GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2023 (COGC-2023)
Semester-V

Course Title: Machine Design & Drawing
(Course Code: 4351802)

Diploma programmer in which this course is offered	Semester in which offered
Marine Engineering	5th Semester

1. RATIONALE

A marine engineer must be capable of machine designing and to draw specific parts with its preferred number and selection. A marine engineer has to understand to read the drawings so as to understand about the machinery in case of ordering spares or to design a new one.

2. COMPETENCY

At the end of the study of V th Semester the student will be able to

- Understand the selection of materials.
- Know about machine designing
- Study about stress and strain w.r.to machine design.
- Acquire broader ideas about designing types of keys.
- Understand the plans, elevations, views of different marine machineries and its orthographic projections.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

CO-1	Understanding about machine design concepts.
CO-2	Understanding concept of stress and strain for design considerations.
CO-3	Prepare Design of Shaft, Keys & Couplings.
C0-4	Prepare Design of bolt and riveted joints.
CO-5	Understanding Principles of Machine drawing.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-projectto facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

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

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Solve problems related to coupling, also prepare detailed drawings of Different couplings(Muff coupling, flange coupling)	I	04
2	Design of shafts, keys and Couplings. Design of Screw jack and Toggle jack	II	04
3	Problems for design of joints using welding, riveting and fasteners.	III	04
4	Problems related to Limits, fits and tolerances.	IV	08
5	Assembly Drawings of marine components in Orthographic projection from Isometricviews: • Cylinder Relief Valve • . Hydraulic Steering Gear • Starting Air Pilot Valve • Gear Pump • Control Valve • Fuel Valve • Parallel Slide Stop Valve • 8. Feed Check Valve • 9. Starting Air Valve . • 10.Fuel injector	V	08

Total	28

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list*

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

6. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

Sr. No.	Unit	Unit Title	Strategies
1	I	**Introduction to machine design**	Real life examples. Demonstration ofreal systems. Movies/Animations. Numerical.
2	II	**Design considerations**	
3	III	**Design of Shaft, Keys & Couplings**	
4	IV	**Design of Bolt and Riveted joints**	
5	V	**Principles of Machine Drawing**	

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Follow safety practices.
c) Follow ethical practices
d) Maintain tools and equipment
e) Practice environment friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Introduction to machine design.**	1.a Machine designing. 1.b Application & selection of engineering materials	1.1 Meaning of Design, Introduction to machine design, Phases in design, Preferred Numbers & Standard codes for materials properties. 1.2 Application of engineering materials and their selection. Factor of Safety and factors influencing it.
Unit – II **Design considerations**	2.a Stress & Strain. 2.b Stress analysis	2.1 Direct stresses (Tensile and Compressive), stress-strain diagram, Bending stresses, Bearing stresses, torsion stresses, Eccentric loading, Principal stresses, Contact stresses. 2.2 Castiglione's theory for determining deflections. Theories of failures. Limits, Tolerances and Type of fits. 2.3 Study of stress analysis on various components & assemblies of Marine Diesel Engine, Marine Steam turbine, Marine Gas turbine, Marine Boiler.
Unit – III **Design of Shaft,Keys & Couplings.**	3.a Shaft design. 3.b Types of keys. 3.c Types of muff & coupling. 3.d Jacks & its working of its different types.	3.1 Design of shaft & axles on basis of bending, torsion & combined loading, Shaft design on the basis of rigidity, Effect of keyways. 3.2 Design of Square key, Rectangular key, Kennedy key, Splines. 3.3 Design of Muff or Sleeve coupling, Clamp coupling, Flange coupling, Pin-bushed coupling, Universal Joint. 3.4 Working of various types of jacks i.e screwjack, toggle jack, hydraulic jack etc.
Unit – IV Design of bolt and riveted joints.	4.a Rivets, Joints and its types 4.b Screws, Threads , and equipment used for fastening purpose	4.1 Riveted joints: Types of riveted joints. 4.2 Design of double and triple riveted butt joint -with equal and unequal cover plates, Design of riveted joint as per IBR, Design of

