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**LABORATORY:** Microwave Engineering Laboratory

**AREA OF RESEARCH:** Microwave Antennas

**TITLE/TOPIC:** Study on metamaterial transmission line based electrically small printed multi-band MIMO antennas in the Sub-6 GHz range for cellular communications

**SUMMARY:** Antennas act as a device for radiation of electromagnetic (EM) waves and play a critical role in all wireless systems. With the rapid development of Very Large Scale Integration (VLSI) devices and computing power, wireless technologies are becoming an important aspect in our day-to-day life. The need is for small antennas with high performance which are embedded in nature. In advanced mobile communications, Multiple-Input Multiple-Output (MIMO) technology is widely implemented, which generally includes a signal processing unit. Implementation of electrically small MIMO antennas at lower frequencies ( $< 1$  GHz) poses a significant challenge in terms of available space, high radiation efficiencies, reasonable bandwidth, enhanced isolation and decorrelation, lower Specific Absorption Rate (SAR) and Bill of Material (BOM) costs. These antenna technologies require fabrication processes like printed circuit board (PCB), Low-Temperature Co-fired Ceramic (LTCC) processes and the recently introduced additive process based 3D printing. Although, substrate material choices are limited conventionally, artificial EM structures namely metamaterials have opened up newer possibilities in realization of these antennas.

**EXPERIMENTAL SET UP:** Antenna Radiation Pattern and Return Loss Measurement Setup are available

