MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR FOURTH YEAR SECOND SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES
BACHELOR OF SCIENCE (PHYSICS)

COURSE CODE:PHY4251-1
COURSE TITLE: INTRODUCTION TO LASERS

DATE: 18/4/2024   TIME: 1100-1300 HRS

INSTRUCTIONS TO CANDIDATES

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i)   Answer Question **One** and **any Two** Questions in Section Two

ii)   Show all the workings clearly

iii)   Do not write on the question paper

SECTION ONE (20 Marks)

Question One

a. Differentiate between Spontaneous Emission and Stimulated Emission. (2 mks)
b. State and explain four characteristics of Laser Beams. (4 mks)
c. State and explain four types of Laser Resonators (4 mks)
d. In the stimulated emission for certain helium-neon laser the energy difference is 1.96ev. What is the wavelength emitted by the laser [5marks]
e. Lasers are now used in eye surgery. Given the wavelength of a certain laser is 5.14nm and the power of the laser is 1.7W how many photons are released if the laser is used for 0.05s during the surgery. [5marks]

SECTION TWO (30 Marks)

Question Two (15 Marks)

a. With the help of a well-labelled diagram, describe how an optical resonator works (6 Marks)
b. Calculate the ratio of the rates of spontanous and stimulated emission(R) for the light emitted by an electric discharge in a gas such as Neon in the Helium -Neon (He-Ne) Laser. If the discharge temperature is 370K for the red line produced by this laser, which has a frequency of 4.74x1014Hz.
[5 Marks]
c. The output of a laser has pulse duration of 30 ms and average output power of 1 W per pulse. How much energy is released per pulse if wavelength is 6600 Å? (4 Marks)

Question Three (15 Marks)

a. Which characteristic of LASER allows it to be used in holography? Explain (2 Marks)
b. In a Ruby Laser, which atom is responsible for the color of the Laser light? (1 Mark)
c. What is population inversion? (2 Marks)
d. Using well-labelled diagrams, describe the working principle of Lasers (5 Marks)

e. Calculate the maximum value of the work function of a photocathode which could be used in a photomultiplier to detect green line of the He-Ne laser of wavelength of 543.5 nm. [5marks]

Question Four (15 Marks)

a. Laser light from a 2mW source of aperture diameter 1.5 cm and wavelength 5000 Å is focused by a lens of focal length 20 cm. What is the intensity of the Image? (4 Marks)

b. Explain the difference between temporal and spatial coherence. (4 Marks)

c. Calculate the ratio of population numbers (N1,N2) for the two energy levels E2 and E1 when the material is at room temperature (3000K), and the difference between the energy is 0.5eV.What is the wavelength of a photon which will be emitted in the transition from E2 and E1?. [7 Marks]