Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

V1 SEMESTER B.TECH. MECHATRONICS

END SEMESTER EXAMINATIONS, May 2022

SUBJECT: VEHICLE DYNAMICS [MTE 4054]

(19-05-2022)

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitable assumed.

Q. No		M	CO	PO	LO	BL
1A.	How do you classify the vehicle into different modules	**2**	**1**	**1**	**1**	**2**
1B.	In Ashok Leyland trucks, rolling resistance consumes almost 30% of the fuel. Illustrate, how this rolling resistance force originates in the trucks. Draw the relevant sketches.	**3**	**1**	**2**	**2**	**3**
1C.	Derive an expression for maximum force developed in front wheel drive.	**5**	**1**	**2,3**	**2,3**	**3**
2A.	In Alto 800, 58% of the total braking force is placed on the front axle, so that maximum deceleration of 0.68g is achieved prior to any tire lock up. Calculate the braking efficiency if the car is moving on a road with coefficient of road adhesion is 0.84. Also calculate the braking efficiency when the car is moving on icy road with coefficient of road adhesion is 0.24	**2**	**3**	**1,4**	**1,4**	**4**
2B	Hyundai venue weighs 14.71 kN and has a wheelbase of 2.5 m. The center of gravity is 1.08 m behind the front axle and 0.488 m above ground level. The braking effort distribution on the front axle is 60%. The coefficient of rolling resistance is 0.02. Determine which set of the tires will lock first. Take coefficient of road adhesion $\mu = 0.2$.	**3**	**3**	**4**	**4**	**4**
2C	Derive an expression for (d/g) when front wheel locks and when the rear wheel locks	**5**	**3**	**2,3**	**2,3**	**3**
3A	It has been observed that, in a vehicle all the tires are replaced with low aspect ratio tires. What differences one can observe in handling and ride? What changes have to be incorporated in the vehicle, to overcome the disadvantage of low aspect ratio tire?	**2**	**5**	**1**	**1**	**3**
3B	Compare rib and lug tires.	**3**	**2**	**1**	**1**	**2**
3C	Develop a relationship between, tire model parameter (θx) and fraction of sticking/sliding (λ) using brush model	**5**	**2**	**2,3**	**2,3**	**3**
4A	Explain the phenomenon by which PRAT is developed in the tire.	**2**	**5**	**1**	**1**	**3**
4B	Classify the tire models based on vehicle oscillation (frequency and amplitude)	**3**	**2**	**2,3**	**2,3**	**2**

4C	In the study of stability of automobiles, the force developed in Y direction is given by Fy=m(v̇+ru). Derive the expression by making suitable assumption.	**5**	**3**	**1**	**1**	**3**
5A	Suggest a method used for handling evaluation of vehicle dynamic performance. Explain with relevant sketches.	**3**	**5**	**1**	**1**	**3**
5B	Kia Seltos has a weight of 20.105 kN and a wheelbase of 2.8 m. The weight distribution on the front axle is 53.5%, and that on the rear axle is 46.5% under static conditions. a) If the cornering stiffness of each of the front tires is 38.92 kN/rad and that of the rear tires is 38.25 kN/rad, determine the steady-state handling behavior of the vehicle. b) If the front tires are replaced by a pair of radial-ply tires, each of which has a cornering stiffness of 47.82 kN/rad, and the rear tires remain unchanged, determine the steady-state handling behavior of the vehicle under these circumstances.	**3**	**4**	**4**	**4**	**4**
5C	Derive an expression for roll rate ($d\phi/da_y$)	**4**	**3**	**2,3**	**2,3**	**3**