

FLUID MECHANICS
1. FLUID MECHANICS

- The liquids and gases together are termed as fluids, in other words, we can say that the substances which can flow are termed as fluids.
- We assume fluid to be incompressible (i.e., the density of liquid is independent of variation in pressure and remains constant) and non-viscous (i.e. the two liquid surfaces in contact are not exerting any tangential force on each other).

1.1 Fluid Statics
1.1.1 Fluid Pressure

Pressure p at every point is defined as the normal force per unit area.

$$p = \frac{dF_{\perp}}{dA}$$

The SI unit of pressure is the Pascal and $1 \text{ Pascal} = 1 \text{ N/m}^2$

- Fluid force acts perpendicular to any surface in the fluid, no matter how that surface is oriented. Hence pressure, has no intrinsic direction of its own, it is a scalar.

Pressure

- (a) Pressure at two points in a horizontal plane or at same level when the fluid is at rest or moving with constant velocity is same.



- (b) Pressure at two points which are at a depth separation of h when fluid is at rest or moving with constant velocity is related by the expression



$p_2 - p_1 = \rho gh$, where ρ is the density of liquid.

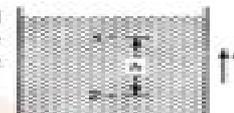
- (c) Pressure at two points in a horizontal plane when fluid container is having some constant horizontal acceleration are related by the expression



$p_1 - p_2 = \rho a$

and $\tan \theta = a/g$, where θ is the angle which the liquid's free surface is making with horizontal.

- (d) Pressure at two points within a liquid at vertical separation of h when the liquid container is accelerating up are related by expression



$$p_2 - p_1 = \rho(g + a)h$$

If container is accelerating down, then $p_2 - p_1 = \rho(g - a)h$.

1.1.2 Atmospheric Pressure

- It is the pressure of the earth's atmosphere. Normal atmospheric pressure at sea level (an average value) is 1 atmosphere (atm) that is equal to $1.013 \times 10^5 \text{ Pa}$.
- The excess pressure above atmospheric pressure is called gauge pressure, and total pressure is called absolute pressure.
- Barometer is a device used to measure atmospheric pressure while U-tube manometer or simply manometer is a device used to measure the gauge pressure.

1.1.3 Pascal's Law

- A change in the pressure applied to an enclosed fluid is transmitted undiminished to every portion of the fluid and to the walls of the containing vessel.
- There are a lot of practical applications of Pascal's law one such application is hydraulic lift.

1.1.4 Archimedes Principle

- When a body is partially or fully dipped into a fluid, the fluid exerts contact force on the body. The resultant of all these contact forces is called buoyant force (upthrust).
- $F =$ weight of fluid displaced by the body.
- This force is called buoyant force and acts vertically upwards (opposite to the weight of the body) through the centre of gravity of the displaced fluid.

$$F = V\rho g$$

where, $v =$ volume of liquid displaced

$\rho =$ density of liquid.

Mechanical Operations Lecture Notes

**Dmytro Pavlenko, Pavlo
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Lecture Notes in Operations Research and Mathematical Economics ,1970

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Advances in Condition Monitoring of Machinery in Non-Stationary Operations Fakher Chaari,Radoslaw Zimroz,Walter Bartelmus,Mohamed Haddar,2015-07-16 The book provides readers with a snapshot of recent research and technological trends in the field of condition monitoring of machinery working under a broad range of operating conditions Each chapter accepted after a rigorous peer review process reports on an original piece of work presented and discussed at the 4th International Conference on Condition Monitoring of Machinery in Non stationary Operations CMMNO 2014 held on

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Notes on Thermodynamics Henry Wilson Spangler,1906 *Journal of the American Society of Mechanical Engineers* American Society of Mechanical Engineers,1918 *The Law of Operations Preliminary to Construction in Engineering and Architecture* John Cassan Wait,1900

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Table of Contents Mechanical Operations Lecture Notes

1. Understanding the eBook Mechanical Operations Lecture Notes
 - The Rise of Digital Reading Mechanical Operations Lecture Notes
 - Advantages of eBooks Over Traditional Books
2. Identifying Mechanical Operations Lecture Notes
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Mechanical Operations Lecture Notes
 - User-Friendly Interface
4. Exploring eBook Recommendations from Mechanical Operations Lecture Notes
 - Personalized Recommendations
 - Mechanical Operations Lecture Notes User Reviews and Ratings
 - Mechanical Operations Lecture Notes and Bestseller Lists
5. Accessing Mechanical Operations Lecture Notes Free and Paid eBooks
 - Mechanical Operations Lecture Notes Public Domain eBooks
 - Mechanical Operations Lecture Notes eBook Subscription Services
 - Mechanical Operations Lecture Notes Budget-Friendly Options

6. Navigating Mechanical Operations Lecture Notes eBook Formats
 - ePub, PDF, MOBI, and More
 - Mechanical Operations Lecture Notes Compatibility with Devices
 - Mechanical Operations Lecture Notes Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Mechanical Operations Lecture Notes
 - Highlighting and Note-Taking Mechanical Operations Lecture Notes
 - Interactive Elements Mechanical Operations Lecture Notes
8. Staying Engaged with Mechanical Operations Lecture Notes
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Mechanical Operations Lecture Notes
9. Balancing eBooks and Physical Books Mechanical Operations Lecture Notes
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Mechanical Operations Lecture Notes
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Mechanical Operations Lecture Notes
 - Setting Reading Goals Mechanical Operations Lecture Notes
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mechanical Operations Lecture Notes
 - Fact-Checking eBook Content of Mechanical Operations Lecture Notes
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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