**Vehicle Model**

The government and the private organizations across the world have classified the vehicle that are used for all regulations, descriptions and categorization of Car.

The International standard IS 3833 -1977 Road Vehicle classify types, terms and definition of Car.

**Quadricycle:** It is a Europe union vehicle type for 4 wheeled micro-cars with a limited weight, engine power and speed.

**A Class:** It is used for city car, the smallest type of passenger vehicle define by Europe commissioning body. In Europe the term City Car is used.

**B Class:** The second smallest of the European segments for passenger car, which describe the small car. It is equivalent to subcompact category in USA and super-mini in Great Britain.

**C Class:** The third smallest of the European segments and is called medium car. It is equivalent to Euro NCAP “Small Family Car” and the compact car category in USA and Britain.

**D Class:** The third largest of the European segments and is called large car. It is equivalent to the Euro NCAP “Large Family Car” and comes under mid-size car category in North America. Compact executive are the part of D- Segment category.

**E Class:** The second largest passenger car in the European Segments terms as executive car.

**F Class:** The largest of the European segments for passenger car and always belongs to “Luxury Car”. The equivalent category are full size luxury sedan in US, luxury saloon in UK and oberklasse in Germany.

**S Class:** Sports car and is equivalent Euro NCPA Class is “Roadster Sport”.

**M Class:** Multi-purpose vehicle include minivans and cargo vans.

**J Class:** It is a sport utility car cover a broad category of vehicle ranging from crossovers, sports utility vehicle and off road vehicle.

For more details [Click Here.](https://en.wikipedia.org/wiki/Car_classification)

**Micro/Mini: Up to 1000cc**

Maruti Alto 800

Renault Kwid

Tata Nano

Honda Life

**Economy hatchback: 1400cc to 2000cc**

Maruti Suzuki Swift

Hyundai i10, i20

Ford Figo

**Sedan: Family Car (5 Passenger with limited storage)**

Maruti Suzuki Desire

Honda Amaze, Honda City

Toyota Yaris

Skoda Rapid

**Coupe: (4 Passenger) with sporty look and power full engine**

Mercedes Benz GLC coupe

Ford Mustang

Lamborghini Huracan

Audi R8

Bugatti Veyron

**Sports cars: High performance (usually V8 and V12 Engine 500hp)**

Hennessey Venom F5 (301MPH)

Bugatti Veyron (268MPH)

SSC Aero (256MPH)

Tesla Roadster (250MPH)

**Convertibles: Retractable roof**

Mazda MX5 Miata

Mercedes Benz C- Class

Chevrolet Corvette

**SUVs: Enhanced suspension and large wheels (5 to 7 Passenger)**

Lincoln Navigator

Land Rover

Mercedes Benz G- Class/ GLS- Class

BMW X7

Toyota Land Cruiser

Infiniti QX80

**Luxury cars: Premium accessories and prioritize comfort**

Mercedes S- Class

Bentley Continential GT/ Bentayga

Roll Royce Panatom

Porsche Panamera

BMW 7 series

Audi A8

**Pickup: Enclosed cab with an open cargo area**

Nissan Titan

Ford F-150

Mahindra Bolero

Tata Xenon Yodha

**Crossover: Similar to SUV with different chassis design**

Honda CR-V

Mazda CX-5

Toyota RAV 4 Hybrid

Hyundai Santa Fe

**Estate cars: Extended boot for extra luggage**

Mercedes AMG- C63S Estate

Ford focus ST Estate

Volkswagen Gold R Estate

Audi RS Avant

**Limousine: Elongated base and unique design**

The Bat mobile Limousine

The Sultan of Brunei’s Roll Royce Silver Spur Limo

Cadillac

The American dream

**Modified cars: Preferable design as per requirement**

Honda Civic

Mazda MX5 Miata

Toyota Supra

Volkswagen Golf

Mazda RX7

Mitsubishi Lancer Evolution

Ford Mustang

**Automobile Basic**

Classification can be done based on;

