University of Glasgow | School of Physics & Astronomy

PHYS5044 Fundamentals of Sensing and Measurement

Course Information Guide 2022-23

1 Course Details

Schedule:	Irregular: see Moodle		
SCQF Credits:	20	ECTS Credits:	10
Assessment:	Exam (75%) Group Project (written report and presentation) (25%)	Co-requisites	None
Level:	SCQF Level 5		
Typically Offered:	Semester 1	Prerequisites:	None

PHYS5044 Fundamentals of Sensing and Measurement is a level 5 course. It is a core course for the MSc in Sensor and Imaging Systems and MSc in Quantum Technology. It is an optional course for the following MSc programmes: MSc Physics: Energy and Environment; MSc Astrophysics; MSc Theoretical Physics; MSc Physics: Advanced Materials; MSc Physics: Nuclear Technology.

Course co-ordinator: Prof Andy Harvey

Lecturers: Prof Andy Harvey (Imaging Concepts Group)
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Prof Giles Hammond (Institute of Gravitational Research)
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Recommended Texts, available through the library and links on Moodle:

1. Measurement, instrumentation, and sensors handbook. Volume 1, Spatial, mechanical, thermal, and radiation measurement / edited by John G. Webster, Halit Eren
2. Measurement, instrumentation, and sensors handbook. Volume 2, Electromagnetic, optical, radiation, chemical, and biomedical measurement / edited by John G. Webster, Halit Eren

Course notes, copies of slides and Question Sheets are available on Moodle.

2 Assessment

The course will be assessed via an examination in the December diet.

3 Required Knowledge

A good understanding of undergraduate-level Physics or Electronic Engineering is a suitable preparation for this course. Students with a background in cognate sciences such as Chemistry and would normally require some remedial preparation in maths, in particular dealing with signals. Students with a background in Computer Science may require remedial preparation in simple analogue electronics and optics. They should contact the Course Co-ordinator to discuss preparation for commencing the course.

4 Course Aims

The aims of this course are:

a. To provide training in fundamental and general concepts in transduction and sensing

b. Familiarise the student with the salient characteristics of sensing across the main physical domains of electromagnetism (radio, optical), electrical, magnetic, ionising radiation, gravitational, biological, chemical

c. To develop understanding of transduction in electrical signals and signal conditioning

d. To provide understanding of the process of imaging with sensing

e. To provide training in solving problems associating with sensing and imaging

5 Intended Learning Outcomes

By the end of this course students will be able to:

a. Propose and assess a range of solutions to a sensing and imaging problem against pertinent criteria

b. Analyse and evaluate data provided by a range of sensors and imaging systems

c. Demonstrate an understanding of the fundamental limitations of a range of sensing and imaging techniques.

d. Demonstrate an understanding of the physical origins of phenomena to be measured

6 Course Outline

The fundamentals of Sensing and Measurement consists of two main components:

- 36 lectures consisting of taught examined material and non-examined case studies. The exam contributes 75% to the mark for this course.
- A group project addressing a novel sensing and measurement problem with a weighting of 25%.

The content of the lectures is summarised below:

	Lecture	Delivered by	Subject
Week 1	1	Andy Harvey	Overview
	2	Andy Harvey	Transduction & Measurement 1
	3	Andy Harvey	Transduction & Measurement 2
Week 2	4	Andy Harvey	Transduction & Measurement 3
	5	Andy Harvey	Optics and Imaging 1
	6	Andy Harvey	Optics and Imaging 2
Week 3	7	Andy Harvey	Optics and Imaging 3
	8	Andy Harvey	Optics and Imaging 4

	9	Andy Harvey	Optics and Imaging 5
Week 4	10	Giles Hammond	Sampling and control 1
	11	Giles Hammond	Sampling and control 2
	12	Giles Hammond	Sampling and control 3
Week 5	13	Giles Hammond	Sampling and control 4
	14	Giles Hammond	Tutorial problems
	15	Giles Hammond	Electronics & Noise 1
Week 6	16	Giles Hammond	Electronics & Noise 2
	17	Giles Hammond	Case Study
	18	Andy Harvey	Brain storm introduction
Week 7	19	Andy Harvey	Brainstorm 1
	20	Giles Hammond	Brain Storm 2
Week 8	Students work on problems		
Week 9			
Week 10			
Week 11			
Week 12		Students	Sensing Presentations
		Students	Sensing Presentations

Sensing and Measurement Problem (60 hours: 30%)

Lecture	Lecturer	Length of Lecture	Type
Problem	Prof Andy Harvey	3 hours	Lecture and Brainstorm

Assessment

Fundamentals Two-hour Examination	75%

Sensing and Measurement Problem Group Report	20% - Students work in groups of three or four to address a sensing and measurement problem and propose a solution. Students start from an open solution employing brainstorming techniques to explore possible solutions. Students then assess all possible solutions, quantitatively where possible, to assess the most promising techniques and produce a proposal for future research. Students produce a single co-authored report which receives a single mark for all contributors.
Sensing and Measurement Problem Group Presentation	5% - Students make a presentation on the work conducted.