# PX370-7.5 Optoelectronics and Laser Physics

## 20/21

**Department**
Physics
**Level**
Undergraduate Level 3
**Module leader**
Steven Dixon
**Credit value**
7.5
**Module duration**
5 weeks
**Assessment**
100% exam
**Study location**
University of Warwick main campus, Coventry

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## Description

## Introductory description

Lasers produce coherent light, which can be used to carry information and energy. Semiconductor lasers, in particular, have become very important in the field of communication. This module covers the basic physics of laser action in the various types of laser and describes their applications in optoelectronics.

Module web page

## Module aims

To provide an introduction to the physical principles upon which the laser and a number of other optoelectronic devices are based. To describe a number of different types of laser, second harmonic generation using lasers, modulators (both electro-opto and acousto-optic) and detectors such as the photodiode, avalanche photodiode and photomultiplier. To describe the properties of optical fibres and the likely requirements of an optical communication system.

## Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Lasers: Spontaneous and stimulated emission, Einstein A and B coefficients; optical cavities, Fabry Perot; inversion mechanisms; examples of different types of laser; gas lasers, solid state optically pumped lasers, dye lasers, homojunction and heterojunction semiconductor diode lasers. Q switching; second harmonic generation. Optical modulators, electro-optic modulators, acousto-optic modulators. Light detectors, semiconductor diode detectors, Avalanche Photodiodes. Optical Fibres. Optical communications.

## Learning outcomes

By the end of the module, students should be able to:

- Explain the essential requirements for laser action in a material and be able to describe different types of laser
- Be able to describe an optical modulator
- Describe and compare the merits of different types of light detector
- Describe the properties of optical fibres which are important in an optical communications system

## Indicative reading list

Optoelectronics An Introduction, J. Wilson and J. F. B. Hawkes, Prentice Hall, 1989

View reading list on Talis Aspire

## Interdisciplinary

Physics has provided techniques and principles which are valuable to other sciences particularly optoelectronics. This module shows how the physics of electromagnetism, optics, semiconductors and thermodynamics are behind the design and operation of lasers in particular and optoelectronic devices generally.

## Subject specific skills

Knowledge of mathematics and physics. Skills in modelling, reasoning, thinking.

## Transferable skills

Analytical, communication, problem-solving, self-study

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## Study

## Study time

| Type | Required |
| --- | --- |
| Lectures | 15 sessions of 1 hour (20%) |
| Private study | 60 hours (80%) |
| Total | 75 hours |

## Private study description

Working through lecture notes, solving problems, wider reading, discussing with others taking the module, revising for exam, practising on past exam papers

## Costs

No further costs have been identified for this module.

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## Assessment

You do not need to pass all assessment components to pass the module.

### Assessment group B1

| | Weighting | Study time | Eligible for self-certification |
| --- | --- | --- | --- |
| **Assessment component** | | | |
| Online Examination<br>Answer 2 questions out of 3 | 100% | | No |

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- Online examination: No Answerbook required

**Reassessment component is the same**

### Feedback on assessment

Personal tutor, group feedback

Past exam papers for PX370

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## Availability

## Courses

This module is Option list A for:

- Year 3 of UPXA-F300 Undergraduate Physics (BSc)
- Year 3 of UPXA-F303 Undergraduate Physics (MPhys)
- Year 4 of UPXA-F301 Undergraduate Physics (with Intercalated Year)

This module is Option list B for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
    - Year 3 of G105 Mathematics (MMath) with Intercalated Year
    - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- Year 3 of UMAA-G100 Undergraduate Mathematics (BSc)
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
    - Year 3 of G106 Mathematics (MMath) with Study in Europe
    - Year 4 of G106 Mathematics (MMath) with Study in Europe
- Year 4 of UPXA-GF14 Undergraduate Mathematics and Physics (with Intercalated Year)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year
- Year 3 of UPXA-F303 Undergraduate Physics (MPhys)