

# Geometry and Topology

## Oral Exam (Individual)

1. How many  $S^2$  bundles on  $S^2$  are there?

2. Describe normal coordinate what is derivative?

When is the derivative nonsingular?

State Cartan-Hadamard Theorem.

And find Taylor expansion of  $g_{ij}$  in normal coordinate.

3. Define Hopf Algebra.

Which space has Hopf Algebra structure.

Why does Lie group structure  $\Rightarrow$  Hopf Algebra structure.

Show  $\pi_i$  (closed loop space)  $= \pi_{i+1}$ .

# **Geometry and Topology**

## **Oral Exam (Team)**

1. State and prove Synge Theorem.
2. Why does Euler number of odd dimensional manifold equal to zero?
3. State Hopf-Poincare Theorem.  
  
    Idea of the proof.  
  
    Any interesting application.
4. State clear Euler Formula.  
  
    Prove there are 5 regular Spheres.