1. **Propulsion system**

[Internal combustion engine](https://en.wikipedia.org/wiki/Internal_combustion_engine)

[Electric vehicle](https://en.wikipedia.org/wiki/Electric_vehicle)

[Battery electric vehicle](https://en.wikipedia.org/wiki/Battery_electric_vehicle)

[Neighborhood Electric Vehicle](https://en.wikipedia.org/wiki/Neighborhood_Electric_Vehicle)

[Hybrid vehicle](https://en.wikipedia.org/wiki/Hybrid_vehicle)

[Plug-in hybrid](https://en.wikipedia.org/wiki/Plug-in_hybrid)

[Plug-in electric vehicle](https://en.wikipedia.org/wiki/Plug-in_electric_vehicle)

[Hydrogen vehicle](https://en.wikipedia.org/wiki/Hydrogen_vehicle)

[Fuel cell](https://en.wikipedia.org/wiki/Fuel_cell)

[Steam car](https://en.wikipedia.org/wiki/Steam_car)

[Alternative fuel vehicle](https://en.wikipedia.org/wiki/Alternative_fuel_vehicle)

[Auto gas](https://en.wikipedia.org/wiki/Autogas)

[Biodiesel](https://en.wikipedia.org/wiki/Biodiesel)

[Common ethanol fuel mixtures](https://en.wikipedia.org/wiki/Common_ethanol_fuel_mixtures)

[Flexible-fuel vehicle](https://en.wikipedia.org/wiki/Flexible-fuel_vehicle)

[Gasoline Direct Injection](https://en.wikipedia.org/wiki/Gasoline_direct_injection)

[Homogeneous Charge Compression Ignition](https://en.wikipedia.org/wiki/Homogeneous_charge_compression_ignition)

[Liquid Nitrogen](https://en.wikipedia.org/wiki/Liquid_nitrogen_vehicle)

1. [**Engine configuration**](https://en.wikipedia.org/wiki/Engine_configuration) ([IC engines](https://en.wikipedia.org/wiki/Internal_combustion_engine) only)

[Flat engine](https://en.wikipedia.org/wiki/Flat_engine)

[Flathead engine](https://en.wikipedia.org/wiki/Flathead_engine)

[Four-stroke engine](https://en.wikipedia.org/wiki/Four-stroke_engine)

[H engine](https://en.wikipedia.org/wiki/H_engine)

[Pushrod engine](https://en.wikipedia.org/wiki/Overhead_valve)

[Reciprocating engine](https://en.wikipedia.org/wiki/Reciprocating_engine)

[Single cylinder engine](https://en.wikipedia.org/wiki/Single_cylinder_engine)

[Straight engine](https://en.wikipedia.org/wiki/Straight_engine)

[Straight-six engine](https://en.wikipedia.org/wiki/Straight-six_engine)

[Two-stroke engine](https://en.wikipedia.org/wiki/Two-stroke_engine)

[V engine](https://en.wikipedia.org/wiki/V_engine)

[W engine](https://en.wikipedia.org/wiki/W_engine)

[Wankel engine](https://en.wikipedia.org/wiki/Wankel_engine)

1. **Fuel Type**

[Diesel engine](https://en.wikipedia.org/wiki/Diesel_engine)

[Gasoline engine](https://en.wikipedia.org/wiki/Petrol_engine)

[Electric car](https://en.wikipedia.org/wiki/Electric_car)

[Hybrid vehicle](https://en.wikipedia.org/wiki/Hybrid_vehicle)

[Hydrogen vehicle](https://en.wikipedia.org/wiki/Hydrogen_vehicle)

[Steam car](https://en.wikipedia.org/wiki/Steam_car)

1. **Positioning**

[Front-engine](https://en.wikipedia.org/wiki/Front-engine_design)

[Rear-engine](https://en.wikipedia.org/wiki/Rear-engine_design)

[Mid-engine](https://en.wikipedia.org/wiki/Mid-engine_design)

