ME AUTOMOBILE ENGG 1ST YEAR 1ST SEM EXAM 2025

Vehicle dynamics

Time: 3hrs Marks: 100

(Assume data if missing)

(Answer any five)

1. a) How is the tractive force being generated by the wheel? Explain with FBD.
   b) Explain the rolling resistance of the wheel with sketches.
   c) 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.

5+5+10=20

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

5+5+5+5=20

3. a) What are the differences between radial and bias tires?
   b) Explain "Temperature" and "Frequency" effects on elastomer.
   c) Explain "Grip" of tires from micro and macro point of views.

4+8+8=20

4. a) 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.
   b) 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.

10+10=20

5. a) Define camber, caster, toe-in and toe-out of a vehicle with neat sketches.
   b) What is the equation of steering gear?
   c) Explain with sketches Ackerman steering gear. Mention the advantages and disadvantages of Ackerman steering gear over Davis steering mechanisms.

8+4+8=20

6. Derive the governing equations of a half car model and further reduce the same into quarter car model. Also find mass, stiffness and damping matrices.

7. a) What is the slip angle? How is the lateral force generated? State the significance of the self-aligning moment with a sketch. What is pneumatic trail? How does it help in vehicle handling?
   b) Establish the relationship between the steering angle and the slip angles of a bicycle.
   c) What do you understand by under steering and over steering of a car? Find out the conditions for oversteer and understeer.

6+8+6=20
