CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Automobile Engineering)**

Semester: **IV**

Course Code: **202010402**

Course Title: **Elements of Machine Design**

Course Group: **Professional Core Course**

Course Objectives: The course is intended to impart the fundamental knowledge of engineering mechanics and mechanics of solids, types of stresses developed, evaluation of various dimensions for a machine component to perform the functions. The course also covers systematic design procedure for some standard machine elements which are part of many equipment.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	50 / 18	25 /9	50 / 17	25 / 9	150 / 53

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

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction to Machine Design** Basic Procedure of machine design procedure, Design of machine elements, Basic requirements of machine elements, Use of standards in design, Selection of preferred sizes, Aesthetic and Ergonomic considerations in Design.	3
2	**Centroid and Moment of Inertia** Centroid of plane and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Polar Moment Inertia, Derivation of equation of moment of inertia of standard lamina using first principle.	5

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3	**Concepts of Stress and Strain** **1. Simple stress and strain** Introduction-definition of stress and strain, tensile & compressive stresses, shear stress, Contact stresses, Crushing and bearing stress, Shear and complementary shear strains: Linear, shear, lateral, thermal and volumetric strain. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus and relations between them with derivation. **2.Principal Stresses and Strains** Principal stresses, Principal planes, Mohr's circle of stresses, Combinations of Axial, Shear, Torsional and Bending loads, Theories of Failures, Factor of safety. **Application Problems** Cotter and Knuckle Joints; Design and analysis of levers: Cranked, Bell crank, Foot, Rocker arm.	**10**
4	**Beams and Columns** **Beams:** Types of beams and supports, Shear force (S.D) and Bending Moment(B.M), Shear force and Bending Moment Diagrams, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, UDL, uniformly varying load and combination of these loads. Theory of simple bending, assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), sections. **Columns:** Types of columns and end conditions, Compressive axial loading of columns and struts, Slenderness ratio, Compressive stress and Buckling of members, Effect of end conditions; Euler's Formula, Applications, validity and limitations; Rankine's Formula.	**9**
5	**Design of shafts, keys and couplings** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity, Design of solid and hollow circular shaft subjected to torque and combined loading for rigidity and stiffness; Design of Keys and splines. Design of Rigid couplings, Design of Flexible couplings.	**9**
6	**Design of joints** **Introduction to threaded joints**: Terminology of Screw thread, Forms of thread, Single and multiple start thread, Basic types of screw fastening, Cap and Set screw, Locking devices. Terminology of power screw, Torque requirement of lifting/lowering a load, coefficient of friction, Self-locking, Efficiency of threads. **Riveted joints**: Important terminologies, Types of riveted joints, Criteria of failure, Strength and efficiency of joint, design of riveted joints. **Welded joints**: Important terminologies ,Types welded joints, Strength of weld joint, Design of welded joint subjected to bending and torsion.	**9**

List of Practicals / Tutorials:Click or tap here to enter text.

1	Problems related to fundamental concepts of design.
2	Locating of center of gravity and evaluation of moment of Inertia of composite shapes.
3	Design of cotter and knuckle joint.
4	Design of levers.

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5	Shear force and bending moment diagram for beams and evaluation of flexural stresses.
6	Analysis of buckling of columns.
7	Design of shafts and keys.
8	Design of couplings.
9	Design of riveted joints.
10	Design of welded joints.

Reference Books:

1	Design of Machine Elements, V B Bhandari, 3/e, McGraw Hill.
2	A Textbook of Machine Design, P C Sharma and D K Aggarwal, S K Kataria & sons
3	Shigley's Mechanical Engineering Design, R G Budnyas, J K Nisbett, McGraw Hill
4	Fundamentals of Machine Component Design, R C Juvinall, 4/e, Wiley.
5	Machine Design: An Integrated Approach, R L Norton, Pearson.
6	Farazdak Haideri, Design of Machine Elements, Nirali Prakashan.
7	Engineering Mechanics of Solids, Pearson Egor Popov, Pearson Publications
8	Strength of Materials by S.S. Ratan, Tata McGraw hill.
9	Engineering Mechanics, Stephen Timoshenko and Donovan H. Young, TATA McGraw-Hill Education.

Supplementary learning Material:	
1	NPTEL Resourses

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment

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,

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R	U	A	N	E	C	**N**: Analyze; **E**: Evaluate; **C**: Create
20%	15%	10%	40%	15	0%	

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	Basic understanding of the philosophy of machine design	**5**
CO-2	Understanding of the concept of center of gravity and moment of inertia	**15**
CO-3	Learn basic concepts of stress and strain ,including it applications in design	**40**
CO-4	Learn to design and analyze shafts, keys and couplings	**20**
CO-5	Learn to design various types of joints	**20**

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

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