(3 Hours)   **[Total Marks: 80]**

NB: -   1) Draw neat sketches whenever necessary.
      2) **Q. No. 1** is compulsory.
      3) Solve any **three** questions from the remaining five questions.
      4) Assume suitable data wherever necessary.

Q.1   Answer **any five** of the following :   20

     a)   What are the advantages of rack and pinion type of steering gear ?
     b)   What are the mechanisms which generated lateral forces at tyre road contact patch during cornering? Explain in short any one.
     c)   Why suspension spring rates are kept low practically?
     d)   What are the sensors used in vehicle dynamics control system? Explain any one.
     e)   What is rolling resistance? Enlist mechanisms which generate rolling resistance.
     f)   Enlist aerodynamic aids used to reduce profile drag and explain any one.

Q.2   a)   Find the curvature response per degree of steering angle at 60 kpH. The data given as :   10
          Mass of the vehicle – 1200 Kg
          Wheel base – 2.4 m
          Position of CG from front axle – 1.25 m
          Cornering stiffness of front tyres – 60 KN/rad
          Cornering stiffness of rear tyres – 65 KN/rad

     b)   Explain special properties of double conjugate points. How it is applied to real vehicle?   10

Q.3   a)   What is variable rate springs? Explain the importance of variable rate in context with vehicle dynamics.   10

     b)   Explain over steer, neutral steer and under steer with the help of stability derivatives.   10

Q.4   a)   Find the distance between the double conjugate points for the passenger car –   10
          Sprung mass = 900 kg, wheel base = 1.2 m , Distance of CG from front axle = 1.2 m ,
          Front suspension stiffness = 50 KN/m,
          Rear suspension stiffness = 150 KN / m.

     b)   What are the tyre properties used during cornering? How cornering stiffness affects vehicle performance?   10

TURN OVER

2

Q.5 a) Explain mechanics of air flow around a vehicle with aerodynamics aids and explain how drag is created ? 10

b) Derive an equation for steady state response to side force. Explain the importance of stability derivatives. 10

Q.6 Write short note on **(Any Four)** 20

a) Vehicle Dynamics simulations
b) Ride
c) Active suspension
d) Anti rollover braking
e) Roll center and roll axis
f) Wheel wobble and wheel shimmy

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