GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Subject Code : BE03000231
Subject Name : Machine Drawing and Elements of Machine Design

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC

Prerequisite:	Nil
Rationale:	The course is intended to strengthen fundamentals of mechanics, different forces and stresses for design and analysis of various machine elements subjected to static and fluctuate loading conditions. Moreover, course is intended to learn the computerized production drawing of machine elements.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Interpret various stress – strain, CG, MI of machine components and their design procedure.	U
2	Evaluate machine components under static loading and application of various basic theories of failures.	E
3	Design and analyze of levers, shafts, keys , couplings and power screw.	C
4	Analyze machine components under fluctuating loading and design for finite and infinite life.	N
5	Make use of modelling/ drafting software for machine drawing and production drawing.	A

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	0	60	15	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Basics of stress, strain and machine design:** Simple stresses: Tensile, Compressive and Shear, Simple strains: Linear and Lateral, Poisson's ratio, Stress – Strain diagram for ductile and brittle materials, Hooke's law, Proportional limit, Elastic limit, Yield, Ultimate and Failure stresses, Modulus of elasticity, Volumetric strain and bulk modulus, Shear strain and Modulus of rigidity, Relations between different constants, Definition and understanding of Machine design, Types of design, Design procedure, Materials Selection in Machine Design, Mechanical Properties of Materials.	**08**	20
2	**Moment of inertia of planar cross -sections:** Centroid, Center of gravity, moment of inertia of standard lamina using first principle, Radius of gyration, Parallel & perpendicular axes theorems, polar moment of inertia.	**04**	5
3	**Theory of bending:** Types of beams and loads, bending and deflection, Assumptions, derivation of equation of pure bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I, T, channel sections etc., Bending stresses in levers.	**05**	10
4	**Theory of torsion:** Torsion, Assumptions, derivation of equation of pure torsion, determination of torsional shear stress, Polar moment of inertia, Polar modulus of solid & hollow circular shaft, power transmission by shaft.	**03**	5
5	**Design Against Static Load:** Types of loads and stresses of machine elements, Factor of safety, Combined stresses (Principal stress), Theories of Failures, Eccentric Loading, Applications: Design of cotter joint, Knuckle joint and levers etc.	**08**	20
6	**Design Against Fluctuating Loads:** Stress Concentration, Endurance limit and Fatigue failure, Factors affecting endurance limit, S-N Diagram, Design for reversed stresses and cumulative damage, Fluctuating stresses: Soderberg, Gerber, Goodman and Modified Goodman criteria, Combined stresses	**05**	10

7	**Shafts, Keys and Couplings:** Design of solid and hollow circular shaft subjected to torque and Combined loading for rigidity and stiffness; Design of Keys, Design of Flange coupling and Buch Pin type coupling.	**06**	15
8	**Power screw:** Forms of square threads, terminology of square thread, torque requires lifting and lowering the load, Efficiency of threads, co-eff of friction, stresses in power screw, Applications: Design of clamp, vise, screw jack, Toggle Jack etc.	**06**	15
9*	**Elements of Production Drawing Tolerances, Limits and Fits (using any modeling software):** Introduction to generation of drawings as a design process for machine assembly. Use of datum planes to locate features and machine elements uniquely in assemblies. Sectioning, dimensioning, notes and version control in drawings. Standardized representation of threads, fasteners, welds, bearings, springs and related components. Introduction to limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Generation of assembly drawings including sectioning and bill of materials. Evolving details of components from assembly considerations. Detailing of components involving shafts, bearing, pulleys, gears, belts, brackets for assembly. Solid modeling of the above assembly and incorporating assembly constraints for animation of motion of machine assemblies. Principle of isometric projections, Isometric views and Isometric projection of solids.	-	
	Total	**45**	**100**

***Sr. No. 9 topics will be covered only in laboratory sessions, and it is part of practical exam**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	15%	10%	40%	10%	15%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Design of Machine Elements, V B Bhandari, 3/e, McGraw Hill.
2. Shigley's Mechanical Engineering Design, R G Budnyas, J K Nisbett, McGraw Hill
3. Engineering Mechanics, Bansal R K, Laxmi Publication.
4. Strength of Materials, Bansal R K, Laxmi publication.
5. Machine Drawing with Autocad, G Pohit, G Ghosh, Pearson

(b) Open source software and website:

1. FreeCAD
2. LibreCAD
3. Autodesk

Suggested Course Practical List:

1. Introduction to modeling software
2. Elements of 2D drawing in modeling/drafting software
3. 2D drawing of machine components in software
4. Orthographic drawing of machine components using software
5. Isometric view, Isometric projection using software
6. Assembly drawing using software
7. Production Drawing using software
8. Design of machine components as per content and computerized production drawings.
9. Case study

List of Laboratory/Learning Resources Required:
Computer laboratory

- **Activities suggested under self-learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs. Total = 10hrs.	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 4hrs. each. Total = 20hrs.	Based on the correctness of submitted assignment.
4.	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB,modeling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
5.	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Identification and solution of	Maximum 2 problems.	Based on the depth of the

	Complex problem	Study of the problem and solution finding, Total = 10hrs.	solution submitted.
7	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on quiz/report submitted
8	Technical paper reading and summarization of research papers based on relevant subject	5 research papers = 20 hrs.	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 hrs.	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 hrs. Non- working = 8 hrs.	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration = 15 hrs. for industrial exposure Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr.per subject. Max. 3 hrs. per subject	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 hrs.	Depending on the complexity of the Application/Software
15.	Research paper publication	Duration = 10 hrs.	Based on submission of proof of publication
16.	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10 hrs.	Based on the performance of the equipment
17.	Expert lecture/session	Duration 3 hrs. For attending the lecture/session– 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted
18.	Annotated Video Explanation	10h (Preparation +	Based on accuracy of

	of Concept/Problem	Recording + Submission)	explanation, clarity, and presentation style.
19.	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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