3C43

LASERS
&
MODERN OPTICS

0 General Introduction

3C43 Lasers & Modern Optics

- Pre-requisites

  Knowledge of quantum and atomic physics to second year level e.g. 2B22, 2B24

- Aims

  To provide a useful and exciting course on lasers and modern optics with insight into non-linear processes and modern laser applications.

- Course structure
  - 32 hours of lectures including treatment of problems

- Assessment

  90% examination

  10% continuous assessment (4 problem sets)

Outline syllabus

1. Matrix optics [about 5 lectures]

- Application of matrix methods in paraxial optics
- Deriving system properties from the transfer matrix

2. Lasers [10]

- fundamental principles of laser action
- rate-equation analysis of model laser systems
- dynamic behaviour and temporal modulation
- examples of important laser systems:
  - ruby, dye, He-Ne, CO_2, NH_3, semi-conductor
- coherence concepts

3. Gaussian beams [5]

- modes of optical resonators,
- stability criteria,
- matrix analysis.

4. Electro-optics [5]

- the electro-optic, magneto-optic and acousto-optic effects,
- applications to amplitude modulation, phase modulation and switching.

5. Non-linear optics [5]

- the non-linear susceptibility
- phase-matching
- second-order non-linearities:
  - second-harmonic generation & sum-frequency mixing
- third-order non-linearities:
  - third-harmonic generation

Reading

1. Matrix optics

PP = Pedrotti & Pedrotti,
Introduction to Optics
(Prentice Hall) 2nd ed. pp. 62-86
H = Hecht, *Optics* (Addison Wesley),
pp. 247-57
G = Guenther, *Modern Optics* (Wiley),
pp. 138-48

2. Lasers

PP: pp. 426-55
H: pp. 580-95, 554-74
WH = Wilson & Hawkes,
Optoelectronics, an introduction,
pp. 169-289

3. Gaussian beams

PP: pp. 456-83
G: pp. 336-51

4. Electro-optics

PP: pp. 541-64
WH: pp. 90-112
G: pp. 569-615

5. Non-linear optics

PP: pp. 541-64
G: pp. 633-68

Course materials on the www

Course materials, including lecture notes and problem sheets will be made available on the internet, following the lectures in which they are introduced, at the URL:

http://lasercooling.phys.ucl.ac.uk/lectures/3C43