

GANPAT UNIVERSITY									
FACULTY OF ENGINEERING & TECHNOLOGY									
Programme	Diploma Engineering				Branch	AUTOMOBILE ENGINEERING			
Semester	IV				Version	1.0.0.0			
Effective from Academic Year	2019-20				Effective for the batch Admitted in	June 2018			
Subject code	1AU2402		Subject Name		VEHICLE KINEMATICS & DYNAMICS				
Teaching scheme					Examination scheme (Marks)				
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	4	0	0	0	4	Theory	40	60	100
Hours	4	0	0	0	4	Practical	0	0	0

Pre-requisites:
Use knowledge of Kinematics and Dynamics in manufacturing and maintenance of automobile systems for vehicle operation and performance.

Course Learning Outcomes:
The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.
<ul style="list-style-type: none"> • Explain basic terminology related theory of machine and vehicle dynamics with their appropriate examples • Solve numerical problems of Rotating mass or Reciprocating mass balancing in the same or different planes applying graphical and/or analytical method. • Identify causes of vibration and factors affecting human comfort in a vehicle • Derive and apply equation of true rolling condition for solving numerical

Course Content				
Name of UNIT	Unit Content	Unit Learning Outcomes	Marks	Hrs
UNIT – 1 Introduction to Theory of Machine and Vehicle Dynamics	1.1 Introduction to theory of machine 1.2 Basic terminology related to theory of machines like kinematic link, kinematic pair, kinematic chain, mechanism, structure, machine, degree of freedom for plane mechanism. 1.3 Different types of basic mechanisms used in Automobile System like - Four bar Mechanism. - Single and Double Slider Crank Mechanisms. - Cam and Follower Mechanism with their types 1.4 Introduction to vehicle dynamics - Drag, Lift, Side force, rolling moment, pitching moment, yawing moment, - Dynamic load on axle	1a. Explain the division of theory of machine 1b. Differentiate Mechanism, Structure and Machine 1c. Classify different types of kinematic pair with their examples 1d. Describe inversions of mechanism with neat sketch 1e. Describe various forces and moments acting on a vehicle.	7	10

<p>UNIT – 2 Balancing</p>	<p>2.1 Need of Balancing, Static and Dynamic Balancing 2.2 Balancing of rotating mass. 2.3 Balancing of single rotating mass. 2.4 Balancing of several rotating masses. 2.5 Primary and secondary unbalanced forces of reciprocating masses. 2.6 Partial balancing of unbalanced primary force in reciprocating engines. 2.7 Variation of tractive force, Swaying couple and Hammer blow with respect to locomotive engine. 2.8 Balancing of primary forces of multi cylinder in-line engine. 2.9 Balancing of secondary forces of multicylinder in-line engine.</p>	<p>2a. Define Static and dynamic Balancing, Primary and Secondary Balancing 2b. Derive an expression for determining value of balancing mass at given radius for given unbalanced Rotating or Reciprocating Masses in the same or different planes 2c. Explain Effects of unbalance primary force in reciprocating engines 2d. Solve numerical of Rotating mass or Reciprocating mass balancing in the same or different planes applying graphical and/or analytical method</p>	<p>10</p>	<p>10</p>
<p>UNIT – 3 Vehicle Vibrations & Ergonomics</p>	<p>3.1 Definitions of Terminologies related to Vibrations 3.2 Sources of vibration in a vehicle, isolation 3.3 Vibration isolation in a vehicle 3.3 Vehicle Vibration and human comfort 3.4 Factors affecting human comfort in a vehicle</p>	<p>3a. Define various terminologies related to Vibrations 3b. Explain causes of vibration 3c. Explain the concept of ergonomic</p>	<p>10</p>	<p>10</p>
<p>UNIT – 4 Steering Mechanism</p>	<p>4.1 Ackerman steering Mechanism 4.2 Condition for true rolling 4.3 Turning circle radius</p>	<p>4a. Differentiate types of Steering Mechanisms 4b. Derive and Apply equation of true rolling condition for solving numerical 4c. Derive an equation for Turning circle radius</p>	<p>10</p>	<p>10</p>
<p>UNIT – 5 Vehicle Performance</p>	<p>5.1 Various resistances to vehicle. 5.2 Power for propulsion 5.3 Traction and tractive effort 5.4 Relation between engine speed and vehicle speed 5.5 Acceleration, drawbar pull and grade ability 5.6 Distribution of weight in three wheeled and four wheeled vehicle 5.7 Stability of vehicle on slope 5.8 Calculation of maximum acceleration, maximum tractive effort and relation for different drives 5.9 Factors affecting braking efficiency.</p>	<p>5a. Explain effects of various resistances on vehicle performance. 5b. Derive relations between various terms responsible for vehicle performance 5c. Determine various performance parameters for given operating conditions and braking of vehicle</p>	<p>13</p>	<p>10</p>

