Analysis 2

1. **Course number and name:** 020AN2NI4 Analysis 2

2. **Credits and contact hours**: 6 ECTS credits, 3x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Chamoun Georges (Coordinator), Saliba Lara, Zaraket Christiana and Abboud Michel.

4. **Instructional materials:** Lecture notes and slides provided by the instructor; practice problem sets and worksheets; past exams and solutions; solutions manual containing step-by-step solutions to the problem sets; additional references: Thomas Jr., G.B., Weir, M.D. and Hass, J. (2013) Thomas'Calculus, edition 12, Pearson, Boston, New York

5. **Specific course information**
   a. **Catalog description:**
   This course aims to deepen the understanding of advanced concepts in mathematical analysis. It covers various areas, such as the pointwise and uniform convergence of sequences and series of functions. Additionally, it provides a detailed exploration of power series, studying their radii of convergence, properties, and their relation to analytic functions. Complex analysis is also introduced, offering a study of functions of a complex variable, which holds great importance in various applications of engineering. Finally, the course addresses Fourier series, which are used to represent periodic functions through linear combinations of sine and cosine functions. This in-depth knowledge prepares students to engage with more advanced concepts in applied mathematics, physics, engineering and other related disciplines.

   b. **Prerequisites:** 020AA1NI2 Analysis 1

   c. **Required/Elective/Selected Elective:** Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
   - Understand and apply the concepts of pointwise and uniform convergence of sequences and series of functions.
   - Be able to study power series, determine their radii of convergence, and analyze their properties.
   - Apply power series in the resolution of differential equations.
   - Acquire a deep understanding of functions of a complex variable and their properties.
   - Use tools of complex analysis such as complex derivatives, line integrals, and Cauchy's theorems.
   - Study Laurent series and their relation to analytic functions.

- Understand and apply the concepts of Fourier series to represent periodic functions.
- Analyze the convergence properties of Fourier series for continuous, periodic, and differentiable functions: Dirichlet Theorem.
- Utilize Fourier series to solve practical problems in fields such as physics, engineering, and signal processing.

b. PI addressed by the course:

PI	1.3
Covered	x
Assessed	x

7. Brief list of topics to be covered

- Review of numerical series and pointwise convergence of functions (2 lectures)
- Uniform convergence of function sequences in the infinity norm and graphical interpretations (3 lectures)
- Graphical analysis of pointwise and uniform convergence (2 lectures)
- Series of functions, pointwise and uniform convergence, normal convergence, differentiability, and integrability (3 lectures)
- Power series, radius and domain of convergence (3 lectures)
- Sum and product of power series (2 lectures)
- Analytic functions, relations with power series, Taylor series expansion, and solving differential equations (3 lectures)
- Complex analysis, holomorphic functions, complex derivatives (2 lectures)
- Continuity and complex integration along complex paths (3 lectures)
- Laurent series, classification of singularities, applications (2 lectures)
- Residue theorem, evaluation of integrals using residues and Jordan's lemmas (3 lectures)
- Piecewise continuous functions, extensions of Fourier series (3 lectures)
- Dirichlet convergence, Parseval's formula (2 lectures)
- Applications of Fourier series: analysis of periodic signals and solving differential equations (3 lectures)