Program : **Diploma in Automobile Engineering**	
Course Code : **4052**	Course Title: **Material Science and Strength of Materials.**
Semester : **4**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester: **60**

Course Objectives:

- To provide a basic knowledge on the suitability of various materials available for automobile manufacturing.
- It imparts basics of engineering design such as relationship between various stresses and strains, strain energy, the concept of moment of inertia, significance of shear force and bending moment diagrams and theories of simple bending and torsion.

Course Prerequisites:

Topic	Course code	Course Title	Semester
Knowledge of Engineering Mechanics		Engineering Mechanics	2

Course Outcomes

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive level
CO1	Illustrate the mechanical properties of materials, different engineering materials used for manufacturing automobile components and various heat treatment processes.	14	Understanding
CO2	Utilize the principles of stress and strain in riveted joints, welded joints and thin cylindrical shells.	15	Applying
CO3	Solve problems on strain energy stored in a body under various load conditions and the moment of inertia for different automobile sections.	14	Applying
CO4	Construct the shear force and bending moment diagram on beams and use these principles in theory of pure bending torsion.	15	Applying
	Series Test	2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3						
CO2	2						
CO3	2						
CO4	2						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Illustrate the mechanical properties of materials, different engineering materials used for manufacturing automobile components and various heat treatment processes.**		
M1.01	Define tensile strength, compressive strength, ductility, malleability, hardness, impact strength, fatigue strength, creep resistance and toughness.	2	Understanding
M1.02	Illustrate the cooling curve for pure iron, effect of rate of cooling on grain size, effect of grain size on mechanical properties and factors promoting fine grain.	2	Understanding
M1.03	Explain the need for heat treatment, various types of heat treatments such as annealing, tempering, hardening, case hardening, normalizing and nitriding and their applications	5	Understanding
M1.04	Understand the need for alloying, list different alloying elements and different alloy steels.	3	Understanding
M1.05	Compare specific applications, merits and demerits of steel, aluminium, magnesium, copper, plastics and composites as automobile component material.	2	Understanding

Contents:

Mechanical properties - tensile strength, compressive strength, ductility, hardness, impact strength, fatigue, creep resistance, malleability, toughness etc.

Cooling curve for pure iron - effect of rate of cooling on grain size, effect of grain size on mechanical properties, factors promoting fine grain.

Heat treatment of metals - Need for heat treatment, description of different process such as annealing, tempering, hardening, case hardening, normalizing, nitriding and their applications

Need for alloying, List different alloying elements and different alloy steels.

Specific applications, merits and demerits of steel, aluminium, magnesium, copper, composites and plastics as automobile component material.

CO2	**Utilize the principles of stress and strain in riveted joints, welded joints and thin cylindrical shells.**		
M2.01	Define Hooks law.	1	Understanding
M2.02	Illustrate stress-strain curve for ductile material.	1	Understanding
M2.03	Define working stress and factor of safety.	2	Understanding
M2.04	Define tensile, compressive, shear, crushing, thermal stresses & strains. Solve simple problems.	4	Applying
M2.05	Define lateral and longitudinal strains, Poisson's ratio, volumetric strain, bulk modulus, shear modulus, relation between bulk modulus and shear modulus, solve simple problems on elastic constants.	3	Applying
M2.06	Classify riveted and welded joints.	1	Applying
M2.07	Define leg, size, throat thickness and strength of a weld. Solve simple problems on the strength of parallel and transverse fillet welded joint.	2	Applying
M2.08	Define thin cylindrical shell, hoop stress, longitudinal stress and shear stress on thin shells. Solve simple problems on them.	1	Applying
	Series Test -I	1	

Contents:

Simple stresses, strains, riveted and welded joints.

Simple stresses & strains viz. tensile, compressive, Shear, Crushing, Thermal stresses, & corresponding strains,

Hook's Law -Problems on Direct Stress & Linear Strain- Stress- Strain curve for Ductile material with all parameters- factor of Safety. Elastic Constants - Lateral Strain, Poisson's ratio, Bulk Modulus, Shear Modulus, Volumetric Strain.

Relation between elastic constants- Problems on elastic constants.

Classification of riveted and welded joints. Calculate the strength and efficiency of parallel and transverse fillet welded joint.

Hoop stress-Longitudinal Stress in thin cylindrical shells subjected to internal pressure.- Problems on thin cylindrical shells.

