COURSE TITLE : ENGINEERING MECHANICS
COURSE CODE : 6Q201

PROGRAMME & SEMESTER

Diploma Programme in which this course is offered	Semester in which offered
Civil/Mechanical/Automobile	Second

1. RATIONALE:

Engineering Mechanics is basic technology course. The purpose of this course is to predict physical phenomena which lay the foundations for engineering applications. By applying Principles of mechanics, Diploma engineers shall be able to analyze the behavior of structural/machine components under the action of various forces. Analysis of components will form basis for design. The Course intends to provide basic understanding about the different types of forces, moments and their effects on structural/machine components. It develops basic analytical abilities.

2. COMPETENCY:

At the end of studying this course students will be able to,

"Use principles of engineering mechanics to analyze structural/machine components"

3. TEACHING AND EXAMNATION SCHEME :

Teaching Scheme (Hours/ Credits)			Total Credits (L+T+P)	Examination Scheme (Marks)				
				Theory		Practical		Total
L	T	P	C	ESE	PT	ESE @ (PR/OR)	PA (TW)	125
4	-	2	6	80	20	--	25	
Duration of the Examination (Hrs)				3	1	--	--	

Legends : L-Lecture; **T**-Tutorial/Teacher Guided Theory Practice ; **PR-** Practical; **C**-Credits; **ESE**- End Semester Examination; **PT – Progressive Test, PA**- Progressive Assessment, OR – Oral Examination, TW - Term Work, # External, @ Internal, ~ Online Examination.

4. COURSE OUTCOMES :

At the end of studying this course students will be able to: -

1. Classify the given force system.
2. Suggest the appropriate simple lifting machines for given situations.
3. Check the stability of engineering systems by applying force equilibrium conditions
4. Use principles of friction to analyze equilibrium of rigid bodies/simple structures for common engineering situations.
5. Locate the Centroid and Centre of gravity of components of engineering systems.

5. DETAILED COURSE CONTENTS:

Unit	Major Learning Outcomes (Cognitive Domain Only)	Topics And Sub-Topics
Unit - I Fundamental Concepts	1a. Explain concepts of given terms 1b. Classify the given quantities 1c. Use Newton's laws of motion in given situations 1d. Use law of transmissibility in given situations	1.1 Definitions of Mechanics, Applied Mechanics, statics, dynamics, kinematics, kinetics. 1.2 Concept of space, time, mass, particle, rigid body. 1.3 Scalar and vector quantities with examples, 1.4 Newton's laws of motion. 1.5 Concept of force, definition, S.I. unit, representation of force as a vector. Bow's notation. Characteristics and effects of forces, Law of transmissibility of force.
Unit – II Simple lifting machines	2a. Suggest appropriate simple lifting machine for the given purpose along with justification 2b. Determine effort required for the load lifted by the given simple lifting machine 2c. Determine the V.R. and efficiency and law of given simple lifting machines. 2d. Draw and interpret the graphs for given data.	2.1 Definition of simple lifting machine, load, effort, mechanical advantages, velocity ratio, input of a machine, output of a machine, efficiency, and relation between MA, VR and efficiency. Ideal machine, ideal effort, ideal load, friction in machine, effort lost in friction, load lost in friction. 2.2 Law of simple machine, maximum mechanical advantage, and efficiency, reversibility of machine, condition for reversibility of machine, self-locking machine. 2.3 Velocity ratio (No derivation) for Worm and worm wheel, differential axle and wheel, Single/double purchase crab, Simple screw jack, Two and three sheave pulley block, Weston's differential pulley block. 2.4 Numerical problems based on the above machines as mentioned in article 2.3 2.5 Graphs of Load V_S Effort, Load V_S ideal effort, Load V_S Effort lost in friction, Load V_S M.A., Load V_S Efficiency

Course Curriculum Design Committee:

Sr No	Name of the faculty members	Designation and Institute
1	Madhuri Ganorkar	Head of Applied Mechanics Department, Govt. Polytechnic, Aurangabad
2	Ganesh Kechkar	Lecturer in Applied Mechanics, Govt. Polytechnic, Aurangabad
3	Rajesh Aghav	Lecturer in Applied Mechanics, Govt. Polytechnic, Aurangabad
4	Dr.Shivaji Dumne	Lecturer in Applied Mechanics, Govt. Polytechnic, Aurangabad

(Member Secretary PBOS) (Chairman PBOS)

GOVERNMENT POLYTECHNIC शासकीय तंत्रनिकेतन औरंगाबाद AURANGABAD

11	Two sheave and three sheave pulley blocks	Double sheave pulley blocks of diameter 65-205 mm,ropediameter10-40 mm and carrying maximum safe working load 500kg Triple sheave pulley blocks of diameter 65-205 mm,rope diameter 10-40 mm and carrying maximum safe load 3600kg

12. LEARNING WEBSITE & SOFTWARE:

i. www.youtube.com for videos regarding simple lifting machines and friction
ii. www.nptel.ac.in:for learning materials with audio and video in technical education
iii. www.discoveryforengineers.com

