Name of Institute: Indus Institute of Technology and Engineering
Name of Faculty: Prof. Marnish Modi

Course code: AU0714
Course name: **Automobile Systems Design**
Pre-requisites: **Automobile Systems**
Credit points: 5
Offered Semester: 7TH

Course Coordinator (weeks 01 - 12)
Course coordinator (11 weeks ,July to Dec 2022)
Full name:Prof. Marnish Modi
Department with siting location: Automobile Department.
Telephone: 7801928607
Email:marnishmodi.me@indusuni.ac.in
Consultation times: Friday 9 to 10 AM

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

To make student get acquainted with to standardize the automobile part after designing the system component like clutch, propeller shaft, axle, steering linkages, braking parts, suspension system etc. within the space limitations and optimize it

Course Outcomes (CO)

At the end of this course students will be able to:

Co 1 Develop a strong knowledge to distinguish between a various Automobile machine parts on the basis of their function and application.
CO 2 Identify and Apply the factors to be considered while designing a machine part.
CO 3 Analyze different automobile component with respect to load analysis, material selection, and factor of safety.
CO 4 Design an automobile component with sturdiness, efficiency and cost effectiveness.

Course Outline

DESIGN OF CLUTCH SYSTEM

Design of various clutch system components (Single plate, multiple plates, centrifugal clutch, lining material) and Pressure Plate Assembly components. Hydraulic Clutch system components (Master Cylinder, Slave cylinder, reservoir clutch fluid – its properties, hydraulic pipes. Clutch Pedal & Clutch hand lever design. Clutch cable Design / selection considerations.

DESIGN OF PROPELLER SHAFT

Design of Propeller shafts for bending, torsion, & rigidity criteria, failure theories. Design of Universal joint and Slip joint. Propeller shaft Assembly testing for balancing.

AXLE DESIGN

Front Axle beam, Steering Knuckle, King pin. Rear Axle (drive Axle) tube, Design of fully floating, half floating axle and dead axle. Design of Final drive and differential: Design of spiral bevel and hypoid type of final drive/differential.

DESIGN OF BRAKING SYSTEMS

Internal expanding shoe brake, friction lining material, drum brake arrangements, disc brake arrangement. Mechanical, hydraulic and air brake system and their components, hydraulic brake fluids, vacuum servo assisted braking, parking brake systems, anti-lock braking system, engine exhaust brake, regenerative brake system, fail-safe- brake, brake efficiency & testing, Weight transfer, braking ratios.

DESIGN OF SUSPENSION SYSTEM

Types of suspension springs based on applications. Material of spring, Stress deflection Equation for helical springs, Wahl Correction Factor, Design of helical springs for Independent Suspension. Buckling of Compression springs, Tension springs, Springs in Series & in parallel, Design Considerations of Belleville springs, Elastomeric springs, Air (Pneumatic) springs, Design of leaf spring for automobile suspension system, Design of coil spring for front independent suspension system. Types of different suspension springs with their requirements, constructional details and characteristics of leaf spring, coils spring and torsion bar springs, Independent suspension, rubber suspension, pneumatic suspension, hydro elastic suspension, use of anti-roll bar and stabilizer bar, shock absorbers- need, operating principles different types.

DESIGN OF STEERING SYSTEM

Steering mechanism and Linkage design for various types of Steering gear box arrangements and Design criterion for Mechanical & Power steering types. Steering geometry for Ackerman’s steering.

FINITE ELEMENT ANALYSIS

Review of stress-strain relation and generalized Hooke's Law, Plane stress and Plane strain conditions; Concept of Total Potential Energy; Basic procedure for solving a problem using Finite Element Analysis.

1-D Analysis: Concept of Shape function and natural coordinates, strain - displacement matrix, derivation of stiffness matrix for structural problems,

properties of stiffness matrix. 1-D structural problems with elimination and penalty approaches, 1-D thermal and fluid problems.
Trusses and Beams: Formulation of stiffness matrix, simple truss problems to find displacement, reaction and stresses in truss members. Structural analysis using Euler-Bernoulli beam element. Higher Order Element: CST element stiffness matrix formulation, shape functions and applications of Quad and axisymmetric elements

Method of delivery

1. Chalk and talk
2. PowerPoint Presentations
3. Self-study material

Study time

3 hours per week Lectures

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	-	2	-	-	-	-	-	-	3	3	-
CO2	1	1	2	-	-	-	-	2	3	-	-	-
CO3	1	-	-	-	-	-	-	-	-	2	-	-
CO4	1	-	-	-	-	-	-	1	-	1	1	1

