GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Automobile Engineering (02) and Mechanical Engineering (19)

SUBJECT NAME: Vehicle Dynamics

SUBJECT CODE: 2170203

B.E. 7th SEMESTER

Type of course: Application

Prerequisite: ---

Rationale: To understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions. At the end of the course the student will be able to identify the various forces and loads and performance under acceleration, ride and braking.

Teaching and Examination Scheme:

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Credits</th>
<th>Examination Marks</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L T P C</td>
<td>Theory Marks</td>
<td>Practical Marks</td>
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<tr>
<td></td>
<td></td>
<td>ESE (E) PA (M) ESE (V) PA (I)</td>
<td></td>
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<tr>
<td>3 0 2 5</td>
<td></td>
<td>70 20 10 20 10</td>
<td>20 10 20 150</td>
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</table>

Content:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Content</th>
<th>Total Hrs</th>
<th>% Weightage</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Performance Characteristics of Vehicle</strong>: SAE Vehicle axis system, Forces &amp; 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.</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td><strong>Aerodynamics</strong>: Mechanics of Air Flow Around a Vehicle, Pressure Distribution on a Vehicle, Aerodynamic Forces, Drag Components, Aerodynamics Aids.</td>
<td>4</td>
<td>10</td>
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<tr>
<td>4</td>
<td><strong>Suspensions</strong>: 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</td>
<td>8</td>
<td>20</td>
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</table>
### Suggested Specification table with Marks (Theory):

<table>
<thead>
<tr>
<th>Distribution of Theory Marks</th>
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</thead>
<tbody>
<tr>
<td>R Level</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

**Legends:** R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**
6. Milliken W F and Milliken D L, Race car Vehicle Dynamics, SAE.

**Course Outcome:**
After learning the course the students should be able to:

- Understand the dynamics of vehicle ride
• Calculate and refer the loads and forces associated to the vehicles
• Analyse the behavior of the vehicles under acceleration, ride and braking

**List of Experiments:**
1. Experimental study of mechanism for air flow over different geometry of vehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.
3. To study the effect of tyre pressure and temperature on the performance of the tyre.
4. To simulate and study a quarter car models using MBD (Multi Body Dynamics) software.
5. To simulate and understand behaviour of sprung / un-sprung mass & lumped mass system MBD software.
6. Finding the stiffness of tyre with variation of air pressure.
7. To simulate and study the effect of different conditions on vehicle loading.
8. Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.
9. Study geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider
10. Study the location & height of Centre of gravity (C.G) of a motorcycle

**Design based Problems (DP)/Open Ended Problem:**
• To design/check aerodynamics shapes of various car bodies, to calculate equivalent weight and maximum acceleration, desired power to propel the vehicle by CFD analysis.

**Major Equipment:**
• Wind tunnel apparatus
• Multibody (MBD) simulation software

**List of Open Source Software/learning website:**
[http://nptel.ac.in/courses/107106080/](http://nptel.ac.in/courses/107106080/)

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.