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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**

**FACULTY OF SCIENCE**

 **OCTOBER/NOVEMBER 2016 EXAMINATION**

**COURSE CODE: PHY406 COURSE TITLE: OPTICS III CREDIT UNIT : 3**

 **TIME: : 3 HOURS**

**INSTRUCTION: Answer question 1 and any other four questions.**

*1.(a)(i)Briefly explain the concept of stimulated emission* ***5 marks***

*(ii) Name four types of laser* ***2 marks***

*(b)(i) The absolute temperature, , for an ordinary source of light is typically of the order of K. Show that in such sources, the process of spontaneous emission will dominate over the stimulated emission.* ***5 marks***

*(ii) Mention four ways of pumping a laser and achieving the population inversion necessary for stimulated emission to occur* ***2 marks***

*2.(a)(i) What is holography?* ***3 marks***

*(ii) Briefly explain the process of image formation by holography* ***5 marks***

*(b) (i)Mention four applications of holography* ***2 marks***

*(ii) If the angle subtended at the hologram by the signal and the reference beam is 15°, what is the spacing of the fringes provided the wavelength is 492 nm?* ***4mark***

*3.(a)(i) Suppose you have two optical fibres A and B. The refractive indices of the core () and the cladding () materials is = 1.52, = 1.41, = 1.53, = 1.39. Which of the two fibres will have higher light gathering capacity?* ***5 marks***

*(ii) A step-index fibre m in diameter has a core of refractive index 1.53 and a cladding of refractive index 1.39. Determine the numerical aperture for the fibre and the acceptance angle (or maximum entrance cone angle).* ***4 marks***

*(b) Briefly discuss two applications of optical fibre* ***5 marks***

*4.(a)(i) Briefly explain the origin of the width of the spectral lines.* ***4 marks***

*(ii) If d is the distance through which one of the mirrors of Michelson interferometer has been moved obtain the equation for condition for disappearance of fringe pattern.* ***6 marks***

*(b) From your equation in 6(a)(ii) which gives the path difference, in terms of two distinct wavelengths  and , for which fringes will disappear, show that  which is for all wavelengths lying between  and.* ***4 marks***

*5. Write short notes on*

*(a) Optical pumping* ***4 ½ marks***

*(b) Optical resonant cavity* ***4 ½ marks***

 *(c) Power loss in optical fibres* ***5 marks***

*6. (a) (i ) Explain the term “coherence” as applied to sources of waves* ***2 marks***

*(ii) If light of 660 nm wavelength has a wavetrain  long, what are its coherence length and coherence time?* ***5 marks***

*(b)(i) What do you understand by the term areana* ***2 marks***

*(ii) If the visibility in an interference fringe pattern is 50 percent and the maxima receive 15 units of light, how much light do the minima receive?* ***5 marks***

*7.(a)(i) What is an optical fibre ?* ***3 marks***

*(ii) Briefly describe two types of optical optical fibre* ***4 marks***

*(b)(i) What will happen if the refractive index of the cladding material is higher than that of the core in an optical fibre?* ***2 marks***

*(ii) If the core and cladding refractive indices for a step-index fibre is 1.47 and 1.46 respectively, what will be the broadening of a pulse after a distance of 5 km?* ***5 marks***