Vehicle Dynamics 3 0 03

Description: Vehicle System- Forces and its effect.

Tires- its mechanics, models and resistance to motion.

Vehicle Handling - Models for a rigid vehicle Simplelinearized models, Steady State Cornering, Stability Derivatives, Understeer&OverSteer.

Vehicle Dynamics testing Instrumentation, ISO Standards in testing.

Ride Perception to Ride. Introduction to Random Process.

Road Excitation and Characterization.

Models for vehicle ride and ride comfort.

Books

1. Gillespie, T. D., 1992. *Fundamentals of Vehicle Dynamics*, SAE International,

Pennsylvania.

2. Wong, J. Y., 1989. *Terramechanics and Off road Vehicles*", Elsevier Science, Amsterdam.

3. CossalterVittore, 2002, Motor Cycle Dynamics, Race Dynamics, Inc. Greendale.

4. Pacejka, H B, Tyre and Vehicle Dynamics, Butterworth – Heinemann, Woburn, MA, 2002.

Automative Engines & Systems 3 0 0 3

Course Contents:

Introduction and Overview – History of automobiles and an overview of a modern car.

Engines – Applications of IC engines, Types of engines and their working, Classification, Automotive engines their systems and requirements, Ideal engine cycles, Factors affecting thermodynamic efficiency, Actual engine cycles, Valves, timing and mechanisms, Mixture requirements in SI and CI engines, Mixture preparation systems for SI and CI engines, Ignition systems and combustion chambers, Combustion in SI and CI engines.

Transmission and Drivelines – Clutches, Manual Transmission and Automatic Transmission, Transmission matching.

Steering System and Steering Dynamics – Mechanism, wheel alignment and steering dynamics.

Suspensions – Components and type of suspension, roll center analysis, tires and their role in handling and ride.

Brake Systems – Principles, Dynamics and Components, Antilock Brake System.

Text Books:

1). R. Stone and J.K. Ball, *Automotive Engineering Fundamentals*, SAE International, 2004.

2). K. Newton, W. Steeds and K. Garrett, *The Motor Vehicle*, Butterworths, 1989.

3). V. Ganesan, *Internal Combustion Engines,* Tata McGraw Hill, 2007.

4. References:

1). D. B Astow, G. Howard and J. P. Whitehead, *Car Suspension and Handling*, SAE International, 2004.

2). R. Limpert, *Brake Design and Safety*, SAE International, 1992.

3) R. Stone, *Introduction to Internal Combustion Engines,* 3rd Edition, Palgrave, 1999.

Structural and Component Design of Vehicles 4 0 0 4

Review of the behaviour of thin walled beams – in bending and torsion, with examples from Vehicle structures. Load Cases and load factors in vehicle design

Analysis of Chassis, body shell analysis.Simple Structural Surface Method and the Finite element method. Safety against Crash

Suspension System : Types of Front and Rear Suspensions. Design, Analysis using Multibody dynamics, Characteristics of Dampers and adaptive damping. Suspension testing.

Steering : Layout, Design of steering systems.

Selection / Design of gearbox, clutch, drivelines, axles and its integration.

Introduction to engine component design

Text Books:

1. J.C. Brown, A.J. Robertson, S.T. Serpento, Motor Vehicle Structures, Butterworth Heinemann Publishers, Oxford, England, 2002
2. H.Heisler, Vehicle and Engine Technology, 2nd Edition, Arnold, 1999

References:

1. J. Fenton, Handbook of Vehicle Design Analysis, SAE International, 1996.
2. J. Pawlowski, Vehicle body Engineering, Business Books, 1969.
3. J.Happian-Smith, An Introduction to Modern Vehicle Design, 2nd Edition, Butterworth- Heinemann, 2000

Mechatronic System Design 2 0 3 4

Introduction to the field of mechatronics; Mechatronics systems; Mechatronics design approach; Modeling electromechanical system; Introduction to sensors, actuators and their characteristics; Introduction to micro-electromechanical-system, Physical system modeling and simulation ; Micro-fabrication techniques ; Smart instrumentation system; Mechatronics-based embedded system design; smart product design. Case studies relevant to the field of Mechatronic systems and applications.

Mechatronic laboratory includes experiments related to exercises in microcontroller programming and interfacing sensors and actuators, drive control system, automation and

modular production system, robotic system, opto-mechatronics, photovoltaic system, mechatronic workstation and mechatronics design project (four weeks).

Mathematical Preliminaries – Review of Laplace transforms, Fourier transforms, linear algebra and ordinary differential equations.

Brief review of classical control theory – Transient response and frequency response of linear time invariant systems, Root locus, Bode and Nyquist plots, Stability criterion.

References:

W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education, New Delhi, 2003, ISBN: 81-7758-284-4

Clarence W. De Silva, Mechatronics: An Integrated Approach, CRC Press, New York, 2005, ISBN: 0-8493-1274-4

Hiroshi Hosaka, YoshitadaKatagiri, TerunaoHirota, Kiyoshi Itao, Micro-Optomechatronics, Marcel Dekker, New York, 2005, ISBN: 0-8247-5983-4

Gerald Gerlach, Wolfram Dötzel, DörteMüller, Introduction to Microsystem Technology, John Wiley & Sons. Ltd., West Sussex, 2008, ISBN: 978-0-470-05861-9

Robert H. Bishop (Ed.), The Mechatronics Handbook: Mechatronic Systems, Sensors, and Actuators: Fundamentals and Modeling, CRC Press, New York, 2008, ISBN: 978-0-8493-9258-0

Finite Element Analysis

Review of Equilibrium equations and linear Elastic Constitutive relations – Their reduction to Plane stress, Plane strain, Axisymmetric. Governing equations for beam, plates and shell.

Energy Principle and Virtual Work principle.Introduction to the Calculus of Variations.

One dimensional Finite elements and the computational procedure.

Element Formulation: Interpolation function, simple 2D Elements and the isoparametric formulation.

Assembly Procedure, Solution and interpretation of results.

Case studies using all the popular elements.

Text books

1. R.D. Cook, Concepts and Applications of Finite Element Analysis, Fourth Edition, John Wiley, 2002.

2. J.N. Reddy, An Introduction to the Finite Element Method, McGraw Hill, 1984.

3. J. Fish and T. Belytschko, A first Course in finite element, John Wiley, 2007.

References

3. O.C. Ziekiewicz, R.L. Taylor and J.Z. Zhu, The Finite Element Method, Its Basis and Fundamentals, Butterworth, 2005.

4. T.J.R. Hughes, The Finite Element Method: Linear Static and Dynamic Analysis, Dover, New York, 2000.