1. **Drive**

[Two-wheel drive](https://en.wikipedia.org/wiki/Two-wheel_drive)

[Four-wheel drive](https://en.wikipedia.org/wiki/Four-wheel_drive)

[Front-wheel drive](https://en.wikipedia.org/wiki/Front-wheel_drive)

[Rear-wheel drive](https://en.wikipedia.org/wiki/Automobile_layout#Rear-wheel-drive_layouts)

1. **Layout**

[Front-engine, front-wheel drive](https://en.wikipedia.org/wiki/Front-engine,_front-wheel_drive_layout)

[Rear-engine, front-wheel drive layout](https://en.wikipedia.org/wiki/Rear-engine,_front-wheel_drive_layout)

[Front-engine, rear-wheel drive](https://en.wikipedia.org/wiki/Front-engine,_rear-wheel_drive_layout)

[Front mid-engine, rear-wheel drive](https://en.wikipedia.org/wiki/Front_mid-engine,_rear-wheel_drive_layout)

[Rear mid-engine, rear-wheel drive](https://en.wikipedia.org/wiki/Rear_mid-engine,_rear-wheel_drive_layout)

[Mid-engine, front-wheel drive](https://en.wikipedia.org/wiki/Mid-engine,_front-wheel_drive_layout)

[Rear-engine, rear-wheel drive](https://en.wikipedia.org/wiki/Rear-engine,_rear-wheel_drive_layout)

For more details: [Click Here.](https://en.wikipedia.org/wiki/Outline_of_automobiles)

**Auto parts and system**

Engine+ Fuel / Motor+ Battery (EV)

Power train

Suspension

Steering

Brake

Tire

Chassis

Body

Accessories and Mounting

ECU, MCU and Power semiconductor device

Sensor

Safety Equipment

Formore details: [Click Here.](https://en.wikipedia.org/wiki/List_of_auto_parts)

**General** **Automobile concept**

Driving

Vehicle Dynamics

ADAS/Road Traffic and Automobile safety

**Tools**

CarSim 2020.0

SCANeR Studio 2021

**Vehicle Dynamics and ADAS**

**Vehicle Dynamics:**

Factor affecting vehicle dynamics are,

**Propulsion and braking [Longitudinal dynamics]**

[Automobile layout](https://en.wikipedia.org/wiki/Automobile_layout) (i.e. location of engine and driven wheels)

[Powertrain](https://en.wikipedia.org/wiki/Powertrain)

[Braking system](https://en.wikipedia.org/wiki/Braking_system)

**Suspension and steering [Vertical and Lateral Dynamics]**

Some attributes relate to the [geometry](https://en.wikipedia.org/wiki/Geometry) of the [suspension](https://en.wikipedia.org/wiki/Suspension_(vehicle)), [steering](https://en.wikipedia.org/wiki/Steering) and [chassis](https://en.wikipedia.org/wiki/Rolling_chassis). These include:

[Ackermann steering geometry](https://en.wikipedia.org/wiki/Ackermann_steering_geometry)

[Axle track](https://en.wikipedia.org/wiki/Axle_track)

[Camber angle](https://en.wikipedia.org/wiki/Camber_angle)

[Caster angle](https://en.wikipedia.org/wiki/Caster_angle)

[Ride height](https://en.wikipedia.org/wiki/Ride_height)

[Roll center](https://en.wikipedia.org/wiki/Roll_center)

[Scrub radius](https://en.wikipedia.org/wiki/Scrub_radius)

[Steering ratio](https://en.wikipedia.org/wiki/Steering_ratio)

[Toe](https://en.wikipedia.org/wiki/Toe_(automotive))

[Wheel alignment](https://en.wikipedia.org/wiki/Wheel_alignment)

Wheel base

### Distribution of mass

Some aspects of vehicle dynamics are purely due to [mass](https://en.wikipedia.org/wiki/Mass) and its distribution are,

[Center of mass](https://en.wikipedia.org/wiki/Center_of_mass)

[Moment of inertia](https://en.wikipedia.org/wiki/Moment_of_inertia)

