Course Syllabus
Gyanmanjari Diploma Engineering College
Semester-5(Diploma)

Subject: Design of Machine Elements – DETME15216

Type of course: Professional Core

Prerequisite: Strength of Materials, Theory of Machines, Material Science and Basic Mathematics

Rationale: This course focuses on the application of these concepts to the design of components under various stresses, such as direct stress, bending stress, twisting moment, and combined stresses. Students will learn how to design critical machine elements like cotter joints, knuckle joints, power screws, springs, couplings, pressure vessels, and bearings. The curriculum ensures that students are familiar with both the theoretical and practical aspects of component design, preparing them for real-world engineering challenges.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

GYANMANJARI INNOVATIVE UNIVERSITY BHAVNAGAR

Course Content:

Unit No	Course content	Hrs.	% Weightage
1	**Introduction:** General consideration and factors influencing the design of machine elements and design process, Various materials used in manufacturing of machine elements and their properties, Types of loads, types of stresses, concept of stress concentration and factor of safety, Standardization and preferred numbers, numeric examples on preferred numbers.	6	15
2	**Design of machine elements subjected to direct stresses:** Illustration of simple machine elements subjected to direct stresses-independently and identification of resisting areas (simple numeric examples), Design of simple machine elements subjected to uniaxial direct stresses- independently, Design procedure (with numeric examples), steps, identification of resisting areas and design of: i. Knuckle joint ii. Cotter joint. iii. Riveted joints. **Design of machine elements subjected to bending stresses:** Principle of bending and its fundamental equation, Modulus of various sections, example of pure bending like levers, beams, axle, etc., Types of levers, Design procedure (with numeric example) of levers including cross section of arms, bosses and pins, Design procedure (with numeric example) of leaf spring.	20	30
3	**Design of machine elements subjected to direct and twisting moments:** Fundamental equation of twisting moment with design procedure, Types of shafts with important features of each, Design of shafts (with numeric examples), Types of keys, applications of each and design procedure (with numeric examples), Types of couplings and applications, Design of muff and flange couplings (with numeric examples), Types of spring, terminology related to helical spring and applications of helical spring. **Design of machine elements subjected to direct and bending stresses:** Eccentric loading i. Concept, ii. Illustrations like frame, C-clamp, Bracket, Column of drilling machine etc. iii. Design of machine element like C- Clamp, bracket, Column of drilling machine. (With numeric examples).	18	25

4	**Design of pressure vessels:** Types and applications of pressure vessels used in industries. State Range of pressure also, Design of thick and thin cylinders (with numeric examples), Design of thin spherical shell (with numeric examples). **Selection procedure for bearings:** Classification of bearings, bearing designation as per IS, Antifriction bearings: types, advantages, applications, Selection procedure of anti-friction bearings, Calculation for anti-friction bearings: basic dynamic load, load rating, equivalent load, bearing life.	16	30

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Design Factors and Considerations** Faculty will assign the topic to promote understanding of design influences such as material selection, loads, stresses, and stress concentration. Students will work in groups to prepare a detailed report. Upload the report on the GMIU web portal.	10
2	**Real-World Case Study on Machine Elements in Industrial Applications** Faculty will assign or approve a real-world machine (e.g., bridge, crane, suspension system) for analysis. Students will study its elements like shafts, bearings, springs, and couplings in terms of materials, stresses, factor of safety, and design. A detailed report will be prepared and uploaded on the GMIU web portal	10
3	**Comparative Study on Different Types of Joints** Faculty will assign a topic for presentation to promote independent learning and communication skills. Upload presentation on the GMIU web portal	10
	Total	30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	**Remembrance (R)**	**Understanding (U)**	**Application (A)**	**Analyze (N)**	**Evaluate (E)**	**Create (C)**
Weightage	20 %	25 %	30 %	15 %	10 %	-

Course Outcome:

After learning the course, the students should be able to:	
CO1	Explain the fundamental considerations, material properties, loading conditions and safety factors.
CO2	Design machine elements under direct and bending stresses, including knuckle joints, cotter joints, riveted joints, levers and leaf springs.
CO3	Assess machine elements under twisting, direct, and bending stresses, including shafts, keys, couplings, springs and eccentric loads.
CO4	Evaluate and calculate pressure vessels and bearings, including thick/thin cylinders, spherical shells and anti-friction bearing load selection.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs.
1	**Preparatory Activity:** Understanding SI Units and Conversions, Material Properties Identification, Factor of Safety Analysis, Sectional Properties Calculation, Orthographic Projection Symbols, Engineering Symbols Representation, Limits, Fits, and Tolerances.	1	2
2	**Standardization using preferred number** Speed of Shaft, Size of Structural Products, Weight of Packages, Size of Industrial Designs, Size of Machine Parts, Size of Cutting Tools.	1	2
3	**Design of simple components subjected to direct load:** Analyze and design machine components experiencing axial tension or compression.	2	2
4	**Design of Simple Components Subjected to Bending Load:** Analyze and design machine components subjected to bending stresses, considering bending moments and section modulus.	2	2
5	**Design of Simple Components Subjected to Twisting Moment:** Analyze and design machine components experiencing torsional stresses using the twisting moment equation.	3	4
6	**Design of Simple Components Subjected to Eccentric Load:** Analyze and design components experiencing combined direct and bending stresses due to eccentric loading.	3	4

7	**Design of Cotter Joint:** Analyze and design a cotter joint for axial tensile and compressive loads in mechanical assemblies.	2	2
8	**Design of Knuckle Joint:** Analyze and design a knuckle joint to transmit axial tensile or compressive loads with angular movement.	2	2
9	**Design of Flange Coupling:** Analyze and design a flange coupling for securely transmitting torque between two shafts.	3	2
10	**Production Drawings of Design Assemblies:** Create detailed production drawings for Cotter Joint, Knuckle Joint, and Flange Coupling with dimensions and specifications.	-	4
11	**Design of Pressure Vessel:** Analyze and design thin cylinders, spherical cylinders, and thick cylinders to withstand internal pressure safely.	4	2
12	**Calculation of Features/Characteristics of Bearings:** Determine bearing parameters such as load rating, equivalent load, dynamic load capacity, and bearing life.	4	2
		Total	30

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment
Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Design of Machine Elements by V.B. Bhandari, Tata McGraw-Hill.

[2] Machine Design by P.S. Khurmi & J.K. Gupta, S. Chand & Co. Ltd.

[3] Mechanical Design of Machine Elements and Machines by Jack A. Collins, Wiley India.

[4] Design Data Handbook for Mechanical Engineers by K. Mahadevan & K. Balaveera Reddy, CBS Publishers.