

Ramgarhia Polytechnic College,
Phagwara



Civil Engineering Department

Head of Department:	Er. Gurcharan Singh
Name of the Faculty:	Er. Gurcharan Singh
Discipline:	Civil Engineering Department
Semester:	3 rd
Subject:	APPLIED MECHANICS
Lesson Plan Duration:	16 Weeks

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

Learning Outcomes

After undergoing the subject, students will be able to:

- Interpret various types of units and their conversion from one to another.
- Analyze different types of forces acting on a body and draw free body diagrams.
- Determine the resultant of coplanar concurrent forces.
- Calculate the co-efficient of friction for different types of surfaces.
- Calculate the least force required to maintain equilibrium on an inclined plane.
- Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.
- Determine velocity ratio, mechanical advantage and efficiency of simple machines

PO 	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 							
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							
CO7							

Syllabus

Units	Details	Hours
1.	<p>Introduction</p> <ul style="list-style-type: none"> • Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics. • Definition, basic quantities and derived quantities of basic units and derived units • Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration • Concept of rigid body, scalar and vector quantities 	(4 hrs)
2.	<p>Laws of forces</p> <ul style="list-style-type: none"> • Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force • Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position • Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components • Free body diagram • Equilibrant force and its determination • Lami's theorem (concept only) [Simple problems on above topics] 	(9 hrs)
3.	<p>Moment</p> <ul style="list-style-type: none"> • Concept of moment • Moment of a force and units of moment Varignon's theorem (definition only) • Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support) • Parallel forces (like and unlike parallel force), calculating their resultant • Concept of couple, its properties and effects • General conditions of equilibrium of bodies under coplanar forces • Position of resultant force by moment [Simple problems on the above topics] 	(9 hrs)

4.	<p>Friction</p> <ul style="list-style-type: none"> • Definition and concept of friction, types of friction, force of friction Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction • Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane. • Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force: a) Acting along the inclined plane Horizontally b) At some angle with the inclined plane 	(9 hrs)
5.	<p>Centre of Gravity</p> <ul style="list-style-type: none"> • Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies • Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion • Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed [Simple problems on the above topics 	(8 hrs)
6.	<p>Simple Machines</p> <ul style="list-style-type: none"> • Definition of effort, velocity ratio, mechanical advantage and efficiency of - a machine and their relationship, law of machines • Simple and compound machine (Examples) • Definition of ideal machine, reversible and self locking machine • Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency • . System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency • . Working principle and application of wheel and axle, Weston's Differential Pulley Block , simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application [Simple problems on the above topics]. 	(9 hrs)

Reference Books:

- 1 A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
- 2 A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi

- 3 A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi..
- 4 Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.
- 5 Test Book of Applied Mechanics by AK Upadhya, SK Kataria & Sons, New Delhi

Delivery/Instructional Methodologies

Sr.No.	Description
1.	Chalk and Talk
2.	PowerPoint Presentation

Assessment Methodologies

Sr. No.	Description	Type
1.	Student Assignment	Direct
2.	Test	Direct
3.	Board Examination	Direct
4.	Student Feedback	Direct

Gaps in the syllabus - to meet industry/profession requirements

S.NO.	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
	N/A	N/A	N/A

Topics beyond syllabus/advanced topics

Units	Details	Hours
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N/A	N/A	N/A
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Web Source References

Sr. No.	URL
1.	https://nptel.ac.in/

Lesson Plan

Week	Theory		Practical	
	Lecture Day		Practical Day	
1 st	1 st	Introduction Concept of engineering mechanics definition of mechanics	1.	Verification of the polygon law of forces using Gravesend apparatus.
	2 nd	Statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.		
	3 rd	Definition, basic quantities and derived quantities of basic units and derived units		
2 nd	4 th	Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration Concept of rigid body, scalar and vector quantities	2.	To verify the forces in different members of jib crane.