CO3	**Solve problems on strain energy stored in a body under various load conditions and the moment of inertia for different automobile sections.**		
M3.01	Define strain energy, sudden, gradual and impact loads, resilience, proof resilience and modulus of resilience.	2	Understanding
M3.02	Make use of the equation for strain energy stored in a body when the load is gradually applied and suddenly applied and solve simple problems.	2	Applying
M3.03	Summarize Moment of Inertia and its importance	2	Understanding
M3.04	Define Parallel & Perpendicular Axis Theorem	2	Remembering
M3.05	Build the equations of Moment of Inertia of solid & hollow sections like Rectangle, Triangle, Circle.	2	Applying
M3.06	Solve simple problems to find the moment of inertias about centre of gravity for I- section, T- section, L-section and Channel Section.	4	Applying

Contents:

Strain Energy, Impact Loading And Moment Of Inertia

Introduction -Strain Energy-Types of loading -Sudden, Gradual & Impact Load-resilience, proof resilience and modulus of resilience -Equation for strain energy stored in a body when the load is gradually applied and suddenly applied (no derivation) - simple problems.

Moment of Inertia & its importance in design, Parallel & Perpendicular Axis Theorem-Moment of Inertia of solid &Hollow sections like Rectangle, Triangle, Circle- Moment of Inertia about C.G for I- section, T- section. L-section and Channel Section.

CO4	**Construct the shear force and bending moment diagram on beams and use these principles in theory of pure bending torsion.**		
M4.01	Summarize types of beams like cantilever, simply supported and overhanging beams and types of loading like point load, uniformly distributed load and gradually varying load.	1	Understanding
M4.02	Compare shear force and bending moment.	1	Remembering
M4.03	Summarize the sign convention and procedure to draw shear force and bending moment diagrams.	1	Understanding
M4.04	Define sagging & hogging moment and point of contra-flexure.	1	Remembering
M4.05	Construct the S.F & B.M diagram for cantilever, simply supported beams subjected to point load and U.D.L.	3	Applying

M4.06	Summarize the assumptions made in the theory of simple bending and equation of simple bending.(No derivation)	1	Understanding
M4.07	Define neutral axis, moment of resistance and section modulus	1	Remembering
M4.08	Solve simple problems to find the section moduli of rectangular, hollow rectangular, circular and hollow circular sections and solve problems on beams of uniform strength.	2	Applying
M4.09	Define torsion, angle of twist, polar moment of inertia.	1	Remembering
M4.10	Summarize the assumptions in the theory of Torsion and study torsion equation (No derivation).	1	Understanding
M4.11	Solve simple problems on Power Transmitted by a shaft of solid and hollow sections subjected to Torsion only.	2	Applying
	Series Test - II	1	

Contents:

Shear Force, Bending Moment In Beams, Theory Of Simple Bending In Beams And Torsion In Shafts

Definition - Shear Force and Bending Moment -Types of beams, types of load acting on beams, Sagging & Hogging Bending Moment and its importance - sign convention to draw SFD and BMD- Concept of maximum bending moment, Point of Contra flexure & its importance - Drawing S.F & B.M Diagram for Cantilever, Simply Supported Beams subjected to Point Load and U.D.L

Introduction, assumptions in theory of simple bending - Bending stress, relation between bending stress & radius of curvature (without proof). - Position of neutral axis, moment of resistance-Bending equation (without proof)-Modulus of section for rectangular, hollow rectangular, circular and hollow circular sections-Beams of uniform Strength-problems.

Introduction to Torsion, Angle of Twist, Polar Moment of Inertia, Torsion equation (without proof) - Assumptions in theory of Torsion -Power Transmitted by a shaft, axle of solid and hollow sections subjected to Torsion - Comparison between Solid and Hollow Shafts subjected to pure torsion - Problems. (No problem on composite and non-homogeneous shaft)

Text / Reference:

T/R	Book Title/Author
T1	Ramamurtham. S., *"Strength of Materials",* 14th Edition, Dhanpat Rai Publications, 2011
T2	Khurmi R S, *"Applied Mechanics and Strength of Materials",* 5 Edition, S.Chandand company
T3	Engineering Materials by Er.R.K.RAJPUT of S.CHAND Publications
R1	Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co., New York, 1995.
R2	Ryder G.H, "Strength of Materials", 3rd Edition, Macmillan India Limited, 2002.
R3	Bansal R. K, "Strength of Materials", Laxmi Publications, New Delhi, 2012.
R4	Timoshenko S.P, "Elements of Strength of Materials", Tata McGraw-Hill, Delhi,

Online Resources:

Sl.No	Website Link
1	www.wikipedia.org/wiki/Shear_and_moment_diagram
2	www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
3	www.engineerstudent.co.uk/stress_and_strain.html