A THESIS ON

VIBRATIONS OF TURBINE BLADES

BY

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CERTIFICATE

This is to certify that the thesis entitled 'VIBRATIONS OF TURBINE BLADES' by H.M. JADVANI has been prepared under my supervision in confirmity with the rules and regulations of the Indian Institute of Technology, Delhi. I further certify that the thesis has attained a standard required for a Ph.D degree of the Institute. The results contained in this thesis have not been submitted, in part or full, to any other university for any degree or diploma.

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VIBRATIONS OF TURBINE BLADES

ABSTRACT

Using energy method, free vibrations of uniform pre-twisted, uniform pre-twisted asymmetric and twisted tapered, cambered asymmetric blades have been determined. The effects of pre-twist, rotation, disc radius, setting angle and asymmetry on the frequency parameter ratio have been found in nondimensional form. An additional effect due to the ratio of principal second moments of area on the natural frequencies in chordwise bending modes is also pointed out. A general computer program has been developed to determine the natural frequencies and mode shapes of a turbine blade with blade geometry defined at suitable number of stations along the length of the blade. The results obtained are compared with those available in the literature.

Using modal analysis, the forced vibration response of uniform pre-twisted blade and twisted, tapered, cambered asymmetric blade is determined at nozzle passing frequency and its harmonics. The excitation force past each nozzle is taken in general digital form at chosen angular intervals.

A test rig has been designed and built to demonstrate the forced vibration phenomenon due to nozzle passing frequency.

The nozzles are simulated by twelve equally spaced permanent magnets and the excitation force due to the permanent magnets is determined by a magnet calibration set up. A pre-twisted blade of uniform rectangular cross-section is chosen for conducting the experiment. The theoretical and experimental results of the blade response in flapwise motion are correlated at the nozzle passing frequencies.

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