

CS/B.Tech/AUE (NEW)/SEM-7/AUE-701/2013-14
2013
VEHICLE DYNAMICS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Graph sheet(s), if required, will be supplied by the Institute.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following : $10 \times 1 = 10$
- i) Tractive effort becomes maximum when the vehicle is at
- a) bottom or 1st gear b) top gear
- c) 3rd gear d) 2nd gear.
- ii) Air resistance of a vehicle moving with velocity of 110 kmph is 19 kg. What will be the air resistance if the vehicle is moving with 100 kmph ?
- a) 18 kg b) 17 kg
- c) 15.4 kg d) None of these.

- iii) A vehicle is travelling on level ground and taking a turn. skidding speed of the vehicle depends on
- a) dimension of vehicle
- b) road parameter only
- c) both (a) and (b)
- d) none of these.
- iv) A vehicle going down the gradient, the limiting value of inclination for overturning of the vehicle is
- a) $\tan \theta = \mu$
- b) $\tan \theta = \frac{b-l}{\mu}$
- c) $\tan \theta = l/b$
- d) $\tan \theta = \frac{\mu l}{b}$.
- v) Breaking torque in drum brake system depend on
- a) vehicle speed
- b) frictional force between brakeshoe lining and brake drum
- c) inner-diameter of brake drum
- d) both (b) and (c).

- vi) Actuating force on leading shoe of drum brake system is
- a) greater than the force on trailing shoe
 - b) less than the force on trailing shoe
 - c) equal to the force on trailing shoe
 - d) can't be compared.
- vii) When a vehicle is taking a turn and brakes are applied the vehicle will be under
- a) apt load
 - b) fore load
 - c) neither apt nor fore load
 - d) apt and fore load combined.
- viii) When velocity of a 2-wheeler vehicle increases, the Heel Angle will
- a) increase
 - b) decrease
 - c) remain constant
 - d) unpredictable.

- ix) Power consumed by rear wheel is
- a) greater than the power consumed by front wheel
 - b) less than the power consumed by front wheel
 - c) equal to the power consumed by front wheel
 - d) can't be compared.
- x) Usual practice of the camber for vehicle is
- a) positive camber
 - b) negative camber
 - c) neutral camber
 - d) both (a) and (b).

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. A front wheel driven vehicle is moving with an acceleration f . Obtain the expression for the reaction of front wheel in terms of other parameter, showing free body diagram of the vehicle.
3. Explain slip angle of a vehicle. Obtain the expression of Ackermann angle in terms of slip angle at the front wheel of a vehicle.

4. Obtain the expression of wheel reaction, when a vehicle is under uniform velocity. Show the free body diagram of the vehicle indicating all the forces act into play.
5. A vehicle weighing 1100 kg having wheel base 2360 mm. The C.G. of the vehicle is 1100 mm from rear axle and 1100 mm above ground level with track length 1500 mm. What should be the maximum Ackermann angle of the vehicle, when radius of curvature of the path is 100 m ?
6. Distinguish between shoe braking torque and wheel braking torque. Obtain the expression of wheel braking torque for passenger car.

GROUP - C

(Long Answer Type Questions)

Answer any three of the following. $3 \times 15 = 45$

7. A sports car having 1620 kg having wheel base 2.68 m. C.G. of the car is 1.25 m from rear axle and 0.5 m above G.L. Average track width 1.66 m. The car is capable to accelerate from 0 to 100 kmph in 3.8 sec. The car is moving in a curved path of 200 m radius. Calculate the load on each suspension. What would be the condition of car ? Neglect gyroscopic force. Draw free body diagram of the vehicle also. $10 + 5$

8. The road resistance of a vehicle is 23 kg per tonne. The air resistance is given by the expression - $0.00843 V^2$; where "V" is the velocity of the vehicle in kmph. Transmission efficiency is 88% in top gear and the car weight is 2.032 tones. Calculate the BHP required for the car engine, when the vehicle is travelling at 144 kmph in top gear. Calculate also the BHP required for the car engine to drive the car up a gradient of 1.5 at 48 kmph, when transmission efficiency is 80%. Speed ratio of propeller shaft to driving axle is 3. $10 + 5$
9. A vehicle is taking a turn, obtain the expression of front inner wheel reaction considering static load, centrifugal load and gyroscopic load. Draw the free body diagram of the vehicle. $10 + 5$
10. A vehicle having the following particulars
 - Gross weight 2721 kg
 - Wheel base 3000 mm
 - Distance of C.G. from rear axle 1400 mm
 - Height of C.G. from G.L. 1300 mm
 - Track length of the vehicle 1600 mmPlot a graph showing variation of corner stiffness against speed of the vehicle for a radius of road curvature of 200 m for the front wheels. Assume vehicle speed 50, 60, 70, 80, 100 kmph.

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11. Drum brake system is provided in all the 4 wheels of a vehicle. Brake drum wheel cylinder inner diameter is 30 mm, while master cylinder inner diameter is 25 mm. Hydraulic oil pressure of the brake system is 1 Mpa. Actuating force from wheel cylinder acts at a distance of 200 mm from the shoe pivot point and the shoe pivot point is 100 mm from the drum centre. The inner diameter of the drum is 300 mm, co-efficient of friction between drum and brake lining is 0.3.

Calculate

- a) force require to operate the brake pedal when pedal liverage is 4.5
- b) actuating force on brake shoe
- c) total braking torque on axles. $3 + 3 + 9$
