

OLLSCOIL NA hÉIREANN
GAILLIMH

NATIONAL UNIVERSITY OF IRELAND
GALWAY

SPRING EXAMINATIONS 2001

M.Sc. in BIOMEDICAL SCIENCE

EP514: Lasers and Applications II

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Time allowed : **Two** hours.

Answer three questions.

1. Give a brief account of the fundamental principles of laser operation. Illustrate your answer with reference to a specific laser of your choice. Give an account of the properties of a laser beam (beam profile, beam divergence, mode structure) and describe how the beam propagates once it leaves the laser head.
2. Lasers are sometimes classified, from the point of view of applications, according to the approximate scheme shown below.
 - (i) low-power passive
 - (ii) low-power active (the laser beam carries information in some way)
 - (iii) high-power : material processing.

Comment on this classification scheme for **either** (a) medical lasers **or** (b) industrial lasers, illustrating your answer with specific examples.

3. Give an account of the different mechanisms by which laser radiation interacts with biological tissue. Distinguish between the effects of continuous and pulsed radiation, and indicate why the effects depend on wavelength and pulse duration. Describe one experimental approach which has been used to monitor the effects which take place during the laser –tissue interaction.

[PTO]

4. Answer either (a) or (b)

(a) Give an overview account of the different therapeutic and diagnostic applications of lasers in medicine, and indicate clearly the type of laser used in each of the applications you describe. Describe also the methods used for beam delivery to the treatment site. Describe one application in detail.

(b) Give an overview account of the use of lasers for marking of products. Illustrate your answer with specific examples. What effects take place in the material during the marking process? Is a rise in temperature inevitable in the marking step? What are the advantages of using laser marking compared to conventional techniques?

5. List the thermo-physical material properties which are important in the application of high power lasers for material processing and indicate how these parameters are related in an energy balance description of laser cutting and welding. Write down and justify the energy balance equation used to describe laser cutting and use it to show that the quantity P/Vt is a constant for a given material and laser spot size, where P is the laser power, V is the workpiece speed, and t is the material thickness.

or

Give an account of the special properties of a laser beam compared to conventional light sources. In the case of any four of these properties, describe briefly at least one example in each case of an application in which that property is exploited. For one of these examples, give a detailed account of that application, with as much quantitative detail as possible.