

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**COURSE CURRICULUM
COURSE TITLE: MACHINE DESIGN
(COURSE CODE: 3352002)**

Diploma Programme in which this course is offered	Semester in which offered
Mechatronics Engineering	5 th Semester

1. RATIONALE

Specific shape and size of machine parts are required to be determined before we do the production of that machine or machine part. We have to also select specific material for that. This process of deciding shape, size and material is known as design. In designing a machine component it is necessary to have a good knowledge of many subjects such as Mathematics, Engineering Mechanics, Strength of Materials, Theory of Machines, Workshop Processes and Engineering Drawing. Students have learnt these subjects in previous semesters. The course curriculum provides the students knowledge of design process, as well as familiarity with design of components subjected to various stresses and moments like direct stress, bending stress, twisting moment and combined stresses. In this course students will learn design of components like cotter joint, knuckle joint, power screw, levers, helical and leaf springs, couplings, pressure vessels, bearings etc.

2. LIST OF COMPETENCY

The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire following competency:

- **Design simple machine elements choosing appropriate material with given user defined boundary and loading conditions.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Select the materials for the design of machine element
- Design simple machine elements subjected to direct stresses.
- Design simple machine elements subjected to bending stresses.
- Design machine elements subjected to direct and twisting moments.
- Design machine elements subjected to direct and bending stresses.

4. TEACHING AND EXAMINATION SCHEME.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	200
3	0	4	7	70	30	40	60	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, ESE -End Semester Examination; PA - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Design Considerations for Machine Element and Materials	1a. State the design considerations of machine elements and design processes. 1b. Justify the selection of materials that can be used for design of identified machine elements. 1c. Explain the loads, stresses, stress concentration factor and factor of safety. 1d. Select standard items and preferred numbers for designing simple machine elements.	1.1 General consideration and factors influencing the design of machine elements and design process. 1.2 Materials used in manufacturing of machine elements and their properties. 1.3 Types of loads, stresses, stress concentration and factor of safety. 1.4 Standardization and preferred numbers, numeric examples on preferred numbers.
Unit– II Design of Machine Elements Subjected to Direct Stresses.	2a. Explain the design process of simple elements like linkages. 2b. Calculate resisting area of simple machine element subjected to direct independent stress. 2c. Design a cotter joint 2d. Design a knuckle joint. 2e. Design a riveted joint	2.1 Simple machine elements subjected to direct stresses, independently and identification of resisting areas 2.2 Simple machine element subjected to uni-axial direct stresses-independently. 2.3 Design simple machine element: Knuckle joint, Cotter joint, Riveted joints.
Unit– III Design of Machine Elements Subjected to Bending Stresses.	3a. Explain the principle of bending with its equation. 3b. Differentiate between first order , second order and third order levers 3c. State modulus of various sections subjected to pure bending like levers, beams and axles	3.1 Principle of bending and its fundamental equation. 3.2 Types of levers: first order , second order and third order levers, 3.3 Modulus of various sections, subjected to pure bending like levers, beams, axle . 3.4 Design procedure (with numeric

	3d. Design simple lever based on given input.	example) of levers including cross section of arms, bosses and pins.
Unit-IV Design of Machine Elements Subjected to Direct and Twisting Moments.	4a. Using twisting moment in design procedure 4b. Explain the design process of different types of shafts with numerical examples. 4c. Explain the design process of different types of keys with numerical examples. 4d. Explain the design process of different types of couplings with numerical examples. 4e. Explain the design process of different types of springs with numerical examples.	4.1 Fundamental equation of twisting moment with design procedure. 4.2 Shafts: Types, features, and design 4.3 Keys: Types, applications and design 4.4 Couplings: Muff and flange types and other types, features, applications and design 4.5 Springs: Types, features, applications and design
Unit-V Design of Machine Elements Subjected to Direct and Bending Stresses.	5a. Explain the features of eccentric loading on machine elements such as bracket, foundation and others. 5b. Design simple machine components subjected to eccentric loading	5.1. Eccentric loading: Concept; C-clamp, Bracket, Foundation bolt, Bolts in flange. 5.2. Design of C-Clamp, bracket, foundation bolt and bolts in flange

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (Theory)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Design Considerations for Machine Element and Materials	8	3	4	4	11
II	Design of Machine Elements Subjected to Direct Stresses.	10	0	7	5	12
III	Design of Machine Elements Subjected to Bending Stresses.	8	0	3	7	10
IV	Design of Machine Elements Subjected to Direct and Twisting Moments.	10	0	7	7	14
V	Design of Machine Elements Subjected to Direct and Bending Stresses.	6	0	4	5	9
	Total	42	03	25	33	70

Legends: R = Remember U= Understand; A= Apply and above levels (Bloom's revised taxonomy)

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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours.
1	ALL	Preparatory Activity: - Interpret various course related SI units and their conversions. - Write normal values of ultimate tensile strength, yield strength, density, modulus of elasticity and Poisson's ratio of commonly used materials. - List normal values of factor of safety for different situations. - Recall area, volume, section modulus, moment of inertia, radius of gyration, etc for commonly used various section and shapes. - Draw orthographic projections symbols. - Draw symbols of threads, surface roughness, geometrical tolerances symbols, section lines, etc. - Recall by sketching the general systems for limits, fits and tolerances. - Recall 2d and 3d commands used in AutoCAD	04
2	I.	Design of simple components: Design plate, rod and bolt diameter based on direct stress formula.	06
3	II, III and IV	Design of assemblies: - Design followings showing other assumptions, steps and final dimensions based on given load, stress and factor of safety value - Knuckle joint. - Cotter joint. - Flange coupling. (Note: Each student of the batch must have different values of data. However problem may be same. Students are also expected to solve these as partial assignments at home.) Use design data book wherever is necessary.	16

