GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3721110
VEHICLE DYNAMICS
SEMESTER: II

Type of course: Program Elective - III

Prerequisite: - Fundamentals of Engineering mechanics, theory of machines.

Rationale: This subject is concerned with the acceleration, braking, ride and turning of Automobile vehicle on a road surface. Dynamic behavior is determined by the forces imposed on the vehicles from the tires, gravity and aerodynamics. The course is designed to provide understanding about effects of various unbalanced forces, its effects on the various components of vehicle and method to balance that unbalanced forces for getting smooth operation and long life of the vehicle. This course also aims to build higher level cognitive skill of future engineers for analyzing vehicle performance against various resistances acting on it during automotive operation, vibrations and its effects with respect to ergonomics of the vehicle. 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	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% 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-IVRide Characteristics**: Excitation Sources: Road Roughness, Tire/Wheel Assembly, Driveline excitation, Engine transmission. Vehicle	7	**17**

	Response properties: Suspension Isolation, Suspension Stiffness, Suspension damping, Wheel hop resonance, Suspension nonlinearity, Rigid body bounce. Perception of Ride: Tolerance to Seat Vibrations, Other Vibration forms.		
5	**Unit-VCornering**: Introduction, low speed turning, high speed turning, Suspension effects on cornering, Methods for measurement of understeer gradients: Constant radius method, Constant Speed Methods	6	**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.	6	**14**

Reference Books:

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 , Springerpublication
7. Vehicle Dynamics : Theory and Application by Reza N Jazar, Springerpublication
8. Theory of Ground Vehicles - J. Y. Woung - John Willey & Sons,NY

Course Learning Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Understanding of Vehicle Dynamics, Vehicle fixed coordinates system and loads acting on vehicle.	15
CO-2	Acquire knowledge of Acceleration performance ,braking performance, Anti-lock Brake System (ABS), Cruise Control and Adaptive Cruise Control (ACC).	20
CO-3	Understanding Aerodynamic Performance of automobile	20
CO-4	Understanding ride characteristics, vehicular response, and calculation of seat tolerances	15
CO-5	Knowledge , calculation of cornering and stability of vehicle	30

List of Experiments

1. Experimental study of mechanism for air flow over different geometry ofvehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnelapparatus.
3. To study Anti-lock Brake System (ABS) used in automobilevehicles.
4. To study Cruise Control and Adaptive Cruise Control (ACC) used in automobilevehicles.
5. To study advanced cornering and parking system used in automobilevehicles.
6. To study automatic wheel alignment and balancingsystem