Syllabus for Diploma Engineering

Automobile Engineering

Semester – IV

Subject Name: Vehicle Kinematics & Dynamics

Subject Code: 09AE0402

Diploma branch in which subject is offered:- Automobile Engineering

Objective: Course is designed to provide understanding about effects of various unbalanced forces, its effects on the various components of vehicle and method to balance that unbalanced forces for getting smooth operation and long life of the vehicle.

Credits Earned: 5

Course Outcomes:

After learning the course the students should be able to:

- 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
- Explain various types of suspension system used in vehicles
- Describe various factors affecting tyre life and which are responsible for vehicle performance

Pre-requisite of course: Applied Mechanics

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
4	2	0	5	50	30	20	25	25	150

Contents:

Sr.No.	Topics	Teaching hrs.	Weightage
1	**Introduction to Theory of Machine and Vehicle Dynamics** Introduction to theory of machine, Basic terminology related to theory of machines like kinematic link, kinematic pair, kinematic chain, mechanism, structure, machine, degree of freedom for plane mechanism, 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, Introduction	8	18

	to vehicle dynamics, Drag, Lift, Side force, rolling moment, pitching moment, yawing moment, Dynamic load on axle		
2	**Balancing** Need of Balancing, Static and Dynamic Balancing, Balancing of rotating mass, Balancing of single rotating mass, Balancing of several rotating masses, Primary and secondary unbalanced forces of reciprocating masses, Partial balancing of unbalanced primary force in reciprocating engines, Variation of tractive force, Swaying couple and Hammer blow with respect to locomotive engine, Balancing of primary forces of multi cylinder in-line engine, Balancing of secondary forces of multi cylinder in-line engine	12	27
3	**Vehicle Vibrations & Ergonomics** Definitions of Terminologies related to Vibrations, Sources of vibration in a vehicle, isolation, Vibration isolation in a vehicle, Vehicle Vibration and human comfort, Factors affecting human comfort in a vehicle	05	12
4	**Steering Mechanism** Ackerman steering Mechanism, Condition for true rolling, Turning circle radius	03	06
5	**Vehicle Performance** Various resistances to vehicle, Power for propulsion, Traction and tractive effort, Relation between engine speed and vehicle speed, Acceleration, drawbar pull and grade ability, Distribution of weight in three wheeled and four wheeled vehicle, Stability of vehicle on slope, Calculation of maximum acceleration, maximum tractive effort and relation for different drives, Factors affecting braking efficiency, Calculation of stopping distance (when brakes are applied to front wheel, rear wheels and four wheels), Braking of vehicle on curved path	10	23
6	**Suspension and Tyres** Function of suspension system(Ride control, height control, roll control, dive and squat control, road holding), 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), Roll axis and effect of side forces, Tyre construction, size and load rating, various terminologies related to tyre, concept of mechanism of force generation in tyre.	06	14

References:

a) List of Books

1. Fundamentals of vehicle dynamics by Thomas D. Gallespie
2. Theory of Machines by R.S. Khurmi
3. Automobile Mechanics by N.K. Giri

4. Theory of Machines by S.S. Rattan

b) List of Major Equipment/ Instrument

i. Charts for various mechanisms and their inversions.
ii. Models for various mechanisms and their inversions.
iii. Rotating mass balancing equipment.
iv. Universal Vibration Apparatus.

Suggested Theory distribution:

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
35%	40%	25%	0	0	0

Suggested List of Tutorials

1. Exercise on theory of machine
2. Exercise on balancing of rotating mass
3. Exercise on balancing of reciprocating mass
4. Exercise on vibration and ergonomics
5. Exercise on steering mechanism
6. Exercise on suspension system and tyre
7. Exercise on vehicle performance

Instructional Method:

a) Presentation through video/animation to explain working of various mechanisms and their inversions.
b) Power point presentation showing wheel balancing, balancing of reciprocating masses,
c) various types of vibrations, its effect and remedies to reduce it, vehicle performance testing etc.
d) Chart and models showing models of various mechanisms and their inversions.
e) Assignments to solve problems related to balancing, steering mechanism, vehicle