

GUJARAT TECHNOLOGICAL UNIVERSITY

BE MINOR - SEMESTER-VII EXAMINATION – SUMMER 2024

Subject Code:117AL01

Date:29-05-2024

Subject Name:Vehicle Dynamics

Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

	Marks
Q.1 (a) Write Bernoulli's equation for studying aerodynamic drag forces around the vehicle. How does it affect the pressure distribution around the vehicle in motion?	03
(b) Derive the equation of dynamic axle loading considering linear acceleration only. Neglect gradient and hitch forces.	04
(c) Draw the trajectory of a four wheel vehicle's coordinates with respect to earth's fixed coordinate system. Define the following terms. Heading angle, side-slip angle, steer angle, course angle.	07
Q.2 (a) Classify and enlist various components of aerodynamic drag forces.	03
(b) Derive the equation to find the longitudinal center of gravity of a vehicle.	04
(c) A 2-wheeler weighing 200 kg accelerates uniformly from 0 to 50 kmph in 10 seconds. Calculate (i) average power required for acceleration, (ii) total tractive force and power required at a speed of 30 kmph. Consider the radius of the wheel as 0.28 m, gear ratio equal to 1 and ($C_d=0.9$, $\rho= 1.2\text{kg/m}^3$, $A=0.6 \text{ m}^2$).	07
OR	
(c) What is the phenomenon of Off Tracking Distance during a turn? Derive the equation of front wheel steer angles, average steer angle and off tracking distance during low speed turning using Ackerman's formula.	07
Q.3 (a) Define the moments which are generated due to aerodynamic drag forces around the different axis of the vehicle and also write their equations.	03
(b) Explain the generation of rolling resistance force at contact patch of tyre.	04
(c) Enlist various steering system mechanisms. Explain components and working of rack-and-pinion steering.	07
OR	
Q.3 (a) Define the terms: Understeer, Oversteer, Neutral steer	03
(b) Discuss the advantages of four wheel steering.	04
(c) Classify the types of suspensions system and compare them.	07
Q.4 (a) Define the terms: Caster angle, Toe angle and Camber angle with necessary figures.	03
(b) Differentiate between active and passive suspension systems.	04

- (c) Explain the working of anti-squat and anti-pitch suspension geometry and with necessary equations. **07**

OR

- Q.4 (a)** Explain the meaning of the tyre size code: P 205 / 60 R 16 96 H. **03**
- (b)** Explain the evolution in construction technology of tyres. **04**
- (c)** Elaborate the phenomenon of Conicity and Ply Steer with tyre. **07**

- Q.5 (a)** Draw the free body diagram to explain quasi-static rollover of a suspended vehicle. **03**
- (b)** A 2-wheeler weighing 200 kg accelerates uniformly from 0 to 50 kmph in 10 seconds. Calculate (i) deceleration, (ii) stopping distance (iii) time to stop and (iv) energy dissipated. Consider the radius of the wheel as 0.28 m, gear ratio of 1 and ($C_d=0.9$, $\rho=1.2\text{kg/m}^3$, $A=0.6\text{m}^2$) **04**
- (c)** Explain the principle of brake proportioning. **07**

OR

- Q.5 (a)** Draw the free body diagram to explain transient roll behavior of a suspended vehicle. **03**
- (b)** Derive the equation of lateral acceleration for quasi-static rollover of a rigid vehicle. Also derive the lateral acceleration for rollover threshold. **04**
- (c)** Explain the development of the boundary layer around the vehicle during the wind tunnel testing of the vehicle. Also discuss the influence of separation point on aerodynamic drag coefficient. **07**