	5.10 Calculation of stopping distance.(when brakes are applied to front wheel, rear wheels and four wheels) 5.11 Braking of vehicle on curved path			
Unit– 6 Suspension and Tyres	6.1 Function of suspension system(Ride control, height control, roll control, dive and squat control, road holding) 6.2 Types of front and rear suspension (Solid axles (Hotchkiss, Four Link, DeDion), Independent suspensions (SLA Front Suspension, Macpherson Strut, Trailing-Arm Rear Suspension, Semi Trailing Arm, Swing Axle, Multi link rear suspension) 6.3 Roll axis and effect of side forces. 6.4 Tyre construction, size and load rating, various terminologies related to tyre, concept of mechanism of force generation in tyre.	6a. Explain the function of suspension with respect to force generation 6b. Explain various types of suspension system 6c. Describe various terminologies related to tyre which is responsible for vehicle performance	10	10

SUGGESTED LIST OF TUTORIAL

THEORY			
SR NO	UNIT NO	Tutorial/Exercises	Approx. Hrs. Required
1	I	Exercise on theory of machine	02
2	II	Exercise on balancing of rotating mass.	04
3	II	Exercise on balancing of reciprocating mass.	04
4	III	Exercise on vibration and ergonomics.	04
5	IV	Exercise on steering mechanism.	04
6	VI	Exercise on suspension system and tyre.	04
7	V	Exercise on vehicle performance.	06
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List of Reference Books			
No	Title of Reference Books	Authors	Publication
1	Fundamentals of vehicle dynamics	Thomas D. Gallespie	SAE
2	Fundamentals of kinematics and dynamics of machine and mechanisms	Oleg Vinogradov	CRC Press
3	Automobile Mechanics	N.K. Giri	Khanna Publishers, Delhi
4	Theory of Machines	R.S. Khurmi	Eurasia Publishing house (P) Ltd. New Delhi
5	Theory of Machines	R.S. Khurmi; J.K. Gupta	S. Chand and Compny., New Delhi
6	Theory of Machines in SI Units	V. P. Singh	Dhanpat Rai and Co (P)
7	Vehicle dynamics	J. R. Ellis	Business Books, 1969

8	Theory of Machine	S S Ratan	
Link of Learning Web Resource			
1	http://www.youtube.com/watch?v=GBnk0iRxEqY (Ackerman Steering Mechanism)		
2	http://www.youtube.com/watch?v=YzGM8Uc2HB0 (Davis Steering Mechanism)		
3	http://www.youtube.com/watch?v=hvpFcSPtDVO (Balancing)		
4	http://www.youtube.com/watch?v=y60dTiuJv24 (Balancing)		
5	http://www.youtube.com/watch?v=y60dTiuJv24 (Balancing)		
6	http://www.youtube.com/watch?v=OfTpw4L9y4Y		
7	http://www.bandgmachine.com/news		
8	http://www.youtube.com/watch?v=XAgRNI6tY58		
9	http://www.youtube.com/watch?v=lLqF7A3SAXE (Vibration of a Steering Wheel)		
10	http://www.youtube.com/watch?v=qhF3I5yIIHM (Wheel Alignment)		
11	https://www.proprofs.com/quiz-school/story.php?title=kinematics-practice-quiz-1		
12	https://www.prep.youth4work.com/Practice-Tests/Mechanical-Engineering-Test		

CO'S AND PO'S MAPPING

Name of PO	Description	CO 1	CO 2	CO 3
PO -1	An ability to apply knowledge of mathematics and engineering science.	SLI	SLI	SLI
PO -2	An ability to demonstrate, develop and conduct experiments, as well as to analyze and interpret data.	SUB	SLI	SLI
PO -3	An ability to design a system component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.	MED	MED	SUB
PO -4	An ability to perform with multidisciplinary teams.	MED	MED	SUB
PO -5	Use of appropriate modern tool and application software that pertain to Automobile engineering technology systems.	NONE	SUB	MED.
PO -6	An ability to identify, formulates, execute and solve engineering problems.	SLI.	SUB	MED.
PO -7	An ability to communicate and present effectively in both verbal and written forms.	SLI	MED.	SUB
PO -8	The broad education necessary to understand the impact of engineering solutions in global, economic, environmental and societal context.	MED.	SUB.	SUB.
PO -9	Recognition of need for self-improvement, and an ability to engage in life-long learning.	SLI	NONE	NONE
PO -10	Ability to aware about the contemporary issues.	SLI	SLI	SLI
PO -11	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	MED.	MED.	MED.
PO -12	Demonstrate to analyse and apply unconventional processes, automation, robotics Nanotechnology, Computer-Aided-Design & Manufacturing and knowledge in Automobile Engineering, Thermodynamics, Refrigeration & Air Conditioning and Jet Propulsion & Rocket Engineering to analyse and solve complex problems and to work professionally in such systems and plants.	SLI	MED.	MED.