Virtual Evaluation Worksheets
For Graduate Trainee Engineer in 2021 for the RFI team

Appendix A: Radio Astronomy Worksheet

You are the Science Reporter for a large media house, your (tough) editor have heard about the MeerKAT project and asked you to investigate and write a story for publication, your story should answer the following questions :

1	What is this MeerKAT story ?
2	Why is it being built in the remote Northern Cape and not close to a City such as Cape Town ?
3	What is it going to do (Science) ?
4	How does it work?
5	Who is funding this and how much is it going to cost?
6	When did the building start and how far are they?
7	When is it going to be finished?
8	What is the benefit / impact on the environment / local community?
9	Get some nice photos to show what it looks like

Handy Links:

https://www.ska.ac.za

https://www.skatelescope.org

https://en.wikipedia.org/wiki/Square_Kilometre_Array

https://sites.google.com/a/ska.ac.za/intranet/home

https://sites.google.com/a/ska.ac.za/intranet/home/ska-sa-inside-info

Appendix B: EMC Chamber Worksheet

Questions and reference	Answer
What is a Faraday cage? Wikiperida page	
Is a Microwave oven a Faraday cage? WIkipedia page	
What can a Faraday cage be used for in the radio telescope environment ?	
What is an Anechoic chamber? Wikipedia page	
What is a Reverberation Chamber ? Wikipedia page	
What can a Anechoic chamber / Reverb chamber be used for in a radio telescope environment ?	

Appendix C: Python Worksheet

A part of what the RFI team of SARAO does to limit the amount of RFI on the SKA SA site is to characterise the emissions from a device that needs to be used on site BEFORE it goes to site. The characterisation of the device is done at an EMC facility like the anechoic chamber at Houwteq or the reverberation chamber at SARAO's offices in Observatory, Cape Town.

An example of a system that was characterised in the SARAO RFI Reverberation chamber is the internal electronics used in the HERA project nodes. The system was characterised by placing it inside the reverberation chamber, having the stirrer paddles rotate at a speed of 15 degrees a second and setting the Tektronix RSA 5115B spectrum analyser to max-hold.
Two measurements were done. One with the HERA electronics running, and one with the HERA electronics turned off, in other words the background of the chamber. Take a look at the files of these two measurements which is available using the following link:
2020_10_07_Hera_Node_18_maxhold_1kHz.zip

You are one of the graduate students working at SARAO and are tasked with the following:

1. Use Python to plot the raw data of the measurements on the same plot.
2. Use Python to plot to plot the corresponding E-Field at 1 m using the following file (ProcHeraAux.csv). This file includes the following: Frequency (MHz), Pow2EfieldFactor, E_Spec and E_Cont.
   The Pow2EfieldFactor should be used to take the data from the spectrum analyzer and calculate the corresponding E-Field at 1 m by adding it to power measured from the spectrum analyzer.
   The E_Spec and E_Cont are the threshold levels that devices must adhere to for a distance of 500 m and a E-Field measured at 1 m, like in this case.
3. Use the plot to determine and fill in the following:

Questions	Answer
At which frequency is the maximum emission?	
What is the E-Field strength @ 1 m of the maximum emission?	
How much shielding (dB) would the node enclosure need to pass the E_Spec threshold?	

Appendix D: Arduino Worksheet

Task

1. Design and build a prototype traffic light control system using Arduino controllers

2. Use online simulation software TinkerCAD from Autodesk
    a. Open a account (if you don't have one already)
    b. Use the Circuits option in the menu on the left
    c. Build the circuit using the drop down components
    d. Develop the code in the simulator and test by running in simulation mode
    e. Use text mode not Code Block for your code

3. The following table gives the basic functional requirement

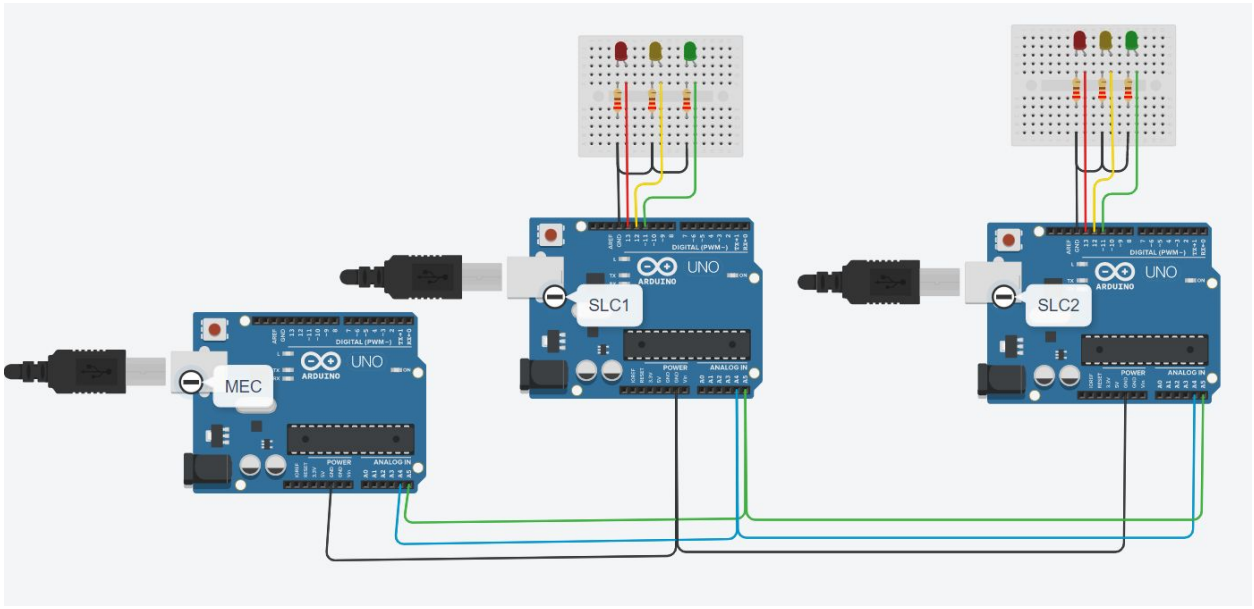
Event No	Duration (Sec)	Pole 1	Pole 2
1	5	G	R
2	2	Y	R
3	1	R	R
4	5	R	G
5	2	R	Y
6	1	R	R

4. Use one arduino as the Main Event Controller (MEC) to schedule the events and two Arduino controllers as Secondary Light Controllers (SLCs) to control the colours of the lights

5. For the prototype the lights can be LEDs

6. For the communications between the MEC and SLCs as the Arduino I2C interface
    a. Youtube to explain I2C interface
    b. Arduino Tutorial with example code

7. Your final circuit should look something like this


MEC
SLC1
SLC2
UNO
ARDUINO