Student's Name: **Course Name: Observational Cosmology**

Teacher's Name: J.F. Macias-Perez

NOTE: Lectures notes can be used.

Q1: BASIC CONCEPTS AND FACTS

1.Describe the cosmological principle and its implications

2. What are the main ingredients of the cosmological standard model? Discuss their relationship.

3. Describe the main cosmological parameter and give their current values

4. What does it mean that the Universe is flat today?

5. Describe the main cosmological probes to date (CMB, SNIa, LST surveys, others). Discuss the notion of concordance model.

Q2: A BIT OF INSTRUMENTATION

Consider a CMB dedicated experiment that consists of a telescope of 4-meters in diameter and a microwave millimeter camera with four frequency bands centered at 100, 143, 217 and 353 GHz, with a total of 10000 high quality detectors (50 $\mu K_{CMB} \cdot s^{1/2}$) equally shared between frequencies and a circular field of view of 1 degree diameter.

1. What is the resolution of the instrument? What kind of detectors could be used? To which temperature do we need to cool down those detectors?

2. Which scientific objectives could be considered which such an instrument? Describe the main observable quantity and how it relates to cosmology. Why do we need multi-frequency observations?

3. Where would you place such an instrument (ground, balloon or satellite? Which scanning strategy will you choose to fulfill your objectives? Discuss what would be the maximum percentage of sky that could be observed.

4. Compute the time needed to improve Planck results on B-modes polarization by a factor of 100 assuming equivalent sky coverage (50 %).

5. As presented in the Astroparticles exam the **SN2014j** supernova recently exploded in the **M82** galaxy. Roughly speaking **M82** has angular size of about 1 arcmin. Assuming the supernova is a point source and that we observe with a Guassian beam, what is the minimum FWHM to discriminate its emission from the host emission?. Can we do this with the proposed instrument?