GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma in Engineering

Level: Diploma

Branch: Civil Engineering, Environmental Engineering

Course / Subject Code : DI02000071

Course / Subject Name : Engineering Mechanics

w. e. f. Academic Year:	2024-25
Semester:	2nd
Category of the Course:	PCC-02

Prerequisite:	Basic knowledge of Laws and Principles of Mathematics and Physics.
Rationale:	The primary purpose of the study of Engineering Mechanics is to develop the capacity to predict the effects of force while carrying out the creative design functions of engineering. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. It bridges the gap between physical theory and its application to technology.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Apply basics of mechanics to identify the force systems and determine unknown force for coplanar concurrent force system.	R,U,A
02	Apply principle of moment to analyses coplanar non-concurrent force system	R,U,A
03	Find the centroid and center of gravity of various components in engineering systems.	R,U,A
04	Apply principle of friction to analyses static equilibrium of coplanar concurrent force system	R,U,A
05	Select relevant simple lifting machine(s) for given purpose	R,U,A

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Basics of Mechanics** 1.1 Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics. Space, time, mass, particle, flexible body and rigid body. 1.2 Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units. 1.3 Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a Force. 1.4 Principle of transmissibility of force, Principle of Superposition 1.5 Force system and its classification.	4	10
2.	**Coplanar Concurrent Forces** 2.1 Resolution of a force - Orthogonal components of a force 2.2 Equilibrium and Equilibrant, Free body and Free body diagram, conditions of equilibrium, 2.3 Resultant of forces using analytical and graphical methods for the forces acting at a point: 1. Law of Parallelogram 2. Law of triangle 3. Law of Polygon 2.4 Lami's Theorem – statement and explanation, Application for various engineering problems.	10	22
3.	**Moment of Force and Parallel Forces** 3.1 Moment of a force, Varignon's Theorem,Couple, application, properties of couple, conditions of equilibrium.	10	22

	3.2 Resultant of force, Equilibrium forces and its position using analytical methods for the coplanar non - concurrent force system. 3.3 Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple). 3.4 Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load. 3.5 Beam reaction graphically for simply supported beam subjected to vertical point loads only.		
4.	**Centroid & Centre of Gravity** 4.1 Concept of Centroid, Centre of Gravity. 4.2 Axis of reference and Axis of Symmetry. 4.3 Centroid of One Dimensional geometrical figures using principle of moment. 4.4 Centroid of Two Dimensional geometrical Plane figures (Square, Rectangle, Triangle, Circle, Semi-circle, Quarter-circle) & Composite figures (not more than three figures) using first moment of area. 4.5 Centre of Gravity of Simple solids (Cube, Cuboid, Cone, Cylinder, Sphere, Hemisphere) & Composite solids (not more than two solids) using first moment of mass..	6	13
5.	**Friction** 5.1 Friction, Types of Friction and laws of friction, limiting equilibrium, limiting friction. 5.2 Coefficient of friction, angle of friction, angle of repose, relation between coefficient of friction and angle of friction. 5.3 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. 5.4 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.	6	13
6.	**Simple Lifting Machines** 6.1 Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines. 6.2 Application of law of machine. Ideal machine, friction in machine, maximum Mechanical advantage and efficiency. 6.3 Reversible and non-reversible machines, conditions for	9	20

	reversibility. 6.4 Velocity ratios of Simple wheel and axle, Differential axleand Wheel and, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack. Relevant problems on simple lifting machines.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**30**	**50**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Eval6uate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:
(a) Books:

Sr. No.	**Title of Book**	**Author**	**Publication with place, year and ISBN**
1	Engineering Mechanics	R. S.Khurmi	S. Chand , New Delhi. (2019) ISBN: 978-93-5283-396-2
2	Engineering Mechanics	D. S. Kumar	S. K. Kataria& Sons, New Delhi (2021 reprint) ISBN: 978-93-5014-311-7
3	Engineering Mechanics 7th edition	Bear &Johnston	New media-McGraw Hill (India), Noida (1999) ISBN: 978-00-7239-513-6
4	Applied Mechanics	Dr. H. J. Shah & S.B. Junnarkar	CHAROTAR Publication, Anand (2013) ISBN: 978-93-803-5861-1
5	Engineering Mechanics	D.S. Bedi	Khanna Publications, New Delhi (2019) ISBN: 978-93-861-7326-3

