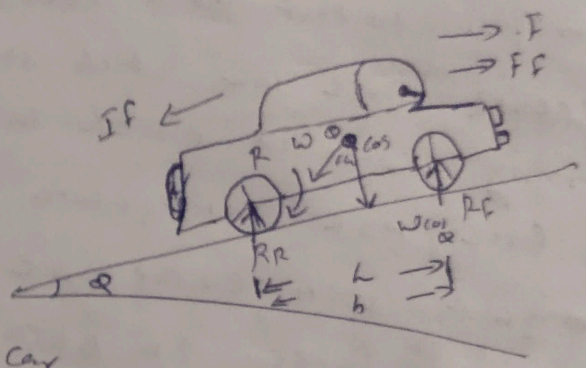
Assignment - II

Derivation

1. Drive the equation of motion and maximum tractive effort for a car inclined at angle θ. Also give the expression of maximum gradability for a 4 wheel driven.

Ans-



W = weight of the car

Con = centre of gravity.

b = wheel base.

f = max^{n} forward acceleration.

f_t = max^{n} tractive effort.

Rand f = Rear and forut wheel.

RRand Rf = Total normal reaction at front and rear wheel.

h = height from Cn to road

If = Inertia force $= m \cdot f - W \sin\theta$

$= m \cdot f - mg \cdot \sin\theta$

$= W/g \cdot f - W \sin\theta$ — ①

$\Sigma V = 0$ - ②

$\Sigma H = 0$ - ③

eqn ②

$$W\cos\theta - R_f + R_R \quad -(8)$$

eqn ③

$$F_f = \frac{\nu}{g}\cdot f + W\sin\theta$$

$$N\cdot R_f = \frac{\nu}{g}\cdot f + W\sin\theta$$

$$R_f = \frac{\nu}{g}\cdot f + \frac{\nu}{N}\sin\theta \quad -(7)$$

$$\frac{\nu}{N}\left(\frac{F}{g}+\sin\theta\right)$$

Taking moment about.

$$R_f \times b + \left(\frac{\nu}{g}\cdot f + W\sin\theta\right)h = W\cos\theta\times 1$$

$$\left(\frac{\nu}{g}\frac{\theta}{N} + \frac{\nu}{N}\sin\theta\right)b + \left(\frac{\nu}{g}f + W\sin\theta\right)\times h = W\cos\theta\times 1$$

$$\left(\frac{F}{gN} + \frac{\sin\theta}{N}\right)b + \left(\frac{F}{g} + \sin\theta\right)h = \cos\theta\times 1$$

$$\frac{b}{N}\left(\frac{F}{g} + \sin\theta\right) + \left(\frac{F}{g} + \sin\theta\right)h = \cos\theta\, 1$$

$$\left(\frac{F}{g} + \sin\theta\right)\left(\frac{b}{N} + h\right) = \cos\theta\, 1$$

$$\left(\frac{F}{g} + \sin\theta\right) = \frac{\cos\theta\, 1}{\left(\frac{b}{N} + h\right)} \quad -(8)$$

$$\frac{F}{g} = \left(\frac{\cos\theta\, 1}{\left(\frac{b}{N} + h\right)}\right) - \sin\theta$$

$$F = g\left[\left[\frac{\cos\theta\, 1}{\left(\frac{b}{N}+h\right)}\right] - \sin\theta\right] \quad -(9)$$

$$R_F = \frac{W}{N} + \times \frac{\cos\theta\, 1}{\left(\frac{b}{N} + h\right)} \quad -(10)$$

$$= \frac{W\cos\theta\, 1}{b + Nh}$$

$$R_R = W\cos\theta - R_f$$

$$= W\cos\theta - \frac{W}{\mu}\frac{\cos\theta_1}{\left(\frac{b}{\mu}+h\right)}$$

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

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

$$F_f = \mu R_f = \mu\left(\frac{\cos\theta_1}{b+\mu h}\right)$$

Four wheel drive

$$F = R_f + F_f = \mu R_R + \mu R_f$$

$$\Sigma V = 0$$

$$W = R_f + R_R$$

$$\Sigma H = 0$$

$$(W/S)F = \mu R_R + \mu R_f$$

$$= \mu(R_R + R_f) = \mu W$$

$$(F/S) = \mu$$

$$\Sigma V = 0$$

$$W = R_R + R_C$$

$$\Sigma H = 0$$

$$(W/S)F = \mu R_R + \mu R_f$$

Assuming slip to occurate front wheels first $R_f < R_R$ then

$$\Sigma M_R = 0 \qquad 2\mu R_f = (W/S)F$$

$$R_F + F_f = (W/S)F_h = W_1$$

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, a1 = 1.22 m, a2 = 1.62 m.

Ans -

m = 1765 kg
l = 2.84 m
a1 = 1.22 m
a2 = 1.62 m

Load on front axles = $F_{Af} = mg\left(\frac{a_2}{l}\right)$
Load on Rear axles = $F_{AR} = mg\left(\frac{a_1}{l}\right)$

$F_{AR} = mg\left(\frac{a_1}{l}\right)$

$= 1765 \times 9.8 \left(\frac{1.22}{2.84}\right)$

~~= 1765~~

$= 17257 \times 0.429$

$= 7430.40 N$

load on Rear axles = ~~7430.40 N~~ $7430.40 N$

$F_{Af} = mg\left(\frac{a_2}{l}\right)$

$= 1765 \times 9.8 \left(\frac{1.62}{2.84}\right)$

$= 17257 \times 0.570$

$= 9866.59 N$

load on front axles = $9866.59 N$ //

3. What are the different parts of tires. Differentiate the types of tires on the basis of their construction

Tire Parts

1. Beads

We'll start from the inside out Tire beads hold the tire to the rim, or the outer edge of the wheel. They're made of copper, brass or bronze - plated high tensile steel wires wound into a rubber bead. 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 sidewall and bead area. The density and stiffness of a tire's bead filler help to determine a tire's ~~pet~~ performance characteristics.

3. Radial CORD Body

The cord body gives the tire strength and transmits cornering forces from the tread travels to the ~~wheels~~ wheels. Rubber coated body plies can be made of polyster, rayon or nylon polyster is most commonly used.

Tread

Treads are designed to have good steering behaviour, adhesion, ~~power~~. Low resistance, and good braking behaviour. It also helps provide a reduction of both tyre rolling resistance and the volume of tyre noise. The Tread is ~~made~~ made up of synthetic and ~~natural~~ rubbers.

Tyre specification

P17 construction

↓

260	60	R	17	96	H
↓	↓		↓	↓	↓
Tread width	sidewall ration		12in diameter	Load inter	speed rating or speed inter

↓

$$\text{sidewall ratio} = \frac{\text{sidewall height}}{\text{tread}} \times 100$$

Types of tires

Bias ply tires :- It have the plies in their structure placed diagonally. This digonal pattern is angled at 30-40° to the centerline. Due to the crisscross pattern of bias ply tire holds they feature thicker sidewall and narrow foot print. This tire construction type offers better load durability. However, since their sidewalls don't flex, their tread life is ~~affected~~ affected as the foot print deforms instead.

· Radial tire :- It feature structures where the plis are added at 90° angle from one bead to the other. This doesn't create the known crisscross pattern of bias-ply tires. The radial construction allows

~~minimal performance. The main reason~~

minimal performance the main reason for this is the heat resistance of radial ply tires.