Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: AU403

Course Name: VEHICLE DYNAMICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) How are tyres specified? Explain the effect of driving and braking torque on the tyre and factors affecting tyre life. (5)

b) Explain i) Slip angle ii) combined braking and cornering (3)

c) An engine is required to power a truck having a gross weight of 40937 N. The maximum grade which the truck will have to negotiate at 32 km/hr in 2^{nd} gear is expected to be 20% (% grade = tanθ x100). The rolling resistance coefficient is 0.017 and the air resistance coefficient is 0.0324 in the relation, Total resistance= $K_rW + K_aAV^2$ N, where A is in m^2 and V in *km/hr*. The frontal area is 5.2 m^2. The transmission efficiency in 2^{nd} gear is 80%. Calculate the minimum power which should be available from the engine and the gear ration in 2^{nd} gear if this power is available at 2400 rpm and the effective radius of the wheels is 0.419 m. Also calculate the minimum speed of the vehicle in top gear on level road at the same engine speed assuming transmission efficiency of 90% in top gear. What is the gear ration in top gear? The differential has a reduction of 3.92. (7)

2 a) What are the various sources of vibration in a vehicle? (4)

b) What are the factors affecting the cornering force? (3)

c) The coefficient of rolling resistance for a truck weighing 62293.5 N is 0.01822 and the coefficient of air resistance is 0.0276 in the formula $R = KW + Kq\ AV^2$, N, where A is "m" of frontal area and V the speed in *km / hr*. The transmission efficiency in top gear of 6.2:1 is 90% and that in the second gear of 15:1 is 80%. The frontal area is 5.574 m. If the truck has to have a maximum speed of 88 *km/ hr* in top gear calculate: (i) the engine b.p. required; (ii) the engine speed if the driving wheels have an effective diameter of 0.8125 (iii) the maximum grade the truck can negotiate at the above engine speed in second gear; and (iv) the maximum drawbar pull available on level at the above engine speed in second (8)

gear.

3 a) Define: tractive effort and traction also derive the equation for the power required to propel a vehicle, gradability, acceleration and draw bar pull (8)

b) Write short notes on the following: i) cornering force ii) self-righting torque (4)

c) Briefly explain damped free vibration (3)

PART B

Answer any two full questions, each carries 15 marks.

4 a) With a neat sketch explain construction details and working of single-tube telescopic damper (3)

b) What do you mean roll axis of a vehicle explain with neat sketch? (4)

c) A supercharged road-racing automobile has an engine capable of giving an output torque of 949 N-m, this torque being reasonably constant over a speed range from 96 *km / hr* to 257.5 *km/hr* in top gear. The road wheels are of 0.76 m effective diameter and the back axle ratio is 3.3 to 1. When travelling at a steady speed of 160 km/hr in top gear on a level road the power absorbed is 55.2 kW. The vehicle weights 9344 N. The four road wheels each weighs 397.3 N and have a radius of gyration of 0.255 m. The moment of inertia of the engine and all parts forward of the differential is 16.5 N. Assuming that the resistance in N caused by windage and road drag varies as the square of speed, determine the time taken for the speed to rise from 96 to 257.5 kg/hr in top gear at full throttle on an up-grade of 1 in 30 (8)

5 a) What are the main components of a vehicle suspension system? (3)

b) Explain the types of springs used in vehicle suspension system and note down the advantages of each one. (4)

c) A car of total weight 19620 N runs at 72 *Km/hr* round a curve so that its C.G moves in a circle of 80 m radius with its wheel axes at an angle of 10^{0} to the horizontal. The C.G of the car is 1m above the ground and is midway between the axles. The diameter of the wheel is 0.6 m, the wheel track is 1m and each pair of axle weighs 1962 N with a radius of gyration of 0.25 m. Determine the normal reactions on each wheel taking in to account centrifugal and gyroscopic effects. (8)

6 a) Derive the expression for the final forces acting on independent suspension under the action of vehicle force and under the action of horizontal force. (8)

b) Illustrate the reaction at the wheels due to weight, centrifugal force and (7)

gyroscopic effect in a four wheeled vehicle while taking a turn

PART C

Answer any two full questions, each carries 20 marks.

7 a) Discuss the various aerodynamic aids used to reduce the effect of aerodynamic forces in passenger cars. (10)

b) A motor car has a wheel base of 2.64 m, the height of its C. G. above the ground is 0.61 m and it is 1.12 m in front of the rear axle. If the car is travelling at 40 km/hr on a level track, determine the minimum distance in which the car may be stopped, when (a) the rear wheels are braked, (b) the front wheels are braked,(c) all wheels are braked. The coefficient of friction between tyre and road may be taken as 0.6. Prove any formula if assumed (10)

8 a) Write note on pressure distribution on a vehicle (5)

b) Define pitching moment, yawing moment and rolling moment (5)

c) A motorcar weights 13341.5 N and has a wheelbase of 2.65 m. The C.G. is 1.27 m behind the front axle and 0.76 m above the ground lever. Maximum braking on all four wheels on level ground will bring the vehicle uniformly to rest from a speed of 64 km /hr in a distance of 25.9 m. Calculate the value of an adhesion between the tyre and the road. Under the same road condition, the vehicle descends a hill of gradient 1 in 20 and is braked on the front wheels only. Determine the load distribution between the front and rear wheels and the distance required to bring the car to rest. (10)

9 a) Write note on i) aerodynamic side forces ii) lift force (10)

b) Find the expressions for reactions on rear and front wheel when the vehicle moving down a slope and brakes applied to the rear wheels (10)

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