MATH0052 (Geometry and Groups)

Year:	2019–2020
Code:	MATH0052
Old code:	MATH7112
Level:	5 (UG)
Normal student group(s):	UG: Year 2 and 3 Mathematics degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Structure:	3 hour lectures. Assessed coursework.
Assessment:	90% examination, 10% coursework. In order to pass the module you must have at least 40% for both the examination mark and the final weighted mark.
Normal Pre-requisites:	MATH0006 (previously MATH1202), MATH0013 (previously MATH2101), MATH0014 (previously MATH2201)
Lecturer:	Prof M Singer

Course Description and Objectives

Geometry attempts to describe and understand the space around us. It is a central activity and main driving force in many branches of mathematics and physics. In this course we will meet some of the basic examples in geometry, build up fundamental understanding of curvature, and enhance familiarity with groups and group actions outside of pure algebra.

Recommended Texts

1. Geometry and Topology, by Miles Reid and Balazs Szendroi, Chapters 1, 2, 3, 8 and 9.
2. Curved Spaces: From Classical Geometries to Elementary Differential Geometry, by P.M.H. Wilson, Chapters 1, 2 and 5
3. Notes on Geometry, by Elmer G. Rees, Parts I and III.

Detailed Syllabus

- Symmetry groups of Platonic solids: using the orbit-stabiliser theorem to count symmetries and identifying symmetry groups by their actions. Classiffcation of Platonic solids.
- Isometries of Euclidean space: Galilean group and orthogonal group. Every rotation is a composition of reflections. Rotations in 3D: every rotation has an axis, quaternionic picture of rotations. Rotations in 4D: quaternion action.
- Spherical geometry: geodesics, spherical triangles, spherical trigonometry. Area controls angle surplus.
- Möbius transformations; the Riemann sphere. Stereographic projection. Conformality and preservation of straight lines and circles, 3-transitivity.
- Hyperbolic geometry: hyperboloid, disc and upper-half plane models. Geodesics, distances and hyperbolic triangles. Failure of parallel postulate. Area controls angle defcit.
- Isometries of hyperbolic space as PSL(2,R). Parabolic, elliptic, hyperbolic elements and their fixed points.