includes the use of computers to communicate solutions and report graphical information and manufacturing processes and records
8. Statistics and metrology of the determination of manufacturing tolerances and accuracy of process control

### **Textbook:**

Robert Bosch GmbH, Automotive Handbook, ISBN 0-7680-1513-8, 2004 **Required**

### **References:**

- Reimpell, Dieter (2001), The Automotive Chassis, (Co-published by the Society of Automotive Engineers International and Edward Arnold), Warrendale
- Robert Bosch GmbH, (2000), Driving Safety Systems, (Distributed by the Society of Automotive Engineers International), Warrendale
- Anselm, Dieter (2000), The Passenger Car Body, Warrendale
- Society of Automotive Engineers (1990), Motor Vehicles—Automatic Control. Traffic Engineering, Warrendale
- Society of Automotive Engineers International (1954-Present, Paper and Micro-form), Technical Papers, Warrendale
- American National Standards Institute (1990), American National Standard for Safety Glazing Material for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land—Safety Equipment, Warrendale
- Society of Automotive Engineers (1990), Spring Design Manual, Warrendale
- Fenton, John (1996), Handbook of Vehicle Design Analysis, Warrendale
- Society of Automotive Engineers (1996), Spring Design Manual, Warrendale
- Dixon, John C. (1996), Tires, Suspension and Handling, Warrendale
- Society of Automotive Engineers (1995), Advances in Automotive Plastic Components and Technology, Warrendale
- Bauer, H (Robert Bosch GmbH) (1995), Automotive Brake Systems, Warrendale
- Society of Automotive Engineers (1996), Investigations into Vehicle Aerodynamics, Warrendale
- Society of Automotive Engineers (1995), Magnesium in Vehicle Design, Warrendale
- Society of Automotive Engineers (1994), Analysis of Vehicle Aerodynamics, Warrendale
- Peacock and Karwowski (1993), Automotive Ergonomics, London
- Bastow and Howard (1993), Car Suspension and Handling, London
- Society of Automotive Engineers (1993), SAE Vehicle Occupant Constraint Systems and Components Standards Manual, Warrendale

Limpert, Rudolf (1999), Brake Design and Safety, 2nd Edition, Warrendale

Gillespie, Thomas D. (1992), Fundamentals of Vehicle Dynamics, Warrendale

Society of Automotive Engineers (1992), Surface Vehicle Brake System Manual, Warrendale

Society of Automotive Engineers (1992), Vehicle Aerodynamics: Wake Flows, Computational Fluid Dynamics and Aerodynamic Testing, Warrendale

Society of Automotive Engineers (1991), Vehicle Occupant Restraint Systems and Components: A Compilation of SAE, ASTM and FMVSS Standards, Recommended Practices and Test Methods, Warrendale

Reimpell and Stoll (1996), The Automotive Chassis: Engineering Principles, Warrendale

Gott, Philip G. (1996), Automotive Air-Conditioning Refrigerant Service Guide, Warrendale

Mack, Josef (1999), ABS-TCS-VDC: Where Will the Technology Lead Us? Warrendale

Society of Automotive Engineers (1997), Topics in Vehicle Aerodynamic, Warrendale

Society of Automotive Engineers (1997), Steering and Suspension Technology, Warrendale

Society of Automotive Engineers (1997), Progress with Human Factors in Automotive Design: Seating Comfort, Visibility and Safety, Warrendale

Society of Automotive Engineers (1997), Aluminum in Vehicle Design, Warrendale

Robert Bosch GmbH (1999), Automotive Electric / Electronic Systems, Stuttgart

Jurgen, Ronald K. (1999), Electronic Braking, Traction and Stability Control, Warrendale

Robert Bosch GmbH (1999), Driving Safety Systems, Stuttgart

Jurgen, Ronald K. (1998), Electronic Instrument Displays, Warrendale

Society of Automotive Engineers International (2001), Brake Technology, ABS/TCS and Controlled Suspensions, Warrendale

Society of Automotive Engineers International (2000), Brake Technology, Warrendale

Society of Automotive Engineers International (1999), Brake Technology and ABS/TCS Systems, Warrendale

Buckman, Leonard C. (1998), Commercial Vehicle Braking Systems: Air Brakes, ABS and Beyond, Distributed by the Society of Automotive Engineers, Warrendale

Society of Automotive Engineers International (1998), ABS/Brake/VDC Technology, Warrendale

Society of Automotive Engineers International (1993), The Influence of Tire, Axle and Brake Characteristics on Truck Braking and Steering Performance, Warrendale

Society of Automotive Engineers International (1998,1999,2000), Proceedings of the 1998,1999,2000 Brake Colloquium and Engineering Display, Warrendale

Anselm, Dieter (2000), The Passenger Car Body, Distributed by the Society of Automotive Engineers International, Warrendale

Society of Automotive Engineers International (1998), Advances in Instrument Panel Design, Warrendale

Chan, Ching-Yao (2000), Fundamentals of Crash Sensing in Automotive Air Bag Systems, Distributed by the Society of Automotive Engineers International, Warrendale

Society of Automotive Engineers International (1998), Polymer Composites and Polymeric Materials, Warrendale

Society of Automotive Engineers International (1999), Polymer Composites and Polymeric Materials for Energy Management and Occupant Safety, Warrendale

Reimpell, Jornsens (2001), The Automotive Chassis, Distributed by the Society of Automotive Engineers International, Warrendale

Society of Automotive Engineers International (2001), SAE Ground Vehicle Lighting Standards Manual, Warrendale

