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**Supervisor**

**Department of Electronics Engineering**

**IIT (BHU), Varanasi**



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**Supervisor**

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**Date:**

**Arun Kumar Saurabh**



*This thesis is dedicated to*

**[My Beloved Parents]**

**&**

**[Family Members]**



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## List of Abbreviations

<b>1G</b>	First-Generation
<b>5G</b>	Fifth-Generation
<b>MIMO</b>	Multiple Input Multiple Output
<b>SISO</b>	Single Input Single Output
<b>SIMO</b>	Single Input Multiple Output
<b>MISO</b>	Multiple Input Single Output
<b>CC</b>	Channel Capacity
<b>SE</b>	Spectral Efficiency
<b>AWGN</b>	Additive White Gaussian Noise
<b>CSI</b>	Channel State Information
<b>SINR</b>	Signal to Interference Noise Ratio
<b>MC</b>	Mutual Coupling
<b>IoT</b>	Internet of Things
<b>ESA's</b>	Electrically Small Antennas
<b>PCB</b>	Printed Circuit Board
<b>PPMA</b>	Printed Planar Monopole Antenna
<b>TE</b>	Total Efficiency
<b>ME</b>	Multiplexing Efficiency
<b>IID</b>	Independent and Identically Distributed
<b>ECC</b>	Envelope Correlation Coefficient
<b>DG</b>	Diversity Gain
<b>MEG</b>	Mean Effective Gain
<b>TARC</b>	Total Active Reflection Coefficient
<b>CCL</b>	Channel Capacity Loss
<b>EMC</b>	Electromagnetic Coupling
<b>EM</b>	Electromagnetic
<b>UWB</b>	Ultrawideband
<b>DGS</b>	Defected Ground Structure
<b>NL</b>	Neutralization Line
<b>SWB</b>	Super Wideband
<b>SRR</b>	Split Ring Resonator

<b>CSRR</b>	Complementary Split Ring Resonator
<b>EBG</b>	Electromagnetic Band Gap
<b>MSS</b>	Metasurface Superstrate
<b>MTMA</b>	Metamaterial Absorber
<b>WLAN</b>	Wireless Local Area Network
<b>UMTS</b>	Universal Mobile Telecommunications System
<b>LTE</b>	Long Term Evolution
<b>QSCA</b>	Quasi Self Complementary Antenna
<b>FSS</b>	Frequency Selective Surface
<b>RCS</b>	Radar Cross Section
<b>Wi-MAX</b>	Worldwide Interoperability for Microwave Access
<b>Wi-Fi</b>	Wireless Fidelity
<b>Sub-6 GHz</b>	Spectrum Below 6 GHz
<b>ISM</b>	Industrial, Scientific and Medical
<b>CL-FSS</b>	Closed-Loop Frequency Selective Surface
<b>HFSS</b>	High Frequency Structure Simulator
<b>VNA</b>	Vector Network Analyzer
<b>IoV</b>	Internet of Vehicle
<b>NR</b>	New Radio
<b>RSLR</b>	Radial Stub Loaded Resonator
<b>CRDN</b>	Coupled Resonator Decoupling Network
<b>WPAN</b>	Wireless Personal Area Networks
<b>GPS</b>	Global Positioning System
<b>SICBS</b>	Substrate Integrated Cavity-Backed Slot
<b>V2P</b>	Vehicle-to-Person
<b>V2X</b>	Vehicle-to-Everything
<b>V2V</b>	Vehicle-to-Vehicle
<b>V2I</b>	Vehicle-to-Infrastructure
<b>PCRs</b>	Parallel Coupled Resonators
<b>AMC</b>	Artificial Magnetic Conductor
<b>DRA</b>	Dielectric Resonator Antenna
<b>GCPW</b>	Grounded Coplanar Waveguide
<b>SIC</b>	Substrate Integrated Cavity

## List of Symbols

$\lambda$	Wavelength
$Z_{in}$	Input Impedance
$f_r$	Resonant Frequency
$c$	Speed of Light
$\epsilon_{reff}$	Effective Relative Dielectric Constant
$\eta_{rad(i)}$	Radiation Efficiency of $i^{\text{th}}$ Antenna Element
$\eta_{tot(i)}$	Total Efficiency of $i^{\text{th}}$ Antenna Element
$\eta_{mis(i)}$	Mismatch Efficiency of $i^{\text{th}}$ Antenna Element
$\tilde{\eta}_{mux}$	Multiplexing Efficiency
$\rho_e(i, j, N)$	Envelope Correlation Coefficient
$\Omega$	Solid Angle
$XPR$	Cross-Polarization Power Ratio
$G_{\theta i}(\Omega)$	$\theta$ -Polarized 3-D Power Gain Patterns
$G_{\varphi i}(\Omega)$	$\varphi$ -Polarized 3-D power Gain Patterns
$P_{\theta}(\Omega)$	$\theta$ -Polarized Components of Angular Power Density
$P_{\varphi}(\Omega)$	$\varphi$ -Polarized Components of Angular Power Density
$\Gamma_a^t$	Total Active Reflection Coefficient
$k$	Wavenumber
$\omega$	Angular Frequency
$\mu$	Effective Permeability
$\epsilon$	Effective Permittivity
$\epsilon_r$	Relative Permittivity
$\mu_r$	Relative Permeability
$\lambda_0$	Free-Space Wavelength
$\lambda_g$	Guided Wavelength
$\tan \delta$	Loss Tangent
$Z_{11}$	Input Impedance for Port 1
$\Omega$	Ohm