# ABSTRACT

Wireless communication has existed for more than a century, and the present-day scenario has made the emergence of wireless communication face many stages of evolutionary history. The improvements in science and technology have made them affordable for people and have created an impact such that life without communication has become unthinkable. Recently, body-centric communications are captivating their place firmly in the field of biomedicine. The increase in chronic pathologies is due to the actual lifestyle, which demands an efficient health care method for the early diagnosis of the health. This method should also be designed in such a way that these monitoring devices should monitor the health without affecting their external life and also need not require any external person for biomedical control.

The research work focuses on designing and developing a diagnosis method that can reduce the limitations of other conventional diagnosis methods like X-ray mammography, ultrasound, tomography, and positron emission tomography. These methods have certain limitations like age limit, repetition of diagnosis requiring a specific time gap, and a frightening lab setup. The proposed method is designed to avoid these limitations by providing a simple, cost-effective, and non-invasive diagnosis method. The device is to be mounted on the human physique; hence, the cloth-based antenna is designed for wearability. This research is focused on designing and developing a textile-based antenna for the early intervention of tumor cells in the human body. The specific advantages of this method include a simple testing setup, affordable cost, no limitation for the test repetition, no age limit, bound under the Specific Absorption Rate (SAR) limit, and efficient test results compared to conventional methods.

In this thesis, an S-shaped monopole antenna is designed and validated to work in an ISM band frequency to satisfy medical needs. The Monopole antenna is preferred for biomedical applications as it is a low-profile antenna with high radiation efficiency and is much more suitable for implantable antenna working in the ISM band with the ease of fabrication. The proposed work is to design and validate a textile-based Microstrip Patch Antenna (MPA) that accomplishes well in ISM band applications. The basic prerequisites of the substrate are to afford greater reflection co-efficient with ideal VSWR value and a wider bandwidth which is achieved in my proposed work by using the denim substrate (permittivity =1.67, thickness=2mm) to diagnose the tumor cells. Despite the availability of a variety of microstrip antenna structures, a specific structure is to be formulated to get the desired radiation characteristics and polarization effects. This was realized using many structures, and finally, the rectangular patch antenna is selected by placing the metallic strap above the plane in the ground having a small fraction of wavelength ($height \ll \lambda_0$,usually $\lambda_0 \leq height \leq 0.05\lambda_0$). This condition was achieved only when the field configuration was chosen beneath the patch. The proposed antenna structure was achieved only after performing various iterations and optimizations.

The CST microwave studio suite is used to simulate and design the proposed antenna structure that provides a 3D field characteristic for the E-field, H-field, and surface current statistics were achieved. The simulated results were analysed, including S-parameters (Return Loss), radiation pattern, current distribution, impedance, gain and directivity. Along with all the stated parameters, the SAR analysis was also performed. The SAR analysis shows that the rate of energy absorbed by the proposed structure lies under the standards of FCC/IEC. The proposed antenna is fabricated and

measured using Agilent technologies, EC 5071C VNA series (300MHz to 18GHz) at free space conditions, on–body conditions, and in the Anechoic chamber. The vector network analyser is used to experimentally test and measure the return loss, Gain, and Impedance. The Return loss characteristics resonated at various modes with frequency values of 2.45 GHz, 1.8 GHz, 3 GHz, and 4 GHz, depending upon the on and off body environment. Comparing the cases with and without the presence of breast tumor, the values of peak SAR are found to increase radically from 22.4914 to 30.7492 and from 64.93 to 83.4544 for 10g and 1 g of tissues. By comparing the position of the cancer tissues (radius =12mm, center = (14mm, 14mm), height = (-8 to -5 mm), the position of maximum SAR occurs very nearer to breast cancer tissue. For 10g tissue, the coordinate of the peak SAR is 14.3333, 29, -7.7, and for 1g tissue, it is 15.667, 23.1875, and -4.5, respectively. Various tests are performed by positioning at different locations of the body model to validate its characteristics.

The results proved that due to the high dielectrics of cancer tissues, the peak SAR is increased around the coordinates of the cancer tissues, and the bending effect substantiated that the reflection coefficient is disturbed in the occurrence of the malignant tumors. The return loss indicates that the volume of the breast cancer cells modifies the maximum amount of the reflection and bandwidth because of the reflection from the breast cancer tissues. It is also clear that due to the high dielectric of cancer tissue, the peak SAR is increased around the coordinates of the tumor cells. The above results prove that the proposed antenna can be used as a portable device for detecting the presence of breast tumors operating in the ISM band frequency.