Syllabus template

Semester: 8	
Course : Economics	
Paper Title: Quantitative Economic Analysis I	
Paper code:	**Credits: 6**
Hours/week : 4	
Category: Core/MDC/SEC/VAC : Core	
Theory / Practical / Composite : Theory	
No of Modules : 3	

Course Overview:

1. To study fundamental concepts and techniques of real analysis in an accessible and structured manner.
2. To study deductive reasoning and develop the ability to analyze mathematical situations beyond routine formula manipulations.
3. To study sets in ℝ and sequences in ℝ along with their associated limit concepts.
4. To study methods for solving non-linear first-order differential equations and analyzing their stability.
5. To study alternative methods for finding particular solutions of linear second-order differential equations with variable terms.
6. To study applications of differential equations in analyzing simultaneous systems.

Course Outcome:

Module 1:

1. Recognize various types of real numbers, including natural numbers, integers, rational, and irrational numbers.
2. Summarize the concepts of sets in ℝ, such as intervals, neighbourhoods, interior points, boundary points, open and closed sets, and bounded sets.
3. Examine sequences to determine convergence, divergence, boundedness, monotonicity, and to explore subsequences and the Bolzano-Weierstrass theorem.
4. Illustrate limits of functions, including one-sided limits, limits at infinity, and limits of monotone functions.
5. Assess the relationships between sequences, limits, and set properties to understand compactness and related concepts in real analysis.
6. Formulate examples of sequences and functions to demonstrate convergence, divergence, and limit behaviour in ℝ.

Module 2:

1. Define non-autonomous linear first-order differential equations and apply the integrating factor method to solve them.
2. Differentiate between nonlinear first-order differential equations, phase diagrams, rest points, and stability analysis to interpret solution behaviour.
3. Demonstrate the solution of Bernoulli's equation and separable differential equations in practical contexts.
4. Illustrate methods for solving linear second-order differential equations with variable terms, including polynomial and exponential forms.
5. Investigate systems of differential equations (2×2) using phase diagrams to analyze dynamics and stability.

6. Develop simple models using differential equations to represent applied problems in economics and related fields.				
Module 3				
1. Identify the fundamental concepts of matrix decomposition, including LU, Cholesky, and Singular Value Decomposition (SVD).				
2. Explain the procedures and mathematical principles underlying LU, Cholesky, and SVD decompositions.				
3. Apply matrix decomposition techniques to solve linear systems and simplify computations in economic models.				
4. Analyze how different decomposition methods affect computational efficiency and stability in applied problems.				
5. Evaluate the suitability of LU, Cholesky, and SVD methods for various types of economic modeling scenarios.				
6. Construct economic models or computational frameworks that utilize matrix decomposition techniques for practical problem-solving.				
SYLLABUS				
UNIT/Module	**CONTENT**	**HOURS or NUMBER OF CLASSES**	**CO Mapping**	**COGNITIVE LEVEL**
I.	• **Basics of Real Analysis** **1.** Real Numbers- Natural numbers, Integers, Rational and Irrational numbers. **2.** Sets in $\mathbb{R}$ - Interval, Neighbourhood, Interior points, Boundary points, Open set, Limit point, Closed set, bounded set. **3.** Sequence – Convergent and divergent sequence, Bounded sequence, Limit of a sequence, divergent sequence, monotone sequence, sub sequence, Bolzano-Weierstrass theorem, compact set. **4.** Limits – Limits of a function, one-sided limits, Limits at infinity, monotone functions and their Limits.		CO1, CO2, CO3, CO4, CO5, CO6	K1,K2, K3, K4, K5, K6
II	• **Dynamics** 1. Non autonomous linear, first order differential equation (Integrating factor). Nonlinear, first order differential equation (phase diagram), Rest point, Stability analysis, Bernoulli's equation and Separable equation. 2. The linear, second order		CO1, CO2, CO3, CO4, CO5, CO6	K1,K2, K3, K4, K5, K6

	differential equation with a variable term (polynomial, exponential). 3. System of differential equations (2x2, phase diagram)			
III	• **Advanced Topics in Matrix Algebra:** Matrix Decomposition - LU, Cholesky and Singular Value Decomposition and its applications in economic models.		CO1, CO2, CO3, CO4, CO5, CO6	K1,K2, K3, K4, K5, K6

