Preface

Conventional microwave tubes cease to generate high power at millimeter and sub-millimeter wave frequencies due to miniaturization of their transverse dimensions at these frequencies. However, there exist a variety of applications both for military and civilian purposes, where high power millimeter wave sources and amplifiers are needed. This led to extensive research and development activities in fast-wave gyro-sources and amplifiers. Gyro devices, by virtue of the interaction phenomena called cyclotron resonance maser (CRM) interaction, are capable of producing high power in the millimeter and submillimeter wave frequency range. Among many of the devices, one such gyro-source, namely, the gyrotron is now commercially available for applications such as in plasma heating and material processing, the gyro-amplifiers like the gyro-klystron and the gyro-TWT are still in the experimental stage.

The gyroklystron amplifier is unparalleled in the family of gyro-devices, mainly because of its capability to provide high power with larger gain and moderate bandwidth in the millimeter and sub-millimeter wave frequency range. It is a fast wave electron beam device that combines the multicavity configuration of a klystron amplifier with the energy extraction mechanism of the cyclotron resonance maser (CRM) instability similar to gyrotron. In recent years, considerable interest has been aroused towards the research and development of the gyroklystron amplifier due to its requirements for the use in supercolliders, mm-wave radars, plasma heating experiments, communications, nonlinear spectroscopy and many other applications. This aspect perhaps motivated the author to enlarge, and strengthen the knowledge in the field of the gyroklystron amplifier.

The present proposed research work is to aim for the design, analysis, simulation, and performance improvements of the gyroklystron amplifier. The design analysis of the two-cavity as well as multicavity gyroklystron amplifiers have been described based on the time independent single mode theory of gyroklystron amplifiers. The different analytical approaches have been implemented to observe the RF behavior of the gyroklystron amplifier and PIC simulation techniques have been used for their validation. Studies have been also made for the performance improvement of the gyroklystron amplifier using the stagger-tuning technique. The author, from time to time, has reported the present work part-wise at national and international conferences as well as in reputed journals, namely, International Journal of Microwave Applications (IJMA), and Journal of Microwave, Optoelectronics and Electromagnetic Applications (JMOe).