**Dynamics of Physical Systems (MTH5106)**

**General information sheet**

**LECTURER:** Prof Reza Tavakol (Room 456, Maths)

**LECTURES:** Tuesday 12 (FB 113), Wed 12 (FB240), Thurs 10 (FB 113a)

**EX CLASSES:** Tues 10 (Eng 216), Thurs 11 (Eng 216)

**COURSE WORK:** Handed out in Lectures and returned CW to be placed in the **YELLOW BOX** on the **THIRD FLOOR** of the Maths Building.

**MARKED COURSE WORK:** Must be collected in EX CLASS.

**COURSE WEB PAGE:** `http://www.maths.qmw.ac.uk/~reza`: Contains **Coursework Regulations**, **Noticeboard** (for the day-to-day information) as well as **Weekly Exercise sheets**.

**OFFICE HOUR:** I will be available in my office on Tuesdays (2-3pm) and Thursdays (2-3pm) to deal with any other problems with the course. My email address for emergency use is r.tavakol@qmul.ac.uk.

**ASSESSMENT AND EXAMINATION:**

Total credit for this course will be based on the following components:

(1) Exercise sheets (10%)

(2) Mid–term test (10%)

(2) Final written exam in May or June (80%)

**PREREQUISITES:** MTH4101 Calculus II, MTH4102 Differential Equations (essential)

**TURN OVER**

## SYLLABUS

• Review of vector algebra, integration and differentiation of vectors, definitions of gradient and curl of vectors;

• Kinematics: velocity, acceleration in Cartesian and polar coordinates.

• Newton's laws of motion and Newton's law of gravitation; application to problems in 1 and 2 dimensions under the action of various types of forces, including resistive and gravitational leading to the idea of classical black holes.

• Momentum, work, kinetic energy, conservative forces and potential energy. Conservation law of energy and its use in obtaining qualitative information about motion.

• Motion near a points of stable equilibrium: SHM, damped and forced SHM.

• Newton's sphere theorem.

• Orbits of planets around the Sun.

• Kepler's laws of planetary motion.

## OUTCOMES

At the end of this module, students should:

• be able to recall vector algebra, integration and differentiation of vectors and be able to evaluate the gradient and curl of vectors

• be able to define position vector, velocity and acceleration in both Cartesian and polar coordinates.

• be able to solve simple kinematical questions.

• be able to state Newton's laws of motion and Newton's law of gravitation.

• be able to solve examples of motion under the action of various forms of forces, in one and two dimensions, including resistive forces and force of gravity, leading to classical idea of black holes.

• be able to define momentum, work, kinetic energy, conservative forces and potential energy.

• be able to derive the conservation law of energy and be able to use it to obtain qualitative information about motion.

• be able to show motion near points of stable equilibrium satisfy SHM and be able to solve this equation

• be able to derive and solve the equation of damped SHM.

• be able to derive and solve the equation of forced, damped SHM and understand the phenomenon of resonance.

• be able to derive the properties of motion under a central force.

• be able to state and use Newton's sphere theorem.

• be able to derive the equation of orbit of planets around the Sun and find its general solution solution.

be able to solve simple orbit examples.

• be able to derive Kepler's laws.

**BOOKS:**

*Hopefully notes will be sufficient. But it is always useful to also consult books. The Library has many book in this area. You may find the following books useful.*

• P Smith and R C Smith, Mechanics (Wiley)

• Phil Dyke & Roger Whitworth, Guide 2 Mechanics (Palgrave Mathematical Guides)

• Collinson, Introductory Mechanics

• Kibble, Classical Mechanics

• Kleppner and Kolenkow, An introduction to Mechanics

**IT IS VITAL TO TAKE ALL COMPONENTS OF THIS COURSE SERIOUSLY. ATTENDANCE AT LECTURES and EXERCISE CLASSES IS COMPULSORY AND RANDOM REGISTERS WILL BE TAKEN AT BOTH. REGISTRATION OF STUDENTS MISSING LECTURES OR EXERCISE CLASSES OR FAILING TO HAND IN COURSE WORKS WITHOUT VALID REASONS WILL BE TERMINATED**