GANPAT UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY

Programme	Diploma Engineering			Branch/Spec.	Automobile Engineering			
Semester	VI			Version	1.0.0.0			
Effective from Academic Year		2020-21		Effective for the batch Admitted in			July 2018	
Subject code	1AU2609	Subject Name		Vehicle Dynamics				

Teaching scheme					Examination scheme (Marks)				
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	1	0	4	Theory	40	60	100
Hours	3	0	2	0	5	Practical	30	20	50

Pre-requisites:
Kinematics of Machines, Dynamics of Machinery (Mechanical Engineering), Automobile System, Physics (Automobile Engineering).

Learning Outcome:
After completion of this course, student will be able to
CO.1 Understand the dynamics of vehicle ride
CO.2 Calculate and refer the loads and forces associated to the vehicles
CO.3 Analyse the behaviour of the vehicles under acceleration, ride and braking

Theoretical syllabus			
Unit	Content	Marks	Hrs
1	**Performance Characteristics of Vehicle** 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, Braking performance, Brake proportioning, Braking efficiency	10	5
2	**Aerodynamics** Periodic function, Trigonometric series, Fourier series, Functions of any period, Even and odd functions, Half-range expansion, Forced oscillations, Fourier integral. Mechanics of air flow Around a Vehicle, Pressure distribution on a vehicle, Aerodynamic forces, Drag components, Aerodynamics aids.	8	5
3	**Tire Mechanics** Tire construction, Size and load rating, Terminology and axis system, Tractive properties, Cornering properties, Camber thrust, Aligning moment, Combined braking and cornering, Conicity and ply steer, Slip, Skid, Rolling resistance, Elastic band model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic tire formula	9	5
4	**Acceleration performance of Vehicle** Power-limited acceleration (based on Engines, Power train – transmission & final drive ratio, Automatic transmissions). Traction-limited acceleration(Transverse weight shift due to drive torque, traction limits) **Braking Performance** Basic equations (Constant Deceleration, deceleration with wind resistance), Energy / Power absorbed during braking, Braking forces, Brakes factor, Tire road Friction, Federal requirements for braking performance, Braking proportioning, Anti-Lock brake system, Braking efficiency, Rear wheel lockup, Pedal force gain.	12	8
5	**Suspensions** Suspension Kinematics, Suspension types, Solid axles, Independent suspensions, Anti-squat and Anti-pitch suspension geometry, Anti-dive suspension geometry, Roll center analysis, Suspension dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable suspension elements: Active, Semi-Active. Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in force and apt directions.	8	8

6	**The Steering System** The Steering Linkages, Steering System Forces and Moments, Steering System Models, Steering Geometry, Steady Handling (2 DOF steady-state model), Under steer and Over steer, Effect of Tire Camber and Vehicle Roll (3 DOF steady-state model), Transient handling and Directional stability (2 DOF unsteady model), Effect of vehicle roll on transient handling (3 DOF unsteady model), Steady-state and Transient handling of Articulated vehicles.	7	8
7	**Rollover** Quasi-Static rollover of a rigid vehicle, Quasi-static rollover of a suspended vehicle, Transient rollover	4	3
	TOTAL	60	42

Practical content	
Practical assignments and tutorials are based on above syllabus	

Text Books	
1	Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992	

Reference Books	
1	Wong J Y,"Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.	
2	R N Jazar, Vehicle Dynamics: Theory and Application, Springer.	
3	R.V. Dukkipati, Vehicle dynamics, Narsova Publications.	
4	Garrett T K, Newton K and Steeds W,"Motor Vehicle",Butter Worths & Co., Publishers Ltd., New Delhi, 2001.	
5	Heinz Heister, "Vehicle and Engine Technology", SAE Second Edition, 1999	
6	Rajesh Rajamani, Vehicle Dynamics & control, Springer	
7	Ganeshan, "Gas turbine & Jet Propulsion" Tata McGraw Hill, New Delhi, 2003.	
8	Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989.	

Link of Learning Web Resource	
1	https://freevideolectures.com/course/3370/vehicle-dynamics/18
2	https://nptel.ac.in/courses/107106080/
3	https://nptel.ac.in/syllabus/101105059/
4	http://www.nptelvideos.com/lecture.php?id=10916
5	https://nptel.ac.in/courses/101106041/Chapter%208%20Lecture%2027%2021-12-2011.pdf
6	https://nptel.ac.in/courses/105101087/04-Ltexhtml/p11/p.html
7	http://web.iitd.ac.in/~achawla/public_html/736/15-Suspension_systems_and_components_v2.pdf
8	https://www.iith.ac.in/~ashok/VD/VD_Project_2015/VD_PPT/GroupF_Suspension.pdf
9	https://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics%20of%20Machine/site/mod9/02.htm

Sr. No.	Name of PO	Description	CO1	CO2	CO3
PO & CO Mapping				
1	PO 1	Acquire fundamental knowledge of mathematics, science, and automobile engineering.	Moderate	High	High
2	PO 2	Design and conduct experiments, as well as analyze and interpret data.	Slight	Slight	Moderate
3	PO 3	Use the techniques, skills, and modern engineering tools necessary for engineering practice	Slight	None	None
4	PO 4	Function in multi-disciplinary teams and identify, formulate, and solve engineering problems.	None	Slight	Slight
5	PO 5	Clear understanding of his duties and responsibilities as an automobile engineer.	None	None	Slight
6	PO 6	Develop effective communication skill and provide leadership for professional development.	None	None	None
7	PO 7	Engage in life-long learning in automobile engineering field and comprehend issues related to environment and sustainable development.	Moderate	Slight	Moderate
8	PO 8	Graduate will demonstrate knowledge of professional and ethical responsibilities.	Slight	Slight	Slight
9	PO 9	Incorporate economics and business practice including project and risk management.	None	None	None
10	PO 10	Graduated are able to share their knowledge to the industries as well as society.	None	None	None
11	PO 11	Graduated will be able to apply their skill and knowledge for the sustainable development of nation.	Slight	Moderate	Moderate
12	PO 12	Graduated are able to learn to work with the team and also with the inter discipliners.	Slight	Slight	Slight