Course title: Introductory Mathematical Methods for Economics			
Course code: TBD	No. of credits: 4	L-T-P: 54-6-0	Learning hours: 60
Pre-requisite course code and title: N/A			
Department: Department of Policy and Management Studies			
Course coordinator:	Course instructor:		
Contact details:			
Course type: Core	Course offered in: 1st Semester		
Course description: This course is an introduction to the mathematical tools that are heavily used in various areas of economics such as microeconomics, macroeconomics, econometrics, etc. The course will cover sets, functions, limits, continuity, differentiability, and static optimisation of one variable.			
Course objective: 1. The primary objective of this course is to familiarise the students with the core concepts and techniques of mathematics that are used in economics. 2. The secondary objective is to teach students how to apply these techniques in economic applications.			

Course contents

S.No	Topics	L	T	P
1	**Introduction to Logic.** Arguments, propositions, deductive and inductive reasoning, necessary and sufficient conditions, proofs techniques.	2		
2	**Introduction to sets and real numbers.** Sets and its operations (union, intersection, complement, difference), Venn diagrams, De Morgan's laws. Real numbers, integers, natural numbers, rational and irrational numbers.	4		
3	**Functions of one variable.** Definitions, domain, range, codomain, graphs. Types of functions. One-to-one, onto, etc. Inverse of a function. Composition of a function. Inverse functions.	6		
4	**Linear and non-linear functions.** Linear functions: Equation of a straight line, slope of a function (intercept formula, two-point formula) Quadratic functions: Parabola, zeros, graphs. Polynomials: General form, fundamental theorem of algebra, roots, remainder theorem.	9		
5	**Limits, sequences, continuity and differentiability.** Limits: Limit of a function, left and right limits, functional limits, algebraic limit theorem, L'Hopital rule. Sequences: Definition, convergence, divergence. Series. Finite and infinite geometric series, harmonic series. Applications Continuity: Definition of a continuous function, geometric interpretations, properties, left and right continuity, discontinuity. Differentiability: Slope of a curve, Newton quotient, derivatives and its rules (power, product, quotient, chain rules etc.), left and right derivatives, higher-order derivatives, economic interpretations.	9	1	

6	**Implications of continuity and differentiability.** Linear approximations, quadratic approximations, differentials, inverse function theorem, rigorous approach to limits Power, exponential and logarithmic functions: General forms, graphs, rules of logarithmics, characterisation of irrational number *e*, Taylor's formula. Applications. Ecology, log-linearity, present discounted values, economic growth.	9	2	
7	**Static optimisation of one-variable.** Optimisation problems, definitions, maxima, minima, interior and boundary points, stationary points, local and global optima, first- and second-derivative tests, necessary and sufficient conditions, applications. Concave and convex functions. Definitions, properties, inflexion points, applications.	9	2	
8	**Matrices and Determinants.** System of linear equations, vectors, matrices and matrix operations, transpose, determinants and its rules, inverse of a matrix, Cramer's rule, rank of a matrix.	6	1	
	Total	54	6	

Pedagogical approach:

Classroom teaching and problem-solving sessions.

Evaluation criteria:

Minor 1: Written Examination - 30% [Syllabus: 1-4, Learning outcomes: 1, 4]
Minor 2: Homework - 30% [Syllabus: 5, Learning outcomes: 1, 2, 3, 4]
Major: Written Examination - 40% [Syllabus: Complete course, Learning outcomes: 1-5]

Learning outcomes:

At the end of the course, the students will be able to:

1. Understand the ideas of core mathematical concepts. [Modules 1-8]
2. Apply the techniques learned during the course in economic problems. [Modules 5-8]
3. Provide economic interpretations of some of the key concepts and results. [Modules 5-8]
4. Graphically analyse economic and mathematical problems, wherever possible. [Modules 3-7]
5. Optimise functions of one variable using more than one technique. [Modules 7]

Core reading:

1. K. Sydsaeter and P. Hammond. "Mathematics for Economic Analysis" (2016) (SH)

Additional readings:

2. A. Chiang. "Fundamental Methods of Mathematical Economics" (2017)
3. M. Hoy, J. Livernois, C. McKenna, R. Rees, T. Stengos. "Mathematics for Economics" (2016)

Module-wise chapters from the core reading: K. Sydsaeter and P. Hammond. "Mathematics for Economic Analysis" (2016) (SH).

1. Module 1: SH, Chapter 1, Sections 1.1-1.3, 1.5, 1.6.
2. Module 2: SH, Chapter 1, Sections 1.4, 1.7.
3. Module 3: SH, Chapter 2, Sections 2.1-2.4; Chapter 3, Section 3.6; Chapter 7, Section 7.6.
4. Module 4: SH, Chapter 2, Sections 2.5; Chapter 3, Sections 3.1-3.5.
5. Module 5: SH, Chapter 4; Chapter 5, Sections 5.1, 5.2, 5.4, 5.5; Chapter 6, Sections 6.1-6.7, Chapter 7; Chapter 8.
6. Module 6: SH, Chapter 9.
7. Module 7: SH, Chapter 12; Chapter 13; Chapter 14, Section 14.2.

Additional information: Course prepared by: Sanyyam Khurana
Student responsibilities: Attendance, feedback, discipline: as per university rules.

Course reviewers:

1. Naveen Joseph Thomas. Associate Professor, Jindal School of Government and Public Policy, O.P. Jindal Global University
2. Niti Khandelwal Garg. Associate Professor, Kirori Mal College, University of Delhi