



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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Programme of Study : Ph.D.
Thesis Title: Design and Analysis of Microwave Passive Devices Using Tapered Lines
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Thesis Submitted to the Department/ Center : Electronics and Electrical Engineering
Date of completion of Thesis Viva-Voce Exam : 25th July 2020
Key words for description of Thesis Work : RF & Microwaves, Microwave Passive Devices, Filters, Power Dividers, Antennas

SHORT ABSTRACT

The research work presented in this thesis deals with size miniaturization and performance enhancement of various microwave passive devices using tapered lines and spoof surface plasmon polariton (SSPP) on planar type of transmission line like microstrip line and substrate integrated waveguide (SIW). Microwave passive devices and components such as filters, power dividers, directional couplers and antennas are the essential building blocks of microwave circuits and systems. In the modern time of ever-expanding wireless and consumer electronics market, it is highly desirable to design these devices which have a compact size, lower cost, lighter weight with superior performances. Novel bandpass filters are designed, analyzed and fabricated for ultra-wideband (UWB) (3.1-10.6 GHz) applications. To suppress the interference from IEEE 302.11a WLAN band signals in UWB spectrum, sharp notch stopband around 5.5 GHz has been created using exponentially tapered impedance line stub loaded microstrip resonator. The theoretical characterization of tapered lines such as triangular taper, exponential taper, and Klopfenstein taper are proposed many years ago, but for practical realization, linear tapers are the most common and simple tapers which are widely used for impedance matching, eliminating the step discontinuities between transmission lines, and in the design of power dividers, directional couplers, filters, antennas, etc. Although linear tapers have been used in the design of such several microwave devices, theoretical characterization of such taper is not available in the literature. Hence, the theoretical characterization of linear tapers is presented in this work. Subsequently, using linearly tapered microstrip lines (MSLs), a taper transition between microstrip line and substrate integrated waveguide (SIW) component, an ultra-broadband bandpass filter, and an unequal T-junction power divider have been designed, fabricated and tested. The proposed T-junction power dividers could be very useful in UWB or super-wideband (SWB) system where coupling ratio of more than 10 dB over a very broad range of frequency is desired for a passive signal cancelation. A very compact dual-port, aperture coupled and tapered fed patch antenna

with a very high isolation has been proposed for in-band full-duplex 2.4 GHz ISM applications. The same technique could further be utilized for designing antennas for in-band full-duplex radios such as for WiMAX applications.

SIW is a relatively new type of transmission line which provides the bridge between bulky metallic waveguide and lossy planar technology. By using the curve fitting technique, an approximate design equation has been developed for calculating the width of iris windows of iris SIW bandpass filter. An iris SIW bandpass filter at V-band has also been designed to validate the proposed method. A taper transition is generally required to connect microstrip line and SIW for smooth impedance and field matching between them over a broad range of frequency. Also, the introduction of slow-wave or low pass characteristics of SSPP in SIW offers higher performances broadband microwave devices. Hence, using hybrid structure of linear taper, SIW and SSPP, broadband bandpass filters with wide out-of-band rejection have been designed for X-band applications. A dumbbell-shaped SSPP has been proposed, which shows more slow-wave effects than rectangle-shaped SSPP for the same height of grooves. Hence, it could be used efficiently in the design of compact, low loss and highly integrated microwave devices. The size of proposed hybrid SSPP-SIW filters are very compact, amounts to only about a wavelength at the center frequency, which is much lesser than the length of existing hybrid SSPP-SIW filters.

