



SILVER OAK UNIVERSITY

**Engineering and Technology (M.Tech.)
Mechanical (I.C. Engine & Automobile Engineering)**

Subject Name: Vehicle Dynamics

Subject Code:

Semester: II

Prerequisite:

Fundamentals of Engineering Mechanics, Theory of Machines.

Objective:

This course is intended to build up to understand basic mechanisms of passenger car vehicles which concerned with acceleration, braking, ride and turning of automobile vehicle. Dynamic behaviour is determined by the forces imposed on the vehicles from the tires, gravity and aerodynamics. The knowledge of this subject is essential to design aerodynamics shapes of car body, to calculate equivalent weight and maximum acceleration, desired power to propel the vehicle.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Evaluation Scheme				Total Marks
L	T	P	C	Internal		External		
				Th	Pr	Th	Pr	
3	2	0	4	40	20	60	30	150

Content:

Unit No.	Course Contents	Teaching Hours	Weightage %
1	Unit-I Introduction: Introduction to Vehicle Dynamics, Lumped mass, Vehicle fixed coordinates system, Earth fixed coordinates system, Forces, Dynamic Axle loads, Static loads, low speed acceleration, Grade Loads	6	14
2	Unit-II Vehicle Performance: Acceleration Performance: Power limited acceleration; Traction limited acceleration, Braking Performance: Basic braking equations, Braking forces, Tire-Road Friction, Brake Proportioning, Anti-lock Brake System (ABS), Cruise Control and Adaptive Cruise Control (ACC)	7	17

3	Unit-III Road Loads: Aerodynamic Performance: Mechanics of air flow around a vehicle, pressure distribution on a vehicle, Aerodynamics forces, Drag force, Lift force, Side force, Pitching Moment, Yawing Moment, Rolling Moment, Crosswind Sensitivity, Aerodynamic aids to vehicle: Bumper Spoiler, Air Dams, Deck Lid Spoilers, Window and Pillar Treatments Rolling Resistance: Factors affecting Rolling Resistance, Tire Temperature, Tire inflation pressure/loads, Tire material and design, Velocity. Effects of Total road loads on fuel economy.	10	24
4	Unit-IV Ride Characteristics: Excitation Sources: Road Roughness, Tire/Wheel Assembly, Driveline excitation, Engine transmission. Vehicle Response properties: Suspension Isolation, Suspension Stiffness, Suspension damping, Wheel hop resonance, Suspension nonlinearity, and Rigid body bounce. Perception of Ride: Tolerance to Seat Vibrations, Other Vibration forms	6	17
5	Unit-V Cornering: Introduction, low speed turning, high speed turning, Suspension effects on cornering, Methods for measurement of understeer gradients: Constant radius method, Constant Speed Methods	5	14
6	Unit-VI Stability of Vehicles: Load distribution, calculation of tractive effort and Reactions for different drives, stability of a vehicle on a slope, on a curve and on banked road.	5	14

Course Outcome:

Students upon learning this subject will be able to

Sr. No.	CO statement	Unit
CO-1	Understanding of Vehicle Dynamics, Vehicle fixed coordinates system and loads acting on vehicle	1
CO-2	Acquire knowledge of Acceleration performance, braking performance, Anti-lock Brake System (ABS), Cruise Control and Adaptive Cruise Control (ACC).	2
CO-3	Understanding Aerodynamic Performance of automobile	3
CO-4	Understanding ride characteristics, vehicular response, and calculation of seat tolerances	4
CO-5	Knowledge, calculation of cornering and stability of vehicle	5,6

List of Tutorial:

1. Study of mechanism for air flow over different geometry of vehicles.
2. Study of measurements of drag and lift coefficient for different geometry vehicle.
3. To study Anti-lock Brake System (ABS) used in automobile vehicles.
4. To study Cruise Control and Adaptive Cruise Control (ACC) used in automobile vehicles.
5. To study advanced cornering and parking system used in automobile vehicles.
6. To study automatic wheel alignment and balancing system.

Books Recommended:-

1. Fundamentals of Vehicle Dynamics – Thomas D. Gillespie, 2013, Society of Automobile Engineers Inc., ISBN:978-1560911999
2. Steering, Suspension & Tyres – J. G. Giles, Ilete Books Ltd., London
3. Mechanics of Road Vehicles – W. Steed, Ilete Books Ltd. London
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK
5. Gillespie.T.D., “Fundamental of vehicle dynamic society of Automotive Engineers ”, USA, 1992.
6. Vehicle dynamics and control by Rajesh Rajamani , Springer publication
7. Vehicle Dynamics : Theory and Application by Reza N Jazar, Springer publication
8. Theory of Ground Vehicles - J. Y. Wong - John Willey & Sons, NY