# 3402 (Waves and Wave Scattering)

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| *Year:* | 2013–2014 |
| *Code:* | MATH3402 |
| *Level:* | Advanced |
| *Value:* | Half unit (= 7.5 ECTS credits) |
| *Term:* | 2 |
| *Structure:* | 3 hour lectures per week |
| *Assessment:* | 100% examination |
| *Normal Pre-requisites:* | 7402 |
| *Lecturer:* | Prof V Smyshlyaev |

*Course Description and Objectives*

Modelling the propagation and scattering of acoustic and electromagnetic waves has proved a major challenge to mathematicians and physicists for many centuries, and its practical importance can be observed in many applications prevalent throughout our modern world. These include the mitigation of aircraft, rail and traffic noise in urban areas, sonar detection, wireless and fibre optic communication, baggage screening, medical diagnostics and the workings of the cochlea. This course aims to provide an introduction to linear and nonlinear wave theory and the approximate methods used to tackle wave transmission and scattering in inhomogeneous media.

*Recommended Texts*

(i) Pierce, A.D, *Acoustics: an introduction to its physical principles and applications,* Acoustic Society of America 1989.

(ii) Billingham, J. and King, A.C. *Wave Motion,* CUP 2001.

*Detailed Syllabus*

- Acoustic waves - governing equations, plane acoustic waves, spherically symmetric waves, causality and the Sommerfield radiation condition, acoustic energy and intensity.
- Electromagnetic (EM) waves - governing equations, plane EM waves, Poynting's vector.
- Impedance and surface boundary conditions, interfacial boundary conditions.
- Plane wave reflection and transmission at interfaces - reflection by acoustically soft and hard boundaries and by a perfect conductor, reflection and transmission between two insulators.
- Radiation from vibrating bodies - a radially pulsating sphere, a traversely oscillating sphere.
- Green's functions, monopoles, dipoles, quadrupoles, multipole expansions.
- Kirchoff-Helmholtz integral theorem, acoustic scattering by air bubbles in water, acoustic scattering by a fixed rigid sphere.
- Introduction to the WKB approximation, slowly varying waveguides, optic fibres.