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Module Title: - Vehicle Technology

Module Code: - M4X00394

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Starting Time of the Exam: - 13:00

Q 1

i) Camber

Camber ~~exaggerates~~ ^{through} can be created by camber angle, which can increase lateral grip, to a point where the contact patch is reduced and lowers overall grip.

ii) Caster angle

A increase in stability and due to caster angle. Due to caster angle adjustments it makes steering heavier due to a ~~at~~ larger caster angle.

(iii) Instant centre

Instant centre is a point in space, governed by the position, angle and length of ~~an~~ ^a long swing arm and short swing arm. A short swing arm increases camber change with bump and a long swing arm length reduces camber change. A high or low IC results in increase scrub.

iv) Roll centre

~~Des~~ A high RC reduces body roll but increases jacking forces. A low RC increases body roll but ~~reduces~~ reduces jacking forces. Design goals of roll centre are, minimize roll centre movement for more predictable driving feel. ~~and~~ Balance front/rear roll centre heights for desired slip angle characteristics.

Q2

i) $a = \frac{v^2}{r}$

$v = 25 \text{ m/s}$

$r = 13 \text{ m}$

$a = \frac{25^2}{13}$

$a = 4.81 \text{ m/s}^2$

ii) $W_t = \frac{mah}{e}$

$m = 915 \text{ kg}$

$a = 4.81 \text{ m/s}^2$

$h = 0.375 \text{ m}$

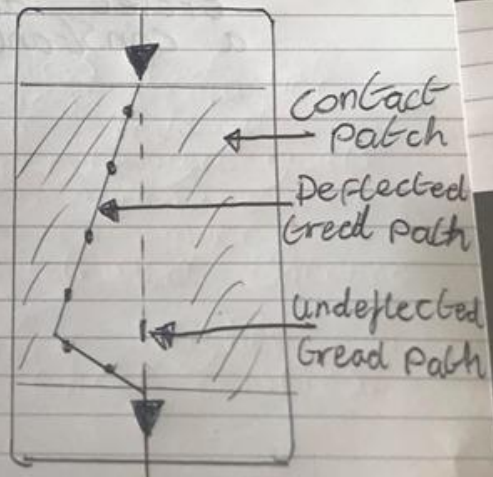
$e = 1.16 \text{ m}$

$W_t = \frac{915 \times 4.81 \times 0.375}{1.16}$

$W_t = 1422.79 \text{ N}$

iii) When weight is transferred from inside tire to the outside while going around a corner, the outside tires are able to generate more grip, but the additional grip that they gain is less than the amount of grip the inside tires lose, and our total grip is reduced.

iv) Slip angle is the angle between the direction in which wheel is pointing and the direction in which the vehicle is actually traveling.



Q3

i) $m_s = 215 \text{ kg}$ $k_1 = 13,000 \text{ N/m}$
 $k_2 = 28,000 \text{ N/m}$

$$\frac{1}{k} = \frac{1}{13000} + \frac{1}{28000} = 8878.05$$

ii) $k = k_1 + k_2$
 $k = 8878.05 \times 2$
 $k = 17756.1 \text{ N/m}$

ii) $f_n = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$
 $f_n = \frac{1}{2\pi} \sqrt{\frac{17756.1}{215}}$
 $f_n = 1.45 \text{ Hz}$

iii) The Frequency of this suspension is ideal for off road vehicle. It will allow vehicle to absorb bumps softly when going over unbalanced terrain. The long soft travel allows the tyres to remain a constant patch contact patch.

Q3₂₀

iv) 1.5

$y(t)$ 1

0.5

π

2π

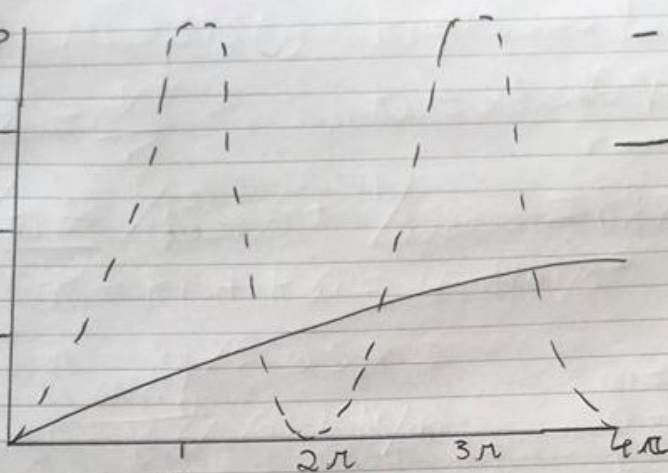
3π

4π

$\omega t / \text{rad}$

-- No Damping

— over damping



Q4

a) $f = ma$

$$m = 875 \text{ kg}$$

$$a = 7.5 \text{ m/s}$$

$$f = 875 \times 7.5$$

$$f = 6562.5 \text{ N}$$

b)

$$\text{Force per wheel} = \frac{6562.5}{2} = 3281.25 \text{ N}$$

Torque required per wheel

$$F_w \times R$$

$$3281.25 \times 0.285$$

$$T = 935.16 \text{ Nm}$$

Slave piston force

$$\frac{T}{\mu \times r} = \frac{935.16}{0.46 \times 0.15} = 13553.04 \text{ N}$$

Line pressure

$$\frac{F_s}{A_s \times n} = \frac{13553.04}{\pi \left(\frac{0.06445}{2} \right)^2 \times 2}$$

$$= 4357092.91$$

Pedal Force

$$\frac{P \times A_m}{P \times R} = \frac{4.36 \times 10^6 \times \pi \left(\frac{0.015875}{2} \right)^2}{4}$$

$$PF = 215.75 \text{ N}$$