MME: Vehicle dynamics

Programme: B. Tech. (ME)/Automotive Tech.   Year: 3rd year - 5th sem,

Course: Core   Credits: 3   Hours: 30 lec.+10 labs

Course Context and Overview (100 words):

The objective of the course is to provide basic knowledge of vehicle dynamics. It covers the fundamental principles of vehicle stability, safety and driving comfort. This will help the students to develop the skill in understanding different types of force and moment acting in 3 dimensions of vehicle. At the end of the course, the student will be able to understand the principle and performance of vehicle.

Prerequisites Courses: Kinematics and Dynamics of Machinery
(Course name and course code)

Course outcomes (COs):

On completion of this course, the students will have the ability to:	
CO1 : Understand the fundamental of longitudinal dynamics	Unit 1
C02 : Able to make tire dynamics model	Unit 2
C03 : Formulate the equations of lateral and vertical dynamics	Unit 3, Unit 4
C04 : Able to make quarter and half car models	Unit 4

Course Topics:

Topics	Lecture Hours	Student development
UNIT - I 1. Topic <u>**Introduction to Longitudinal dynamics**</u> Various forces acting on the vehicle, Acceleration and Braking - Brake Force, Braking Distance, longitudinal dynamics on different roads. Aerodynamics on the vehicle. Modelling of longitudinal dynamics	5	Skill development
UNIT – II **Topic <u>Tire Mechanics</u>** An Introduction of tire mechanics, Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development - Contact Patch and Contact Pressure Distribution, simple tire model, magic formula. Modelling of tire model	7	Employability
UNIT - III **Topic <u>Lateral Dynamics</u>** Bicycle Model - Stability and Steering Conditions, Understeer Gradient and State space Approach, Parameters affecting vehicle handling characteristics. Modelling of lateral dynamics	9	Skill development
UNIT – IV **Topic <u>Vertical Dynamics</u>** Passive suspension, semi-active suspension, active suspension, quarter car model, half car model, Rollover Prevention, Modelling of quarter and half car models	9	Skill development

Textbook references (IEEE format):
Text Book:

1. Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992.

2. Rajesh Rajamani, "Vehicle Dynamics & control", Springer, ISBN: 978-1-4614-1432-2.

3. R N Jazar, "Vehicle Dynamics: Theory and Application", Springer, 2017.

4. Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.

5. Hans Pacejka, "Tire and Vehicle Dynamics", Elsevier, 2012.

Reference books:

6. R.V. Dukkipati, "Vehicle dynamics", Narsova Publications.

7. Milliken W F and Milliken D L, "Race car Vehicle Dynamics", SAE.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.): NPTEL, MIT Opencourseware etc.

Evaluation Methods:

Item	Weightage
Quiz/Assignments/Project:	25
Midterm	25
Final Examination	50

Attendance: 70% Compulsory to present in exam

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Experiment Name	Lab Hours
1. Modelling and Simulation of longitudinal dynamics in Matlab/Simulink 2. Modelling and Simulation of Braking performance in Matlab/Simulink 3. Simulation of vehicle dynamics in IPG Carmaker 4. Simulation of lateral dynamics model of vehicle in IPG Car maker 5. Modelling and Simulation of quarter car in Matlab/Simulink 6. Modelling and Simulation of half car model dynamics in Matlab/Simulink 7. Modelling and Simulation of vehicle dynamics in AVL Cruise (4 hr) 8. Aerodynamics modelling on the vehicle model in Ansys/Fluent (4 hr)	2

List of Experiments:

Department of _MME_____   The LNM IIT, Jaipur

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