

Faculty of Engineering

End Semester Examination May 2025

AU3CO35 Vehicle Dynamics

Programme	:	B.Tech.	Branch/Specialisation	:	AU
Duration	:	3 hours	Maximum Marks	:	60

Note: All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.
 Notations and symbols have their usual meaning.

Section 1 (Answer all question(s))				Marks CO BL
Q1. Which factor primarily affects the braking distance of a vehicle?				1 1 1
<input type="radio"/> Tire pressure	<input checked="" type="radio"/> Brake force distribution			
<input type="radio"/> Vehicle color	<input type="radio"/> Engine type			
Q2. In the bicycle model of lateral dynamics, which parameter directly influences vehicle stability?				1 1 1
<input type="radio"/> Roll center height	<input checked="" type="radio"/> Under-steer gradient			
<input type="radio"/> Brake pad material	<input type="radio"/> Exhaust system design			
Q3. Which factor is primarily responsible for lateral force generation in a tire?				1 2 1
<input type="radio"/> Rolling resistance	<input checked="" type="radio"/> Ply steer and conicity			
<input type="radio"/> Contact patch shape	<input type="radio"/> Tire inflation pressure			
Q4. What is the primary purpose of the Magic Formula in tire modeling?				1 2 2
<input type="radio"/> To design tire tread patterns	<input checked="" type="radio"/> To predict tire force behavior under various conditions			
<input type="radio"/> To calculate rolling resistance	<input type="radio"/> To assess rubber elasticity			
Q5. Which suspension geometry is designed to reduce the pitching motion of a vehicle during acceleration and braking?				1 3 1
<input type="radio"/> Anti-Squat Geometry	<input checked="" type="radio"/> Anti-Pitch Geometry			
<input type="radio"/> Anti-Dive Geometry	<input type="radio"/> Roll Centre Geometry			
Q6. Which type of suspension allows for independent movement of each wheel, enhancing ride comfort and handling?				1 3 1
<input type="radio"/> Solid Axle Suspension	<input checked="" type="radio"/> Independent Suspension			
<input type="radio"/> Leaf Spring Suspension	<input type="radio"/> MacPherson Strut Suspension			
Q7. Which parameter is most critical in determining the likelihood of a quasi-static rollover in a rigid vehicle?				1 4 1
<input type="radio"/> Tire pressure	<input checked="" type="radio"/> Center of gravity height			
<input type="radio"/> Suspension stiffness	<input type="radio"/> Brake force distribution			
Q8. Transient rollover is primarily influenced by which dynamic factor?				1 4 1
<input type="radio"/> Static vehicle weight	<input checked="" type="radio"/> Sudden steering inputs and lateral acceleration			
<input type="radio"/> Suspension spring rate	<input type="radio"/> Tire wear and tear			
Q9. Which parameter in motorcycle geometry is crucial for ensuring straight-line stability?				1 5 1
<input type="radio"/> Wheelbase	<input checked="" type="radio"/> Trail			
<input type="radio"/> Steering angle	<input type="radio"/> Suspension stiffness			

Q10. Which of the following is not considered a resistance force acting on a motorcycle?

1 5 1

- Tyre rolling resistance
- Aerodynamic resistance
- Engine torque
- Slope resistance force

Section 2 (Answer all question(s))

Marks CO BL

Q11. Explain how acceleration and braking affect the longitudinal load distribution in a tractor-semi trailer. Provide real-world examples to support your explanation.

3 1 3

Rubric	Marks
Explain how acceleration and braking affect the longitudinal load distribution in a tractor-semi trailer.	2
Provide real-world examples to support your explanation.	1

Q12. (a) Evaluate the effectiveness of the Immure plot in analyzing lateral transient responses in vehicle dynamics. How does this method assist in improving vehicle handling?

7 1 5

Rubric	Marks
Evaluate the effectiveness of the Immure plot in analyzing lateral transient responses in vehicle dynamics.	3
How does this method assist in improving vehicle handling?	4

(OR)

(b) Design a basic model for rollover prevention in a half-car system. What key parameters would you consider to enhance the vertical dynamics and prevent rollover incidents?

Rubric	Marks
Design a basic model for rollover prevention in a half-car system.	4
What key parameters would you consider to enhance the vertical dynamics and prevent rollover incidents?	3

Section 3 (Answer all question(s))

Marks CO BL

Q13. How do slip and grip characteristics influence the performance of a tire during acceleration and braking?

