ISD 599 883 WN 2016

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Office Hours

Instructor (Amey Karnik) (akarnik@umich.edu)

Mon : 08:00 - 08:30pm [WebEx Only]

Wed : 08:00 - 08:30pm [WebEx Only]

Thu : 05:00 - 06:00pm [WebEx Only]

GSI (Fengwen Song) (enos@umich.edu)

Mon: 06:30 - 07:00pm [WebEx Only]

Wed: 10:00 - 10:30am [WebEx Only]

Fri: 1:00 - 2:00pm [OnCampus/WebEx] @ Findley Learning Center (2502 GGB)

[1 hr] : As per the preference of Distance Learning students

The course is an introduction to the design of road vehicles through modeling and system analysis. The course is designed to provide basic introduction to various vehicle subsystems and their functional performance characteristics. Domain specific modeling and analysis methods will be discussed and applied. The scope of this course will be limited to modeling and analysis of the basic phenomena related to longitudinal motion, propulsion systems and lateral motion.

Longitudinal motion topics will cover vehicle statics and weight transfer effects of acceleration and deceleration, wheel-road interaction and braking systems, and analysis related to brake proportioning and traction control.

Propulsion systems will cover combustion engines and transmission. Modeling of thermodynamic cycles for internal combustion engines, engine breathing, engine losses, fuel consumption and emissions; Moving-off elements in transmissions, gear selection for combustion powertrain, and analysis of epicyclical gears; Energy management systems and cold start requirements.

Ride and handling topics will cover suspension systems, pitch and bounce, basics of lateral motion, lateral dynamics model, understeer and oversteer during cornering, and interaction with suspensions.

The course will provide an exposure to modeling and analysis tools such as numerical integration, transfer functions, state space representation, frequency response and state-transitions.

Matlab/Simulink toolbox will be used for modeling, system analysis and controls development. The tools and methods reviewed in this course supports a systems engineering framework, commonly used in the design and manufacture of complex products, such as road vehicles.

Books and references:

[**GIL**] Fundamentals of Vehicle Dynamics by Thomas D. Gillespie, Society of Automotive Engineers, 1992

[**HEY**] Internal Combustion Engine Fundamentals, by John Heywood, McGraw-Hill Education, 1988

[**NAU**] Automotive Transmissions: Fundamentals, Selection, Design and Application, by Harald Naunheimer, Bernd Bertsche, Joachim Ryborz, Wolfgang Novak, Springer

Notes Additional references for specific topics or notes from the instructor

Grading policy

Exam 1	15
Exam 2	15
Exam 3	15
Home-work & Quiz	30
Project	20
Participation	5
	100

Date	**Topic**	**Reference**	**Module**
6-Jan	Introduction to Vehicle Modeling and System Analysis		1
11-Jan	Longitudinal motion: Statics	GIL Ch.1	1
13-Jan	Longitudinal motion: vehicle acceleration	GIL Ch.2	1
18-Jan	Martin Luther King - No class (Brakes lecture recording)	GIL Ch.4	2
20-Jan	Longitudinal motion: Brakes	GIL Ch.3	2
25-Jan	Longitudinal motion: Brake Systems/ Review	GIL Ch.3	2
27-Jan	**Exam 1**		
1-Feb	Propulsion Systems - Combustion Powertrain	HEY Ch.2	3
3-Feb	Propulsion Systems - Combustion Powertrain	HEY Ch.5	3
8-Feb	Propulsion Systems - Combustion Powertrain	HEY Ch.5	3
10-Feb	Propulsion Systems - Transmissions	NAU	4
15-Feb	Propulsion Systems - Transmissions	NAU	4
17-Feb	Propulsion Systems - Transmissions	NAU	4

22-Feb	Propulsion Systems - Modeling/Review		
24-Feb	**Exam 2**		
29-Feb	Spring break		
2-Mar	Spring break		
7-Mar	No class/Reserve for snow day		
9-Mar	Control Systems		5
14-Mar	Control Systems: Longitudinal motion	Notes	5
16-Mar	Control Systems: Propulsion systems	Notes	6
21-Mar	Control Systems: Energy Management	Notes	6
23-Mar	Project review		
28-Mar	Lateral Dynamics	GIL Ch.6	7
30-Mar	Lateral Dynamics	GIL Ch.6	7
4-Apr	**Project presentations**		
6-Apr	**Project presentations**		
11-Apr	Ride & Vibrations: Suspensions, NVH	GIL Ch.5	8
13-Apr	Ride & Vibrations: Cornering with Suspensions	GIL Ch.5	8
18-Apr	Review		
20-Apr	-		
25-Apr	**Exam 3* (or Apr 27, Wed 8:00-10:00)**		

We will be using Piazza for conducting all class-related discussion. The quicker you begin asking questions on Piazza (rather than via emails), the quicker you'll benefit from the collective knowledge of your classmates and instructors.

Instructions related to Assignments

- Assignments will be made available at the start of every module
- All assignments are due electronically by 8pm on the Friday.
- Late submissions will attract a penalty of 10% per day
- All assignments must be completed (even if late) to obtain a B- grade or higher.
- Distance learning students are eligible for a penalty-free grace period of 2 days. (This allows 2 weekends to complete the assignment.) Valid excuses, prior to the due date, due to unforeseen circumstances will be entertained.

Please do not wait until the last minute to complete the assignments! Consult with classmates, and discuss over Piazza if you have questions, but provide individual solutions. Do not copy scripts from your classmates, write your own. Note that one of the objectives is to increase familiarity with Matlab Tools.

Submit your solution as a single PDF. You do not need to include the details of your Matlab scripts or snapshots of the simulink model unless explicitly asked for.

Instructions related to Quiz

The level of difficulty in the Quiz will be similar to homework but will have to be solved independently without discussions with classmates

Instructions related to Exam

Exams will mainly include analytical problems similar to those covered in class or assignments. Pay attention to the **tasks** provided in the class slides, and make sure you attempt those while preparing for the exam.

Grading scale (Tentative) [will be revised after first exam]

B- : All assignments + 60 points

B+ : All assignments + 75 points

A : 90 points or higher