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Catastrophe theory

A lecture course

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Annotation:

The lecture course "Catastrophe theory" is focused on mathematical foundations of catastrophe theory and application of various mathematical models for quantitative description of catastrophic events that occur in nature, society, industry and in private affairs. These lectures introduce key concepts of catastrophe theory – the vast area of mathematics which studies non-linear and non-equilibrium dynamic systems(i.e., theory of bifurcations of differential equations, singularity of smooth mapping, topological dynamics, cascades of bifurcations etc.).

Particular attention is drawn to methods of obtaining a "normal form" of studied object (either as a differential equation or mapping) around "catastrophe point". Building on this techniques, the author develops a novel system for object classification. Seven types of catastrophes, as well as classification of catastrophic events are reviewed within the framework of the group theory.

Provided numerous examples of behavior of discontinuous functions are used to describe catastrophes in real world (natural and man-made systems). The author discusses possible applications of catastrophe theory in applied mathematics and

physics, in chemistry and medical sciences, in cybernetics and computer science, in biology and ecology, in technology and economics studies.

Possible applications of catastrophe theory to socioeconomic analysis, prognosis and prediction of civil unrest and revolutions are outlined in Lecture **14** of given course. Further examples demonstrate how various natural phenomena (such as rainbow, caustic surface, robustness of complex systems, vibrational motion and destruction in structural engineering, catastrophes in industry and in transportation, disastrous consequences of self-destructive behavior of animals and human beings, prison revolts etc.).

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This lecture cource is aimed at on-line students of **I.N. Beckman Transdisciplinary University(**`http://beckuniver.ucoz.ru`**)**.especially interested in gaining practical experience of using catastrophe theory for risk management and analysis, as well for quantitative description of complex systems in space in time.

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The annotation and ToC were translated by: Dr. V. Deineko