ELECTRICAL MACHINE DYNAMICS

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Preface

The book is designed to give a straightforward, logical presentation of the methods available for predicting the dynamic behaviour and response of electrical machines. Three particular aspects of machine theory have been utilised to achieve this.

1. The early chapters contain a simple presentation of electromagnetic theory underlying the concepts of self and mutual inductance in saturable machines containing several windings.
2. The generalised form of electrical machine theory is developed in simple matrix terms. The d.c. machines, induction motor and alternator are treated in detail. Extension to other types of machines not treated in the book is straightforward.
3. A torque-balance analysis of machines is presented, from which the dynamic response and the synchronising and damping forces can be investigated and computed. The effect of a generator voltage regulator is introduced and its influence on power system dynamic response is discussed.

The material is developed to the level of final year honours undergraduate and first year post-graduate students in electrical engineering. The authors also had in mind power system engineers concerned with the design, performance and control of turbo-alternators and large salient-pole generators for hydro-electric schemes, together with ancillary electrical drives, and mechanical engineers concerned with industrial electrical machine systems.

In presenting the dynamical analysis of electrical machine systems, the authors are very conscious that a vast amount of important machine theory has been taken for granted, or only very briefly discussed in the text. The book is clearly based on the work of three or four generations of outstanding electrical machine engineers who provided industry with a wide variety of convenient, easily controlled and highly efficient drive systems. Names such as Miles

Walker, Say, Gibbs, Adkins, Concordia, Park, Alger and Kron, to mention only a few well known to students, span both post-war and pre-war technologies. The authors hope that the present book may make a contribution to the dynamical aspects of machine and power system engineering.

They wish to express their thanks to their former colleagues, Drs C. V. Jones and B. W. Hogg for continuing interest and discussion. They are very much indebted to past research students who carried out the experimental work and computation for virtually all of the results presented here. Dr M. Y. M. Yau developed the earlier work on regulator effects in Chapters 7 and 8, in the laboratories at the University of Liverpool, and the more recent work was done by Mr N. G. Narahari at the Indian Institute of Science, Bangalore. The electromechanical studies using the alternator and induction motor in the laboratory were carried out by Dr J. S. Gorley and the Ward-Leonard system dynamics by Dr M. W. Main, both at that time at the University of Liverpool. The latter experiments were suggested by Mr H. J. T. Whitehead and Mr J. Warnock of B. N. F. L. Windscale in discussions on power system dynamics and the authors wish to acknowledge the valuable insight into practical power system dynamic problems which emerged from these talks.

Mrs Joan Johnston carefully and patiently typed the manuscript and her assistance throughout is gratefully acknowledged. The authors wish to express their thanks to Mr Malcolm Stewart and Mr Richard Powell of The Macmillan Press Ltd for their guidance at all stages in the preparation of the manuscript.

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