13. MAPPING OF PROGRAMME OUTCOMES (POs) AND PROGRAMME SPECIFIC OUTCOMES (PSOs) WITH COURSE OUTCOMES (COs) :

Sr. No	Course Outcome	POs										PSOs	
		1	2	3	4	5	6	7	8	9	10	01	02
1	Classify the given force system.	3	2	1	1	-	-	-	-	-	-	-	-
2	Select the appropriate simple lifting machines for given situations.	2	2	3	2	-	-	-	-	-	-	-	-
3	Check the stability of engineering systems by applying force equilibrium conditions	2	3	2	1	-	-	-	-	-	-	-	-
4	Use principles of friction to analyze equilibrium of rigid bodies/simple structures for common engineering situations.	2	3	2	1	-	-	-	-	-	-	-	-
5	Locate the Centroid and Centre of gravity of components of engineering systems.	2	2	3	2	-	-	-	-	-	-	-	-

Unit - III Resolution and composition of coplanar forces	3a. Resolve the given single force. 3b. Determine analytically resultant of given force system. 3c. Determine graphically resultant of the given force system.	3.1 Concept of system of forces: Coplanar, Non coplanar, collinear, concurrent, non-concurrent, parallel (like & unlike) 3.2 Resolution of a force – Orthogonal and non orthogonal components 3.3 Composition of forces, definition of resultant, Law of parallelogram of forces and Law of polygon of forces. 3.4 Determination of resultant of collinear and concurrent force system analytically. 3.5 Moment of a force, magnitude, lever arm, types and sign convention,. Law of moment, Varignon's theorem, Couple, characteristics of couple with examples. 3.6 Resultant of parallel force system and non-concurrent, non-parallel force system by analytical method. 3.7 Resultant of parallel and concurrent coplanar force system by graphical method
Unit - IV Equilibrium of coplanar forces	4a. Draw free body diagram (F.B.D.) of a rigid body / object for the given situation. 4b. Use Lami's theorem in given situation. 4c. Determine analytically reactions for the given type of beam. 4d. Determine graphically reactions for the given simply supported beam.	4.1 Equilibrium and equilibrant, relation between resultant and equilibrant. 4.2 Concept of free body, free body diagram, Conditions of equilibrium for collinear, concurrent, parallel & non concurrent non parallel force systems. 4.3 Lami's Theorem and its applications such as cables. Lami's theorem problems with two unknowns only. 4.4 Beam-Definition, types of beam: cantilever, simply supported, over hanging, continuous, fixed beams. Types of supports: simple, fixed, hinged and roller. Types of load- point load (vertical and incline), uniformly distributed load, couple. 4.5 Beam reactions for cantilever, simply supported beam with or without overhang-subjected to combination of point load and U.D.L. or vertical point load and couple. 4.6 Using graphical method determine beam reactions for the simply supported beam (without overhang) subjected to vertical load and U.D.L.

Unit - V Friction	5a. Determine frictional force, coefficient of friction and unknown forces acting on body(s) for the given situation. 5b. Determine frictional force, coefficient of friction unknown forces acting on ladder in given situation.	5.1 Concept and definition of friction, Advantages and disadvantages of friction. Types of friction (static, dynamic, rolling, sliding), laws of friction, Definition of co-efficient of friction, angle of friction, angle of repose and relation between angle of friction and angle of repose. 5.2 Equilibrium of bodies on level plane subjected horizontal & incline force (pull and push). 5.3 Equilibrium of bodies on inclined plane subjected to parallel & incline force (pull and push). 5.4 Ladder friction. (With one surface smooth)
Unit - VI Centriod and Center of gravity	6a. Determine centroid of the given composite lamina. 6b. Determine center of gravity of the given composite solids.	6.1 Centroid- Definition, Centroid of geometrical plane figures- triangle, square, rectangle, circle, semicircle, quarter circle. 6.2 Determination of centroid of composite figures composed of not more than three geometrical regular figures. 6.3 Center of gravity- Definition, C.G. of simple regular solids- cube, cylinder, cone, sphere, hemisphere 6.4 Determination of C.G. of composite solid composed of not more than two regular solids

3	Beam reaction apparatus	Two circular dial type 10 kg, extension spring balances or tube in tube type. Complete with suitable stands, a wooden beam with scale and slots at regular intervals, four stirrups with hooks and necessary slotted weights, hanger
4	Friction apparatus	Base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees. A 5 cm diameter friction less pulley is attached to the end by means of a clamp adjustable to any necessary position. Two weight boxes 01 of 5 gm,01 of 10 gm, 02 of 20 gm, 02 of 50 gm, 02 of 100 gm weight, Boxes each weighing 300 gm with 8 mm ply case and bottom of different surfaces.
5	Simple screw jack	Screw of pitch of 5mm carrying a double flanged turn table 20 cm diameter fitted on steel base and two adjustable pulleys, cords and hooks.
6	Worm and worm wheel	Threaded spindle, load drum, effort wheel; necessary slotted weights, hanger and thread
7	Weston's differential pulley	Two pulleys; one bigger and other smaller. Both pulleys are rigidly fixed to each other with same center and mounted on same shaft. They have cogs around periphery and having continuous chain passing around these pulleys along with snatch block.
8	Differential axle and wheel	A wheel of 40 cm diameter and axles are of different diameter 20 cm and 10 cm giving a ratio of 1:2:4 ; with common axis and supported on ball bearings in iron brackets, necessary slotted weights, hanger and thread.
9	Single purchase winch crab	Effort wheel of C.I. material having 25 cm diameter mounted on a shaft of about 40mm diameter on the same shaft, a geared wheel of 15 cm diameter is mounted. The teeth of pinion wheel shall mesh with spur toothed wheel of 30 cm diameter is mounted on another axle to which load drum of about 7.5 cm diameter, necessary slotted weights, hanger and thread)
10	Double purchase winch crab	A winch having assembly same as that of single purchase crab winch except an additional set of gearing arrangement.

