MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

AUE-701

VEHICLE DYNAMICS

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer *all* questions. $10 \times 1 = 10$

(i) Acceleration developed by vehicle is minimum when
(A) vehicle is rear wheel driven (B) vehicle is front wheel driven
(C) vehicle is ati wheel driven (D) both (A) and (B)

(ii) A vehicle is traveling in a laterally inclined road of angle α : The vehicle overturning angle is given by

(A) $\tan \alpha = \mu$ (B) $\tan\alpha = \frac{a}{2h}$ (C) $\tan\alpha = \frac{1}{h}$ (D) none of these

Where a = vehicle track length, h = height of C.G. above G.L., l = Distance of C.G. from near angle, μ = co-efficient of friction.

(iii) Lateral acceleration of vehicle is given by

(A) $V^2 \times R$ (B) $\frac{R}{V^2}$ (C) $\frac{V^2}{R}$ (D) $1 - \frac{V^2}{R}$

Where V is the velocity of vehicle and R is radius of road curvature.

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(iv) A vehicle will skid
(A) when wheel braking torque is greater than brake braking torque
(B) when wheel braking torque is equal to brake braking torque
(C) when wheel braking torque is less than brake braking torque
(D) none of these

(v) Actuating force on trailing shoe drum brake assembly is
(A) greater than the force on leading shoe
(B) less than the force on leading shoe
(C) equals the force on leading shoe
(D) can't be compared

(vi) A vehicle white moving having the following conditions. i.e. front slip angle = rear slip angle = 0°, movement of the vehicle will be
(A) in the curved path of constant radious
(B) in the curved path of variable radious
(C) in straight forward path
(D) in zig-zag motion

(vii) Gyroscopic couple of vehicle wheel during turning is given by

(A) $I_w V^2 \times R \times r$ (B) $\frac{I_w V^2}{(R \times r)}$ (C) $\frac{I_w (R \times r)}{V^2}$ (D) none of these

Where I_x = Moment of inertia of wheel
V = Vehicle velocity
R = Radious of curvature of the path
R = Wheel radious.

(viii) Usual practice of camber for vehicle is
(A) positive camber (B) negative camber
(C) neutral camber (D) both (A) and (B)

(ix) If the tractive effort at any point during motion is more than the resistance of the vehicle, the vehicle will be under
(A) acceleration (B) deceleration
(C) uniformed speed (D) can't be predicated

(x) Ackerman angle of front steering wheel is given by

(A) $b \times R$ (B) $\frac{b}{R}$ (C) $\frac{R}{b}$ (D) $\frac{1 - R}{b}$

Where b = Wheel base of the vehicle
R = Radious of curvature of the path.

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Distinguish between shoe braking torque and wheel braking torque. Obtain the expression of wheel braking torque for a passenger car? 2+3

3. A vehicle is travelling on a laterally inclined ground. Draw the free body diagram of the vehicle showing all the forces acting and road condition clearly. 5

4. Obtain the expression of wheel reaction, when the vehicle is under the static load condition. 5

5. A passenger car having gross vehicle weight is 900 kg. The wheel base 2.5m. C.G. of the vehicle is 1.4m from front axle and 0.7m above ground level. The vehicle is travelling up the gradient of 10°. Calculate the reaction on each wheel. 5

6. A vehicle is provided with 4 wheels having 12 kg weight each wheel. Mean diameter of the wheel is 30cm. The engine speed is 5000r.p.m. The vehicle is running at gear ratio 3. Calculate the power required to run the wheel only. 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) A car has weight of 11280 N, including 4 passengers and luggage. The engine is running in top gear at 5000 r.p.m. The size of wheel tyre is 0.508m. the crown wheel to pinion ratio is 4:3. The frontal area of body is 2.2 m^2. Assuming the coefficient of rolling friction and air resistance as 0.012 and 0.007 respectively and transmission efficiency as 80%, find the brake power of the vehicle. 7

(b) What are the different types of resistances, which a vehicle has to overcome while moving and describe the factors that effects on a vehicle. 8

8. A vehicle is moving down the gradient. Draw the free body diagram of the vehicle showing various forces and vehicle dimensions. Derive the expression of reactions of front and rear wheels. Assume uniform speed of vehicle. 15

9. A vehicle is travelling in a curved path at 80 KMPH. The radious of curvature of the path is 200 m. The vehicle weight is 1800 kg. 10+3+2
Calculate:
(i) 1/b ratio, when maximum lateral force is 250 kg, where "b" is wheel base and "l" is the distance of C.G. from rear axle.
(ii) What would be the Ackerman angle of the vehicle, if the vehicle is to take a blind turn, when track length of the vehicle is 1.5 m and wheel base is 25 m.
(iii) Can the vehicle develop 100°, Ackerman angle? If not state the reason(s).

10. Obtain the expression of Gyroscopic force developed in the front and rear wheels of a vehicle due to the movement of wheels and engine rotating parts. Assume wheels and engine rotating parts are rotating in parallel plane but in opposite direction. 15

11. A vehicle having gross weight 2500kg with wheel base 3.5 m, C.G. of the vehicle is 1.5m above ground level and 1.65m from rear axle. The track length of the vehicle is 1.5m. The vehicle is traveling on curved path having radious of curvature 500m. The vehicle speed gradually increased, what will happen to the vehicle – overturning or skidding? Calculate the velocity, when it will overturn or skid. 15