

# Applications of Critical Point Theory to Semilinear Elliptic Boundary Value Problems

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The interplay between the Critical Point Theory and Algebraic Topology produces powerful methods to study existence and multiplicity of solutions of semilinear elliptic partial differential equations.

In this talk, I will briefly describe some of these methods and study the existence and multiplicity of solutions of the boundary-value problem

$$\begin{cases} -\Delta u &= -\lambda|u|^{q-2}u + au + b(u^+)^{p-1}, & \text{in } \Omega; \\ u &= 0, & \text{on } \partial\Omega, \end{cases} \quad (1)$$

where  $\Delta$  denotes the  $N$ -dimensional Laplacian,  $\Omega$  is a bounded domain with smooth boundary,  $\partial\Omega$ , in  $\mathbb{R}^N$  ( $N \geq 3$ ),  $u^+$  denotes the positive part of  $u: \Omega \rightarrow \mathbb{R}$ ,  $1 < q < 2 < p < 2^* = 2N/(N-2)$ ,  $\lambda > 0$ ,  $a \in \mathbb{R}$  and  $b > 0$ .

Using infinite-dimensional Morse Theory, we extend the results of Paiva and Presoto [1] and establish some conditions for the existence of at least four nontrivial solutions of (1). This is a work done in collaboration with Adolfo Rumbos [2].

## REFERENCES

- [1] PAIVA, F.O, A. PRESOTO, - Semilinear elliptic problems with asymmetric nonlinearities, Anal. J. Math. Anal. Appl. 409, 254-262, **2014**.
- [2] RECÔVA, LEANDRO, ADOLFO RUMBOS - , Multiple nontrivial solutions of a semilinear elliptic problem with asymmetric nonlinearity, J. Math. Anal. Appl. 484, 123720, **2020**.