9. SUGGESTED SPECIFIC INSTRUCTIONAL STRATERGIES:

These are sample strategies, which a teacher can use to facilitate the attainment of course outcomes.

a. Improved Lecture methods-
b. Q & A technique.
c. Demonstration.
d. Activity based learning.
f. Use of video, animation films to explain concepts, facts and applications of mechanics.

10. SUGGESTED LEARNING RESOURCE:

S.No.	Name of Book	Author	Publication
1	Applied Mechanics	R. S. Khurmi	Dhanpat Rai & Sons, Delhi.
2	Engineering Mechanics	S. S. Bhavikatti	I. K. International Publishing House Pvt. Ltd., New Delhi
3	Engineering Mechanics (Static and Dynamics)	A. Nelson	Tata McGraw Hill Co., Delhi.
4	Fundamental of Applied Mechanics (SI Version)	Dadhe, Jamdar, Walavalkar	Sarita Prakashan, Pune
5	Engineering Mechanics	Dr.S. M. Dumne	Nikita Publication, Latur.
6	Engineering Mechanics	Dr.Abhishek Jain	Invincible Publishers
7	Engineering Mechanics	Dr.R.K.Bansal	Laxmi Publication,ISBN-978-81-318-0078-2

11. LIST OF MAJOR EQUIPMENTS AND MATERIALS REQUIRED :

Sr. No.	Name of equipment	Brief specification
1	Universal Force Table	A circular 40 cm diameter aluminum disc, graduated into 360 degrees. Leveling screws clamping devices to fix the table to desired angle, six sliding clamp pulleys, control ring, string and six sets of iron nickel slotted weigh
2	Law of moment apparatus	A stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at center. The top of beam is provided with notches at the interval of 10mm for carrying hanger weights with spirit bubble level tube with necessary slotted weights, hanger

6. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No	Title Of Unit	Teaching Hours	Distribution Of Theory Marks			
			R level	U Level	A Level	TOTAL
I	Fundamental Concepts	02	04	---	---	04
II	Simple lifting machine	12	02	04	06	12
III	Resolution and composition of coplanar forces	14	04	08	06	18
IV	Equilibrium of coplanar forces	14	04	06	08	18
V	Friction	12	04	04	08	16
VI	Centroid and center of gravity	10	02	04	06	12
	Total	**64**	**20**	**26**	**34**	**80**

Legends: *R – Remember, U – Understand, A – Apply and above (Bloom's revised Taxonomy)*

7. LIST OF PRACTICAL / LABORATORY EXPERIMENTS/ TUTORIALS :

Sr. No.	Unit	Title Practical/ Lab. Work/ Assignments/ Tutorials	Hours
	Practical performance on any three lifting machines from 1 to 5		
1	II	Use differential axle and wheel to establish law of machine and find maximum efficiency	04
2	II	Use simple screw jack to establish law of machine and find maximum efficiency	04
3	II	Use single or double purchase crab to establish law of machine and find maximum efficiency	04
4	II	Use two sheave or three sheave pulley block to establish law of machine and find maximum efficiency	04
5	II	Use Weston's differential pulley to establish law of machine and find maximum efficiency	04
6	III	Use force table to determine resultant of coplanar concurrent force system applying law of polygon of forces	04
7	III	Use law of moment apparatus to determine unknown forces.	02
8	IV	Use force table to find unknown forces by applying Lami's theorem.	02
9	IV	Use beam reaction apparatus to check equilibrium of parallel forces.	02
10	V	Use friction apparatus to determine coefficient of friction for motion on horizontal plane (for two pairs of different contact surfaces)	04
11	V	Use friction apparatus to determine coefficient of friction for motion on incline plane (for two pairs of different contact surfaces)	04
12	VI	Determine centroid of geometrical plane figures	02
		TOTAL	**32**

8. SUGGESTED STUDENTS ACTIVITIES:

Other than class room and laboratory activities following are the suggested co-curricular students activities which need to be undertaken to facilitate the attainment of various course outcomes of this course. The students are required to maintain portfolio of their experiences.

Sr. No.	ACTIVITY
1	Collect photographs of concurrent ,Parallel, general force system in equilibrium
2	Illustrate practical situations where friction is essential and not essential
3	For given situations(three) suggest appropriate simple lifting machine
4	Collect photographs where hinge, roller and fixed supports are used.
5	Prepare model of irregular geometrical figure and locate it's centroid