Module Code: MAU22E02
Module Name: Engineering Maths IV
ECTS: 5
Semester Taught: Semester 2
Module Coordinators: Professor Anthony Brown (browna2@tcd.ie)

Module Content:
(1) Vector-valued functions.
   • Calculus,
   • Change of parameter,
   • Tangent vectors.

(2) Partial derivatives.
   • The Chain Rule,
   • Directional derivatives and gradients,
   • Tangent planes and normal vectors
   • Maxima and minima.

(3) Multiple Integrals.
   • Double and triple integrals,
   • Surface areas,
   • Volumes, masses and centres of gravity.

(4) Topics in vector calculus.
   • Vector fields,
   • Line integrals,
   • Green’s Theorem,
   • Surface integrals,
   • The Divergence Theorem,
   • Stokes’ Theorem.

(5) Laplace transforms.
   • Differential equations,
   • Unit and delta functions,
   • Convolutions.

Learning Outcomes:
On successful completion of this module, students should be able to:

1. Analyse the behaviour of functions of several variables, present the results graphically and efficiently calculate partial derivatives of functions of several variables (including functions given implicitly);
2. Obtain equations for tangent lines to plane curves and tangent planes to space surfaces;
3. Apply derivative tests to find local and global maxima and minima of functions of several variables;
4. Calculate multiple integrals in Cartesian, polar, cylindrical and spherical coordinates, and in particular, find areas, volumes, masses and centres of gravity of two- and three-dimensional objects;
5. Determine whether a vector field is conservative, find a potential function for a conservative field, and use it to calculate line integrals;
6. Use Green’s, Stokes’ and the Divergence Theorems to calculate double, surface and flux integrals;
7. Solve differential equations by applying Laplace transforms.

**Recommended Reading:**
*Calculus, Late Transcendentals* - Howard Anton, Irl C. Bivens and Stephen Davis, 9th Edition
*Advanced Engineering Mathematics* - Erwin Kreyszig, 8th Edition

**Assessment Details:**
Continuous Assessment – 20%
Examination – 80%