Preface

The horizon of microwave tubes still finds its dominance in delivering gigawatt (GW) power at microwave frequencies, and this is an area where their solid-state counterparts are not able to compete. Such High Power Microwave (HPM) sources are used to design HPM systems for various applications, though HPM systems generate azimuthally symmetrical modes *TEM* or TM_{01}. When such modes are radiated, then their radiation pattern has null at the axis of propagation. Thus, the HPM systems require specific mode converter, capable of performing conversion of *TEM* or TM_{01} mode to TE_{11} mode for HPM sources. Therefore, during the past few decades, considerable research interest has been aroused in the development of the HPM mode converter to bridge the gap between source generated mode and required mode to radiate on target.

HPM systems have applications in the defence sector, where lightweight, compact, axially aligned mode converters are required with features of high convergence efficiency, high power capability, along with beam stability. Such mode converter can also be used in HPM system having application in microwave propulsion, microwave thruster, rebuilding the ozone layer by high dielectric discharge, solar power transmission using HPM beaming, enhancing radar capability through HPM and plasma heating for controlled fusion reaction.

The earliest method was to radiate source generated mode slant cut in a circular waveguide, named as Vlasov converter, for the conversion of output *TM* mode to directly into a Gaussian beam. This converter is well famous in Gyro devices, but it is not useful in the HPM system because it deviates the direction of propagation away from the central axis of the source. In recent decades, considerable research and development have been in the area of a mode converter for conversion of TM_{01} to TE_{11} mode. Class of mode converters developed using gradual discontinuity do have good conversion efficiency. These mode converters are axially aligned but are difficult to use, and they are very complex in design and development. The mode converter based on axial discontinuity such as sectoral waveguide (SWG) mode converters is axially aligned having the advantage of high convergence efficiency and is compact in structure. As SWG structures are waveguide structures evolved by separating coaxial waveguide, the field distributions inside these structures are very close to the rectangular waveguide in bend format.

However, due to analysing mode converter with a cylindrical coordinate system the characteristics of SWG depends upon radial and azimuthal parameter. The existence of an aperture changes from coaxial waveguide to SWG and vice versa introduces a set of modes in adjacent waveguide. This fact has given us an opportunity to deploy efficient Mode Matching Techniques (MMT) to analyse these structures in this thesis. In addition, beam stability, lightweight design, and high power capability are an important characteristic which requires attention while designing any mode converter and are discussed in this thesis.

The author, from time to time, has reported the present work part-wise in national conferences as well as in reputed international journals, namely, Journal of Microwave Power and Electromagnetic Energy, and Microwave and Optical Technology Letters. Also, he would consider his efforts a success, if the proposed design of mode converters in thesis proves to be useful in the design, development and experimentation of HPM systems.