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

DEPARTMENT OF MECHATRONICS
V1 SEMESTER B.TECH. MECHATRONICS

END SEMESTER EXAMINATIONS, JULY 2022 MAKEUP

SUBJECT: VEHICLE DYNAMICS [MTE 4054]

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.	Suggest the preferred sequence of locking of tire in tractor-semitrailer during braking.	2	1	1	1	2
1B.	How do you specify a tire? Explain the meaning of each term used in specification.	3	1	2	2	3
1C.	Derive an expression for maximum force developed in rear wheel drive.	5	1	2,3	2,3	3
2A.	In Renault kwid 58% of the total braking force is placed on the front axle and it has a braking efficiency of 81% on concrete road with coefficient of road adhesion is 0.84. Calculate the maximum deceleration achieved prior to any tire lock up.	2	3	1,4	1,4	4
2B	Maruti Ertiga weighs 12.2 kN and has a wheelbase of 2.74 m. The center of gravity is 1.48 m behind the front axle and 0.52 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 the rear wheel lock	5	3	2,3	2,3	3
3A	Define Aspect ratio in tires. Compare the performance of low and high aspect ratio tires.	2	5	1	1	3
3B	Suggest a suitable tire (Rib/Lug) to be used in front wheel. Explain its salient features.	3	2	1	1	2
3C	Derive an expression for deformation of bristle of tires using brush model. Draw a relevant sketch and explain each term used in derivation	5	2	2,3	2,3	3
4A	Consider a motorcycle is cornering and braking. Let us assume after sometime brake released suddenly and cornering is continued. Explain, what happened to longitudinal and lateral forces	2	5	1	1	3
4B	It is observed that lateral forces are generated in a tire even when the vehicle is not cornering. List any two sources which develop these forces. Also explain how these forces are developed.	3	2	2,3	2,3	2

4C	Prove that in an automobile, the lateral force Fy=m($\dot{v}$+ru). State the assumption made during derivation	5	3	1	1	3
5A	With a sketch explain mimuro plot used for lateral transient response.	3	5	1	1	3
5B	Consider a Toyota Innova weighing 20kN and a wheelbase of 2.75m. The front rear static weight distribution is 55%-45%. If the cornering stiffness of each of the four tyres is 40kN/rad. A) Comment on the steady state handling response of the vehicle. B) Now the front tyres are replaced with ones that have a cornering stiffness of 50kN/rad (each of front tire). Comments on the steady state handling response in this scenario	3	4	4	4	4
5C	Derive an expression for roll angle (ø) of an automobile	4	3	2,3	2,3	3