2 2 1

Rubric	Marks
How do slip and grip characteristics influence the performance of a tire during acceleration?	1
How do slip and grip characteristics influence the performance of a tire during braking?	1

Q14. Analyze how the contact patch and pressure distribution affect the force development in a tire during cornering. What role do these factors play in maintaining vehicle stability?

3 2 4

Rubric	Marks
Analyze how the contact patch and pressure distribution affect the force development in a tire during cornering.	2
What role do these factors play in maintaining vehicle stability?	1

Q15. (a) Evaluate the effectiveness of the Magic Formula model in predicting tire behavior under combined slip conditions. How reliable is it compared to other tire models?

5 3 5

Rubric	Marks
Evaluate the effectiveness of the Magic Formula model in predicting tire behavior under combined slip conditions.	3
How reliable is it compared to other tire models?	2

(OR)

(b) Design an experimental setup to measure the impact of ply steer and conicity on lateral force generation in tires. What key parameters would you consider?

Rubric	Marks
Design an experimental setup to measure the impact of ply steer and conicity on lateral force generation in tires.	3
What key parameters would you consider?	2

Section 4 (Answer any 2 question(s))

Marks CO BL

Q16. Explain how anti-dive suspension geometry improves vehicle stability during braking. Provide examples of how this is implemented in modern vehicles.

5 3 3

Rubric	Marks
Explain how anti-dive suspension geometry improves vehicle stability during braking.	3
Provide examples of how this is implemented in modern vehicles.	2

Q17. Evaluate the importance of calculating the effective spring rate in vehicle suspension design. How does it influence ride comfort and vehicle dynamics?

5 3 1

Rubric	Marks
Evaluate the importance of calculating the effective spring rate in vehicle suspension design.	3
How does it influence ride comfort and vehicle dynamics?	2

Q18. Design a conceptual suspension system that minimizes both body and wheel hop modes. What key controllable elements would you incorporate to enhance suspension dynamics?

5 3 3

Rubric	Marks
Design a conceptual suspension system that minimizes both body and wheel hop modes.	3
What key controllable elements would you incorporate to enhance suspension dynamics?	2

Section 5 (Answer all question(s))

Marks CO BL

Q19. Compare the differences between quasi-static rollover in rigid and suspended vehicles. How does suspension behavior influence rollover dynamics?

4 4 4

Rubric	Marks
Compare the differences between quasi-static rollover in rigid and suspended vehicles.	2
How does suspension behavior influence rollover dynamics?	2

Q20. (a) Evaluate the effectiveness of modern suspension systems in minimizing the risk of transient rollovers. What design considerations are most important?

6 4 5

Rubric	Marks
Evaluate the effectiveness of modern suspension systems in minimizing the risk of transient rollovers.	4
What design considerations are most important?	2

(OR)

(b) Design a safety strategy to reduce rollover risk in SUVs, focusing on suspension design and electronic control systems. What key technologies would you implement?

Rubric	Marks
Design a safety strategy to reduce rollover risk in SUVs, focusing on suspension design and electronic control systems.	4
What key technologies would you implement?	2

Section 6 (Answer all question(s))

Marks CO BL

Q21. Explain how the location and height of the center of gravity (C.G) affect the handling and stability of a motorcycle during cornering. 3 5 2

Rubric	Marks
Explain how the location and height of the center of gravity (C.G) affect the handling of a motorcycle during cornering.	1.5
Explain how the location and height of the center of gravity (C.G) affect the stability of a motorcycle during cornering.	1.5

Q22. (a) Evaluate the significance of the moment of inertia in motorcycle dynamics. How does it affect the motorcycle's performance during acceleration and braking? 7 5 5

Rubric	Marks
Evaluate the significance of the moment of inertia in motorcycle dynamics.	4
How does it affect the motorcycle's performance during acceleration and braking?	3

(OR)

(b) Design an experimental approach to determine the impact of aerodynamic resistance on motorcycle speed and fuel efficiency. What factors would you measure and analyze?

Rubric	Marks
Design an experimental approach to determine the impact of aerodynamic resistance on motorcycle speed and fuel efficiency.	4
What factors would you measure and analyze?	3