	5 th	Laws of forces Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force		
	6 th	Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position		
3 rd	7 th	Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically	3	To verify the reaction at the supports of a simply supported beam.
	8 th	Analytically, resolution of forces, resolving a force into two rectangular components		
	9 th	Free body diagram Equilibrant force and its determination		
4 th	10 th	Free body diagram Equilibrant force and its determination	4	To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane
	11 th	Lami's theorem (concept only) [Simple problems on above topics]		
	12 th	Lami's theorem (concept only) [Simple problems on above topics]		
5 th	13 th	Analytically, resolution of forces, resolving a force into two rectangular components	5	To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
	14 th	Triangle law of forces, polygon law of forces - graphically		
	15 th	Overview on Moment		

6 th	16 th	Concept of moment Moment of a force and units of moment	6	To find the mechanical advantage, velocity ratio and efficiency of worm and worm wheel.
	17 th	Varignon's theorem (definition only)		
	18 th	Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)		
7 th	19 th	Parallel forces (like and unlike parallel force), calculating their resultant	7	To find mechanical advantage, velocity ratio and efficiency of single purchase crab.
	20 th	Concept of couple, its properties and effects		
	21 st	General conditions of equilibrium of bodies under coplanar forces		
8 th	22 nd	Position of resultant force by moment [Simple problems on the above topics]	8	To find out center of gravity of regular lamina.
	23 rd	Parallel forces (like and unlike parallel force), calculating their resultant		
	24 th	Parallel forces (like and unlike parallel force), calculating their resultant		
9 th	25 th	Overview on Friction	9	To find out center of gravity of irregular lamina..
	26 th	Definition and concept of friction, types of friction, force of friction		
	27 th	Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction		
10 th	28 th	Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.	10	To determine coefficient of friction between three pairs of given surface

	29 th	Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force: a) Acting along the inclined plane Horizontally b) At some angle with the inclined plane		
	30 th	Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force: a) Acting along the inclined plane Horizontally b) At some angle with the inclined plane		
11 th	31 st	Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction	11	Verification of the polygon law of forces using gravesend apparatus
	32 nd	Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.		
	33 rd	Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force: a) Acting along the inclined plane Horizontally b) At some angle with the inclined plane		
12 th	34 th	Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force: a) Acting along the inclined plane Horizontally b) At some angle with the inclined plane	12	To verify the forces in different members of jib crane.
	35 th	Centre of Gravity		

		Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies		
	36 th	Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion		
13 th	37 th	Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed	13	To verify the reaction at the supports of a simply supported beam
	38 th	Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed		
	39 th	Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed		
14 th	40 th	Simple Machines Definition of effort, velocity ratio, mechanical advantage and efficiency of - a machine and their relationship, law of machines	14	To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane
	41 st	Simple and compound machine (Examples)		
	42 nd	Definition of ideal machine, reversible and self locking machine		
15 th	43 rd	Effort lost in friction, Load lost in friction,	15	To find the mechanical advantage, velocity ratio

		determination of maximum mechanical advantage and maximum efficiency		and efficiency of worm and worm wheel
	44 th	System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency		
	45 th	Working principle and application of wheel and axle, Weston's Differential Pulley Block , simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application		
16 th	46 th	Single and double winch crab. Expression for their velocity ratio and field of their application	16	To find out center of gravity of regular lamina.
	47 th	System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency	.	
	48 th	Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency		

NBA has defined the following seven POs for an Engineering diploma graduate:

i) **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

- ii) **Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
- iii) **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
- iv) **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- v) **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- vi) **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- vii) **Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes.

Program Specific Outcomes (PSOs)

PSOs are a statement that describes what students are expected to know and be able to do in a specialized area of discipline upon graduation from a program. Program may specify 2-4 program specific outcomes, if required.

These are the statements, which are specific to the particular 11 program. They are beyond POs. Program Curriculum and other activities during the program must help in the achievement of PSOs along with POs.