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours.
4	II	Make 2d AutoCAD drawing of detail and assembly a. Prepare 2d production drawing of detail and assembly of joint given in previous exercise. b. Take print out of same on A4 OR A3 with title block	14
5	II	Make 3d Models of Assembly a. Prepare 3d model assembly solve in exercise 3 with found dimensions b. Take print out on A4 or A3 with 3d model and its orthographic view with design dimensions in layout of AutoCAD	14
6	I,II,I II,IV ,V	Make Report on design of: a. Rivet joint b. Lever (Rocker and bell crank) c. Shaft d. Couplings (muff and flange type) e. Helical spring f. Eccentric bracket This Report can be prepare based on theory study	12
Total Hours			56

Note:

- Students should bring any one reference design book (preferably English author) and one design data book (By PSG Coimbatore) during theory and practical/exercises sessions.
- It is compulsory to prepare log book of exercises. It is also required to get each exercise recorded in logbook, checked and duly dated signed by teacher. PA component of practical marks is dependent on continuous and timely evaluation of exercises.
- Term work report must not include any photocopies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only. However, teacher may allow related photographs/movie for experience number 4.
- For 40 marks ESE, students are to be assessed for competencies achieved.

They should be given following type of tasks:

- Design some elements of cotter joint/knuckle joint/ power screw.
- Design some mechanical elements subjected to three to four types of stresses.
- Design of flange coupling.
- Design of leaf spring/ lever.

8. SUGGESTED LIST OF STUDENT ACTIVITIES

S. No.	Activity
1	Download and present various presentations related to stresses in machine elements.
2	Download and present various presentation related to failure of machine elements.
3	Download and present various presentation related to design of machine elements.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

S. No.	Unit	Unit Name	Strategies
1	I	Design planning of machine element and materials	Power point presentations, live examples, demonstration of BIS on preferred numbers and standardizations,
2	II	Design of simple machine elements subjected to direct stresses.	Movies/ animations/ educational charts, videos and model of different machine elements subjected to various stresses, live demonstration of failed components,
3	III	Design of simple machine elements subjected to bending stresses.	Movies/ animations/ educational charts, videos and model of different machine elements subjected to bending, live demonstration of bending and induced stresses.
4	IV	Design of simple machine elements subjected to direct and twisting moments.	Movies/ animations/ educational charts, videos and model of different machine elements subjected to twisting, live demonstration of twisting.
5	V	Design of machine elements subjected to direct and bending stresses.	Movies/ animations/ educational charts, videos and model of different machine elements subjected to direct and bending stresses.

10. SUGGESTED LEARNING RESOURCES**A) List of Books**

S. No.	Title of Book	Author	Publication
1.	Machine Design.	Jain ,R.K.	Khanna Publishers, New Delhi
2.	Machine Design	Murthy, TVS and Shanmugam N.	
3.	Machine Design	Pandya and Shah	Charotar Publishing House Pvt. Ltd, Anand, Gujarat
4.	Machine Design	Patel, R.C. and Pandya A.D.	Acharya Book Depot, 1959
5.	Design of Machine Elements	Shigley	Tata McGraw-Hill Education, New Delhi
6.	Design Data Book	P.S.G. College of Technology, Coimbatore	P.S.G. Publication, Coimbatore
7.	Design Data Book	Mahadevan, K. and Balveera Reddy.	S. Chand, New Delhi
8.	A Text book of Machine Design	Khurmi, R.S. and Gupta J.K.	S. Chand, New Delhi
9.	Design of machine elements	Bhandari	

B) List of Major Equipment/ Instrument with Broad Specifications:

S.No.	Major Equipment/ Instrument	Broad Specifications
1	Wooden models (with cut sections) of knuckle joint, cotter joint, riveted joints, welded joints, screw jacks,	Two sets of each with design dimensions.
4	Assorted levers, shafts, couplings, flanges, keys, C-clamps, frames, other machine components.	used as machine elements.
5	Assorted failed components.	used as machine elements.

C) List of Software/Learning Websites

- a. Chp:1 Introduction.
http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_home.html
- b. Chp:2 Design of Machine elements subjected to direct stresses.
http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod4.html
- c. Chp: 3 Design of Machine elements subjected to Bending stresses.
http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod7.html
- d. Chp:4 Design of Machine elements subjected to direct and twisting moments.
 - i. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod4.html
 - ii. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod5.html
 - iii. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod8.html
- e. Chp: 5 Design of Machine elements subjected to direct and bending stresses.
http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod11.html
- f. Chp:ALL
https://www.machinedesignonline.com/MDO_Portal/design_component.html

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE,**Faculty Members from Polytechnics**

- **Prof. Jignesh M Patel**, Lecturer in Mechanical Engineering, B.S.Patel Polytechnic, Kherva
- **Prof. Kalpesh P Patel**, Head of Department Mechanical Engineering, B.S.Patel Polytechnic, Kherva
- **Prof. Vijay K Patel**, I/C Head of Department Mechatronics Engineering, Kherva

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr Vandana Somkuwar**, Associate Professor, Department of Mechanical Engineering
- **Dr. C. K. Chugh**, Professor, Department of Mechanical Engineering