[Roll moment](https://en.wikipedia.org/wiki/Roll_moment)

[Sprung mass](https://en.wikipedia.org/wiki/Sprung_mass)

[Unsprung mass](https://en.wikipedia.org/wiki/Unsprung_mass)

[Weight distribution](https://en.wikipedia.org/wiki/Weight_distribution)

**Aerodynamics [Vehicle Interaction]**

Some attributes or aspects of vehicle dynamics are purely [aerodynamic](https://en.wikipedia.org/wiki/Aerodynamics). These include:

[Automobile drag coefficient](https://en.wikipedia.org/wiki/Automobile_drag_coefficient)

[Automotive aerodynamics](https://en.wikipedia.org/wiki/Automotive_aerodynamics)

[Center of pressure](https://en.wikipedia.org/wiki/Center_of_pressure_(fluid_mechanics))

[Down force](https://en.wikipedia.org/wiki/Downforce)

[Ground effect in cars](https://en.wikipedia.org/wiki/Ground_effect_in_cars)

**Tires [Vehicle Interaction]**

Some attributes or aspects of vehicle dynamics can be attributed directly to the [tires](https://en.wikipedia.org/wiki/Tire). These include

[Camber thrust](https://en.wikipedia.org/wiki/Camber_thrust)

[Circle of forces](https://en.wikipedia.org/wiki/Circle_of_forces)

[Contact patch](https://en.wikipedia.org/wiki/Contact_patch)

[Cornering force](https://en.wikipedia.org/wiki/Cornering_force)

[Ground pressure](https://en.wikipedia.org/wiki/Ground_pressure)

[Pacejka's Magic Formula](https://en.wikipedia.org/wiki/Pacejka#The_Pacejka_.22Magic_Formula.22_tire_models)

[Pneumatic trail](https://en.wikipedia.org/wiki/Pneumatic_trail)

[Radial Force Variation](https://en.wikipedia.org/wiki/Radial_Force_Variation)

[Relaxation length](https://en.wikipedia.org/wiki/Relaxation_length)

[Rolling resistance](https://en.wikipedia.org/wiki/Rolling_resistance)

[Self-aligning torque](https://en.wikipedia.org/wiki/Self_aligning_torque)

[Skid](https://en.wikipedia.org/wiki/Skid_(automobile))

[Slip angle](https://en.wikipedia.org/wiki/Slip_angle)

[Slip (vehicle dynamics)](https://en.wikipedia.org/wiki/Slip_(vehicle_dynamics))

[Spinout](https://en.wikipedia.org/wiki/Spinout_(driving))

[Steering ratio](https://en.wikipedia.org/wiki/Steering_ratio#Alternate_definition)

[Tire load sensitivity](https://en.wikipedia.org/wiki/Tire_load_sensitivity)

**Vehicle Behavior:**

[Body flex](https://en.wikipedia.org/wiki/Body_flex)

[Body roll](https://en.wikipedia.org/wiki/Body_roll)

[Bump Steer](https://en.wikipedia.org/wiki/Bump_Steer)

[Bundorf analysis](https://en.wikipedia.org/wiki/Bundorf_analysis)

[Directional stability](https://en.wikipedia.org/wiki/Directional_stability)

[Critical speed](https://en.wikipedia.org/wiki/Oversteer#Critical_speed)

[Noise, vibration, and harshness](https://en.wikipedia.org/wiki/Noise,_vibration,_and_harshness)

[Pitch](https://en.wikipedia.org/wiki/Flight_dynamics_(aircraft))

[Ride quality](https://en.wikipedia.org/wiki/Ride_quality)

[Roll](https://en.wikipedia.org/wiki/Flight_dynamics_(aircraft))

[Speed wobble](https://en.wikipedia.org/wiki/Speed_wobble)

[Understeer, oversteer](https://en.wikipedia.org/wiki/Understeer), [lift-off oversteer](https://en.wikipedia.org/wiki/Lift-off_oversteer), and [fishtailing](https://en.wikipedia.org/wiki/Fishtailing)

