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MATH 3833: Linear Algebra With Applications

Module Details

Module Code:	MATH 3833
Module Long Title:	Linear Algebra With Applications APPROVED
Banner Title:	Linear Algebra With Applictns
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Sept 2018 (September 2018)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	MILENA VENKOVA-MCGARRAGHY
Module Coordinators:	MILENA VENKOVA-MCGARRAGHY (07 January 2020 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	This module builds on knowledge gained in MATH 2831, developing concepts of abstract vector spaces, linear transformations and inner products, with particular emphasis on applications.
Indicative Syllabus	**Abstract Vector Spaces** Abstract vector spaces over a field, subspaces. Bases and dimension. Linear transformations, change of basis and similar matrices. **Eigenvectors and eigenvalues** Characteristic polynomial, diagonalization and complex eigenvalues. Cayley-Hamilton theorem. Applications to differential equations, Markov chains and PageRank algorithm. **Inner Product and Orthogonality** Inner products, length, orthogonality, orthogonal sets and orthogonal matrices. Orthonormal bases and the Gram-Schmidt process, Fourier series and Legendre polynomials. Orthogonal projections and their applications to approximation theory.
Learning and Teaching Methods	Lectures supported by tutorials

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	Prove general properties of abstract vector spaces.
MLO2	produce change of coordinate matrices between two bases,
MLO3	determine if two matrices are similar,
MLO4	demonstrate an understanding of Stochastic matrices and Markov chains and their applications,
MLO5	find the steady-state vector of a regular stochastic matrix,
MLO6	demonstrate an understanding of the connection between eigenvectors and diagonalization,
MLO7	use eigenvalues and eigenvectors for applications to difference equations and Markov chains
MLO8	demonstrate an understanding of the properties of inner products
MLO9	recognize orthogonal sets and matrices
MLO10	use the Gram-Schmidt process to produce orthogonal or orthonormal bases
MLO11	recognize the relationship between Fourier series and orthogonal bases
MLO12	Use orthogonal projections in applications to approximation theory.

Requisites

Assessment Threshold	35% on final exam

Module Content & Assessment

Assessment Breakdown	**%**
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 14	**Learning Outcomes**	1,2,3,4,5,6,7,8,9,10,11,12
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
End of Semester examination

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	See Student Handbook	**Learning Outcomes**	1,2,3,4,5,6,7
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Recommended Reading List

Recommended Book Resources

DAVID. LAY LAY (STEVEN. MCDONALD, JUDI.),Steven Lay,Judi McDonald. Linear Algebra and Its Applications, Global Edition, [ISBN: 1292351217].

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MATH 3837: Mechanics with Mathematical Modelling

Module Details

Module Code:	MATH 3837
Module Long Title:	Mechanics with Mathematical Modelling APPROVED
Banner Title:	Mechanics with Modelling
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Sept 2020 (September 2020)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	Richard Ellard
Module Coordinators:	• JOHN BUTLER (09 January 2020 to 06 January 2022) • Richard Ellard (06 January 2022 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	This module introduces concepts from classical mechanics as well as basic techniques in mathematical modelling of real world problems. Using simple examples from mechanics, students will analyse data, make assumptions, construct mathematical models and interpret results.
Learning and Teaching Methods	Lectures supported by problem-solving tutorials and laboratory sessions using mathematical software packages

Indicative Syllabus

1. Mechanics
1.1) Motion in one, two and three dimensions. Forces and Newton's laws of motion. Kinetic and potential energy. Conservation of energy. Collisions of two bodies: elastic and inelastic collisions. Hooke's Law and simple harmonic motion. Motion under a central force: uniform circular motion, angular velocity and acceleration, equations of motion.

2. Mathematical Modelling
2.1) Students are introduced to the topic of mathematical modelling and are asked to design and solve a mathematical model for different problems from mechanics. Examples may include projectile motion in sports science /ballistics, astronomy and spring-mass-damper systems.

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	explain the concepts of velocity, acceleration, momentum, kinetic energy, potential energy, work, angular momentum and friction;
MLO2	state Newton's laws of motion and apply them to solve simple problems in mechanics;
MLO3	solve a range of problems involving collisions of two bodies;
MLO4	describe and analyse simple harmonic motion;
MLO5	describe and analyse motion under a central force;
MLO6	take a real life problem in mechanics and, making the necessary assumptions, translate it into a mathematical model;
MLO7	use mathematics and mathematical software to analyse and solve the problem and refine the assumptions if necessary.

