Microwave power divider is frequently used by various wireless subsystems. They are dividing an input power into a number of smaller outputs for excitation of the radiating elements in an antenna array. Usually, the same piece can also be used for power combining. Most existing power dividing structures are made of resonators such as hybrid and \( \lambda/4 \) line, which do not have high selectivity in spectrum. It is well known that a high-Q resonator gives better selectivity, but with the price of narrower bandwidth. Broad bandwidth, which is very demanded by the modern microwave systems, can only be made on low-Q resonators. To solve this problem, they are usually incorporated with bandpass filters for improving selectivity. However, this causes the circuit size and footprint to increase significantly. In my project, for the first time, zeros are introduced to a multi-pole power divider for shaping the roll-off skirts at both the cutoff frequencies around the passband. By such, it can be made to achieve wide bandwidth and high selectivity at the same time. The first part of this project is to explore different resonators for the making of the high-selective in- and out-of-phase power dividers. Multifunction concept is later introduced to re-configure the output phase.

Slot resonator, with low Q, is selected for broadband performance in the first part of my project. Travelling-wave mechanism is deployed. Three slots are symmetrically cascaded in
series for designing a 3-port power divider, giving simultaneous in-phase and out-of-phase outputs at different ports. Here, four resonances are introduced to form a passband that has good amplitude and phase performances (In-phase fractional BW of -104.8% and Out-of-phase fractional BW of -106.3%). Transmission zeroes are placed to the lower and upper bounds for reshaping the frequency roll-off rate, resulting in excellent selectivity. Later, the power divider is incorporated with the RF diodes so that it becomes a dual-functional components that gives either in-phase or out-of-phase signal.

In the 2nd part, the multilayered traveling-wave slot-based bandpassing couplers are proposed and explored. They are designed on a circular sectorial slot resonator to provide bandpassing effect and multiple outputs. The proposed bandpassing power divider can provide two 20dB coupled signals simultaneously on a same design configuration by simply adding in two output ports. Meanwhile, it has kept the original performance of the half power division. In this case, two resonances are introduced to form a very wide passband from 2.32 GHz to 3.04 GHz (fractional BW 26.87%) for power division, at the same time, the dual-functional component provides a 20dB BW of 11.71% at the two coupled ports. Also, excellent selectivity has been achieved because two transmission zeroes are placed near to the lower and upper bounds for reshaping the frequency roll-off rate.

Ansoft HFSS was used to simulate all the configurations, with experiments done for verification. Good agreement is found between the simulated and measured data. A complete parametric analysis has been performed to study the effects of all the design parameters. Literature survey shows that this design idea is brand new.