CS/B.TECH/AUE/ODD SEM/SEM-7/AUE-701/2016-17

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : AUE-701
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 sheets, if required will be supplied by the institute.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for 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 air resistance, if the vehicle is moving with 100 kmph ?
      a) 18 kg   b) 17 kg
      c) 15.4 kg   d) None of these.

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   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) $\tan \theta = b - 1/\mu$
      c) $\tan \theta = l/b$ d) $\tan \theta = \mu l/b$.

   v) Braking torque in drum brake system depends on
      a) Vehicle speed
      b) Frictional force between brake shoe lining and brake drum
      c) Inner diameter of brake drum
      d) Both (a) and (c).

   vi) Braking torque in disc brake depends on
      a) Vehicle speed only
      b) Inner & outer diameter of brake pad only
      c) Frictional force between brake pad and disc only
      d) Both (b) & (c).

vii) A vehicle will overturn, when reaction at the

    a)   inner wheels becomes zero

    b)   inner wheels becomes positive

    c)   outer wheels becomes zero

    d)   outer wheels becomes positive.

viii) To produce the same braking effect on vehicle, the effort required on disc brake system is

    a)   greater than drum brake system

    b)   equal to that of drum brake system

    c)   less than drum brake system

    d)   cannot be compared.

ix) A vehicle will be under steer condition when

    a)   Front slip angle = Rear slip angle ≠ 0

    b)   Front slip angle = Rear slip angle = 0

    c)   Front slip angle > Rear slip angle

    d)   Front slip angle < Rear slip angle.

x) When a vehicle is taking a turn and brakes are applied, the vehicle will be under

    a)   Apt. load condition

    b)   Fore load condition

    c)   Neither Apt. nor Fore load condition

    d)   Apt. and Fore load condition.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following.   3 × 5 = 15

2. Obtain the expression of braking torque on disc brake in terms of disc brake parameter.

3. Explain with neat sketch the following :

    a)   Slip angle

    b)   Cornering stiffness.

4. Obtain the expression of overturning speed of a vehicle in terms of road and vehicle parameter.

5. A vehicle weighing 1100 kg has 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. What are the different types of resistances which a vehicle has to overcome.

GROUP – C

(Long Answer Type Questions)

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

7. A car weighing 1100 kg. is powered by an engine which develops 80 BHP at 4500 r.p.m. The corresponding vehicle speed in top gear is 106 kmph. The frontal area of the vehicle is 1.8 m^2 and the air resistance coefficient may be assumed as 0.0032, while air resistance is expressed in kg and vehicle speed in kmph. The rolling resistance is 0.015 times gross vehicle weight. The car has a rear axle ratio of 4.8 : 1 and tyres are of effective radius of 0.3 m. The transmission efficiency in top gear is 90%. If the vehicle is accelerating up the grading of 1 in 22 at a speed of 80 kmph, calculate the following :

a)   The drive force available at the wheels

b)   Total resistance in kg

c)   Vehicle acceleration in m/sec^2.   5 + 5 + 5

8. A vehicle weighing 1200 kg has wheel base 2.5 m and C.G. of the vehicle is 1.2 m from near axle, 1.0 m above ground level and mid-way between track length of

1.5 m. The mean radius of the wheel is 15 cm, having weight 10 kg. The diameter of the stub axle is 5.0 cm and overall diameter of the wheel is 40 cm. The co-efficient of friction in the bearing is 0.01. Calculate the power loss in driving the four wheels when speed of the vehicle is 60 kmph.

9. a)   What are the effects of camber, caster & king pin on a vehicle steering stability ?

   b)   What is the gyroscopic couple ? Write about the effect of gyroscopic couple on four wheel vehicle stability.   7 + 8

10. A vehicle is travelling at high speed on a curved path. The total weight of the vehicle is 1000 kg having wheel base 2540 mm. The C.G. of the vehicle is 1000 mm from rear axle. Calculate the Ackermann angle of the vehicle for the front wheels as per conditions stated below :

   a)   i)   At 100 kmph having radius of curvature of 150 m

      ii)   At 200 kmph having radius of curvature of 100 m.

   b)   Calculate the lateral force developed in the front and rear wheels.

   c)   Calculate the cornering stiffness in each case.   5 + 5 + 5

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11. 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.