# F10NC Numerical Analysis C

## COURSE DETAILS
- **Course Code:** F10NC
- **Full Course Title:** Numerical Analysis C
- **SCQF Level:** 10
- **SCAF Credits:** 15
- **Available as Elective:** No

## DELIVERY LEVEL
- **Undergraduate:** Yes
- **Postgraduate Taught:** No
- **Postgraduate Research:** No

## COURSE AIMS
This course provides an introduction to the derivation and analysis of techniques for the numerical approximation of ordinary differential equations.

## LEARNING OUTCOMES – SUBJECT MASTERY
By the end of the course, students should be able to:

- reduce higher order systems to a first order system of ODEs
- derive Euler's method and use it to approximate ODEs
- prove convergence of Euler's method
- (RK) derive explicit two-stage RK schemes
- (RK) establish stability intervals for explicit RK schemes
- (RK) investigate the computational efficiency of RK schemes
- (RK) use explicit RK schemes to approximate scalar and vector-valued examples
- derive error estimates based on the use of two different schemes
- combine RK schemes for efficient error control
- (LMM) derive simple LMMs via integration of Lagrange interpolants
- (LMM) deal with starting values in LMMs
- (LMM) carry out LTE analysis for general and specific LMMs
- (LMM) derive LMMs via LTEs
- (LMM) understand the relative advantages and disadvantages of explicit and implicit methods
- (LMM) deal with implicit methods
- solve homogeneous and simple inhomogeneous linear difference equations
- (LMM) carry out zero stability analysis of LMMs
- (LMM) understand the relationships between zero stability, convergence, LTE, root=1
- (LMM) carry out absolute stability analysis of LMMs (scalar and vector-valued problems)
- (LMM) deal with nonlinear systems of equations
- (LMM) understand the concept of stiffness
- (LMM) understand the construction, properties and uses of backward difference formulae (BDFs)
- deal with the ideas and methods in the final topic
- understand and use the Lax Equivalence Theorem

## LEARNING OUTCOMES – PERSONAL ABILITIES

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- Demonstrate the ability to learn independently
- Demonstrate knowledge of an area of mathematics.
- Manage time, work to deadlines and prioritise workloads

SYLLABUS

Introduction and Basic Concepts: definitions, reduction to first order system of ODEs, Euler's method, global and local truncation errors (LTE), convergence

Linear Multistep Methods: derivation, LTE, implicit vs. explicit, linear difference equations, zero and absolute stability, stiffness, backward difference formulae

Runge Kutta Methods: derivation of explicit schemes, stability, efficiency, vector-valued problems

Time Step and Error Control: error estimates based on two different methods, efficient use of RK schemes in error control

Final Topic: Boundary value problems or geometric integration

Practical Work:

Revision and problem solving:

COURSE RELATIONSHP

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<tr>
<th>Course Code</th>
<th>Level</th>
<th>Title</th>
<th>School</th>
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<td>School of Math and Comp Sci.</td>
<td>Pre-Requisite</td>
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LOCATION AND ASSESSMENT METHODS

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