Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	BIOMEDICAL OPTICS
COURSE CODE	:	BEU 41303
PROGRAMME	:	BACHELOR OF ELECTRONIC ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS ON THIS QUESTION BOOKLET

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 (a) Define Huygen's principle.

(4 marks)

(b) Name **TWO (2)** types of light reflection.

(4 marks)

(c) Total internal reflection (TIR) occurred when incoming light refracted at an angle larger than 90° upon arriving at the boundary of two media of different reflective index. The angle at which TIR starts is known as critical angle. Given that light travel from water into air, determine its critical angle.

(7 marks)

(d) Young's double slit experiment showed that light passes through a pair of closely spaced narrow slits would produce a pattern of alternating bright and dark fringes on a distant screen. Calculate the angle between the fifth dark fringe and its central maximum for Young's double slit experiment if the light wavelength, λ = 530 nm, spacing between the slits, d = 10 μm, and distance between the slits and screen, L = 1 m.

(7 marks)

Q2 (a) Compare between spherical aberration and comatic aberration.

(4 marks)

(b) With the help of a diagram, trace the ray's path and validate the formation of the image at the infinity if the object is placed at focal length, f_L = 2 cm, of a symmetrical positive thin lens.

(8 marks)

(c) Lens is made from glass of refractive index n, with radius of curvatures (R_1 and R_2). Calculate the focal length of the lens using Lensmaker formula given that n = 1.3, R_1 = 10 mm, R_2 = 5 cm.

(6 marks)

(d) An object is placed in front of two thin symmetrical coaxial lens (lens 1 and lens 2) with focal length f_1 = -20 cm and f_2 = -10 cm, with a lens separation of L = 15 cm. The object is 8 cm from lens 1.

(i) Calculate the location of the image.

(7 marks)

(ii) Evaluate the magnification of the image.

(6 marks)

Q3 (a) Name **TWO (2)** advantages of Photomultiplier Tube (PMT) compared to P-type intrinsic N-type (PiN) photodiode.

(4 marks)

(b) List **THREE (3)** differences between Complimentary Metal Oxide Semiconductor (CMOS) and Charge Coupled Detector (CCD).

(6 marks)

(c) Quantum efficiency is a parameter used to describe number of electron produced per number of photon absorbed. Given that a P-type intrinsic N-type (PiN) detector has a quantum efficiency of 15% at a wavelength of 680 nm. At a wavelength of 850 nm, the responsivity is triple the responsivity at 680 nm. Calculate the quantum efficiency of this detector at 850 nm.

(6 marks)

(d) A P-type intrinsic N-type (PiN) photodiode has dynamic range value of 110dB and noise floor of 1μV(rms). Determine the maximum signal value (in *Vrms*) of this device.

(7 marks)

Q4 (a) Discuss the working principle of Light Amplification by Stimulated Emission of Radiation (LASER).

(6 marks)

(b) One of the keys to the operation of a laser is stimulated emission process in an active medium. Given that in the stimulated emission for a certain helium/neon laser, the energy difference is 1.54 eV. Calculate the wavelength of light emitted by this laser.

(8 marks)

(c) Optics is a branch of physics which involves the study of the behaviour and properties of light interacting with matter and the construction of instruments that use or detect it. In your own words and using a simple diagram (if any), summarize the working operation of an optical system in medical field **other than** endoscope and pulse oximetry.

(10 marks)

- END OF QUESTION -