GUJARAT TECHNOLOGICAL UNIVERSITY

BE – Semester 7
Minor Degree : Electrical & Computer
Subject Code : N117AL01(w.e.f. AY 2026-27)
Subject Name : Vehicle Dynamics

Type of course : Minor degree

Prerequisite :

Rationale : To understand the performance of vehicle in various modes such as longitudinal, vertical and lateral directions, identification of various forces and loads, and evaluation of performance under acceleration, braking, cornering and ride conditions is essential.

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	-	100

Content :

Sr. No.	Content	Total Hrs
1	Understanding Vehicle Dynamics: Introduction, Fundamental approach to modeling (Lumped mass, Vehicle fixed coordinate system, Earth fixed coordinate system, Euler angles), Dynamic axle loads, Location and height of center of gravity (C.G) of vehicle, Total road loads, Effect of road loads on fuel economy	05
2	Acceleration Performance of Vehicle: Power-limited acceleration, Traction-limited acceleration Braking Performance of Vehicle: Basic equations (Constant deceleration, deceleration with wind resistance), Energy/Power absorbed during braking, Braking forces, Brake factor, Tyre-Road friction, Federal requirements for braking performance, Brake proportioning, Anti-Lock brake system, Braking efficiency, Rear wheel lockup, Pedal force gain	06
3	Aerodynamics: Mechanics of air flow around a vehicle, Pressure distribution on a vehicle, SAE aerodynamic axis system, Aerodynamic forces and moments, Drag components, Lift coefficient, Drag coefficient, Aerodynamics aids, Cross wind sensitivity, Wind tunnel testing and measurement	07
4	Suspensions: Functions, Suspension types (Solid axles, Independent), Suspension kinematics, Anti-Squat and Anti-Pitch suspension geometry, Anti-Dive suspension geometry, Roll center analysis, Suspension dynamics, Multi-Body vibration, Controllable suspension elements: Active, Semi-Active	08

5	Steering System: Steering linkages, Steering geometry, Steering geometry error, Steering system forces and moments, Steering system models, Four-Wheel steering, Steady-State Cornering: Low-Speed turning, High-Speed cornering.	08
6	Rollover: Quasi-Static rollover of a rigid vehicle, Quasi-Static rollover of a suspended vehicle, Transient rollover.	04
7	Tyre Mechanics: Tyre construction, Size and load rating, Terminology and axis system, Mechanics of force generation, Rolling resistance, Factor affecting rolling resistance, Tractive properties, Cornering properties, Camber thrust, Aligning moment, Combined braking and cornering, Conicity and ply steer.	07

Suggested Specification table with Marks (Theory) :

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**50**	**-**	**-**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books :

1. Fundamentals of Vehicle Dynamics by Thomas D. Gillespie.
2. Race Car Vehicle Dynamics by W. F. Milliken and D. L. Milliken.
3. Vehicle Dynamics: Theory and Application by R. N. Jazar.
4. Theory of Ground Vehicles by J. Y. Wong.
5. Advanced Vehicle Technology by Heinz Heisler.

Course Outcomes :

Sr. No.	CO statement	Marks % weightage
CO-1	To explain the basic concepts of vehicle dynamics and rollover theory.	20
CO-2	To analyse the acceleration and braking performance of vehicle.	14
CO-3	To apply the aerodynamic concept/theory to vehicle and evaluate the aerodynamic forces and moments.	15
CO-4	To examine/analyse the characteristic/properties of suspension and steering system for/on the dynamics of the vehicle.	36
CO-5	To identify important of tyre mechanism for aspect of dynamics of the total vehicle.	15

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List of Experiments :

1. Experimental study of mechanism for air flow over different geometry of vehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.
3. To study the effect of tyre pressure and temperature on the performance of the tyre.
4. To simulate and study a quarter car models using MBD (Multi Body Dynamics) software.
5. To simulate and understand behavior of sprung / un-sprung mass & lumped mass system MBD software.
6. Finding the stiffness of tyre with variation of air pressure.
7. To simulate and study the effect of different conditions on vehicle loading.
8. Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.
9. Study the location & height of Centre of gravity (C.G) of a vehicle
10. To study the dynamic axle load condition

Major Equipment :

1. Wind tunnel apparatus
2. Multibody (MBD) simulation software

List of Open-Source Software/learning website :

1. http://nptel.ac.in/courses/107106080

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