Requisites

Assessment Threshold	35% in the end of module written exam. 35% in the CA component.

Module Content & Assessment

Assessment Breakdown	%
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 18	**Learning Outcomes**	1,2,3,4,5
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
End of Semester Exam

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	See Student Handbook	**Learning Outcomes**	1,2,3,4,5,6,7
Assessment Threshold:	35	**Assessment Role**	Not yet determined
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
Continuous Assessment

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Recommended Reading List

Recommended Book Resources

David Halliday,Robert Resnick,Jearl Walker. (2013), Fundamentals of Physics, Extended, John Wiley & Sons, p.1448, [ISBN: 978-1-118-23072-5].

Henry Mulholland,John Horace George Phillips. Applied Mathemathics for Advanced Level, [ISBN: 0408014458].

Dilwyn Edwards,Michael Hamson. (1996), Mathematical Modelling Skills, Palgrave, p.164, [ISBN: 978-0333595954].

Supplementary Book Resources

Herbert Goldstein,Charles P. Poole,John L. Safko. (2002), Classical Mechanics, Addison-Wesley Longman, p.638, [ISBN: 978-0201657029].

Daniel Kleppner,Robert J. Kolenkow,Robert Kolenkow. (1973), An Introduction to Mechanics, McGraw-Hill Science, Engineering & Mathematics, p.546, [ISBN: 978-0070350489].

APPROVED

MATH 3834: Modern Algebra With Applications

Module Details

Module Code:	MATH 3834
Module Long Title:	Modern Algebra With Applications APPROVED
Banner Title:	Modern Algebra With Applictns
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Jan 2019 (January 2019)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	MILENA VENKOVA-MCGARRAGHY
Module Coordinators:	MILENA VENKOVA-MCGARRAGHY (07 January 2020 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	This module introduces the student to concepts in Number Theory and Group Theory and explores their applications in the areas of Coding Theory and Cryptology.
Indicative Syllabus	Number Theory, the integers modulo n and Applications to Coding Theory. The integers, division algorithm, primes, Euclidean Algorithm, Equivalence relations, the integers modulo n and modular arithmetic. Solutions of linear congruences, Fermat's Little Theorem, The Chinese Remainder Theorem, applications in error correcting codes. Matrix Algebras, Vector spaces over finite fields and applications in Cryptography The concepts of matrix algebra, vector spaces over the integers modulo p, the basics of cryptography, some simple cryptosystems, shift and affine transformations, enciphering matrices, Public key encryption. Euler's phi function and Euler's theorem, the RSA encryption system. Introduction to Algebraic Coding Theory Basic definitions and examples. Linear codes, Hamming distance, generator matrix, parity check matrix decoding, coset decoding.
Learning and Teaching Methods	Lectures supported by tutorials.

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	demonstrate an understanding of the integers modulo n and their applications in Coding Theory and Cryptology
MLO2	to solve systems of linear congruences,
MLO3	demonstrate an understanding of the concepts of vector spaces over a finite field,
MLO4	demonstrate an understanding of the basic concepts of algebraic coding theory,
MLO5	identify if a given code is a linear code,
MLO6	demonstrate an understanding of the Hamming distance and its relevance to the error correction and detection capabilities of a code,
MLO7	encode and decode using generator and parity check matrices and coset decoding.

Requisites

Assessment Threshold	35% on final exam

Module Content & Assessment

Assessment Breakdown	**%**
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 28	**Learning Outcomes**	1,2,3,4,5,6,7
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
End of semester written examination.

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	See Student Handbook	**Learning Outcomes**	1,2,3
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Recommended Reading List

Recommended Book Resources

Joseph Gallian. (2012), Contemporary Abstract Algebra, Cengage Learning, p.656, [ISBN: 978-1133599708].

Supplementary Book Resources

John B. Fraleigh. A First Course in Abstract Algebra, [ISBN: 1292024968].

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MATH 3838: Statistics II: Statistical Modellling

Module Details

Module Code:	MATH 3838
Module Long Title:	Statistics II: Statistical Modellling APPROVED
Banner Title:	MATH 3838 Statistics II: Stat
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Jan 2019 (January 2019)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0542 - Statistics
Current Coordinator::	JOE CONDON
Module Coordinators:	JOE CONDON (23 January 2020 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	

This module expands on the material in MATH2837 to include methods of finding the moments of random variables including moment generating functions. Jointly distributed random variables are introduced and covariance and correlation are examined. The likelihood and method of moments based estimation methods are compared and statistical inference via the likelihood is introduced in single and multiple parameter settings. Linear statistical modelling including simple and multiple regression and ANOVA are explored, including the use of up-to-date software for model fitting.

