INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: Investigation on Advanced Interaction Structures for Millimeter Wave and Sub-THz Vacuum Electron Devices

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Thesis Submitted to the Department/ Center	:	EEE
Date of completion of Thesis Viva-Voce Exam	:	17.12.2022
Key words for description of Thesis Work	:	VEDs, mm-wave VEDs, sub-THz VEDs, PIC Simulations

SHORT ABSTRACT

Vacuum Electron Devices (VEDs) find numerous applications due to their inherent merits, such as unmatchable output power, ruggedness, higher gain, and less heat generation at the junction in comparison to its solid-state counterparts. Traditional VEDs using a linear electron beam suffer from a severe decrease in power level as the operating frequency increases. The issues like unwanted reflection from the interaction structure, and, beam-wall interception become more predominant in sub-THz and THz frequency range. The magnetic focusing and cooling become more stringent at elevated frequency range. Therefore, various beam wave interaction mechanism is being explored by the researchers to develop highly efficient, powerful mm-wave, sub-THz, and THz radiation sources to tackle the above problem. This thesis reports the study and design of a highly efficient medium power Gyrotron for material processing application. The key subsystems of the gyrotron, such as, Magnetron Injection Gun (MIG), cavity, depressed collector and magnet system are studied. The output power of the gyrotron is obtained by using single mode time dependent approach. Particle-in-cell simulation is carried out to calculate and optimize various output parameters of the device. An innovative interaction cavity is introduced to eliminate mode competitions for the operating TE_{02} mode. A three-staged depressed collector is employed to realize a high efficiency. The thesis also reports study and design of wide-band sine waveguide (SWG) travelling wave tubes (TWT) at 0.22 THz and 0.65 THz. Various cold parameters are evaluated and optimized for a width modulated two-section SWG structure to obtain higher value of interaction impedance in comparison to conventional SWG structure. The interaction structure is designed in two sections to reduce the reflection of RF power at the input coupler. A truncated SWG structure is considered for 0.65 THz. The interaction impedance is evaluated at various points of beam tunnel area to choose rectangular beam of suitable aspect ratio.