1-Lightly Mapped 2- Moderately Mapped 3- Highly Mapped

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

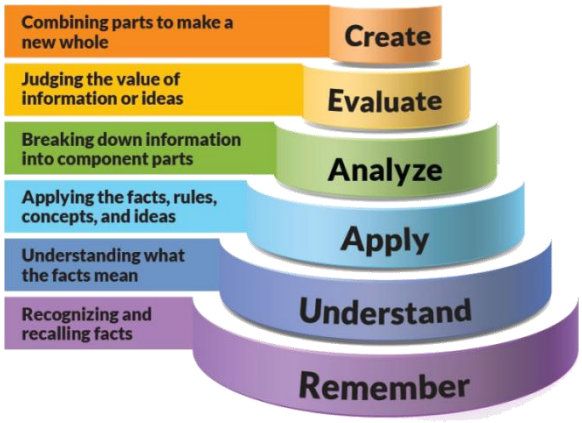

Figure 1: Blooms Taxonomy

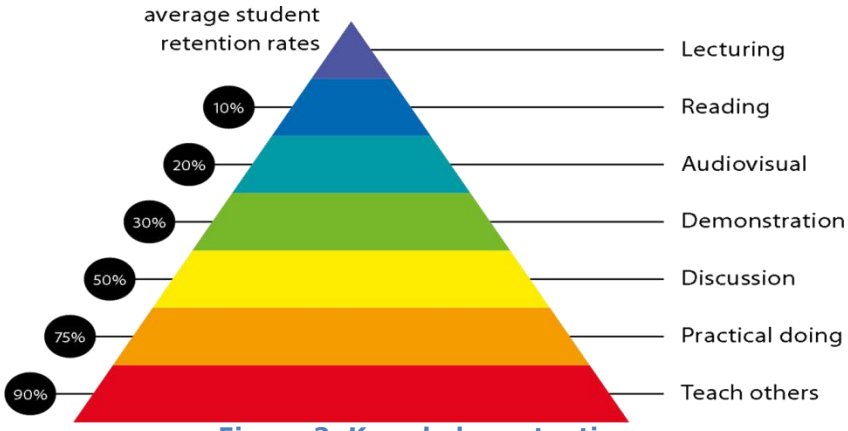

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

General Graduate Qualities	Specific Department of Automobile Engineering Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of	**2 Information literacy, gathering & processing**

sources and technologies. Acknowledge the work and ideas of others.	
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Lecture: 3hr
Tut : 2 Hr

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

1. Text Books and Reference Books
2. Tutorials
3. Online Resources

Text books

1. Machine Design by R S Khurmi J.K.Gupta, S chand & Co..

Additional Materials

1. http://nptel.ac.in/courses/112105126/ (For whole syllabus)

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Please note the evaluation pattern to be followed for all theory courses from the comingsession, to be started from 01 July 2020.

(a) CIE 60 marks (40 marks mid semester examination + 20 marks internalevaluation)

> Components of internal evaluation need to include (05 marks as attendance bonus for all students having attendance > 80%)+(05 marks for presentation)+(10marks for assignment or case studies, limited to minimum 02 assignments per course).

(b)**End Semester 40 marks.**

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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Course schedule

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	*Design of various clutch system components (Single plate, multiple plates, centrifugal clutch, lining material) and Pressure Plate Assembly components. Hydraulic Clutch system components (Master Cylinder, Slave cylinder, reservoir clutch fluid – its properties, hydraulic pipes. Clutch Pedal & Clutch hand lever design. Clutch cable Design / selection considerations*	*CO1*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*
	Weeks 2	*Design of Propeller shafts for bending, torsion, & rigidity criteria, failure theories. Design of Universal joint and Slip joint. Propeller shaft Assembly testing for balancing*	*CO1*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*
	Week 3	*Front Axle beam, Steering Knuckle, King pin. Rear Axle (drive Axle) tube, Design of fully floating, half floating axle and dead axle.*	*CO2*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*
	Week 4	*Design of Final drive and differential: Design of spiral bevel and hypoid type of final drive/differential.*	*CO2*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*

	Week 5	*Internal expanding shoe brake, friction lining material, drum brake arrangements, disc brake arrangement. Mechanical, hydraulic and air brake system and their components, hydraulic brake fluids, vacuum servo assisted braking*	*CO2*	*1. Chalk and talk* *2. PowerPoint Presentations* *3. Study Material*
	Week 6	*parking brake systems, anti-lock braking system, engine exhaust brake, regenerative brake system, fail-safe-brake, brake efficiency & testing, Weight transfer, braking ratios.* *field of application of Horizontal boring machines,*	*CO2*	*1. Chalk and talk* *2. PowerPoint Presentations* *3. Study Material*
	Week 7	*Types of suspension springs based on applications. Material of spring, Stress deflection Equation for helical springs, Wahl Correction Factor, Design of helical springs for Independent Suspension. Buckling of Compression springs, Tension springs, Springs in Series & in parallel, Design Considerations of Belleville springs, Elastomeric springs, Air (Pneumatic) springs, Design of leaf spring for automobile suspension system*	*CO2 CO3*	*1. Chalk and talk* *2. PowerPoint Presentations* *3. Study Material*
	Week 8	*Types of different suspension springs with their requirements, constructional details and characteristics of leaf spring, coils spring and torsion bar springs, Independent suspension, rubber suspension, pneumatic suspension, hydro elastic suspension, use of anti-roll bar and stabilizer bar, shock absorbers- need, operating principles different*	*CO3*	*1. Chalk and talk* *2. PowerPoint Presentations* *3. Study Material*

		types.		
	Week 9	*Steering mechanism and Linkage design for various types of Steering gear box arrangements and Design criterion for Mechanical & Power steering types. Steering geometry for Ackerman's steering*	*CO3*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*
	Week 10	*Review of stress-strain relation and generalized Hooke's Law, Plane stress and Plane strain conditions; Concept of Total Potential Energy; Basic procedure for solving a problem using Finite Element Analysis*	*CO3*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*
	Week 11	*1-D Analysis: Concept of Shape function and natural coordinates, strain - displacement matrix, derivation of stiffness matrix for structural problems*	*CO4*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*
	Week 12	*properties of stiffness matrix. 1-D structural problems with elimination and penalty approaches, 1-D thermal and fluid problems. Trusses and Beams: Formulation of stiffness matrix, simple truss problems to find displacement, reaction and stresses in truss members. Structural analysis using Euler-Bernoulli beam element. Higher Order Element: CST element stiffness matrix formulation, shape functions and applications of Quad and axisymmetric elements*	*CO4*	1. *Chalk and talk* 2. *PowerPoint Presentations* 3. *Study Material*