Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(AUE)/SEM-7/AUE-701/2011-12

2011

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.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : 10 × 1 = 10

i) Wheels will be in locking condition when

a) wheel braking torque is less than brake braking torque.

b) wheel braking torque is more than brake braking torque.

c) wheel braking torque is equal to brake braking torque.

d) wheel will be under (a) and (b) only.

ii) A vehicle is provided with tyre of same dimension, cornering stiffness of the vehicle tyre will be

a) front tyre stiffness = rear tyre stiffness = 0

b) front tyre stiffness = rear tyre stiffness ≠ 0

c) front tyre stiffness ≠ rear tyre stiffness

d) canno't be compared.

iii) Braking torque on the trailing shoe is

a) greater than that of leading shoe

b) less than that of leading shoe

c) equal to that of leading shoe

d) cannot be compared with leading shoe.

iv) The Ackermann angle (slip) of the vehicle is

a) (b – 1) / R

b) b/R

c) (R – 1) / b

d) b/1.

where b = wheel base; I = distance of CG from rear wheel; R = radius of curvature of path.

v) A vehicle is taking a turn and brakes are applied to all the wheels. Which wheel will under maximum load condition ?

a) Front outer wheel

b) Front inner wheel

c) Rear outer wheel

d) Rear inner wheel.

vi) The coefficient of fluctuation of speed is the ratio of maximum fluctuation of speed and the mean speed

a) product b) ratio

c) sum d) difference.

vii) A vibrating system consists of a mass of 3 kg with a spring (k = 100N/m) and a damper (c = 3N/m/s). Frequency of the system in Hz is

a) 9·2 b) 0·92

c) 3·2 d) 5·75.

viii) A vibrating system consists of a mass of 3 kg with a spring (k = 100N/m) and a damper (c = 3N/m/s). Logarithmic decrement is

a) 0·242 b) 0·542

c) 0·678 d) none of these.

ix) Which of the following is a spring control governor ?

a) Hartnell b) Hartuing

c) Pickering d) All of these.

x) A vehicle of 2500 kg has wheel base 2.5 m. CG of the vehicle is 1.65 m from the rear axle and 1.5 m above ground level with track length 1.5. The vehicle is moving in curved path of 200 m radius. μ = 0.4. Critical speed for toppling in m/s is

a) 495 b) 49.5

c) 4.95 d) 0.495.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A simple U Tube manometer is filled with liquid of density 780kg/m ^{3} . Calculate frequency of resulting motion if the minimum length of manometric fluid is 0.25 m.

3. In what way does a flywheel differ from that of a governor ? Illustrate your answer with suitable examples.

4. Define and explain the following terms relating to governors :

   i) Stability

   ii) Sensitivity

   iii) Isochronous

   iv) Hunting.

5. Explain with neat sketches the difference between wheel braking torque and brake braking torque. Discuss the effect of above braking torque on wheel locking.

6. Explain apt loading and fore loading on vehicle. Discuss the condition under which the above mentioned types of loading appear on a vehicle.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Explain critical damping by the basic equation. Prove that in critical damping displacement decreases with time. 5

b) The torque exerted on the crank shaft of an engine is given by the equation :

T = 14500 + 2300 sin 2θ – 1900 cos 2θ, where θ is the crank angle displacement from the inner dead center. Assuming the resisting torque to be constant, determine,

i) the power of the engine when the speed is 200 r.p.m.

ii) the moment of inertia of the flywheel if the speed variation is not exceed to 0.2% of the mean speed. 10

8. a) The damped vibration record of a spring mass dashpot system shows the following data :

Amplitude of second cycle = 1.2 cm; Amplitude of third cycle = 1.05 cm

Spring constant = 8kg/cm; Weight on the spring = 2 kg.

Determine the damping constant and damping ratio. 5

b) Determine the resultant motion of three harmonic motions given below :

$x_1 = a \sin \omega t$

$x_2 = a \sin (\omega t + 2\pi/3)$

$x_3 = a \sin (\omega t + 4\pi/3)$. 6

c) A coil spring (k = 4N/mm) supports vertically a mass of 0.5kg at the free end. Initial displacement is 0.2 cm. Find the spring stiffness and natural frequency of the system. 4

9. a) A vehicle is moving in road whose lateral slope is θ. Calculate toppling speed and skidding speed for the vehicle when the vehicle is taking a right turn. 7

b) A vehicle is travelling on a laterally inclined road and taking a right turn, having radius of curvature of the path 65 m. The vehicle is of 1200 kg having wheel base 2.5 m. CG of the vehicle is 1.65 m from the rear axle and 0.80 m agbove ground level, track length is 1.2 m. Co-efficient of friction between road and tyre is 0.35.

Calculate the change in the critical speed of toppling and skidding if inclination (lateral) of the road changes from 10° to 15°. 8

10. A vehicle of 1200 kg has wheel base 2.75. CG of the vehicle is 1.0 m from the front axle and 1 m above ground level with track length 1.5. The vehicle is moving in curved path of 100 m radius with a max. velocity of 100 kmph. Vehicle is retarded to 30 kmph in 1 minute. Calculate the most heavily loaded suspensions. 15

11. a) Obtain the expression of lateral force on a vehicle both for front and rear wheels in terms of different vehicle and road parameters. 10

    b) A vehicle of 1000 kg has wheel base 2.5 m. CG of the vehicle is 1.2 m from the rear axle and 0.75 m above ground level. Track length = 1.5 m. What should be the Ackermann angle of the vehicle, if it is taking a blind turn ? 5