

INSTITUTE	FACULTY OF TECHNOLOGY
PROGRAM	MASTER OF TECHNOLOGY in ELECTRICAL ENGINEERING
SEMESTER	1
COURSE TITLE	VEHICLE DYNAMICS
COURSE CODE	01EV1104
COURSE CREDITS	4

Objective:

- 1 Understanding of Dynamic behaviour of different systems in different running and loading condition in automobile vehicle

Course Outcomes: After completion of this course, student will be able to:

- 1 To breakdown the dynamics of vehicle ride under different riding condition.
- 2 To present a problem-oriented in-depth knowledge of Vehicle Dynamics.
- 3 To address the underlying concepts and methods behind Vehicle Dynamics.
- 4 To calculate and refer the loads and forces associated with the vehicles.
- 5 To analyze the behaviour of the vehicles under acceleration, ride and braking.

Pre-requisite of course: Basic knowledge of Kinematics of Machine, Dynamics of Machine & Automobile system

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction to Vehicle Dynamics Vehicle classifications, fundamental approaches to vehicle dynamics modelling, SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, raking performance, Brake proportioning, braking efficiency	8
2	Aerodynamic Loads Wind drag and car body design, rolling resistance, breakdowns of total road loads, gas mileage analysis and driving styles; Aerodynamics	6

Contents : Unit	Topics	Contact Hours
3	Tire Mechanics Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance, Tire Construction and Force Development, Contact Patch and Contact Pressure Distribution Lateral Force Generation, Ply Steer and Conicity - Tire Models, Magic Formula - Classification of Tire Models and Combined Slip	7
4	Vertical Dynamics Rollover Prevention - Half Car Model, Quarter Car Model, Subjective and Objective Evaluation of Vehicle Handling, Bicycle Model - Stability and Steering Conditions, Understeer Gradient and State space Approach – Handling Response of a Vehicle	8
5	Dynamics of Chassis and Suspension Systems Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Centre Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes	8
6	Motorcycle Dynamics Kinematic structure and geometry of motorcycles, the importance of trail, Resistance forces acting on the motorcycle (tyre rolling and aerodynamic resistance forces, the resistant force caused by slope), Location of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle	7
Total Hours		44

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment No. 01 Experimental study of mechanism for air flow over different geometry of vehicles.	2
2	Experiment No. 02 Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.	2
3	Experiment No. 03 To study the effect of tyre pressure and temperature on the performance of the tyre.	2
4	Experiment No. 04 To simulate and study a quarter car models using MBD software.	2
5	Experiment No. 05 To simulate and understand behaviour of sprung / un-sprung mass & lumped mass system MBD software.	2
6	Experiment No. 06 Finding the stiffness of tyre with variation of air pressure.	2
7	Experiment No. 07 To simulate and study the effect of different conditions on vehicle loading.	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
8	Experiment No. 08 Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.	2
9	Experiment No. 09 Experimental studies of geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider	2
10	Experiment No. 10 Finding the location & height of Centre of gravity (C.G) of a motorcycle	2
11	Experiment No. 11 Hands on Experiment on any of the dynamic system of vehicle.	2
Total Hours		22

Textbook :

- 1 Fundamentals of Vehicle Dynamics, Thomas D. Gillespie,, SAE Publication., -
- 2 Vehicle Dynamics, Theory and Application, Reza N. Jazar, Springer, 2009
- 3 Vehicle Dynamics & control, Rajesh Rajamani, Springer., -
- 4 Vehicle dynamics, R.V. Dukkipati, Narsova Publications, -

References:

- 1 Motorcycle Dynamics, 2nd Edition, Motorcycle Dynamics, 2nd Edition, Vittore Cossalter, LULU.com, -
- 2 Race Car Vehicle Dynamics, Race Car Vehicle Dynamics, W.F. Milliken and D.L. Milliken, SAE, 1995

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	30.00	20.00	20.00	0.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and classroom.

Instructional Method:

- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

- 1 <https://archive.nptel.ac.in/courses/107/106/107106080/>