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Existence of solution for a resonant p-Laplacian second-order m-point boundary value problem on the half-line with two dimensional kernel

O.F. Imaga^{1*}  and S.A. Iyase¹

*Correspondence: imaga.ogbu@covenantuniversity.edu.ng
¹Department of Mathematics, Covenant University, Ota, Nigeria

Abstract

The existence of a solution for a second-order p-Laplacian boundary value problem at resonance with two dimensional kernel will be considered in this paper. A semi-projector, the Ge and Ren extension of Mawhin's coincidence degree theory, and algebraic processes will be used to establish existence results, while an example will be given to validate our result.

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1 Introduction

The following second-order p-Laplacian boundary value problem will be considered in this work:

$$\begin{cases} (\varphi_p(u'(t)))' + g(t, u(t), u'(t)) = 0, & t \in (0, +\infty), \\ \varphi_p(u'(0)) = \int_0^{+\infty} v(t)\varphi_p(u'(t)) dt, & \varphi_p(u'(+\infty)) = \sum_{j=1}^m \beta_j \int_0^{\eta_j} \varphi_p(u'(t)) dt, \end{cases} \quad (1.1)$$

where $g : [0, +\infty) \times \mathbb{R}^2 \rightarrow \mathbb{R}$ is an L^1 -Carathéodory function, $0 < \eta_1 < \eta_2 < \dots \leq \eta_m < +\infty$, $\beta_j \in \mathbb{R}$, $j = 1, 2, \dots, m$, $v \in L^1[0, +\infty)$, $v(t) > 0$ on $[0, +\infty)$, and

$$\varphi_p(s) = |s|^{p-2}s, \quad p \geq 2.$$

There are many real life applications of boundary value problems with integral and multi-point boundary conditions on an unbounded domain, for instance, in the study of physical phenomena such as the study of an unsteady flow of fluid through a semi-infinite porous medium and radially symmetric solutions of nonlinear elliptic equations. They also arise in plasma physics and in the study of drain flows; see [1–3].

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