	4.c Stresses in screw fastenings with respect to its axis.	lap joint, Lozenge joint, Bolted joints. 4.3 Definitions types of threads, screw fastenings, locking devices for nuts, washers, eye bolts, Efficiency of threads. 4.4 Static stresses in screw fastenings Eccentricloading in riveted and bolted joints: a) Loading parallel to axis of bolts b) Loading perpendicular to axis of bolts c)Eccentric loading on circular base
Unit – V **Principles of Machine drawing.**	5.a Plans, elevation, views of a machine drawing 5.b Orthographic projection . 5.c Interpretations of notations of machine drawing.	5.1 Plans, elevation, views of machine drawing. First angle and Third angle projection and its correct symbols for both first and third angle. Various views of machine drawing ,orthographic projection 5.2 Dimensioning in different views and to indicate materials of different components inTabular form 5.3 Clearances & clearness in working drawings, tolerances & curves of intersection. 5.4 Interpretation of drawing notations and symbols of machine drawing, Free handsketches of machinery parts. 5.5 Machinery components and assembly drawing , Isometric views and assembly drawings of various machinery parts and components on board.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Introduction to machine design.**	06	02	03	03	10
II	**Design considerations**	08	04	03	05	12

III	**Design of Shaft, Keys & Couplings.**	06	04	04	05	14
IV	**Design of bolt and riveted joints.**	10	03	06	08	16
V	**Principles of Machine drawing.**	12	06	08	05	18
Total		**42**	**19**	**24**	**26**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Notes:

1. This specification table shall be treated as a general guideline for students and Teachers. The actual distribution of marks in the question paper may slightly vary from above Table.
2. If mid sem test is part of continuous evaluation, unit numbers I, II and unit III up to 3 are to be considered.
3. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

10. SUGGESTED STUDENT ACTIVITIES

Perform the tasks mentioned in above Practical/Exercise.

NOTE: Students must draw the assembly of marine components as given in the 6.5 table and must get assessed by the concerned faculty at the completion of each component. Students will have to draw any of those 10 marine components which will be counted in internal marks .
Students must be able to draw any one of those 10 marine components by himself/ herself.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:
Effective use of following :

a) Stress strain
b) Shaft,keys,coupling
c) Bolt and riveted joint
d) Various drawing symbols

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Machine design	R.S. Khurmi	S chand
2	Mechanical Engineering Design	Joseph Shigley & Charles Michele	Tata McGraw-Hill
3	Design of Machine Elements	V.B. Bhandari	Tata McGraw-Hill, 2nd Edition
4	Machine Drawing	N.D. Bhatta	Charotar publishing House Pvt.Ltd

13. LEARNING WEBSITES

(a) http://ecoursesonline.iasri.res.in/mod/page/view.
(b) https://www.machinedesign.com/fastening- joining/article/21812885/design-considerations
(c) https://engineeringproductdesign.com/knowled e-base/keys-keyways/
(d) https://www.aisc.org/Guide-to-Design-Criteria-for- Bolted-and-Riveted-Joints-2nd-Ed

14. PO-COMPETENCY-CO MAPPING

Semester V	MACHINE DESIGN & DRAWING (Course Code: 4351802)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation& Testing	PO 5 Engineering practices for society, Sustainability & environment	PO 6 Project Management	PO 7 Life-long Learning
Competency	Prepare production drawings using the computer and relevant software and following standards codes and norms						
Course Outcomes CO-1) Understanding about machine design concepts.	3	1	1	1	-	-	1
CO-2) Understanding concept Of stress and strain for design considerations.	2	1	1	1	1	-	1
CO-3) Prepare Design of Shaft, Keys & Couplings.	2	2	1	1	-	-	1

CO-4) Prepare Design of bolt and riveted joints.	**3**	**2**	**2**	**1**	**1**	**-**	**-**
CO 5) Understanding Principles of Machine drawing.	**2**	**2**	**2**	**1**	**1**	**1**	**1**

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Dr.S.H.Sundarani BOS Chairman HOD Mechanical Engg	Government Polytechnic Ahmadabad	9227200147	gpasiraj@gmail.com
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4	Prof Nair Gopikrishnan Lecturer in Marine engineering	Govt Polytechnic Diu		

17. BOS Resource Persons

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3.	Dr. Atul S.Shah (BOS Member & Principal)	B. V. Patel Institute of Technology, Bardoli	7567421337	Asshah97@yahoo.in