Indicative Syllabus

Moments & generating functions

Properties of expectation and variance. Moments of the standard discrete and continuous probability distributions. Moment generating functions; properties and uses.

Jointly Distributed Random Variables

Jointly distributed discrete and continuous random variables. The expected value of functions of two or more random variables. Independence. Covariance and correlation.

Likelihood based methods

Likelihood based model formulation and fitting. Likelihood estimation compared to the method of moments. Likelihood inference for single and multiple parameter cases. Wald based hypothesis testing and confidence intervals. Likelihood ratio tests and the chi-squared distribution.

Linear statistical models : special distributions; t and F. simple and multiple regression models. ANOVA.

Learning and Teaching Methods	Lectures supported by tutorials and computer lab. sessions.

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	Define and find the expectation and variance of simple and standard discrete/continuous random variables and linear transformations of random variables. Be able to find moment generating functions of random variables, understand the properties of MGFs and find moments using MGFs.
MLO2	Understand jointly distributed random variables (mass and density functions), covariance and correlation.
MLO3	Use the method of moments to estimate population parameters. Apply likelihood based approaches to model formulation, estimation and inference in single and multiple parameter cases. Perform Wald based tests of hypotheses and CIs for single parameters and likelihood ratio tests for multiple parameters.
MLO4	Formulate, fit and report the results of linear statistical models with one and more that one predictor, including regression models and ANOVA. Perform t and F based hypothesis tests in the context of such models.
MLO5	Use a major statistical software package for data analysis (e.g. R or equivalent), applying techniques covered in the module.

Requisites

Assessment Threshold	

End of semester exam: 35%

Module Content & Assessment

Assessment Breakdown	**%**
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 15	**Learning Outcomes**	1,2,3,4,5
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description

n/a

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	Week 7	**Learning Outcomes**	1,2,3,5
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description

n/a

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

APPROVED

MATH 3831: Mathematical Methods 1

Module Details

Module Code:	MATH 3831
Module Long Title:	Mathematical Methods 1 APPROVED
Banner Title:	Mathematical Methods 1
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Jan 2020 (January 2020)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	Nicole Beisiegel
Module Coordinators:	• BRENDAN REDMOND (07 January 2020 to 06 December 2021) • Nicole Beisiegel (06 December 2021 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	This module introduces mathematical techniques such as integral transforms and Fourier series, as well as some of their applications to solving differential equations and calculating definite integrals and infinite series. It also introduces differentiation of scalar and vector functions of two or more variables and calculating maximum and minimum points of real-valued functions subject to constraints using the method of Lagrange multipliers.
Indicative Syllabus	1. F ourier series (periodic functions, definition and examples of Fourier series, even and odd functions, Parseval's theorem and applications) 2. The Dirac delta and Heaviside step functions 3. Laplace transforms (definition, properties, applications to solving ordinary differential equations and evaluating definite integrals) 4. Differentiable functions of several variables (t he total derivative as a linear mapping, the implicit and inverse function theorems) 5. Constrained extrema and Lagrange multipliers 6. Directional derivatives and gradients 7. Vector fields, divergence and curl; vector calculus identities
Learning and Teaching Methods	Lectures, supported by tutorials.

Rationale for Change :	Changes made in accordance with revised module descriptor.

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	Construct Fourier series expansions for periodic functions
MLO2	Use Parseval's theorem to evaluate infinite series
MLO3	Calculate Laplace transforms and inverse transforms of elementary functions, using the definition and transform tables
MLO4	Use the properties of the Laplace transform
MLO5	Use Laplace transforms to solve linear ordinary differential equations
MLO6	Calculate partial derivatives, directional derivatives and gradients of scalar functions of several variables
MLO7	Find minimum and maximum points of multi-variable functions subject to constraints using Lagrange multipliers
MLO8	Apply differential operators such as grad, div and curl on vector functions

Requisites

Assessment Threshold	35% on end of module written exam.

