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UNIVERSITY EXAMINATIONS 2023/2024

FOURTH YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN PHYSICS AND BACHELOR OF SCIENCE IN PHYSICS AND MATHEMATICS
AND
THIRD YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN PHYSICS AND BACHELOR OF SCIENCE IN PHYSICS AND MATHEMATICS

SPH 3355: LASER AND MASER PHYSICS

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Give the full meaning of LASER and MASER. (2 Marks)

b) List five properties that makes lasers be used for cutting materials. (5 Marks)

c) State what is meant by pumping action in lasers. Hence list four types of pumping. (5 Marks)

d) List the three main processes for laser action. (3 Marks)

e) What is population inversion? List the three conditions necessary for population inversion. (5 Marks)

f) What is a metastable state and how does it aid the laser action? (3 Marks)

g) Differentiate between a continuous and a pulsed laser. (2 Marks)

h) List five types of lasers and give one application for each type. (5 Marks)

QUESTION TWO (20 MARKS)

a) State and write a brief description of the four methods of pumping for lasers. (12 Marks)

b) State two types of lasers. For each

i. Describe the working principle

ii. Give one advantage and a disadvantage

iii. Give an application (8 Marks)

QUESTION THREE (20 MARKS)

a) List the three main processes for laser action. Hence give a brief description of each of them. (14 Marks)

b) Briefly describe two applications of lasers in the following areas

i. Medical

ii. Military

iii. Space exploration. (6 Marks)

QUESTION FOUR (20 MARKS)

a) A Nd:YLF amplifier operating at a wavelength of 1.047 µ,m was measured to provide an increase of a factor of 5 when a low-intensity probe beam was passed through it. A laser beam operating at the same wavelength with a pulse duration of 10 ns and an energy of 100 ml is then injected into the amplifier. What would be the output energy of the beam when it emerges from the amplifier? (10 Marks)

b) Determine the saturation energy of the following lasers:

(i) Nd:YAG at 1.06 ,um;

(ii) Ti:Ab03 at 800 nm;

(iii) ruby at 694.3 nm;

(iv) Nd:YV04 at 1.06 ,um. (10 Marks)