

1. Preamble

This course imparts understanding of role of safety systems in automobiles through technology.

2. Pre-Requisite

1150EC101 Basic Electronics Engineering

3. Links to Other Courses

- Vehicle Body Engineering
- Automotive chassis

4. Course Educational Objectives

Students undergoing this course are expected to

- Gain knowledge about the vehicles structural crashworthiness and crash testing
- Gain knowledge about the working of vehicle vision safety systems

5. Course Outcomes:

On successful completion of this course students will be able to:

| CO Nos. | Course Outcomes | Level of learning domain (Based on revised Bloom's) |
|---------|--------------------------------------------------------------------------|-----------------------------------------------------|
| CO1 | Identity different safety systems and vehicle structural crashworthiness | K2 |
| CO2 | Analyse and simulate vehicle in barrier impacts | K2 |
| CO3 | Design vehicle safety systems | K3 |
| CO4 | Determine the fundamentals of light ,vision and colour | K2 |
| CO5 | Analyse pedestrian safety by use of light measurement and testing | K3 |

6. Correlation of COs with Programme Outcomes:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | H | H | L | H | | L | L | | | | | | H | L |
| CO2 | H | H | L | H | | L | L | | | | | | H | H |
| CO3 | H | H | L | H | | L | L | | | | | | M | H |
| CO4 | H | H | L | H | | L | L | | | | | | L | L |
| CO5 | H | H | L | H | | L | L | | | | | | M | H |

H- High; M-Medium; L-Low

7. Course Content

UNIT I INTRODUCTION VEHICLE SAFETY, STRUCTURAL CRASHWORTHINESS AND CRASH TESTING

Automotive Safety-Active and Passive Safety, Driver Assistance Systems in Automobiles, Definitions and Terminology. Balance of Stiffness and Toughness Characteristics and Energy Absorption Characteristics of Vehicle Structures, Design of Crash Crumple Zones, Modeling and Simulation Studies, Optimization of Vehicle Structures for Crash Worthiness, Types of Impacts, and Impact With Rebound, Movable Barrier Tests, Analysis and Simulation of Vehicle in Barrier Impacts, Roll Over Crash Tests, Behavior of Specific Body Structures in Crash Testing, Photographic Analysis of Impact Tests.

UNIT II ERGONOMICS AND HUMAN RESPONSE TO IMPACT L-9

Importance of Ergonomics in Automotive Safety, Locations of Controls, Anthropometry, Human Impact Tolerance Determination of Injury Thresholds, Severity Index, Study of Comparative Tolerance, Application of Trauma for Analysis of Crash Injuries. Injury Criteria's and Relation with Crash and Modeling and Simulation Studies in Dummy.

UNIT III VEHICLE SAFETY SYSTEMS L-9

Survival Space Requirements, Restraints Systems Used Automobiles, Types of Safety Belts, Head Restraints, Air Bags Used in Automobiles, Use of Energy Absorbing Systems in Automobiles, Impact Protection from Steering Controls, Design of Seats for Safety, Types of Seats Used in Automobiles. Importance of Bumpers in Automobiles, Damageability Criteria in Bumper Designs. Introduction to the Types of Safety Glass and their Requirements and Rearward Field of Vision in Automobiles, Types of Rear View Mirrors and their Assessment. Warning Devices, Hinges and Latches etc., Active Safety

UNIT IV FUNDAMENTALS OF LIGHT, VISION AND COLOUR L-9

Electromagnetic Radiation and Light, Propagation of Light, Spectral Sensitivity of Light, Measures of Radiation and Light, Standard Elements for Optical Control. Illuminant Calculations, Derivation of Luminous Flux from Luminous Intensity, Flux Transfer and Inter Reflection, Luminance Calculations, Discomfort Glare, Eyes as an Optical System Visual Processing, Lighting For Results, Modes of Appearance, Pointers for Lighting Devices. Nature of the Color Tri-Chromatic Colorimetry, Surface Color, Color Spaces and Color Solids, Color Rendering.

UNIT V LIGHT MEASUREMENTS, TESTING EQUIPMENT, CALIBRATION AND PHOTOMETRIC PRACTICE L-9

Basics of Standards and Detectors, Spectral Measurements and Colorimetry, Illuminant Meters and Luminance Meters, Colorimeters. Fundamentals of Equipment Used for Light Measurement in Automotive Field - Gonio- Photometer, Reflecto-Meter, Colorimeter, Integrating Sphere, Types, Application, Coordinates System, Types of Sensors and Working Principle, Construction, Characteristics Etc. Used in Different Equipment. National and International Regulations, Test Requirements and Testing Procedure

Total: 45 Periods

8. Text Books:

1. Watts, A. J., et al "Low speed Automobile Accidents" Lawyers and Judges 1996
2. Jullian Happian-Smith 'An Introduction to Modern Vehicle Design' SAE, 2002
3. Johnson, W., and Mamalis, A.G., "Crashworthiness of Vehicles, MEP, London, 1995
4. Edward .A, Lamps and Lighting, Hodder & Stoughton, London, 1993.
5. Bosch –automotive -handbook ,edition 5-SAE Publication-2000

9. References:

1. Keitz H. A. E, Light calculations and Measurements, Macmillan, 1971.
2. Olson L. P, Forensic aspects of driver perception and response, Lawyers and Judges 1996.
3. Pantazis. M, Visual instrumentation: Optical design & engineering Principles, McGraw - Hill 1999.
4. Matthew Huang, "Vehicle Crash Mechanics".
5. David C. Viano, "Role of the Seat in Rear Crash Safety".
6. Jeffrey A. Pike, "Neck Injury".
7. Ching-Yao Chan, "Fundamentals of Crash Sensing in Automotive Air Bag Systems".
8. Rollover Prevention, Crash Avoidance, Crashworthiness, Ergonomics and Human Factors", SAE Special Publication, November 2003.