COURSE SPECIFICATION FORM

for new course proposals and course amendments

Department/School:	**Mathematics**	**Academic Session:**	**2017-18**
Course Title:	Further Linear Algebra and Modules	**Course Value:** (UG courses = unit value, PG courses = notional learning hours)	0.5 unit
Course Code:	MT3880	**Course JACS Code:** (Please contact Data Management for advice)	G100
Availability: (Please state which teaching terms)	Term 2	**Status:**	Optional Condonable
Pre-requisites:	MT2800 and MT2830	**Co-requisites:**	-
Co-ordinator:	-		
Course Staff:	-		
Aims:	The language and concepts of linear algebra are of widespread use within mathematics and also in the social and natural sciences. The purpose of the course is to cover some further topics in linear algebra and to provide an introduction to the theory of modules. If a matrix cannot be diagonalised, one uses alternative matrix representations, such as the Jordan canonical form or the rational canonical form. This course introduces these canonical forms, and aims to explain why they are important. To understand their importance, some of the basic theory of modules over a Euclidean domain is introduced. Roughly speaking, a module bears the same relationship to a vector space as a ring does to a field. Key aims of the course include to treat canonical forms of linear operators and to develop the basic theory of modules over a Euclidean ring, and to link concrete matrix manipulations to conceptual interpretations.		
Learning Outcomes:	1. determine the Jordan canonical form and rational canonical form of a suitable matrix; 2. compute the characteristic and the minimum polynomial of a square matrix and to draw conclusions regarding its canonical forms; 3. understand and apply the basic theory of modules over a Euclidean domain in its relation to matrix canonical forms.		
Course Content:	Linear algebra: revision of the matrix representation of a linear transformation and change of basis, Euclidean domains; elementary operations; generalized eigenspaces, Jordan canonical form for matrices with split characteristic polynomial. If time permits, Smith normal form. Modules: modules, submodules and homomorphisms; annihilators, cyclic modules and direct sums; free modules; structure theorem for finitely generated modules over a Euclidean domain; primary decomposition. Applications and further topics: connection between normal forms of matrices and module theory; companion matrix and extended companion matrix; rational canonical form and primary rational canonical form; minimal polynomials; further topics as time permits, for example the Cayley-Hamilton theorem.		
Teaching & Learning Methods:	The total number of notional learning hours associated with this course are 150. 3 hours of lectures a week over 11 weeks. 33 hours total. 117 hours of private study, including work on problem sheets and examination preparation. This may include discussions with the course leader if the student wishes.		
Key Bibliography:	Introduction to Algebra - P.J. Cameron (Oxford Univ Press) 512.11 CAM Linear algebra -- S.H. Friedberg, A.J. Insel and L.E. Spence (Prentice Hall) 512.5 FRI		
Formative Assessment & Feedback:	Formative assignments in the form of 8 problem sheets. The students will receive feedback as written comments on their attempts.		
Summative Assessment:	**Exam:** 100% Written exam. A two hour paper. **Coursework:** None		

Updated September 2017