(b) Open source software and website:

a) https://youtube.com/playlist?list=PLD85An3RPybx5psW5HwPtUGH7AXtBjhLm (Bisag Video Lectures by DTE, Gujarat)
b) https://youtube.com/playlist?list=PLyqSpQzTE6M_MEUdn1izTMB2yZgP1NLfs (NPTEL Video Lectures by IIT, Kanpur)
c) https://nptel.ac.in/courses/122/104/122104015/ (NPTEL Video Lectures by IIT, Madras)
d) www.vlab.co.in (Virtual Lab by Ministry of Education, Government of India)

Suggested Course Practical List:

Sr. No.	Practicals	Unit No.	Approx. Hrs. required
1	Verify and calculate resultant force through Law of Parallelogram using analytical and graphical methods.	II	02
2	Verify Law of Triangle using analytical and graphical methods.	II	02
3	Verify and calculate resultant force through Polygon Law of Forces using analytical and graphical methods.	II	04
4	Verify and calculate the value of unknown force through Lami's Theorem.	II	02
5	Verify and calculate support reactions of a simply supported beam using analytical and graphical methods.	III	02
6	Calculate centroid of a lamina having regular and irregular shapes.	IV	04
7	Calculate angle of repose for different surfaces – Wood , Glass, Steel, plastic, wrought iron etc.	V	02
8	Calculate coefficient of Static Friction for different surfaces – Wood , Glass, Steel, plastic, wrought iron etc.	V	02
9	Verify and calculate theoretical and practical velocity ratios of any four simple lifting machines. (Simple wheel and axle, Differential axle and wheel, simple screw jack, worm and worm wheel. Single purchase crab, Double purchase crab.)	VI	04
10	Derive and draw a graph of law of machine for any two simple lifting machines and verify the effort required to lift a particular load. (Simple wheel and axle, Differential axle and wheel, simple screw jack, worm and worm wheel. Single purchase crab, Double purchase crab.)	VI	06
	Total hours	30 Hrs.	

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	Practical No.
1	Apparatus for Law of Parallelogram.	1,2 & 4
2	Universal Force table with all accessories.	3
3	Beam reaction apparatus with two circular dial types supports having 10 kg capacity each.	5
4	Stand, Regular Lamina, Irregular Lamina, Inextensible string, weight	6
5	Friction apparatus with scale on it, with wood, glass, steel, plastic surfaces, dish, string, weights	7,8
6	Simple wheel and axle, Differential axle and wheel, Single and double purchase crab, simple screw jack, worm and worm wheel. Vernier caliper, weights, dish, string	9,10

Suggested Project List:

a) Prepare spreadsheet or computer program to calculate the resultant force by the law of parallelogram and the law of polygon.
b) Using Drafting software calculate graphically the resultant force by the law of parallelogram and the law of polygon for at least five different conditions.
c) Prepare a spreadsheet or computer program to find out reactions for at least five different loading conditions on a simply supported beam.
d) Prepare spread sheet or computer program to calculate centroid and centre of gravity for different geometrical sections.
e) Compare coefficient of sliding Friction for different surfaces (Wood , Glass, Steel, plastic, wrought iron etc.) with & without lubricant
f) Compare a suitable simple lifting machine used in your daily life in your branch.

Suggested Activities for Students: If any

a) Collect five different situations with photographs indicating concurrent, parallel, general force system in equilibrium.
b) Collect five different situations with photographs where law of moment plays an important role.
c) Prepare charts showing various types of supports.(hinged, roller and fixed)

d) Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

e) Prepare a chart for friction examples which you are facing in day to day life and also interpret whether it is useful and harmful.

f) Prepare a list with photographs of simple lifting machines used in your daily life in your branch.

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