Text Books

1. Bartle R. G and Sherbert D. R.: Introduction to Real Analysis, John Wiley and Sons. 1982.
2. Binmore: (Real Analysis)
3. Chiang and Wainwright (2017): Fundamental Methods of Mathematical Economics.
4. K. Sydsater and P. Hammond, Mathematics for Economic Analysis, Pearson Educational Asis: Delhi, 2002.
5. Matrix Computations, G. H. Golub and C. F. Van Loan, 3rd Edition, John Hopkins University Press, 1996.

Suggested readings

1. Proter M. H. and Morrey C. B.: A First Course in Real Analysis, Springer Verlag 1991.
2. Ken Binmore: Mathematical Analysis – A straightforward Approach
3. Lawrance Blume and Carl Simon, Mathematics for Economists, W. W. Norton and Company 1994.
4. Abadir, K.M., & Magnus, J.R. (2005) – Matrix Algebra. Cambridge University Press

Web Resources

NA

Evaluation :CIA: 30 (20+5+5)+ End Semester:70

Paper Structure for Theory Semester Exam:

Module	**No. of questions to be answered**	**No. of alternatives given**	**Marks**
Module 1 (35 marks)	3	4	3×5=15
	2	3	2×10=20
Module 2 (25 marks)	3	4	3×5=15
	1	2	1×10=20
Module 3 (10 marks)	1	2	1×10=20
		Total	**70**

Course outcomes (COs) and Cognitive Level Mapping

COs	**CO Description**	**Cognitive levels**
	Module 1	
CO1	Recognize various types of real numbers, including natural numbers, integers, rational, and irrational	K1

	numbers.	
CO2	Summarize the concepts of sets in ℝ, such as intervals, neighbourhoods, interior points, boundary points, open and closed sets, and bounded sets.	K2
CO3	Examine sequences to determine convergence, divergence, boundedness, monotonicity, and to explore subsequences and the Bolzano-Weierstrass theorem.	K3
CO4	Illustrate limits of functions, including one-sided limits, limits at infinity, and limits of monotone functions.	K4
CO5	Assess the relationships between sequences, limits, and set properties to understand compactness and related concepts in real analysis.	K5
CO6	Formulate examples of sequences and functions to demonstrate convergence, divergence, and limit behaviour in ℝ.	K6
	Module 2	
CO1	Define non-autonomous linear first-order differential equations and apply the integrating factor method to solve them.	K1
CO2	Differentiate between nonlinear first-order differential equations, phase diagrams, rest points, and stability analysis to interpret solution behaviour.	K2
CO3	Demonstrate the solution of Bernoulli’s equation and separable differential equations in practical contexts.	K3
CO4	Illustrate methods for solving linear second-order differential equations with variable terms, including polynomial and exponential forms.	K4
CO5	Investigate systems of differential equations (2×2) using phase diagrams to analyze dynamics and stability.	K5
CO6	Develop simple models using differential equations to represent applied problems in economics and related fields.	K6
	Module 3	
CO1	Identify the fundamental concepts of matrix decomposition, including LU, Cholesky, and Singular Value Decomposition (SVD).	K1
CO2	Explain the procedures and mathematical principles underlying LU, Cholesky, and SVD decompositions.	K2
CO3	Apply matrix decomposition techniques to solve linear systems and simplify computations in economic models.	K3
CO4	Analyze how different decomposition methods affect computational efficiency and stability in applied problems.	K4
CO5	Evaluate the suitability of LU, Cholesky, and SVD methods for various types of economic modeling scenarios.	K5
CO6	Construct economic models or computational frameworks that utilize matrix decomposition techniques for practical problem-solving.	K6