A TECHNIQUE FOR MECHANICAL VIBRATION PROBLEMS

Mechanical Admittances and their Applications to Oscillation Problems

By Prof. W. J. Duncan. (Ministry of Supply: Aeronautical Research Council, Reports and Memoranda, No. 2000.) Pp. 128. (London: H.M. Stationery Office, 1947.) 22s. 6d. net.

IN the days when electrical engineering was emerging from physics and when alternating current circuit theory was in its infancy, progress was greatly helped by the fortunate circumstance that the equations to which the new theory led were formally similar to those already encountered in mechanics. Thus Maxwell, in his treatise, devotes a chapter to the dynamical principles and equations of Lagrange and Hamilton, and is at pains to stress the fact that the circuit equations fall within their scope. As it grew, electric circuit theory elaborated concepts, developed techniques, and invented a nomenclature, appropriate to the problems encountered and to their growing complexity. More recently, problems in mechanical vibrations, of increasing complexity, have presented themselves, notably in aeroplane design, and circuit theory has been able to repay with interest the debt it has for so long owed.

The word 'admittance' in the title of this monograph is borrowed from circuit theory, where it signifies, for any branch, relative to a pair of terminals, the ratio of current in the branch to E.M.F. across the terminals. The most obvious analogue of electric current is mechanical *velocity*, but since the interest in mechanical problems is more often focused on *displacement*, the liberty has been taken of altering the significance and of defining 'mechanical admittance' as a ratio of displacement to force—with 'displacement' and 'force' used as in the language of generalized co-ordinates. More immediately descriptive terms would have been 'dynamic flexibility', or a 'dynamic influence coefficient'—expressing the harmonically varying response to a harmonically varying unit stimulus.

The power of the 'admittance' method lies in the ability it confers of expressing rapidly the displacements at chosen key points of a system in terms of internal and external forces acting on the system or upon a sub-system. Eliminating internal forces from the set of equations so formulated leads to either (i) the frequency equations in the absence of external forces, or (ii) equations for the chosen (generalized) co-ordinates in terms of the external forces. As the author says of admittances, "their use greatly facilitates the splitting of problems on mechanical vibrations into manageable portions", so that "the range of tractable problems is greatly extended".

The monograph contains an elementary exposition of the fundamental ideas, with examples of their application to a number of systems. The purpose is didactic, and the examples are 'academic', but the advantages of the method are clear to see, and students and designers should derive much profit therefrom. There are conceivably other topics upon which similar monographs might be included in the Reports and Memoranda Series issued by the Aeronautical Research Council, and Prof. Duncan may be congratulated upon creating an excellent precedent.

The electro-mechanical analogy is, however, not perfect, and the technique of mechanical admittances has not yet acquired all the facility of electric circuit theory. The idea of mechanical 'circuits' needs elaboration, and the analogues of Kirchhoff's laws would seem desirable, although the greater complexity of mechanical couplings and interconnexions does present some difficulties.

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COLLEGE PHYSICS

College Physics

By Prof. Jonn A. Eldridge. Third edition. Pp. x + 720. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1947.) 27s. net.

College Technical Physics

By Robert L. Weber, Marsh W. White and Kenneth V. Manning. Pp. x + 761. (New York and London: McGraw-Hill Book Co., Inc., 1947.) 22s. 6d. 4.50 dollars.

THESE two text-books, designed for use in the first-year course of American colleges, are suitable for classes in Britain of intermediate degree examination standard, particularly where a combined course of instruction is given for students from various faculties. The subject-matter is similar in both, covering mechanics, heat, sound, electricity and magnetism, and optics. Calculus is not used, and only an elementary knowledge of algebra and trigonometry is required.

"College Physics", which is now in its third edition, first appeared in 1937. In the new edition a large part of the text has been rewritten, a slight change made in the order of presentation, and a greater number of worked-out examples given, though the problems at the ends of the chapters have not greatly altered. The author has tried to arouse an interest in physics and to make the student think for himself. In this he has succeeded admirably, but it is a pity that occasionally he has allowed his enthusiasm to run away with him, for some of his language is much too colloquial and his historical sketches very often ridiculous. The diagrams and explanations are very clear, and fundamentals are carefully stressed. The British 'gravitational' system (in which the unit of mass is the 'slug'), and the c.g.s. system of units are used.

"College Technical Physics" is a new book, although some of the material has been adapted from an earlier book of the authors entitled "Practical Physics". It is on conventional lines, with one unique feature—the chapter headpieces. These are portrait drawings by C. S. Hauschka—one for every chapter—of the fifty Nobel prize winners in physics, arranged in chronological order, from Röntgen in 1901 to Bridgman in 1946. Every portrait is accompanied by a brief biographical note. The portraits bear no relation to the chapters to which they are attached, nor is any reference made to the drawings in the text. Indeed, several of these eminent physicists, for example, Sir J. J. Thomson, who it is expected would be mentioned even in an elementary text-book, get no mention at all in the text. The book is very well produced and contains some excellent illustrations, both line drawings and half-tones. In particular, the chapter on colour, with its unusual but excellent coloured illustrations, must receive special commendation.

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