# ***Ramgarhia Polytechnic College, Phagwara***

# ***Mechanical Engineering Department***

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| Head of Department: | Er. Gaurav Kumar |
| Name of the Faculty: | Er. Amanjot Singh |
| Discipline: | Mechanical Engineering Department |
| Semester: | 3rd |
| 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 student.

**Learning Outcomes**

After undergoing this course, the students will be able to:

CO1. Interpret various types of units and their conversion from one to another.
CO2. Analyze different types of forces acting on a body and draw free body diagram
CO3. Determine the resultant of coplanar concurrent forces.
CO4. Calculate the co-efficient of friction for different types of surfaces
CO5. Calculate the least force required to maintain equilibrium on an inclined plane
CO6. Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.
CO7. Determine velocity ratio, mechanical advantage and efficiency of simple machines

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| PO ⇨ <br> CO ⇩ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | | | | | |
| CO2 | | ✓ | ✓ | | | | |
| CO3 | | | ✓ | | ✓ | | |
| CO4 | | | | ✓ | | | |
| CO5 | | | ✓ | | | | |
| CO6 | | | ✓ | | | | |
| CO7 | | | ✓ | | | | |

# Syllabus

| Units | Details | Hours |
|---|---|---|
| 1. | 1. Introduction<br>1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.<br>1.2 Definition, basic quantities and derived quantities of basic units and derived units<br>1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration<br>1.4 Concept of rigid body, scalar and vector quantities | (04hrs) |
| 2. | 2. Laws of forces<br>2.1 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<br>2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position<br>2.3 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<br>2.4 Free body diagram<br>2.5 Equilibrant force and its determination<br>2.6 Lami's theorem (concept only) [Simple problems on above topics] | (09 hrs) |
| 3. | 3. Moment<br>3.1 Concept of moment<br>3.2 Moment of a force and units of moment<br>3.3 Varignon's theorem (definition only)<br>3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)<br>3.5 Parallel forces (like and unlike parallel force), calculating their resultant<br>3.6 Concept of couple, its properties and effects<br>3.7 General conditions of equilibrium of bodies under coplanar forces<br>3.8 Position of resultant force by moment [Simple problems on the above topics] | (09 hrs) |
| 4. | 4. Friction<br>4.1 Definition and concept of friction, types of friction, force of friction<br>4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction<br>4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.<br>4.4 Calculation of least force required to maintain equilibrium of a body | (09hrs) |

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| | on a rough inclined plane subjected to a force: a) Acting along the inclined plane Horizontally b) At some angle with the inclined plane | |
| 5. | 5. Centre of Gravity<br>5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies<br>5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion<br>5.3 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] | (08 hrs) |
| 6. | 6. Simple Machines<br>6.1. Definition of effort, velocity ratio, mechanical advantage and efficiency of - a machine and their relationship, law of machines<br>6.2. Simple and compound machine (Examples)<br>6.3. Definition of ideal machine, reversible and self locking machine<br>6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency<br>6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency<br>6.6. 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] | (09 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 |
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| 1. | Chalk and Talk |
| 2. | PowerPoint Presentation |

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**Assessment Methodologies**

| Sr. No. | Description | Type |
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| 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 |
|---|---|---|
| N/A | N/A | N/A |

## Web Source References

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

## Lesson Plan

| Week | Theory | | Practical | |
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| | Lecture Day | | Practical Day | 02hrs per week |
| 1st | 1st | Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics. | 1. | Verification of the polygon law of forces using gravesend apparatus. |
| | 2nd | Definition, basic quantities and derived quantities of basic units and derived units | | |
| | 3rd | Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration | | |
| 2nd | 4th | Concept of rigid body, scalar and vector quantities | 2. | To verify the forces in different members of jib crane. |
| | 5th | 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 | | |
| | 6th | | | |
| 3rd | 7th | Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position | 3. | To verify the reaction at the supports of a simply supported beam |
| | 8th | | | |
| | 9th | Composition and resolution of coplanar concurrent | | |

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| 4th | 10th | 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 | 4. | To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane. |
| | 11th | Free body diagram | | |
| | 12th | Equilibrant force and its determination | | |
| 5th | 13th | Lami's theorem (concept only) [Simple problems on above topics] | 5. | To find the mechanical advantage, velocity ratio and efficiency of a screw jack |
| | 14th | Concept of moment | | |
| | 15th | Moment of a force and units of moment, Varignon's theorem (definition only) | | |
| 6th | 16th | Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support) | 6. | **REVISION** |
| | 17th | Parallel forces (like and unlike parallel force), calculating their resultant | | |
| | 18th | **REVISION** | | |
| 7th | 19th | **1st Sessional Test (Tentative** | 7. | |
| | 20th | Concept of couple, its properties and effects | | |
| | 21st | General conditions of equilibrium of bodies under coplanar forces | | |
| | 22nd | Position of resultant force by moment [Simple problems on the above | | |

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| 8th | | topics] | 8. | To find mechanical advantage, velocity ratio and efficiency of single purchase crab |
| | 23th | Definition and concept of friction, types of friction, force of friction | | |
| | 24th | | | |
| 9th | 25th | Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction | 9. | To find out center of gravity of regular lamina. |
| | 26th | Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane. | | |
| | 27th | | | |
| 10th | 28th | | 10. | To find out center of gravity of irregular lamina |
| | 29th | 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 | | |
| | 30th | | | |
| 11th | 31st | | 11. | To determine coefficient of friction between three pairs of given surface. |
| | 32nd | Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies | | |
| | 33rd | | | |
| 12th | 34th | **PTM** | 12. | **REVISION** |
| | 35th | **2nd Sessional Test (Tentative)** | | |
| | 36th | Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion | | |
| | 37th | Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite | 13. | |

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| 13th | | bodies and bodies with portion removed [Simple problems on the above topics] | | To find the mechanical advantage, velocity ratio and efficiency of worm and worm wheel |
| | 38th | . Definition of effort, velocity ratio, mechanical advantage and efficiency of - a machine and their relationship, law of machines | | |
| | 39th | | | |
| 14th | 40th | Simple and compound machine (Examples) | 14 | |
| | 41st | Definition of ideal machine, reversible and self locking machine | | |
| | 42nd | Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency | | |
| 15th | 43rd | | 15. | **REVISION** |
| | 44th | System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency | | |
| | 45th | 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] | | |
| 16th | 46th | | 16. | **VIVA** |
| | 47th | **REVISION** | | |
| | 48th | **3rd Sessional Test** | | |