16AE306 VEHICLE DYNAMICS

Hours Per Week :

L	T	P	C
2	1	0	3

Total Hours :

L	T	P	WA/RA	SSH/HSH	CS	SA	S	BS
30	15	-	2	40	2	3	2	-

Course Description and Objectives:

This course offers fundamental concepts of vehicle vibrations, dynamics of suspension, stability of vehicles, performance and aerodynamics of vehicles.The objective of this course is to impart knowledge on basic and advanced concepts in vehicle vibrations, suspensions and stability of vehicle and their effects, related to longitudinal, vertical and lateral dynamics.

Course Outcomes:

The student will be able to:

- □ evaluate the fundamentals of vibration.
- □ analyze multi degree freedom system for mode shape in transmission linkages.
- □ analyze the vehicle directional stability and roll behavior.
- □ enumerate the suspension systems, tyre dynamics and directional stability of the vehicle.
- □ analyze the vehicle dynamic using statistical methods.

SKILLS:

Identify different types of vibrating systems.

Design and analyze spring required for a given suspension system

Identify the effect of different resistances on vehicle performance.

Identify the effect of aerodynamics on vehicle performance.

UNIT - 1   **L-6**

BASICS OF VIBRATION: Classification of vibration, Definitions, Mechanical vibrating systems, Mechanical vibration and human comfort.Modeling and simulation studies. Single degree of freedom, Multi degree freedom systems, Free, Forced and damped vibrations. Magnification factor and transmissibility.Vibrationabsorber.Two degree of freedom system.Modal analysis.

UNIT - 2   **L-6**

DYNAMICS OF SUSPENSION &TYRES: Requirements of suspension system.Spring mass frequency, Wheel hop, Wheel wobble,Wheel shimmy, Choice of suspension spring rate.Calculation of effective spring rate. Vehicle suspension in fore and aft & roll axis. Human response to vibration, Vehicle ride model. Tire forces and moments, Rolling resistance of tires, Relationship between tractive effort and longitudinal slip of tyres, Cornering properties of tyres, Ride properties of tyre.

UNIT - 3   **L-6**

STABILITY OF VEHICLES: Resistance, Types of resistance, Load distribution, Stability on a curved track slope and a banked road, Calculation of tractive effort and reactions for different drives.

UNIT - 4   **L-6**

PERFORMANCE &HANDLING CHARACTERISTICS OF VEHICLES: Equation of motion and maximum tractive effort.Aerodynamics forces and moments.Power plant and transmission characteristics.Prediction of vehicle performance.Brakingperformance.Steeringgeometry.Steady state handling characteristics.Steady state response to steering input.Transient response characteristics.Directional stability of vehicle.

UNIT - 5   **L-6**

BASICS OF CAR AERODYNAMICS: Objects — Vehicle types of drag. Various types of forces and moments.Effects of forces and moments.Various body optimization techniques for minimum drag.Principle of wind tunnel technology. Flow visualization techniques. Test with scale models.

ACTIVITIES:

o *Draw free body diagram of different vibration system.*

o *Calculate spring rate, tractive effort of vehicles.*

o *Estimate different types of resistances on vehicles.*

o *Estimate different aerodynamic forces*

TEXT BOOKS:

1.   Giri N.K, "Automobile Mechanics", 8th edition, Khanna Publishers, 2006.

2.   Rao J.S and Gupta. K, "Theory and Practice of Mechanical Vibrations", 3rd edition, Wiley Eastern, 2002.

REFERENCE BOOKS:

1.   Heldt.P.M, "Automotive Chassis",5th edition, Chilton Co., 1992.

2.   Ellis.J.R, "Vehicle Dynamics", 3rd edition, Business Books,1991.

3.   Giles.J.G.Steering, "Suspension and Tyres", 2nd edition, LIliffe Books, 1998.

4.   Ham B, Pacejka,"Tyre and Vehicle Dynamics", 3rd edition SAE Publication, 2002.

5.   J. Y. Wong, "Theory of Ground Vehicles", 3rdedition, John Willey and Sons,1997.