[Weight transfer and load transfer](https://en.wikipedia.org/wiki/Weight_transfer)

[Yaw](https://en.wikipedia.org/wiki/Yaw_(rotation))

**Analysis and Simulation:**

Dynamic behavior of vehicles can be analysed in several different ways. It can be as simple as [spring mass](https://en.wikipedia.org/wiki/Tuned_mass_damper) system, through a three-[degree of freedom](https://en.wikipedia.org/wiki/Degrees_of_freedom_(mechanics)) (DoF), to a large degree of complexity using The a [multibody system simulation](https://en.wikipedia.org/wiki/Multibody_system) package such as [MSC ADAMS](https://en.wikipedia.org/wiki/MSC_Software) or [Modelica](https://en.wikipedia.org/wiki/Modelica). As computers have gotten faster, and software user interfaces have improved, commercial packages such as [CarSim](https://en.wikipedia.org/wiki/CarSim) have become widely used in industry for rapidly evaluating hundreds of test conditions much faster than real time. Vehicle models are often simulated with [advanced controller](https://en.wikipedia.org/wiki/Electronic_stability_control) designs provided as software in the loop (SIL) with controller design software such as [Simulink](https://en.wikipedia.org/wiki/Simulink), or with physical hardware in the loop (HIL).

Vehicle motions are largely due to the shear forces generated between the tires and road, and therefore the tire model is an essential part of the math model. The tire model must produce realistic shear forces during braking, acceleration, cornering, and combinations, on a range of surface conditions. Many models are in use. Most are semi-empirical, such as the [Pacejka](https://en.wikipedia.org/wiki/Pacejka) Magic Formula model.

It is important that the models should agree with real world test results, hence many of the following tests are correlated against results from instrumented test vehicles.

Techniques include:

[Linear range constant radius understeer](https://en.wikipedia.org/wiki/Bundorf_analysis)

Fishhook

[Frequency response](https://en.wikipedia.org/wiki/Frequency_response)

[Lane change](https://en.wikipedia.org/wiki/Lane_change)

[Moose test](https://en.wikipedia.org/wiki/Moose_test)

Sinusoidal steering

[Skid pad](https://en.wikipedia.org/wiki/Skidpad)

[Swept path analysis](https://en.wikipedia.org/w/index.php?title=Swept_path_analysis&action=edit&redlink=1)

For more details: [Click Here.](https://en.wikipedia.org/wiki/Vehicle_dynamics)

**ADAS**

Advanced driver-assistance systems are systems developed to automate, adapt and enhance vehicle systems for safety and better driving.

**Implementation:**

[Nissan ProPilot Assist](https://en.wikipedia.org/wiki/Nissan_ProPilot_Assist)

[Tesla Autopilot](https://en.wikipedia.org/wiki/Tesla_Autopilot)

[Mobileye](https://en.wikipedia.org/wiki/Mobileye)

[openpilot](https://en.wikipedia.org/wiki/Openpilot)

[Volvo](https://en.wikipedia.org/wiki/Volvo) [IntelliSafe](https://en.wikipedia.org/wiki/IntelliSafe)

[Mercedes-Benz](https://en.wikipedia.org/wiki/Mercedes-Benz) [Distronic Plus](https://en.wikipedia.org/wiki/Distronic_Plus)

**Features:**

[Adaptive cruise control](https://en.wikipedia.org/wiki/Adaptive_cruise_control) (ACC)

[Glare-free high beam](https://en.wikipedia.org/wiki/Glare-free_high_beam) and [pixel light](https://en.wikipedia.org/w/index.php?title=Pixel_light&action=edit&redlink=1)

[Adaptive light control: swiveling curve lights](https://en.wikipedia.org/wiki/Adaptive_Front-lighting_System_(AFS))

[Anti-lock braking system](https://en.wikipedia.org/wiki/Anti-lock_braking_system)

