



MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER

**SCHOOL OF SCIENCE
BACHELOR OF SCIENCE**

COURSE CODE: PHY 429E

COURSE TITLE: INTRODUCTION TO LASERS

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES

1. Answer Question **ONE** and any other **TWO** questions
2. Use of sketch diagrams where necessary and brief illustrations are encouraged.
3. Read the instructions on the answer booklet keenly and adhere to them.

Question one (30 marks)

- a) Explain the following terms, you may use diagrams where necessary
- i) Absorption (2marks)
 - ii) Spontaneous emission (2marks)
 - iii) Excitation (2marks)
 - iv) Amplification (2marks)
 - v) Oscillator (2marks)
- b) Briefly explain the energy-matter interactions that results to laser production. (3marks)
- c) State any two criteria used in designating classes of lasers (2marks)
- d) Explain the three important characteristics that distinguish laser from normal light (6marks)
- e) What are the salient features of a confocal resonator (2marks)
- f) i. Explain how population inversion is attained in a four energy level laser system. (2marks)
- ii. State two advantages of a four energy level laser system as compared to three energy level laser systems (2marks)
- g) Explain the pumping process by electric current in diode lasers (3marks)

Question Two (20 marks)

- a) With comparison to electronic amplification, show that laser is an oscillation process. (10marks)
- b) Briefly describe the three principle elements of a laser (6marks)
- c) Show that the divergence angle of a Gaussian beam depends on λ and ω_0 (symbols have their usual meaning) (4marks)

Question Three (20 marks)

- a) State and briefly explain the applications of lasers (12marks)
- b) Differentiate between active and passive Q-switching (4marks)
- c) State the non-eye-safe classes of lasers (4marks)

Question Four (20 marks)

- a) Describe the two laser modes encountered in a laser cavity (4marks)
- b) Describe the working mechanisms of any four types of lasers. Give an example of each (8marks)
- c) Briefly describe the four resonator configurations (4marks)
- d) Show that the magnitude and location of waist w_0 are determined by the radius of curvature of cavity mirror (R_1 and R_2) and the distance between them (L). (4marks)