工程学位课程IIA，3C5：动力学，2018-19

课程负责人
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教师
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时间结构
Michaelmas学期，16次讲座。介绍和刚体动力学：每两周2次讲座，第1-5周（Prof J Woodhouse）；拉格朗日力学：每两周2次讲座，第6-8周（Prof R S Langley）

目标
课程的目标是：

- 介绍三维动力学的想法和方法：刚体在三维空间中在给定力和力矩下的运动，以及拉格朗日形式的表示。
- 展示如何以直接的方式应用这些方法解决力学中的各种问题。

具体目标
课程结束时，学生应能够：

- 代表刚体的惯性以惯性矩阵的形式表示，能够计算简单形状的转动惯量和极惯量。
- 推导刚体在给定力矩下的运动的欧拉方程。
- 将这些方程应用到对称旋转器的运动中，解释进动、偏动和速率陀螺的原理。
- 分析刚体滚动的简单问题，例如便士在桌面上旋转。
- 解释广义坐标的概念，以及其对应的广义力。
- 用广义坐标的广义坐标表示系统的动能和势能，以获得系统的拉格朗日方程。
- 说明守恒定律和能量形式之间的联系。
- 说明约束的概念，并能够计算拉格朗日方程中的力。
- 约化动能和势能为二次形式，从而推导系统在其平衡位置的小振幅振动的刚度矩阵。

内容

本课程旨在以系统的方法研究动力学。一旦掌握了主要技术，就可以自信地解决各种问题。课程的前部分介绍和刚体动力学，然后介绍拉格朗日力学。
the tools required to analyse rigid-body motion in three dimensions. These are necessary for a proper understanding of gyroscopic systems, inertial navigation, satellites in space and the stability of high-speed rotating systems such as turbines and compressors.

The second part of the course deals with Lagrangian mechanics, a systematic way to formulate dynamical problems using energy functions.

**Introduction and Rigid-body Dynamics (10L)**

- Equations of motion of a rigid body in three dimensions.
- The inertia tensor; principal axes.
- Gyroscopes and their application.
- Problems involving rolling bodies.

**Lagrangian Mechanics (6L)**

- Lagrange's equations; connection to Newton's laws; generalised coordinates and generalised forces.
- Applications; calculation of forces of constraint.

**Coursework**

**Gyroscopic Phenomena**

**Learning objectives:**

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**Practical information:**

- Sessions will take place in [Location], during week(s) [xxx].
- This activity [involves/doesn't involve] preliminary work ([estimated duration]).

**Full Technical Report:**

Students will have the option to submit a Full Technical Report.

**Booklists**

Please see the [Booklist for Part IIA Courses](http://teaching.eng.cam.ac.uk) for references for this module.

**Examination Guidelines**

Please refer to [Form & conduct of the examinations](http://teaching.eng.cam.ac.uk).

**UK-SPEC**

The [UK Standard for Professional Engineering Competence (UK-SPEC)](http://teaching.eng.cam.ac.uk) describes the requirements that have to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has been developed, and is regularly updated, by panels representing professional engineering institutions, employers
and engineering educators. Of particular relevance here is the 'Accreditation of Higher Education Programmes' (AHEP) document [5] which sets out the standard for degree accreditation.

The Output Standards Matrices [6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.

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Links
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