

A Text Book on  
**ENGINEERING  
MECHANICS**  
*for*  
**GATE**

**PSUs & UPSC EXAMINATIONS**

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“A great text book cum practice book for preparation of Engineering Mechanics”

According to new syllabus of GATE 2016, engineering mechanics is now been added in Civil Engineering while it was pre-existed in Mechanical engineering. The present book has been designed as a “self study book” taking into account the severe shortage of technical teachers of Engineering Mechanics in engineering colleges and technical institutions.

The text in the book is well explained through examples supplemented by self explanatory illustration exercises supplemented by hints, key points, thought provoking multiple choice questions, special problems so that a student can learn the basic subject in the shortest possible time.

The book covers all the Syllabi in the Engineering Mechanics of GATE, PSUs all the universities, IITs, NITs, deemed universities. The book will greatly help the students who could not grasp the subject in the classroom.

## Salient feature of the book :

- A self study book.
- Question from GATE, PSUs & Civil Services.
- Comprehensive explanations of the text through illustrations.
- About 500+ solved questions.

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A Text Book on  
**ENGINEERING  
MECHANICS**

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**GATE**

**PSUs & Other Competitive Exams**

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# 01

## CHAPTER



# Vector Quantities in Mechanics

## 1.1 Introduction

Study of engineering mechanics is incomplete if the vector quantities are not understood thoroughly for the correct solution of any problem in engineering mechanics *specially three-dimensional problems*.

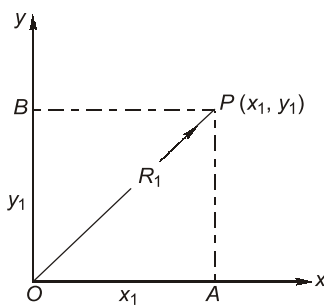
Vector quantities as position vector, displacement vector, force vector, moment of a force about a point or about an axis, couple vector, addition and subtraction of couple vectors form the text of this chapter.

## 1.2 Position Vector

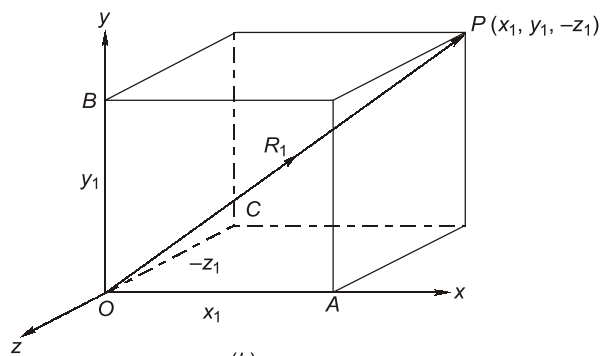
A position vector of a point is defined by the *position of a point in any coordinate system*. A vector starting from the origin of a coordinate system to the point in space is termed as *position vector*.

**Fig. 1.1 (a)** shows a point  $P$  in  $x$ - $y$  coordinate system with coordinates  $P(x_1, y_1)$ . Position vector of  $P$  is  $OP$  starting from the origin of coordinate system. Position vector  $R_1$  from  $O$  to  $P$  can be expressed as

$$R_1 = x_1 i + y_1 j$$



(a)



(b)

**Fig. 1.1**

Similarly **Fig. 1.1 (b)** shows a point  $P$  in  $x$ - $y$ - $z$  coordinate system with coordinates  $P(x_1, y_1, -z_1)$ ,  $\vec{OP}$  is the position vector of point  $P$  and can be expressed as

$$R_1 = x_1 i + y_1 j - z_1 k.$$

**Example 1.1** (a) Mark the position vector of a point  $P(4, -3)$ , (b) Show the position vector of a point  $P(4, -3, +2)$ . What are its direction cosines?