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**KIBABII UNIVERSITY**

**MAIN UNIVERSITY EXAMINATIONS**

**ACADEMIC YEAR 2021/2022**

**SECOND YEAR SECOND SEMESTER EXAMINATIONS**

**BACHELOR OF SCIENCE**

**COURSE CODE: SPC 221**

**COURSE TITLE: PHYSICAL OPTICS**

**DATE: 13/05/2022**

**TIME: 9:00AM-11:00AM**

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**INSTRUCTIONS TO CANDIDATES**

**Answer question ONE and any TWO of the remaining.**

**Time: 2 hours**

**KIBU observes ZERO tolerance to examination cheating**

### **QUESTION ONE (30 MARKS)**

- a) Define Physical optics (2 marks)
- b) State the difference between Physical optics and Geometric optics (2 marks)
- c) Define following terms:
- i) a wave (1 mark)
  - ii) wavelength (1 mark)
  - iii) amplitude (1 mark)
  - iv) harmonic function (1 mark)
  - v) a phase (1 mark)
  - vi) Phase constant (1 mark)
  - vii) sinusoidal wave (1 mark)
  - viii) wave number (1 mark)
  - ix) wave speed (1 mark)
- d) What are coherent sources of waves (2 marks)
- e) Differentiate between polarized and unpolarized light (2 marks)
- f) What are wavefronts (1 mark)
- g) State any two uses of X-rays (2 marks)
- h) State three important qualities of fibre optic materials (3 marks)
- i) Name any three medical applications of lasers (3 marks)
- j) State Fermat's principle (2 marks)
- k) State any two merits of an optical fibre (2 marks)

### **QUESTION TWO (20 MARKS)**

- a) Explain why two flashlights held close together do not produce an interference pattern at a distant screen? (3 marks)
- b) Young's experiment is performed with sodium light of wavelength of 589nm. Fringes are measured carefully on a screen 100 cm away from the double slit and the center of the 20<sup>th</sup> fringe is found to be 11.78nm from the axis. Determine the separation of the two slits (5 marks)
- c) Discuss how ultra-violet rays are produced, their uses and dangers (12 marks)

### **QUESTION THREE (20 MARKS)**

- a) Why is the lens on a good quality camera coated with a thin film? (3 marks)
- b) In Newton's rings experiment the radius of curvature of the lens is 5.0 m and its diameter is 2.0 cm. Determine:
- (i) how many dark rings are produced? (3 marks)
  - (ii) how many dark rings would be seen if the arrangement was immersed in water of refractive index 1.33 (Assume the wavelength of light used is 589 nm) (3 marks)

- c) Using Red light, state the effect of the following procedure on the appearance of the fringes
- i) The separation distance of the slit is decreased (1 mark)
  - ii) The source slit is moved closer to the two slits (1 mark)
  - iii) the screen is moved closer to the slit (1 mark)
  - iv) blue light is used in place of the red light (2 mark)
  - v) one of the slit is covered up (1 mark)
  - vi) the source slit is made wider (2 marks)

**QUESTION FOUR (20 MARKS)**

- a) Distortion in an optical fibre arises due to dispersion effects. State any three mechanisms which contribute to the distortion in the light pulse in a fibre (3 marks)
- b) Optical fibres have many advantageous features which are not found in conducting wire. Highlight any six merits of an optical fibre. (6 marks)
- c) A glass clad fibre is made with core glass of refractive index 1.5 and cladding is doped to give a fractional index difference of 0.0005. Find:
  - i) The cladding index. (3 marks)
  - ii) The critical internal reflection angle. (3 marks)
  - iii) The external critical acceptance angle. (3 marks)
  - iv) The numerical aperture. (2 marks)

**QUESTION FIVE (20 MARKS)**

- a) Name the five major categories of lasers? (5 marks)
- b) A laser beam of intensity  $50 \text{ W/m}^2$  falls on a perfectly reflecting plane mirror for an hour. The area of the mirror is  $0.5 \text{ cm}^2$ . Calculate:
  - i) Momentum imparted to the mirror in this time. (3 marks)
  - ii) Average force acting on this mirror (3 marks)
- c) Discuss defense applications of lasers (9 marks)