SEMESTER S6

VEHICLE STABILITY AND DYNAMICS

Course Code	PCAUT602	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand the performance characteristics and vibration behaviour of road vehicles, including the effects of tractive resistance, tractive effort, and power requirements
2. Comprehend the dynamics of tires and braking systems, focusing on tire behaviour during cornering, braking dynamics, and the impact of tire characteristics on vehicle performance
3. Analyze the stability of vehicles under various conditions, considering load distribution, gyroscopic effects, and the impact of aerodynamic forces on road loads and vehicle handling

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Performance of road vehicles**: Tractive resistance, tractive effort, power required for propulsion, grade ability, drawbar pull and the problems related to these terms. Road performance curves- acceleration, grad ability and drawbar pull. Vibrations-Free vibrations of single degree freedom systems, energy method. Undamped and damped free vibrations, viscous damping, critical damping, logarithmic decrement (Numericals only) transmissibility. Vehicle Vibration and human comforts	9
2	**Tires**: tire dynamics Ride characteristics, Behavior while Cornering, Slip angle, Cornering force, Power consumed by Tire, Over steer, under steer, steady state cornering, aligning moment-combined braking and Cornering, effect of camber & transient effects in cornering. Tire Vibrations. **Braking Dynamics:** Braking requirements, stopping distance,	9

	braking efficiency, work done in braking, tire adhesion.	
3	**Stability of vehicles**: Load distribution (Three wheeled and four wheeled vehicles), Calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road. Gyroscopic effects, weight transfer during acceleration, Cornering and braking, cross wind handling.	**9**
4	**Road Loads**: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

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Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concepts of tractive resistance, tractive effort, and power required for vehicle propulsion.	**K2**
CO2	Understand tire dynamics, including behaviour while cornering and the effects of camber and transient cornering.	**K2**
CO3	Understand vehicle stability concepts, including load distribution, tractive effort, and gyroscopic effects	**K2**
CO4	Understand the effects of air resistance on vehicles, including aerodynamic forces and cross wind sensitivity.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2								
CO2	3	2		2								
CO3	3	2		2								
CO4	3	2		2								

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electrical Machines	Kothari D. P. and I. J. Nagrath .	Tata McGraw Hill	2004
2	Automobile Mechanics	N. K. Giri	Khanna Publishers	8th Edition, 2018
3	The Automotive Transmission Book	Fischer and Pollack	Springer	2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Automotive Mechanics	S. Srinivasan	Tata McGraw-Hill	2nd Edition, 2017
2	Vehicle Dynamics and Control	Rajesh Rajamani	Springer	2nd Edition, 2011
3	Theory of Machines and Mechanisms	Sadhu Singh	Pearson Education	4th Edition, 2017

Video Links (NPTEL, SWAYAM…)	
	Link ID
	Fundamentals of Automotive Systems By Prof. C. S. Shankar Ram, IIT Madras

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