

Enrollment No.....



Faculty of Engineering  
End Sem Examination May-2024  
AU3CO35 Vehicle Dynamics

Programme: B.Tech.

Branch/Specialisation: AU

**Duration: 3 Hrs.****Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

- Q.1 i. Drag force is proportional square of- 1  
 (a) Volume (b) Viscosity (c) Velocity (d) None of these
- ii. Traction force is required for- 1  
 (a) To stability of vehicle (b) To propel the vehicle  
 (c) To control the vehicle (d) None of these
- iii. The ratio of tyre section height to the tyre section width- 1  
 (a) Ply rate (b) Aspect ratio (c) Tyre ratio (d) None of these
- iv. The radius of a pneumatic tyre is- 1  
 (a) The radius of unloaded fully inflated tyre  
 (b) The height of center of tyre from the ground when it is loaded  
 (c) It is fixed radius, based on the dimensions of the tyre  
 (d) None of these
- v. A front stabilizer bar is used to- 1  
 (a) Increase vehicle load carrying capacity  
 (b) Provide a softer ride  
 (c) Control suspension movement and body roll  
 (d) All of these
- vi. The rigid suspension is beneficial when- 1  
 (a) It is desired to reduce the unsprung mass  
 (b) It is desired to have more flexibility in design  
 (c) It is desired to improve tyre to ground contact characteristics  
 (d) Large change in load make it necessary to have a large suspension stroke
- vii. The roll angle is- 1  
 (a)  $\phi = \tan^{-1} \frac{h}{t}$  (b)  $\phi = \tan^{-1} \frac{t}{h}$   
 (c)  $\phi = \tan^{-1} \frac{2h}{t}$  (d)  $\phi = \tan^{-1} \frac{2t}{h}$

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- viii. The roll-axis is- 1  
 (a) The vehicle rolling axis (b) The vehicle center axis  
 (c) The vehicle lateral axis (d) None of these
- ix. The horizontal position of CG from front ground contact point- 1  
 (a)  $X_{CG} = \frac{L_r W_B}{W_t}$  (b)  $X_{CG} = \frac{2L_r W_B}{W_t}$   
 (c)  $X_{CG} = \frac{L_r W_B}{2W_t}$  (d)  $X_{CG} = \frac{L_r W_t}{W_B}$
- x. Position of mass center is effects the- 1  
 (a) Load transfer (b) Traction (c) Angle of lean (d) All of these
- Q.2 i. What do you mean by vehicle control loop? 3  
 ii. Describe the position of the moving vehicle center of gravity with respect to the axis fixed on the ground. 7
- OR iii. Derive the force at front wheels of Tractor-Semitrailer model. 7
- Q.3 i. Describe Radial-ply tire with neat sketch. 2  
 ii. What is traction? Explain traction on dry and wet surfaces. How traction affects the vehicle dynamics? 8
- OR iii. Explain the tyre tractive properties in terms of peak and slide coefficient of friction and its dependence on vertical load, inflation pressure, surface friction, speed. 8
- Q.4 i. What do you mean by solid axle? 3  
 ii. Explain anti-dive suspension geometry with neat sketch. 7
- OR iii. Explain multi-link rear suspension with neat sketch. 7
- Q.5 i. What do you mean by roll center? 4  
 ii. Discuss quasi-static rollover of a suspended vehicle. 6
- OR iii. Explain transient rollover with generic car model. 6
- Q.6 Attempt any two:  
 i. Find the height of motorcycle's center of gravity. 5  
 ii. Explain in brief basic motorcycle geometry with neat sketch. 5  
 iii. What is trail? Explain how it affects the motorcycle stability. 5

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## Marking Scheme

### Vehicle Dynamics (T) - AU3CO35 (T)

Q.1	i.	Drag force is proportional square of	1
		(a) Volume (b) Viscosity	
		<b>(c) Velocity</b> (d) None of these	
	ii.	Traction force is required for	1
		(a) To stability of vehicle <b>(b) To propel the vehicle</b>	
		(c) To control the Vehicle (d) None of these	
	iii.	The ratio of tyre section height to the tyre section width:	1
		(a) Ply rate <b>(b) Aspect ratio</b>	
		(c) Tyre ratio (d) None of the above	
	iv.	The radius of a pneumatic tyre is	1
		<b>(a) The radius of unloaded fully inflated tyre</b>	
		(b) The height of center of tyre from the ground when it is loaded	
		(c) It is fixed radius, based on the dimensions of the tyre	
		(d) None of these	
	v.	A front stabilizer bar is used to	1
		(a) Increase vehicle load carrying capacity	
		(b) Provide a softer ride	
		<b>(c) Control suspension movement and body roll</b>	
		(d) All of the above	
	vi.	The rigid suspension is beneficial when	1
		(a) It is desired to reduce the unsprung mass	
		(b) It is desired to have more flexibility in design	
		(c) It is desired to improve tyre to ground contact characteristics	
		<b>(d) Large change in load make it necessary to have a large suspension stroke</b>	
	vii.	The roll angle is	1
		(a) $\phi = \tan^{-1} \frac{h}{t}$ (b) $\phi = \tan^{-1} \frac{t}{h}$	
		<b>(c) <math>\phi = \tan^{-1} \frac{2h}{t}</math></b> (d) $\phi = \tan^{-1} \frac{2t}{h}$	
	viii.	The roll-axis is	1
		<b>(a) The vehicle rolling axis</b> (b) The vehicle center axis	
		(c) The vehicle lateral axis (d) None of these	
	ix.	The horizontal position of CG from front ground contact point	1
		<b>(a) <math>X_{CG} = \frac{L_r W_B}{W_t}</math></b> (b) $X_{CG} = \frac{2L_r W_B}{W_t}$	
		(c) $X_{CG} = \frac{L_r W_B}{2W_t}$ (c) $X_{CG} = \frac{L_r W_t}{W_B}$	
	x.	Position of mass center is effects the	1
		(a) Load Transfer (b) Traction	
		(c) Angle of lean <b>(d) All of the above</b>	

Q.2	i.	What do you mean by vehicle control loop?	3
	ii.	Describe the position of the moving vehicle center of gravity with respect to the axis fixed on the ground.	7
OR	iii.	Derive the force at front wheels of Tractor-Semitrailer model.	
		Diagram	2
		Derive	5
Q.3	i.	Describe Radial-ply tire with neat sketch.	2
	ii.	What is Traction?	2
		Explain traction on dry and wet surfaces.	3
		How traction effects the vehicle dynamics?	3
OR	iii.	Explain the Tyre tractive properties in terms of Peak and Slide	4
		Coefficient of friction	
		its dependence on Vertical load, Inflation Pressure, Surface	4
		Friction, Speed.	
Q.4	i.	What do you mean by solid axle?	3
	ii.	Explain anti-dive suspension geometry with neat sketch.	
		Sketch	2
		Explain	5
OR	iii.	Explain Multi-Link Rear Suspension with neat sketch.	
		Sketch	2
		Explain	5
Q.5	i.	What do you mean by roll center?	3
	ii.	Discuss quasi-static rollover of a suspended vehicle.	7
OR	iii.	Explain transient rollover with generic car model.	7
Q.6		Attempt any two:	
	i.	Find the height of motor cycle's center of gravity.	5
	ii.	Explain in brief basic motorcycle geometry with neat sketch.	5
	iii.	What is trail?	2
		Explain how it is effects the motorcycle stability?	3

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