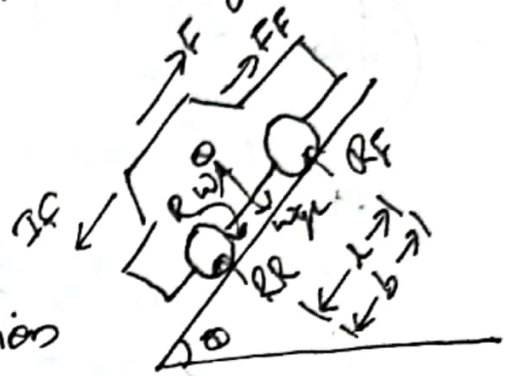
# Assignment - 2.

1. Derive the equation of motion & maximum tractive effort for a car inclined at angle $\theta$. Also give the expression of maximum gradeability for a 4 wheel drive.




W = weight of the car.
Cen. = centre of gravity.
b = wheel base
F = maximum forward acceleration
$F_E$ = maximum tractive effort.
R1f = Rear & front wheel.
$R_R$ & $R_F$ = Total normal reaction at front & rear wheel.
h = height from CG to road
If = Inertia force = m·f - W sin$\theta$.
= mf - $\frac{W}{g}$ sin$\theta$.
= $\frac{W}{g}$ f - W sin$\theta$ —— (1)

$\Sigma V = 0$ —— (2)
$\Sigma H = 0$ —— (3)

using (2)
W cos$\theta$ = $R_f + R_R$ —— (4)

using (3)
$F_E = \frac{W}{g} \cdot f + W \cdot \sin\theta$.
$R_R \cdot R_F = \frac{W}{g} \cdot f + W \sin\theta$.
$R_F = \frac{W}{g} f + \frac{W}{\mu} \sin\theta$ —— (7) $\frac{W}{\mu}\left\{\frac{f}{g} + \sin\right.$

Taking moment about y

$R_F \times b + \left(\frac{\omega}{g} \cdot f + \omega \sin\theta\right) h = \omega \cos\theta \times l.$

$\left(\frac{\omega}{g}\frac{Q}{\mu} + \frac{\omega}{\mu}\sin\theta\right) b + \left(\frac{\omega}{g} f + \omega \sin\theta\right) h = \omega \cos\theta \cdot l.$

$\left(\frac{f}{g\mu} + \frac{\sin\theta}{\mu}\right) b + \left(\frac{f}{g} + \sin\theta\right) h = \cos\theta \, l.$

$\frac{b}{\mu}\left(\frac{f}{g} + \sin\theta\right) + \left(\frac{f}{g} + \sin\theta\right) h = \cos\theta \, l.$

$\left(\frac{f}{g} + \sin\theta\right)\left(\frac{b}{\mu} + h\right) = \cos\theta \, l.$

$\frac{f}{g} = \left(\frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)}\right) - \sin\theta.$

$F = g\left[\left[\frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)}\right] - \sin\theta\right] \quad \text{——(9)}$

——(10)

$R_F = \frac{\omega}{\mu} \times \frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)}$

$= \frac{\omega \cos\theta \, l}{b + \mu h}.$

$R_R = \omega \cos\theta - R_F = \omega \cos\theta - \frac{\omega}{\mu}\frac{\cos\theta \, l}{\left(\frac{b}{\mu} + h\right)}$

$= \omega \cos\theta \left[1 - \frac{1}{(b + \mu h)}\right]$

$= \omega \cos\theta \left[\frac{b + \mu h - l}{b + \mu h}\right]$

$F_F = \mu R_F = \mu \times \left(\frac{\omega \cos\theta \, l}{b + \mu h}\right)$

## Four Wheel drive.

$$F = R_F + F_F = \mu R_R + \mu R_F$$

$$E_v = 0$$

$$W = R_F + R_R$$

$$\Sigma H = 0$$

$$(W/g) F = \mu R_R + \mu R_F = \mu (R_R + R_F) = \mu W.$$

$$(f/g) = \mu$$

$$\Sigma V = 0$$

$$W = R_R + R_F$$

$$\Sigma H = 0$$

$$(W/g) F = \mu R_R + \mu R_F.$$

Assuming slip to accurat front wheels

First $R_F < R_R$ then

$$\Sigma M_R = 0 \qquad 2\mu R_F = (W/g) F$$

$$R_f b + (W/g) f_b = W1$$

2) Consider a car with the following specifications that is parked on a level road. Find the load on the front and rear axles. m = 1765 kg,
l = 2.84 m  $a_1$ = 1.204 m  $a_2$ = 1.640 m.

M = 1765 kg
l = 2.84 m
$a_1$ = 1.204 m
$a_2$ = 1.640 m.

load on front axies = $F_{AF} = mg\left(\frac{a_2}{l}\right)$
load on rear axies = $F_{AR} = mg\left(\frac{a_1}{l}\right)$

$F_{AR} = mg\left(\frac{a_1}{l}\right) = 1765 \times 9.8 \times \left(\frac{1.204}{2.84}\right) = 17297 \times 0.424$
$= 7430.40N$

load on rear axis = 7430.40N

$F_{AF} = mg\left(\frac{a_2}{l}\right) = 1765 \times 9.8 \left(\frac{1.640}{2.84}\right) = 17297 \times 0.570$
$= 9866.59N$

load on front axies = 9866.59 N

3) what are the different parts of tires? Differentiate between types of tires on the basis of their construction.

Tire parts

1. Beads
We'll start from the inside out Tire beads hold tire to the rim, or the outer edge of the wheel.

They are made of copper, brass, or bronze-plated high tensile steel wires wound into a rubber band. Tire beads prevent the tire from sliding out of place when the wheel rolls.

2. BEADS

Bead filler is a rubber compound inside the tire's beads. It provides stability to the lower side wall and bead area. The density and stiffness of a tire's bead filler help to determine a tires performance characteristics.

3. RADIAL CORDBODY

The Cardbody gives the tire strength and transmits cornering forces from the tread to the wheel. Rubber coated fabric cord, called body plies, make up the card body. Body plies can be made of polyester, rayon or nylon. polyester is most commonly used.

4. INNER LINER

The Inner Liner is rubber compound bonderd to the inside of the cord body that retains air under pressure. It has no cord reinforcement, and it functions like an inner tube. That modern Car tires no longer have inner tubes inside them.. A tire's beads, bead filler and inner liner work together to hold air with in the tire wall.

5. BELT PLIES

Belt plies are two or more strong layers of cord just under the tread area of the tire. The primary function of belt plies is to provide strength and stability to the tire tread. They play a role is impraving tire mileage, impact resistance, and traction. Steel is the most common cord material used in belt plies.

6. SIDE WALL

The area of a tire from the bead to the tread The side of the tire - is called the sidewall. It forms a protective covering for the cord body.

7. TREAD

The tread is the portion of the tire that comes in contact with the road surface. The tread's compound and its design have to balance to traction, handling, fuel economy, resistance and other characteristics of the tire.

BIAS TIRES

- Nylon Belts
- Standard duty
- Less Expensive
- Low life Expectancy

RADIAL TIRES.

- steel belts
- Severe/extreme duty.
- More expensive
- long life expectancy.