Section A: Overview of the Research Project

1. **Title:** A Correlator for the use at the Hartebeesthoek Radio Astronomy Observatory (HartRAO)
2. **Broad Area:** Engineering
3. **Academic Level:** PHD
4. **Abstract:** The objective is to research, design and develop a FPGA-based correlator for use at the Hartebeesthoek Radio Astronomy Observatory. A basic requirement is to perform correlation of single basebands between different future AVN radio telescopes. Methods will be investigated for novel algorithm implementations as well as novel algorithms design for this underlying digital platform established by the FPGA system.
5. **Primary Supervisor:**
    a. **Name:** Professor Michael Antonie van Wyk
    b. **Email:** mavanwyk@gmail.com
    c. **University:** University of the Witwatersrand (WITS)
6. **Co-supervisor:**
    a. **Name:** Andre Martin McDonald
    b. **Email:** AMcdonald@csir.co.za
    c. **Institute:** Council for Scientific and Industrial Research (CSIR)

Section B: Details of Research Project

1. Scientific/Engineering merit
   Modern radio astronomy applications require high-speed real-time Digital Signal Processing. At present, high-performance Digital Signal Processing equipment is extremely specialized with complicated hardware that is designed, built and used for specific applications. Correlation is one of these objectives. Correlation of single basebands between the different future AVN radio telescopes (single dish antennas) is fast becoming a requirement. Modern Field Programmable Gate arrays (FPGAs) have now largely replaced custom hardware in correlator design and implementation. FPGAs can compute millions of FFTs (fast Fourier transforms) per second which makes it possible to improve resolution.

2. Feasibility
   The primary objective is to design and build a correlator for the specific use at HartRAO using the standardized CASPER hardware and software. This can be subdivided into smaller objectives. The first one is to investigate how to implement correlator on FPGAs. The second objective is to investigate how to implement the design of the radiometer with. When all of the smaller objectives has been completed then the primary objective will be completed and met.

3. SARAO Research Priority Areas
   This fits into SARAOS real-time digital signal processing instrumentation for radio astronomy, specifically using FPGA and GPU platforms priority area for engineering. The student will be devolving a full radio astronomy backend system that The be making use of FPGAs and the CASPER framework and tools.

4. Particular qualifications, academic abilities, skills and/or experience
   The student must have sufficient patients and be willing to learn new skills. The student also must be familiar with FPGAs and the CASPER toolchain and framework.