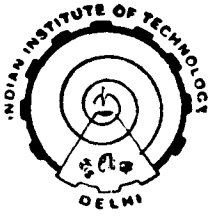
UNBALANCE RESPONSE AND STABILITY OF SYMMETRIC AND ASYMMETRIC ROTORS

By

K. V. BHASKARA SARMA

Thesis submitted in fulfilment of the
requirements of the degree of

DOCTOR OF PHILOSOPHY



Department of Mechanical Engineering

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to

Bharat Heavy Electricals Limited (India)

CERTIFICATE

This is to certify that the thesis entitled, "UNBALANCE RESPONSE AND STABILITY OF SYMMETRIC AND ASYMMETRIC ROTORS" being submitted by Mr. K.V. Bhaskara Sarma to the Department of Mechanical Engineering, Indian Institute of Technology, New Delhi for the award of the Degree of 'Doctor of Philosophy' in Mechanical Engineering is a record of bonafide research work carried out by him. He has worked under our supervision and guidance, and has fulfilled the requirement for the submission of this thesis which has reached the requisite standard.

The results contained in this work have not been submitted in part or in full to any University or Institute for the award of any degree or diploma.

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ABSTRACT

Study presented in this thesis is concerned with the unbalance response and stability analysis of symmetric and asymmetric rotors, mounted on fluid film bearings. Jeffcott models of rotors as well as the actual multi-mass rotors are analysed.

A numerical integration procedure to study the Jeffcott model of asymmetric shafts mounted on rigid as well as fluid film bearings is developed. The coupled differential equations of motion are solved by modified Euler's method using a time marching procedure to obtain whirl orbits of asymmetric rotors taking into account both the gravity and unbalance effects. Under stable operating conditions the final orbit shows good agreement with the closed form solution.

To study the actual rotor-bearing systems, a time marching transfer matrix method is developed to obtain the whirl orbits of the rotor. Several case studies are presented for symmetric as well as asymmetric rotors and the results obtained are compared with Jeffcott models.

This work also presents the transfer matrix method with a continuous element model to determine the unbalance response of a rotor mounted on fluid film bearings. These results are compared with Jeffcott model analysis. Though the critical speeds obtained by both the methods are in good agreement, the amplitudes of whirl obtained by the Jeffcott model at the critical speed are higher than those determined with the transfer matrix approach.

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