VECTOR MECHANICS SOLUTION MANUAL pdf

1: Vector Mechanics for Engineers: Dynamics

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Customary Units xxxix of Problems in U. Statics is designed for the first course in statics offered in the sophomore year of college. New concepts have, therefore, been presented in simple terms and every step has been explained in detail. However, because of the large number of optional sections which have been included and the maturity of approach which has been achieved, this text can also be used to teach a course which will challenge the more advanced student. The text has been divided into units, each corresponding to a well-defined topic and consisting of one or several theory sections, one or several Sample Problems, a section entitled Solving Problems on Your Own, and a large number of problems to be assigned. To assist instructors in making up a schedule of assignments that will best fit their classes, the various topics covered in the text have been listed in Table I and a suggested number of periods to be spent on each topic has been indicated. Both a minimum and a maximum number of periods have been suggested, and the topics which form the standard basic course in statics have been separated from those which are optional. The total number of periods required to teach the basic material varies from 26 to 39, while covering the entire text would require from 41 to 65 periods. If allowance is made for the time spent for review and exams, it is seen that this text is equally suitable for teaching a basic statics course to students with limited preparation since this can be done in 39 periods or less and for teaching a more complete statics course to advanced students since 41 periods or more are necessary to cover the entire text. In most instances, of course, the instructor will want to include some, but not all, of the additional material presented in the text. In addition, it is noted that the text is suitable for teaching an abridged course in statics which can be used as an introduction to the study of dynamics see Table I. We note that, in most cases, problems have been arranged in groups of six or more, all problems of the same group being closely related. This means that instructors will easily find additional problems to amplify a particular point which they may have brought up in discussing a problem assigned for homework. A group of problems designed to be solved with computational software can be found at the end of each chapter. To assist in the preparation of homework assignments, Table I provides a brief description of all groups of problems and a classification of the problems in each group according to the units used. It should also be noted that the answers to all problems are given at the end of the text, except for those with a number in italic. Because of the large number of problems available in both systems of units, the instructor has the choice of assigning problems using SI units and problems using U. To illustrate this point, sample lesson schedules are shown in Tables I, IV, and V, together with various alternative lists of assigned homework problems. Since the approach used in this text differs in a number of respects from the approach used in other books, instructors will be well advi- sed to read the preface to Vector Mechanics for Engineers, in which the authors have outlined their general philosophy. In addition, instructors will find in the following pages a description, chapter by chapter, of the more significant features of this text. It is hoped that this material will help instructors in organizing their courses to best fit the needs of their students. The authors wish to acknowledge and thank Amy Mazurek of Williams Memorial Institute for her careful preparation of the solutions contained in this manual. The six fundamental principles listed in Sec. The SI metric units are discussed first. The base units are defined and the use of multiples and submultiples is explained. The various SI prefixes are presented in Table 1. In the second part of Sec. The SI equivalents of the principal U. For instance, multiples and submultiples such as kN and m are used whenever possible to avoid writing more than four digits to the left of the decimal point or zeros to the right of the decimal point. When 5-digit or larger numbers involving SI units are used, spaces rather than commas are utilized to separate digits into groups of three for example, 20 0 km. In order to achieve as much uniformity as possible between results expressed respectively in SI and U. However, the traditional use of commas to separate digits into groups of three has been maintained for 5-digit and larger numbers involving U. Chapter 2 Statics of Particles This is the first of two chapters dealing with the fundamental properties of force systems. A simple, intuitive classification of forces has been used: Chapter 2 begins with the parallelogram law of addition of forces and with the introduction of the fundamental properties of vectors. In the text, forces and other vector quantities are always shown in bold-face type. Thus, a force F boldface , which is a vector quantity, is clearly distinguished from the magnitude F italic of the force, which is a scalar quantity. On the blackboard and in handwritten work, where bold-face lettering is not practical, vector quantities can be indicated by underlining. Both the magnitude and the direction of a vector quantity must