MATH-610(I)

Elastic Rods and Birods I (2018)

Maddocks John H.

Cursus	Sem.	Type
Mathematics		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Oral presentation
Workload	60h
Hours	**43**
Lecture	15
Exercises	5
Practical work	23
Number of positions	

Remark

Next time: 11-15 February 2019

Summary

Long slender structures are ubiquitous: wires, cables, ropes and plant tendrils are mac-roscopic examples. At the micro scale, nanotubes, microtubules, actin filaments and DNA are other cases. These lectures develop the theories of elastic rods and birods which are necessary to model such structures

Content

The fundamentals of the theory of elastic rods and birods including an introduction to analytical and numerical techniques.

1) Balance Laws for both dynamics and statics
2) Constitutive Relations including inextensible and unshearable cases.
3) Introduction to the Calculus of Variations with dependent variable in R^n and SE(3). Theory of first and second variations.
4) Variational principles for Rod Dynamics and Statics. Hamiltonian forms of balance laws. Application to stability analysis of special solutions via Lyapunov methods.

Long slender structures, which have one dimension much larger than the characteristic size of their cross-section, are ubiquitous in Nature: wires, cables and ropes are man-made examples, while plant tendrils are another macroscopic example. At the micro scale, nanotubes are another man-made example while microtubules, actin filaments and DNA are naturally occurring cases. This series of lectures will develop the theory describing the dynamics, statics and stationary equilibrium distributions of elastic rods, along with associated computational schemes. As time permits the analogous theories of birods will be described, where birods are a system of two interacting rods, e.g. a bicycle brake cable, with its two concentric parts, or the two strands of DNA.

Note

Exam will involve oral presentation of a research article in specialised area of rod mechanics

Keywords

Mechanics of rods and birods

Learning Prerequisites

Required courses

Undergraduate core courses in Analysis, Linear Algebra and Numerical Analysis

Learning Outcomes

By the end of the course, the student must be able to:

- Use the theory of rods in the analysis and computation of various modelling problems

Resources

Bibliography

Given in class