Module Content & Assessment

Assessment Breakdown	%
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 28	**Learning Outcomes**	1,2,3,4,5,6,7,8
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
End of semester examination

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	Week 1	**Learning Outcomes**	1,2,3,4
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
Continuous Assessment

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Module MATH 3836 - Numerical Methods 2 v1 (Year/Cycle:2 / Semester:Semester 1 / Delivery Type:Mandatory)

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MATH 3836: Numerical Methods 2

Module Details

Module Code:	MATH 3836
Module Long Title:	Numerical Methods 2 APPROVED
Banner Title:	Numerical Methods 2
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Jan 2019 (January 2019)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	MILENA VENKOVA-MCGARRAGHY
Module Coordinators:	MILENA VENKOVA-MCGARRAGHY (14 December 2021 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	This module introduces the learner to methods for estimating eigenvalues and eigenvectors and to the theory of interpolation (using Lagrange / Newton polynomials and cubic splines) and approximation.
Indicative Syllabus	1. Numerical methods for finding eigenvalues and eigenvectors: The Gershgorin circle theorem; The power and inverse power method; The QR factorisation method; 2. Interpolation and approximation methods: The Lagrange and Newton forms of the interpolation polynomial; Interpolation errors; Chebyshev polynomials and interpolation using their roots; Cubic Spline interpolation (natural, clamped, etc.); 3. Approximation methods: Linear least squares approximation and applications to exponential models; Taylor series and error terms; Economization of power series using properties of Chebyshev polynomials. Padé approximation.
Learning and Teaching Methods	Lectures supported by problem-solving tutorials and laboratory sessions using mathematical software packages.

Indicative Syllabus
1. n/a 1.1) n/a

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	Recognise when numerical methods can be employed for solving mathematical problems
MLO2	Use numerical methods for approximating eigenvalues and eigenvectors
MLO3	Construct Lagrange and Newton interpolation polynomials and cubic splines
MLO4	Use Chebyshev polynomials for interpolation and approximation
MLO5	Use least squares and Taylor series for approximating functions
MLO6	Use mathematical software to complement and apply the topics encountered

Requisites	
Assessment Threshold	Exam 35%

Module Content & Assessment

Assessment Breakdown	**%**
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 15	**Learning Outcomes**	1,2,3,4,5
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	Week 7	**Learning Outcomes**	1,2,3,6
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Recommended Reading List

Recommended Book Resources

B. Bradie. (2006), A Friendly Introduction to Numerical Analysis, Pearson Education.

Burden R.J. & Faires J.D.. (2004), , Numerical Analysis, Brooks Cole.

Supplementary Book Resources

Gerald, C.F., Wheatley, P.O.. (2003), Applied Numerical Analysis, Addison Wesley.

Sauer, T.. (2006), Numerical Analysis, Pearson Education.

Module MATH 3835 - Numerical Analysis for Differential Equations v1 (Year/Cycle:2 / Semester:Semester 2 / Delivery Type:Mandatory)

APPROVED

MATH 3835: Numerical Analysis for Differential Equations

Module Details

Module Code:	MATH 3835
Module Long Title:	Numerical Analysis for Differential Equations APPROVED
Banner Title:	Num Analysis for Dif Equations
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Jan 2019 (January 2019)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	MILENA VENKOVA-MCGARRAGHY
Module Coordinators:	MILENA VENKOVA-MCGARRAGHY (15 December 2021 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	The learner is introduced to numerical methods for approximating derivatives and integrals, discretizing initial value and boundary value problems for ordinary differential equations and estimating their solutions.
Indicative Syllabus	**1. Numerical Differentiation and Integration.** Finite difference formulas for derivatives; Newton-Cotes integration formulas and error terms (Simpson's, trapezoidal, midpoint); Composite integration formulas; Rates of convergence for composite rules and numerical verification; Gaussian quadrature formulas **2. Initial value problems for ordinary differential equations.** The Euler and modified Euler method; Runge-Kutta and multi-step methods; Convergence and stability analysis. **3. Boundary value problems for ordinary differential equations.** Techniques for solving two-point boundary value problems for linear second order ordinary differential equations with Dirichlet and Neumann boundary conditions: Finite difference methods and shooting methods

Learning and Teaching Methods	Lectures supported by problem-solving tutorials and laboratory sessions using mathematical software packages.