be given to completely define that quantity. Unit vectors i and j are introduced in Sec. These first sections provide a review of the methods of plane trigonometry and familiarize the students with the proper use of a calculator. A general procedure for the solution of problems involving concurrent forces is given: The second part of Chap. Note that since this chapter deals only with particles or bodies which can be considered as particles, problems involving compression members have been postponed with only a few exceptions until Chap. It should be observed that when SI units are used a body is generally specified by its mass expressed in kilograms. The weight of the body, however, should be expressed in newtons. Therefore, in many equilibrium problems involving SI units, an additional calculation is required before a free-body diagram can be drawn compare the example in Sec. This apparent disadvantage of the SI system of units, when compared to the U. Chapter 3 Rigid Bodies: Equivalent Systems of Forces The principle of transmissibility is presented as the basic assumption of the statics of rigid bodies. However, it is pointed out that this principle can be derived from Newton s three laws of motion see Sec. The vector product is then introduced and used to define the moment of a force about a point. The convenience of using the determinant form Eqs. The scalar product and the mixed triple product are introduced and used to define the moment of a force about an axis. Again, the convenience of using the determinant form Eqs. The amount of time which should be assigned to this part of the chapter will depend on the extent to which vector algebra has been considered and used in prerequisite mathematics and physics courses. It is felt that, even with no previous knowledge of vector algebra, a maximum of four periods is adequate see Table I. While this fundamental property of couples is often taken for granted, the authors believe that its rigorous and logical proof is necessary if rigor and logic are to be demanded of the students in the solution of their mechanics problems. This concept is made more intuitive through the extensive use of free-body-diagram equations see Figs. Note that the moment of a force is either not shown or is represented by a green vector Figs. A red vector with the symbol is used only to represent a couple, that is, an actual system consisting of two forces Figs. Since one of the purposes of Chap. However, many students may be expected to develop solutions of their own, particularly in the case of two-dimensional problems, based on the direct computation of the moment of a force about a given point as the product of the magnitude of the force and the perpendicular distance to the point considered. Such alternative solutions may occasionally be indicated by the instructor as in Sample Prob. It should be pointed out that in later chapters the use of vector products will generally be reserved for the solution of three-dimensional problems. Chapter 4 Equilibrium of Rigid Bodies In the first part of this chapter, problems involving the equilibrium of rigid bodies in two dimensions are considered and solved using ordinary algebra, while problems involving three dimensions and requiring the full use of vector algebra are discussed in the second part of the chapter. Particular emphasis is placed on the correct drawing and use of free-body diagrams and on the types of reactions produced by various supports and connections see Figs. Note that a distinction is made between hinges used in pairs and hinges used alone; in the first case the reactions consist only of force components, while in the second case the reactions may, if necessary, include couples. For a rigid body in two dimensions, it is shown Sec. It is also shown that it is possible to choose equilibrium equations containing only one unknown to avoid the necessity of solving simultaneous equations. This topic is presented only after the general case of equilibrium of a rigid body to lessen the possibility of students misusing this particular method of solution. The equilibrium of a rigid body in three dimensions is considered with full emphasis placed on the free-body diagram. While the tool of vector algebra is freely used to simplify the computations involved, vector algebra does not, and indeed cannot, replace the free-body diagram as the focal point of an equilibrium problem. Therefore, the solution of every sample problem in this section begins with a reference to the drawing of a free-body diagram. Emphasis is also placed on the fact that the number of unknowns and the number of equations must be equal if a structure is to be statically determinate and completely constrained.

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Chapter 5 Distributed Forces: Centroids and Centers of Gravity Chapter 5 starts by defining the center of gravity of a body as the point of application of the resultant of the weights of the various particles forming the body. This definition is then used to establish the concept of the centroid of an area or line. All problems assigned for the first period involve only areas and lines made of simple geometric shapes; thus, they can be solved without using calculus. The theorems of Pappus-Guldinus are given in Sec. Here again the determination of the centroids of composite shapes precedes the calculation of centroids by integration. Parte 1 de

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