

**Subject Code: 01AE0603**

**Subject Name: Vehicle Dynamics**

**B.Tech. III Year – (Sem-6) Automobile Engineering**

**Type of course:** Engineering

**Prerequisite:** Basic knowledge of KOM, DOM & Automobile system

**Rationale:** Understanding of Dynamic behaviour of different systems in different loading condition in automobile vehicle

**Course Outcomes:**

1. To present a problem oriented in depth knowledge of Vehicle Dynamics.
2. To address the underlying concepts and methods behind Vehicle Dynamics

**Teaching and Examination Scheme:**

Teaching Scheme (Hours)			Credits	Evaluation Scheme					Total Marks
Theory	Tutorial	Practical		Theory Marks			Practical Marks		
				ESE(E)	IA	CSE	Viva(V)	Term Work(TW)	
4	0	2	5	50	30	20	25	25	150

Sr No	Topics	Duration	Weightage
1	<b>Introduction to Vehicle Dynamics:</b> History, vehicle classifications, fundamental approaches to vehicle dynamics modelling; SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, braking performance, Brake proportioning, braking efficiency.	6	10
2	<b>Acceleration Performance</b> Power train components; power and traction limited acceleration; transverse weight shift; front wheel drive vs rear wheel drive vs. all-wheel drive vehicles	5	15

<b>3</b>	<b>Braking Performance</b> Braking force analysis; brake design and analysis; federal regulation on braking performance; antilock braking system; wheel lock-up; tire/road friction; safety and maintenance issues in braking	5	15
<b>4</b>	<b>Road Loads</b> Wind drag and car body design, rolling resistance; breakdowns of total road loads; gas mileage analysis and driving styles; Aerodynamics	6	10
<b>5</b>	<b>Tire and Tire Dynamics</b> Tire specifications and constructions; tire motion analysis; tire force analysis; tire contact stress analysis; tire vibration analysis; tire models	5	10
<b>6</b>	<b>Ride &amp; Cornering/steering</b> Riding comfort; perception of vibration; vibration sources; vibration transmission to the passengers; lower speed cornering; high speed corner; cornering bicycle model; Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover	8	15
<b>7</b>	<b>Chassis and Suspension Systems</b> Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and aft directions.	5	15
<b>8</b>	<b>Motorcycle Dynamics</b> Kinematic structure and geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling and aerodynamic resistance forces, resistant force caused by slope), Location of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle	5	10

R Level	U Level	A Level	N Level	E Level
20	35	20	20	05

## REFERENCES

1. Fundamentals of Vehicle Dynamics, Thomas Gillespie, SAE Publication.
2. The Multibody systems Approach to Vehicle Dynamics, Mike Blundell and Damian Harty, Elsevier, 2004.
3. Vehicle Dynamics, Theory and Application, Reza N. Jazar, Springer, 2009, ISBN 978-0-387-74243-4, e-ISBN 978-0-387-74244-1.
4. Race Car Vehicle Dynamics, W.F. Milliken and D.L. Milliken, SAE, 1995, ISBN 1-56091-526-9.
5. Reimpell, Stoll and Betzler: The Automotive Chassis: Engineering Principles.
6. Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012
7. Rajesh Rajamani, Vehicle Dynamics & control, Springer.
8. R.V. Dukkipati, Vehicle dynamics, Narsova Publications.
9. Vittore Cossalter, Motorcycle Dynamics, 2nd Edition, Publisher: LULU.com

## 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 software.
5. To simulate and understand behaviour 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 geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider
10. Study the location & height of Centre of gravity (C.G) of a motorcycle