

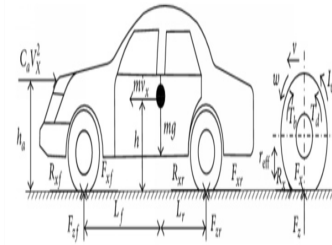
19AE404 VEHICLE DYNAMICS

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P	CS	WA/RA	SSH	SA	S	BS
45	-	-	5	5	30	20	5	5



Source :

[https://
www.researchgate.net/](https://www.researchgate.net/)

COURSE DESCRIPTION AND OBJECTIVES:

This course enriches knowledge of the learners in analyzing forces and moments exerted in vehicle under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle.

LINKS TO OTHER COURSES:

- Finite element analysis
- Vehicle Design and Data Characteristics

COURSE OUTCOMES:

Upon completion of the course, the students will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand the basics of vibration, when the vehicle is at dynamic condition.	10
2	Understand the tyre dynamics with respect to force & moments.	2,6
3	Derive the effective cornering stiffness when considering the elastic elements in the wheel suspension and be able to analyze effect on the dynamic characteristics of the vehicle.	3,9,10
4	Understand the aerodynamic forces & moments, load distribution in the various vehicles.	4,12
5	Test the effective steering geometry, vehicle handling & directional control of vehicle.	5,10

SKILLS:

- ✓ Identify the various concepts in vibration.
- ✓ Identify the concepts in tire Dynamics.
- ✓ Design & analysis of various types of suspension system.
- ✓ Explore the concepts the longitudinal and lateral dynamics.

UNIT - I**L-9**

CONCEPT OF VIBRATION: Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed.

UNIT - II**L-9**

TIRE DYNAMICS: Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Magic formulae tire model, Estimation of tire road friction. Test on Various road surfaces. Tire vibration.

UNIT - III**L-9**

VERTICAL DYNAMICS: Human response to vibration, Sources of Vibration. Design and analysis of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.

UNIT - IV**L-9**

LONGITUDINAL DYNAMICS: Aerodynamic forces and moments. Equation of motion. Resistance, rolling resistance, Load distribution for three wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for different drives. Braking and Driving torque. Prediction of Vehicle performance.

UNIT - V**L-9**

LATERAL DYNAMICS: Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles .Roll center, Roll axis, Vehicle under side forces. Stability of vehicle running on slope, banked road and during turn, Effect of suspension on cornering, latest trends in Vehicle dynamic testing like four poster, Multi axis simulator, etc.

TEXT BOOKS :

1. Amitosh DE "Vehicle Dynamics" 2nd Edition, Galgotia Publications, 2012.
2. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010.
3. Wong. J. Y., "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2001.
4. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005.
5. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992.

REFERENCE BOOKS:

1. Dean Karnopp, "Vehicle Stability", 1st edition, Marcel Dekker, 2004.
2. NakhaieJazar. G., "Vehicle Dynamics: Theory and Application", 1st edition, Springer, 2008.
3. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", Elsevier limited 2004.
4. Hans B Pacejka, "Tire and Vehicle Dynamics", 2nd edition, SAE International, 2005 65.
5. John C. Dixon, "Tires, Suspension, and Handling", 2nd edition, Society of Automotive Engineers Inc, 1996.
6. Jan Zuijdijk, "Vehicle dynamics and damping", Author House, 2009.