

**ME AUTOMOBILE ENGG 1<sup>ST</sup> YEAR 1<sup>ST</sup> SEM EXAM 2024**

## Vehicle dynamics

Time: 3hrs

Marks: 100

(Assume data if missing)

(Answer any four)

1. a) Derive the expression for weight distribution on front and rear wheels of a four-wheeler car while moving on an uphill grade with acceleration.
- b) How is the tractive force being generated by the wheel? Explain with FBD.
- c) Explain the rolling resistance of the wheel with sketches.
- d) A front wheel driven motorcar having gross vehicle weight of 1000 kg with wheelbase 2.75 m and C. G. of the vehicle is at 0.85 m above ground level and 1.6 m behind the front axle. The coefficient of friction between road and tyre is 0.4. Neglecting the air drag, calculate the maximum possible acceleration of the car on a level road. Assume coefficient of rolling friction is 0.01.

8+4+4+9=25

2. a) What is the condition of maximum braking? Derive the expression.
- b) Explain "Loss of directional stability" and "Loss of directional control".
- c) Find the expression of maximum deceleration when rear wheel locks.
- d) What is the characteristic curve " $(d/g)$  vs.  $K_{br}$ " - Explain.

7+6+7+5=25

[Turn over]

[2]

3. a) What are the differences between radial and bias tires? What are the properties of elastomer? How do you explain spring and viscous effects of elastomer from micro point of view?  
b) Explain "Temperature" and "Frequency" effects on elastomer.  
c) What are the two macro level events occurred due to interaction between tread block and road?  
d) What is WLF equation and where it is used?

8+6+6+5=25

4. a) Find the governing equations of a half car model.  
b) The curb weights of a continental 4-door sedan without passengers or cargo are 1050 kg on the front axle and 600 kg on the rear. The wheelbase is 2.77 m. Determine the fore / aft position of the centre of gravity for the vehicle.  
c) A vehicle having gross weight 2500 kg, wheel base 3.5 m, C. G. of the vehicle 1.5 m above ground level and 1.65 m from rear axle and track length (width) 1.5 m is travelling on a curved path of radius 500 m. Calculate the skidding and overturning speed of the vehicle, if coefficient of friction between the road and tyre is 0.4.

12+5+8=25

5. a) Derive the expression for wheel reaction of a car considering both gyroscopic and centrifugal effects while taking a turn. Find the limiting condition of overturning.  
b) Establish the relationship between the steering angle and the slip angles of a bicycle  
c) What is pneumatic trail? How does it help in handling?

10+8+7=25

6. a) What are the different types of camber? Which type is favorable in turning and why? Discuss advantages and disadvantages of different types of camber.  
b) Why positive caster is used in vehicle? How toe angle affects the vehicle handling?  
c) What is the equation of steering gear?

12+8+5=25

[3]

7. a) Explain with sketches Ackerman steering gear.  
b) Mention the advantages and disadvantages of Ackerman steering gear over Davis steering mechanisms.  
c) What do you understand by under steering and over steering of a car? Find out the conditions for oversteer and understeer. Also explain the same in graph.

9+6+10=25