

GUJARAT TECHNOLOGICAL UNIVERSITY

AUTOMOBILE ENGINEERING

B. E. SEMESTER: VII

Subject Name: **Vehicle Dynamics**

Subject Code: **170203**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	University Exam (E)		Mid Sem Exam (Theory) (M)	Practical (Internal)
				Theory	Practical		
4	0	1	5	70	30	30	20

Sr. No.	Course Contents	Total Hrs
1.	Understanding Vehicle dynamics History, Fundamental Approach to Modeling (Lumped mass, Vehicle Fixed Coordinate system, Earth Fixed Coordinate System, Euler Angles). Dynamic loads in moving vehicle Study of Forces (Newton's Second Law), Dynamic Axle loads (Static Loads on Level ground, Low-speed Acceleration, Loads on Grades) Load transfer during acceleration, braking, constant velocity motions, conditions for traction, layout analysis as front engine, rear engine, front wheel and rear wheel drive.	5
2.	Tyres: Tire Construction, Size and load rating, Terminology and Tyre Axis system, mechanics of Force Generation, Effect on various performance parameters (Slip angle, Tire Type, Vertical load, Inflation pressure, Size and Width, Tread Design, Surface friction, Speed, Path curvature), having Relevance to vehicle performance on Tractive properties, cornering properties, Camber Thrust, Aligning moment, Combined braking and Cornering, Conicity and Ply steer.	6
3.	Acceleration performance of Vehicle Power-limited Acceleration (based on Engines, Power Train – transmission & final drive ratio, Automatic Transmissions). Traction-limited Acceleration(Transverse weight shift due to drive torque, traction limits)	6

4.	Braking Performance Basic Equations (Constant Deceleration, deceleration with wind resistance), Energy / Power absorbed during braking, Braking Forces, Brakes factor, Tire-road Friction, Federal Requirements for Braking Performance, Braking Proportioning, Anti-Lock brake system, Braking Efficiency, Rear wheel Lockup, Pedal Force Gain.	7
5.	Suspension system Solid axles (Hotchkiss, Four Link, DeDion), Independent suspensions (SLA Front Suspension, Macpherson Strut, Trailing-Arm Rear Suspension, Semi-Trailing Arm, Swing Axle, Multi link rear suspension), Anti-Squat, Anti-pitch and Anti-Dive Suspension Geometry (Equivalent Trailing Arm Analysis, Rear Solid Drive Axle, Independent Rear Drive, Front Solid Drive Axle, Independent front-Drive Axle, four-Wheel Drive), Active suspension, Roll Center Analysis.	8
6.	The Steering system Steering linkages, steering geometry error, Front wheel geometry, Forces and moments, Steering system models and its effects - Steering ratio, Understeer, Influence of front-wheel drive (Driveline Torque about the steer axis, Influence of tractive force on tire cornering stiffness and Aligning moment, Fore/ Aft load Transfer, FWD understeer influences), Four-Wheel steer (Low-speed Turning, high speed cornering). Force analysis during steering, steering oscillation, tramp, shimmy, wobble, directional stability.	6
7.	Road Loads Aerodynamics(Mechanics of air flow around a vehicle, Pressure distribution on a Vehicle, Aerodynamic Forces, Drag Components, Aerodynamics Aids, Drag, Side Force, Lift Force, Pitch Moment, Yawing moment, Rolling Moment, Crosswind Sensitivity), Rolling Resistance(Factors affecting rolling resistance, Typical coefficient), Total road Loads and effect of Road loads on Fuel economy.	8
8.	Ride: Excitation sources (Road Roughness, Tire/ wheel assembly, Driveline Excitation, Engine/ Transmission), Vehicle Response Properties(Suspension Isolation, Suspension Stiffness, Suspension Damping, Active Control, Wheel Hop Resonances, Suspension Nonlinearities, Rigid body Bounce/Pitch motions, Bounce/ pitch Frequencies, Special cases). Perception of ride (Tolerance to seat vibrations, other vibration forms).	7
9.	Steady-state Cornering Basics, Low-speed Turning, High-speed cornering (Tire Cornering forces, Cornering Equations, Understeer Gradient, Characteristic speed, Critical speed, Lateral Acceleration Gain, Yaw velocity Gain, Side slip angle, Static Margin), Suspension effects on Cornering(Rolling moment distribution, Camber Change, Roll steer, Lateral Force compliance steer, Aligning Torque, Effect of tractive force on Cornering).	7

Term Work:

The term work shall be based on the topics mentioned above.

Text Book:

1. Vehicle dynamics, by Dr. Thomas Gallespie, SAE Publications.

Reference Books:

1. Vehicle dynamics, by R.V.Dukhopati, Narsova Publications.
2. Mechanics of Road vehicles , by Stead, TMH
3. Vehicle Dynamics, by S.R.Ellise, East West Press.
4. Automotive Mechanics, by N.K.Giri, Khanna Publishers,
5. Motor Vehicles, by Khovak, Mir Publishers
6. Automotive mechanics by Crouse, TMH
7. Automobile system by Anil Chikara, Satya Prakashan