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	Recognise when numerical methods can be employed for solving mathematical problems.
MLO2	Approximate derivatives using forward, central and backward difference formulas.
MLO3	Approximate integrals using standard and composite Newton-Cotes rules and calculating error bounds
MLO4	Derive and apply quadrature methods for approximating integrals
MLO5	Solve initial value problems in ordinary differential equations
MLO6	Solve boundary value problems in ordinary differential equations
MLO7	Use mathematical software to complement and apply the topics encountered

Requisites

Assessment Threshold	Formal examination 35%

Module Content & Assessment

Assessment Breakdown	**%**
Formal Examination	70.00%
Other Assessment(s)	30.00%

Derogations from the General Assessment Regulations

N/A

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 25	**Learning Outcomes**	1,2,3,4,5,6
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	Week 22	**Learning Outcomes**	1,2,3,7
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Module Activity

Part Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Recommended Reading List

Recommended Book Resources

Bradie, B. (2006), A Friendly Introduction to Numerical Analysis, Pearson Education.

Burden R.J. & Faires J.D. (2004), Numerical Analysis, Brooks Cole.

Supplementary Book Resources

Sauer, T. (2006), Numerical Analysis, Pearson Education.

Gerald, C.F., Wheatley, P.O.. (2003), Applied Numerical Analysis,, Addison Wesley.

APPROVED

MATH 3832: Vector Calculus

Module Details

Module Code:	MATH 3832
Module Long Title:	Vector Calculus APPROVED
Banner Title:	Vector Calculus
Version:	1
Indicative NFQ level:	Level 7
Valid From:	Jan 2020 (January 2020)
Language of Instruction:	English
ECTS Credits::	7.5
ISCED Code:	0541 - Mathematics
Current Coordinator::	DANA MACKEY
Module Coordinators:	DANA MACKEY (07 January 2020 to ---)
School Responsible:	School of Mathematical Sciences (CC)
Campus:	City Campus
Module Overview	This module introduces techniques for integrating multi-variable functions over curves and surfaces as well as open subsets of two and three-dimensional space. The relationship between these integrals is studied, through the integral theorems of Green, Stokes and Gauss. A wide range of applications of integration, such as finding areas and volumes, circulation and flux of vector fields, etc. is also introduced.
Indicative Syllabus	Geometry of curves in two and three dimensions, parametrizations; Line integrals; path independence and conservative fields; Double and triple integrals; changing the order of integration; Green’s theorem and applications; General curvilinear systems; change of variables, Jacobian, polar coordinates; Parametrized surfaces in R^3; surface area and surface integrals; Stokes’ theorem and Gauss’ theorem.
Learning and Teaching	Lectures, supported by tutorials.

Methods	

Learning Outcomes	
Upon successful completion of this module the learner will be able to	
#	
MLO1	Parametrise curves in 2 and 3 dimensions and calculate line integrals;
MLO2	Evaluate double integrals and triple integrals and use them for calculating areas and volumes
MLO3	Formulate and solve integration problems in polar, or general curvilinear, coordinate systems;
MLO4	Apply Green’s Theorem;
MLO5	Parametrise surfaces and calculate surface areas and surface integrals;
MLO6	Apply the theorems of Stokes and Gauss;
MLO7	Develop advanced computational skills and an intuitive understanding of integration.

Requisites

Assessment Threshold	35% on end-of-module written exam

Module Content & Assessment

Assessment Breakdown	**%**
Formal Examination	70.00%
Other Assessment(s)	30.00%

Assessments

Formal Examination

Assessment Type	Written Examination	**% of Total Mark for Module**	70
Indicative Week	Week 28	**Learning Outcomes**	1,2,3,4,5,6,7
Assessment Threshold:	35	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Other Assessment(s)

Assessment Type	In Class Test	**% of Total Mark for Module**	30
Indicative Week	See Student Handbook	**Learning Outcomes**	1,2,3
Assessment Threshold:	None	**Assessment Role**	Individual
Assessment Authenticity	Not Online	**Pass/Fail**	No

Assessment Description
n/a

Module Activity

Full Time hours per semester	
Activity Type	*Duration (Hours)*
Lecture	39
Self Directed	111
Hours (up to 100 for 5 ECTS credits)	150.00

Recommended Reading List

Recommended Book Resources

Sean Dineen. (2014), Multivariate Calculus and Geometry, Springer Undergraduate Mathematics Series.

Supplementary Book Resources

Robert C Wrede, Murray Spiegel. (2002), Advanced Calculus, Schaum's Outline Series.

Dominic Jordan, Peter Smith. (2003), Mathematical Techniques: An Introduction for the Engineering, Physical, and Mathematical Sciences, Oxford University Press.