PREFACE

In recent years, the development of High-power microwave (HPM) sources has been very popular in the microwave community due to its various civilian and military applications. The main purpose of HPM sources is to deliberately disrupt or destroy electronic equipment without harming the infrastructure or harming the humans. The generation of RF power by HPM sources from KW's to GW's in the frequency range from GHz to THz with single and dual-frequency by a single HPM device has drag the attention of researchers and academia around the world for R&D in this domain. There are many HPM sources to generate high power using Relativistic electron beam such as Relativistic Klystron, Relativistic Backward Wave Oscillator (RBWO), Relativistic Magnetron, Magnetically Insulated Line Oscillator (MILO), fast wave devices such as gyro devices and space-charged devices such as Vircator and FEL and these devices are still in active research in many countries. Above all, Relativistic Backward Wave Oscillator (RBWO) is one of the most prominent slow-wave relativistic device used in many applications like E-bomb and Directed Energy Weapons (DEW) applications, and it is more promising HPM source in terms of design, efficiency, repetition rate, and frequency tunability. The only drawback is that it requires a strong external guiding magnetic field. This makes this device cumbersome and can be overcome. Since most applications are used with the help of ground-based stations, I chosen S- and C-bands frequency of operation for my research work.

In the present thesis, the author has designed and simulate the S-band RBWO by considering an experimentally demonstrated S-band overmoded RBWO and the Trapezoidal resonant reflector has been replaced with resonant reflector to enhances the pre-modulation during electron beam propagation, thus increasing the generated RF

signal overall efficiency and coherency. In addition, the pulse shortening study is analyzed by considering its various mechanisms in MAGIC-PIC simulations. Authors tried to develop the look-alike environment causing RF breakdown which leads to the pulse shortening of RF wave. Further, significant use of the helically corrugated cylindrical waveguide named Bragg structure is made to directly generate the HE_{11} / TE_{11} mode from an RBWO for the Gaussian output. The Bragg structure is used as an integral part of a device that performs many functions, such as reflectors, mode converters, and RF interaction structure. It eliminates the requirement of external mode converter to convert outputted TM_{01} mode to Gaussian-like TE_{11} mode which increases the overall length and reduces the overall efficiency of the RBWO device. A single band and dual-band RBWO device are designed and simulated using Bragg structure to achieve high power conversion efficiency. A dual-band relativistic backward wave oscillator (RBWO) with sectional slow-wave structures (SWSs) also has been designed to generate a long high-power microwave (HPM) pulse at two different frequencies.

The author present work has been partially reported in national and international conferences, as well as in reputed journals, in the IEEE Transactions on Electronic Devices, and in the Defence Science Journal. If it useful in the designing, developing, and experimenting with single and dual frequency RBWO, the author would consider his efforts a success.