1056-35-436 **Abbas Momeni*** (momeni@mast.queensu.ca), Department of Mathematics and Statistics, Queen's University, Jeffery Hall, University Ave., Kingston, Ontario k7L3N6, Canada. *A variational principle associated with a certain class of boundary value problems.*

A variational principle is introduced to provide a new formulation and resolution for several boundary value problems. Indeed, we consider systems of the form

$$\begin{cases} \Lambda u = \nabla \Phi(u), \\ \beta_2 u = \nabla \Psi(\beta_1 u) \end{cases}$$

where $\Phi$ and $\Psi$ are two convex functions and $\Lambda$ is a possibly unbounded self-adjoint operator modulo the boundary operator $\mathcal{B} = (\beta_1, \beta_2)$. We shall show that solutions of the above system coincide with critical points of the functional

$$I(u) = \Phi^*(\Lambda u) - \Phi(u) + \Psi^*(\beta_2 u) - \Psi(\beta_1 u)$$

where $\Phi^*$ and $\Psi^*$ are Fenchel-Legendre dual of $\Phi$ and $\Psi$ respectively. Note that the standard Euler-Lagrange functional corresponding to the system above is of the form,

$$F(u) = \frac{1}{2}\langle \Lambda u, u \rangle - \Phi(u) - \Psi(\beta_1 u).$$

An immediate advantage of using the functional $I$ instead of $F$, is to obtain more regular solutions and also the flexibility to handle boundary value problems with nonlinear boundary conditions. Applications to Hamiltonian systems and semi-linear Elliptic equations with various linear and nonlinear boundary conditions are also provided. (Received September 07, 2009)