

The calculus of variations and methods of optimization

The list of questions

Weierstrass theorem for lower semicontinuous functions. Weierstrass theorem for lower semicontinuous functions in Banach space.

Theorem of approximation in normed space. Uniqueness Theorem. Theorem of approximation in Hilbert space. Separation theorem. Theorem of the cone conjugations.

Elementary linear programming problem. Kuhn-Tucker theorem. Kuhn-Tucker theorem in the form of a saddle point.

Derivatives in a normed space. The theorem on the superposition. The mean value theorem. Higher-order derivatives. Necessary and sufficient optimality conditions in smooth problems without constraints.

Lemma on the closure of the image. Lemma on annihilator. Lemma on annihilator for kernel regular operator. Ljusternik theorem.

The theorem on the necessary conditions of smooth problems with equality constraints. The theorem on the necessary conditions of smooth problems with inequality constraints.

Lagrange Lemma. Du Bois-Reymond lemma. The necessary conditions for a weak local minimum in Boltz problem. The necessary conditions for a weak local minimum in the Lagrange problem. The necessary conditions for a weak local minimum in the classical isoperimetric problem. The necessary conditions for a weak local minimum in general isoperimetric problem.

Generalization of DuBois-Reymond Lemma. The necessary conditions for a weak local minimum in the vector Lagrange problem. The necessary conditions for a weak local minimum in vector Boltz problem. The necessary conditions for a weak local minimum in problems with higher derivatives. The necessary conditions for strong local minimum in the Lagrange problem for piecewise smooth functions. Weierstrass necessary condition of a strong local minimum. Lemma on straightening corners. The necessary conditions for a weak local minimum of the second order.

Bellman function. Theorem about the properties of the Bellman function. Bellman theorem. Bellman equation, necessary optimality conditions in terms of the Bellman equation. Analytical design of linear regulator.

Pontryagin maximum principle. Pontryagin maximum principle in Boltz problem. Pontryagin maximum principle in optimal speed problem. Optimality conditions in terms of the Pontryagin maximum principle.