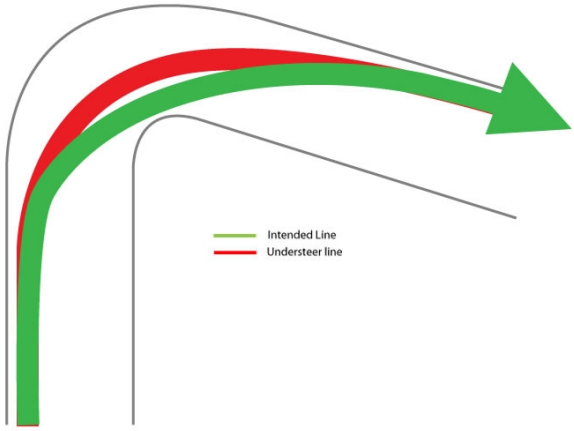
Freshmen Summer Internship Program 2013
Assignment 2

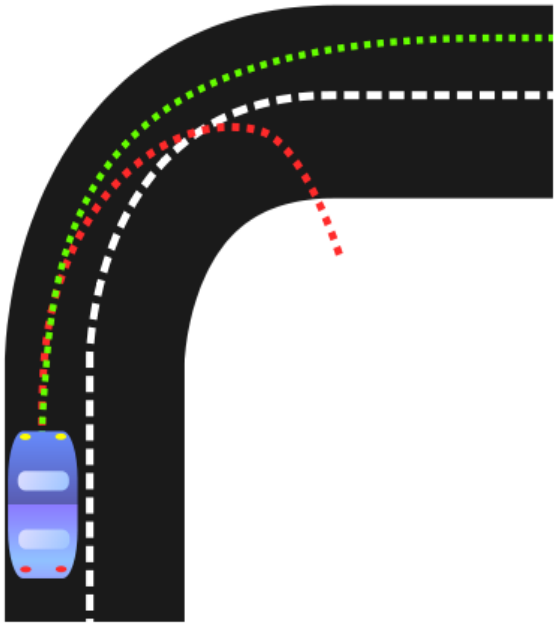
Avani Tanna, Alankar Kotwal
Electrical Subsystem

Section A: SSB (Basic)

1. Understeer and oversteer refer to the sensitivity of the steering wheel with respect to the desired value.
   a) Understeer happens when the vehicle turns less than it should have while negotiating a turn. This is because the sensitivity of the vehicle to steering is lesser than what we would like it to be.



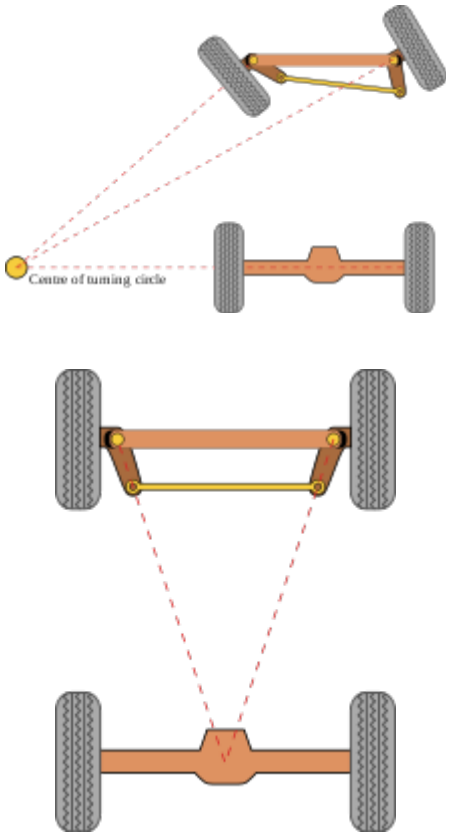
   b) Oversteer happens when the vehicle turns more than it should have while negotiating a turn. This is because the sensitivity of the vehicle to steering is more than what we would like it to be.



2. An internal force cannot affect the motion of an object with respect to an external frame of reference. So the friction between the wheels and the road has to be the force that stops the car's motion. How it works is this: the brake disk locks the wheel and prevents its rotation. This causes the frictional force, which is usually in the forward direction, to flip and point in

the backward direction. This is because of the change in the change in the direction of relative motion. Thus it is the frictional force that stops the car.

3. While a vehicle turns, its inner and outer (with respect to the turn) wheels have to turn with different radii because of the finite size of the car. Hence we need to make sure, for ensuring that the wheels don't slip, that the instantaneous center of rotation of the four wheels is the same. A simple Ackerman steering geometry, shown in the diagram, makes sure that this is the case.
The disadvantage of this steering system is that while designing it we neglect the effects of dynamical forces. These forces arise when we have high lateral accelerations. Hence the Ackerman geometry works only for low lateral accelerations, and fails for high lateral accelerations. One example of such dynamical forces are lateral load transfer due to the centripetal acceleration.



4. 1. Brake fluid is subjected to high temperatures esp in disk brake calipers. So it must have high boiling point to avoid vaporizing.
   2. For reliable, consistent brake system operation, brake fluid must maintain a constant viscosity under a wide range of temperatures, including extreme cold .
   3. Brake fluids must not corrode the metals used inside components such as calipers, master cylinders, etc. They must also protect against corrosion as moisture enters the system. Additives (corrosion inhibitors) are added to the base fluid to accomplish this.
   4. Brake fluids must maintain a low level of compressibility that remains low, even with varying temperatures .
   5. Brake fluids get pretty hot and produce pressures. The expansion properties of metal and rubber lead to this difference. Metallic brake lines more effectively resist expansion than rubber. Also, over a period, rubber bulges due to pressure making the brake pedal feel softer, thus calling for replacement.

5. a) Mass of the members is negligible compared to that of the applied loading. Friction and compliance at the joints assumed negligible.
   b) The instant center of rotation, also called instantaneous center and instant center, is the point in a body undergoing planar movement that has zero velocity at a particular instant of time. At this instant the velocity vectors of the trajectories of other points in the body generate a circular field around this point which is identical to what is generated by a pure

rotation. The velocities of various parts of bodies could be expressed as a result of rotation whose axis is perpendicular to the plane.