



FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Automobile Engineering)

Semester: VII

Course Code: 202010708

Course Title: Vehicle Crashworthiness and Occupant Protection

Course Group: Professional Elective Course-IV

Course Objectives: This course will teach the basics of vehicle crashworthiness and occupant protection vehicle safety designs. Students should be able to understand the general procedures and state-of-the-art tools to evaluate vehicle crash safety, apply fundamental principles to interpret injury mechanisms, safety concerns, and design benefits in different types of crashes, and assess safety systems using finite element models for crash simulations. This course will be featured with three projects, including a modeling project, a literature review project, and a group project on vehicle crash safety designs.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Internal		External		Total
				Theory	J/V/P*	Theory	J/V/P*	
3	0	0	3	50/18	---	50/17	---	100/35

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Introduction: Motor vehicle safety, Automobile structure, body types, Body-In-White construction, Crashworthiness Requirements, Model requirements, common injuries in different types of motor-vehicle crashes, NCAP standards.	8
2	Safety systems: Integrated vehicle model for safety analysis, passive safety parameters, occupant model preparation, crash configuration, seat model mechanism, seat squash, belt fit, seat positioning with reference to x,y,z coordinates.	8



3	Injury Mechanisms: Head, neck, thoracic and abdominal mechanism, Thoraco-Lumbar Spine, Pelvic Injury Mechanisms, Injury Mechanisms of the Lower Extremity, Mechanical Response: Head, skull, neck, thorax, abdomen etc. human tolerance to impacts.	8
4	Vehicle design for crash: Introduction, structure design for crash, principles of occupant protection with restraint systems, FE modelling, Crash/Crush Design Techniques for Front Structures, design via crash mode matching, Design of Substructures, Vehicle Front Structure Design for Different Impact Modes, Vehicle-to-Vehicle Frontal Collisions, Finite Element Analytical techniques and to structure design.	10
5	Anthropometric test device: Introduction, study of man-machine reachability, Dummy preparation: CRABI (Child Restraint Air Bag Interaction) dummies, Side Impact Dummies, dummy harmonization, NCAP test parameters.	8
6	Road safety regulations: Safety and traffic regulations, global and national road safety policy, AIS on safety, Latest NCAP occupant protection report, comparison of global NCAP and Euro NCAP, WHO road safety initiative.	3

Reference Books:

1	Vehicle Crashworthiness And Occupant Protection, Priya Prasad and Jamel E. Belwafa, Automotive applications committee American iron and steel institute Southfield, Michigan
2	Development of Integrated Vehicle-Occupant Model for Crashworthiness Safety Analysis, NHTSA, U. S. Department of Transport.
3	Crashworthiness of Transportation Systems: Structural Impact and Occupant Protection, Jorge and Manuel, Springer.
4	Vehicle Crash Modeling And Analysis, Karimi Hamid Reza, But-Hein

Supplementary learning Material:

1	NPTEL Resources
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Pedagogy:

- Direct classroom teaching



- Audio Visual presentations/demonstrations
- Assignments/Quiz

Internal Evaluation :

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
25	25	30	5	10	5	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the vehicle, occupant safety and safety mechanism.	35
CO-2	Understand the injury mechanism.	20
CO-3	Understand the vehicle design for crashworthiness.	20
CO-4	Understand human anthropometry parameters for testing.	20
CO-5	Understand road safety regulations.	05

Curriculum Revision:

Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2027