Course Title: Calculus of Variations	**Number of Units** 1
SSD : MAT05	**CFU:** 6
Course aims: The course aims to provide a basic knowledge of Calculus of Variations with particular focus on the application to optimization methods for engineering and scientific problems.	
Course Description: Introduction to Calculus of Variations, classical problems and examples. Function spaces. Weak and strong minimizers. Frèchet and Gâteaux differentiation. Fundamental lemma, DuBois-Reymond lemma, one-dimensional Euler-Lagrange equations. Problems with free ends, piecewise functions and minimization. Erdmann-Weierstrass equations. Regularity of solutions.One-dimensional Poincaré and Wirtinger inequalities. Second Euler-Lagrange and Erdmann-Weierstrass equations. Minimization with constraints. Geodesics on surfaces. Hamiltonian formulation. Hamilton-Jacobi equations. Optimal control problems and examples. Pontryagin principle.Convex functionals. Jacobi and Weierstrass conditions. Excess. Legendre condition. Second variation of a functional. Lipschitz minimizers and regularity. Absolutely continuous minimizers and regularity. Existence and regularity of minimizers of one-dimensional problems. Multidimensional problems. Dirichlet functional and harmonic functions. Euler equations in the multidimensional case. Dirichlet functional: existence, uniqueness and regularity of minimizers. Poincaré inequalities. Isoperimetric problems. Worked examples.	
Assumed Background: Mathematical Analysis at undergraduated level	
Assessment methods: Oral examination	