Society of Automotive Engineers International (2001), Intelligent Vehicle Initiative (IVI), Warrendale

Society of Automotive Engineers International (2000), Intelligent Vehicles Technology, Warrendale

Society of Automotive Engineers International (2000), Intelligent Vehicles Systems, Warrendale

Society of Automotive Engineers International (2001), Lighting Technology Developments for Automobiles, Warrendale

Society of Automotive Engineers International (2000), Human Factors in 2000, Warrendale

Society of Automotive Engineers International (2001), Human Factors in Automotive Design, Warrendale

Crocker, Malcolm J. (1998), Handbook of Acoustics, Distributed by the Society of Automotive Engineers International, Warrendale

Society of Automotive Engineers International (2000), Noise and Vibration, Warrendale  
Society of Automotive Engineers International (2001), Airbag Technology 2001, Warrendale  
Society of Automotive Engineers International (1999), SAE Vehicle Occupant Restraint Systems and Components Standards Manual, Warrendale  
Society of Automotive Engineers International (1998), SAE Wheel Standards Manual, Warrendale  
National Lubricating Grease Institute (1987), Lubricating Grease Guide, Kansas City

**Course Coordinator:** James VanDePolder, F-230 Parkview Campus, james.vandepolder@wmich.edu

**Objectives:**

Based on the above stated course description at the conclusion of the semester the student will be able to:

1. Identify, assemble and measure structural characteristics and aerodynamic components of the automotive body/frame system (a,b,c,d,e,f,g,h,i,j,k)
2. Identify, assemble and evaluate the components that make up the interior and seating of a vehicle (a,b,c,d,e,f,g,h,i,j,k)
3. Identify, assemble and evaluate the components that make up the comfort and safety systems included in the interior and exterior of the vehicle (a,b,c,d,e,f,g,h,i,j,k)
4. Identify, assemble, test and adjust components in a suspension system (a,b,c,d,e,f,g,h,i,j,k)
5. Identify, assemble and test brake power supply systems with ABS, TCS, VDC and stability control systems (a,b,c,d,e,f,g,h,i,j,k)
6. Identify, assemble and test occupant passive restraint systems (a,b,c,d,e,f,g,h,i,j,k)
7. Identify and interact with system designers and manufacturers of smart road and vehicle systems (a,b,c,d,e,f,g,h,i,j,k)
8. Identify, assemble, test and modify components in the vehicle comfort and ergonomic systems (a,b,c,d,e,f,g,h,i,j,k)

**Topics:**

1. Body structural, energy absorption and aerodynamic requirements
2. Suspension requirements and wheel passive and active motion control for ride and handling
3. Brake system requirements for Vehicle Directional Control (VDC), Anti-Lock Brake System (ABS) and Traction Control System (TCS) systems
4. Electronic navigation, collision avoidance and smart highway systems compatibility
5. Smart power assist devices for reduction skill, fatigue and strength reduction
6. Suspension component isolation and damping for vibration and noise control

**Evaluation:**

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|-------------------------------|-----|
| 1. Exams and Quizzes:         | 25% |
| 2. Homework:                  | 10% |
| 3. Lab Assignments:           | 25% |
| 4. Projects:                  | 25% |
| 5. Attendance, Participation: | 15% |

**Performance Criteria:**

1. Assemble and test the structural integrity, evaluate crash energy management and safety systems (1,2,3,4)
2. Evaluate aerodynamic characteristics of the body profile and frontal area (1,2,3,4)
3. Assemble and evaluate the interior fits, acoustics, ergonomics and vision characteristics (1,2,3,4)
4. Assemble, evaluate and diagnose vehicle environmental systems (1,2,3,4)
5. Assemble, evaluate, adjust and diagnose vehicle suspension and steering systems (1,2,3,4)
6. Assemble, evaluate, adjust and diagnose vehicle brake systems including VDC, TDC and ABS (1,2,3,4)
7. Evaluate, and diagnose navigation and smart and safety systems (1,2,3,4)
8. Evaluate hydraulic fluids and greases using SAE, NLGI and ASTM tests (1,2,3,4)

**Computer Usage:**

The computer will be used for calculation of suspension angles, torques, and natural frequencies And simulations of road system frequencies. It will also be used to program shaker frequencies Found on road testing into off road testing. Simulations of traffic flow, road conditions and Simulations of TAC, ABS and VDC will be used.

**Laboratory Projects:**

1. Assembly, evaluation and testing of automotive brake systems including VDC, TCS, ABS and stability
2. Assembly evaluation testing and adjustment of vehicle suspension systems including active control using force analyzers, aligners and dynamic instrumentation
3. Body, door, window construction, testing and evaluation noting vibration and noise characteristics
4. Assembly, evaluation and installation of climatic control systems
5. Evaluation of navigation and smart highway systems
6. Evaluation of vehicle safety systems and crash energy management
7. Evaluation of fluids and lubricants used in modern chassis systems

**Oral and Written Communication:**

Laboratory reports will be used on all laboratory activities with the students writing an individual report on each activity using library references. Students will make oral presentations to classmates regarding research and laboratory observations. On written assignments a minimum of 25% of the grade will be based on grammar and spelling.

**Calculus Usage:**

Calculus will be used in the process of calculating noise, vibrations and spring. Computer packages use calculus in evaluations of energy management and collision reconstruction.

**Library Usage:**

The use of the library is mandatory in making evaluations of laboratory projects. The library contains a wealth of information from SAE and other professional society and engineers

Prepared by James VanDePolder Modified 2006