Concluding Remarks
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The thesis presents some studies on characteristics of low-dimensional, low power consumption and high frequency devices and some of their applications which assume great importance from the technological point of view. The results obtained in the present thesis are also compared wherever necessary and are summarized.

Small-signal ac mobility of two-dimensional degenerate hot electrons in an InSb square quantum well is studied on a heated drifted Fermi-Dirac distribution function for the carriers. We have proposed an InSb Quantum well device which is more fruitful in the high frequency applications, infrared detectors and also magnetic sensors. High frequency and low power consuming nanodevices are possible due this work. Here the millimeters and sub millimeters wave response characteristic is described. The ac mobility is found constant upto certain frequency (around 80GHz) beyond which it falls and gives cut off frequency where ac mobility is 0.707 of its low frequency value. The cut off frequency is found to decrease with increasing channel length (vide Fig. 2.4) and increases with increasing lattice temperature (vide Fig. 2.5).

One of the most important requirements in the current time is faster device so that if we use the device in processor, the processor will be faster in computation and in case of memory, access time will be less. It is an established fact that Si or SiGe based devices become faster if we add a small amount of carbon as
dopant; also the devices will be faster. The extent of carbon determines the quanta of fastness. Hence we have tried to optimize the extent of carbon to get faster devices. There are several ways for optimization, like Genetic algorithm, Particle swarm optimization, Artificial Neural Network based optimization. In our present work, we have used Artificial Neural Network based optimization technique. Here our work shows one way of getting optimized base transit time in SiGeC HBT by predicting the faster device parameters for efficient switching operations in the devices. New applications in information technology like wireless applications such as wireless local area network (WLAN), hyper LAN and broadband satellite communications, which are of interest, are asking for still faster circuits. Definitely, this work promises in getting faster devices by applying optimized parameter values in the device fabrication of SiGeC HBT.

Spin based devices have secured attractive features to embed them in VLSI/ULSI chips for higher density of integration, better computational speed and also less cost. The basic needs of modern electronic industry are low power consumption, high operating speed and high integration density equipments. As a consequence, the search for new principle of operation of the small size and low power consuming devices are becoming more and more important. Recent advantages in controlling quantum ‘spin ’ effect have broadened the path for the newly emerging field, called ‘Spin’ based electronics or “spintronics”. It is not an electronic charge, but the electronic spin that carries information and they offer opportunities for a new generation of novel devices that are extremely fast.
Information is injected, stored or manipulated with spin degree of freedom in the spin based electronics.

The candidate has designed a RFID system using single spin logic and has used the system to realize binary tree protocol which is one of the popular anti-collision protocols because it reduces the average inquiry time by remembering the previous inquiry results [4.36-4.41]. It is sure that present circuit is much faster than the conventional logic circuits and supports very high-density integration. Spin based logic circuits are of course at the top of the hierarchy. Since these logic circuits (spin based) are classical, rather than quantum mechanical spin coherence is not an issue. Consequently implementing these circuits is far easier than building quantum logic gates employing single electron spin while considerable efforts and research have been conducted in search of spintronics quantum computers, which are very little, if any, investment has been made to realize single spin logic. In this respect the present work is an early attempt for spin based digital systems. In order to substantiate our designed spintronic device based RFID system we have made simulation and found that the results are in good argument with the expected results.

Here sol-gel technique is used to fabricate nanocrystalline zinc oxide thin film which was deposited on silicon. This heterojunction revealed an exciting sensor behavior in the presence of methane gas. It gives ~52% response magnitude at optimum temperature and voltage 250oC and 3V. This particular range is much desirable to detect CH4 in mines. Reduction of film thickness and
use of other catalysts to enhance sensitivity is a matter of future research. As per the V-I characteristics shown in Fig.5.2 (a) and 5.2(b) the response magnitude of the designed device was calculated using equation (1). The same has been shown in the Fig.5.3 (a) and 5.3(b) respectively. From the figure it is clear that the optimum voltage and the temperature of the device is 3V and 250°C. In this particular Voltage and Current the sensor gives us maximum response which is denoted as Response Magnitude. Increase in temperature beyond 250°C the response of the sensor reduces upon the exposure of the target gas. Further miniaturization of the sensor device will provide better response and recovery times requisite for real time and industrial applications. Our future experiments with this junction are directed towards this target.