[Automatic parking](https://en.wikipedia.org/wiki/Automatic_parking)

[Automotive head-up display](https://en.wikipedia.org/wiki/Automotive_head-up_display)

[Automotive navigation system](https://en.wikipedia.org/wiki/Automotive_navigation_system) with typically [GPS](https://en.wikipedia.org/wiki/GPS) and [TMC](https://en.wikipedia.org/wiki/Traffic_Message_Channel) for providing up-to-date [traffic information](https://en.wikipedia.org/wiki/Traffic_information)

[Automotive night vision](https://en.wikipedia.org/wiki/Automotive_night_vision)

[Backup camera](https://en.wikipedia.org/wiki/Backup_camera)

[Blind spot monitor](https://en.wikipedia.org/wiki/Blind_spot_monitor)

[Collision avoidance system](https://en.wikipedia.org/wiki/Collision_avoidance_system) (Pre-crash system)

[Crosswind stabilization](https://en.wikipedia.org/wiki/Crosswind_stabilization)

[Cruise control](https://en.wikipedia.org/wiki/Cruise_control)

[Driver drowsiness detection](https://en.wikipedia.org/wiki/Driver_drowsiness_detection)

[Driver Monitoring System](https://en.wikipedia.org/wiki/Driver_Monitoring_System)

[Electric vehicle warning sounds](https://en.wikipedia.org/wiki/Electric_vehicle_warning_sounds) used in [hybrids](https://en.wikipedia.org/wiki/Hybrid_electric_vehicle) and [plug-in electric vehicles](https://en.wikipedia.org/wiki/Plug-in_electric_vehicle)

[Electronic stability control](https://en.wikipedia.org/wiki/Electronic_stability_control)

[Emergency driver assistant](https://en.wikipedia.org/wiki/Emergency_driver_assistant)

[Forward Collision Warning](https://en.wikipedia.org/wiki/Forward_Collision_Warning) (FCW)

[Intersection assistant](https://en.wikipedia.org/wiki/Intersection_assistant)

[Hill descent control](https://en.wikipedia.org/wiki/Hill_descent_control)

[Hill-Start Assist](https://en.wikipedia.org/wiki/Hill_holder)

[Intelligent speed adaptation](https://en.wikipedia.org/wiki/Intelligent_speed_adaptation) or intelligent speed advice (ISA)

[Lane centering](https://en.wikipedia.org/wiki/Lane_centering)

[Lane departure warning system](https://en.wikipedia.org/wiki/Lane_departure_warning_system) (LDW)

[Lane change assistance](https://en.wikipedia.org/wiki/Lane_change_assistance)

[Parking sensor](https://en.wikipedia.org/wiki/Parking_sensor)

[Pedestrian protection system](https://en.wikipedia.org/wiki/Pedestrian_protection_system)

[Rain sensor](https://en.wikipedia.org/wiki/Rain_sensor)

[Surround View system](https://en.wikipedia.org/wiki/Surround_View_system)

[Tire Pressure Monitoring](https://en.wikipedia.org/wiki/Tire_Pressure_Monitoring)

[Traction control system](https://en.wikipedia.org/wiki/Traction_control_system)

[Traffic sign recognition](https://en.wikipedia.org/wiki/Traffic_sign_recognition)

[Turning assistant](https://en.wikipedia.org/wiki/Turning_assistant)

[Vehicular communication systems](https://en.wikipedia.org/wiki/Vehicular_communication_systems)

[Wrong-way driving warning](https://en.wikipedia.org/wiki/Wrong-way_driving_warning)

**Automobile Basic**

[Four-wheel drive](https://en.wikipedia.org/wiki/Four-wheel_drive) /[Front-Rear-wheel drive](https://en.wikipedia.org/wiki/Front-wheel_drive)

Power train

Steering

Brake

Tire

ECU, MCU and Power semiconductor device

Sensor

Safety Equipment

**Vehicle Dynamics**

**ADAS**

**CarSim 2020.0**

**SCANeR Studio 2021**