MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

THIRD YEAR *FIRST* SEMESTER

SCHOOL OF SCIENCE
BACHELOR OF EDUCATION SCIENCE AND BACHELOR OF SCIENCE

COURSE CODE: PHY 312

COURSE TITLE: OPTICS

DATE: 4TH MAY 2018 **TIME: 11:00-1:00 PM**

INSTRUCTIONS TO CANDIDATES

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

Important Constants

Speed of sound in air =340m/s

Speed of light in vacuum (c) =3.0×10^{8} *m/s*

Acceleration due to gravity (g) =9.80 m/s^2

SECTION A (30 MARKS)

1. a.Define the following terms
   (i) Path difference
   (ii) diffraction **(2marks)**

   b. state the conditions for interference **(2marks)**

   c. In Young's double-slit experiment, why do we use monochromatic light? if white light is used,how would the pattern change? **(2marks)**

   d. A double slit has a separation of 0.5mm between centers is illuminated with yellow light from cadmium-arc lamp of wavelength $4799.91\text{x}10^{-10}$ m. how far behind the slits must one go in order to measure the distance y to be 1mm(refer the diagram in question **(4 marks)**

   e. (i) In Michelson interferometer, three conditions are essential to obtain interference fringes. State them. **(3 marks)**

   (ii) Through what distance must the movable mirror of a Michelson interferometer be displaced for 2500 fringes of red cadmiums line to cross the center of the field of view given that the wavelength of the source is $6438\text{x}10^{-10}$ m **(5 marks)**

   f. Explain the concept of polarization as used in waves **(3mks)**

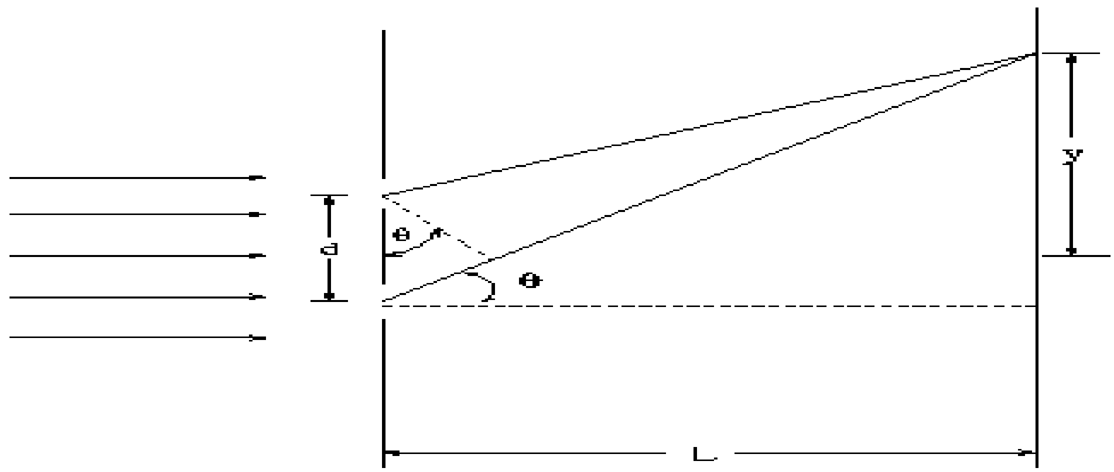
   g. light of wavelength 580nm is incident on a slit having a width of 0.3mm. The viewing screen is 2.0 m from the slit. Find the position of the 1^{st} dark fringe and the width of the central bright fringe. What if the width is increased by an order of magnitude to 3.0 mm. What happens to the diffraction pattern? **(6 marks)**

   h. What is resolution is as applied to diffraction? Use a diagram to illustrate. **(3 marks)**

SECTION B (40 MARKS)

2. a. Define the term interference. **(1 marks)**

b. suppose two light waves s1 and s2 arrive at point p after passing through the two slits as shown below,



Show that the condition for maximum intensity is when $\delta = m2\pi$ on the screen placed L mitres behind the two slits and also when $\Delta = m\lambda$. Also show that minimum intensity occurs when $\delta = (m+1)\,\pi$ and $\Delta = (m + \frac{1}{2})\lambda$ **(7 marks)**

b. A thin film of thickness 0.00325 cm forms bright fringes with light of wavelength of 6500×10^{-10}m. find the order of interference if the light is incident on the film at an angle $\phi = 0^0$ and the first two angles of refraction ϕ' at which bright fringes will appear (let n=1.3) **(5 marks)**

c. (i) Define Newtons rings **(2 marks)**

(ii) The radius of curvature of the convex surface of plano convex lens is 30 cm. this lens is placed with the convex surface on a glass plate. The system is illuminated from above with light of $\lambda = 6500 \times 10^{-10}$m. find the diameter of the third bright ring. (n=1.4) **(5 marks)**

3. Show that for a single slit diffraction the condition for destructive interference is given by $\sin\vartheta = \frac{m\lambda}{a}$ where m = 0, 1, 2, 3…. **(5 marks)**

b. (i)show that the conditions for constructive and destructive interference in thin film are given by $2nt = \left(m + \frac{1}{2}\right)\lambda$ and $2nt = m\lambda$ where m = 0,1, 2, 3…. **(5 marks)**

(ii) calculate the minimum thickness of a soap bubble film (n= 1.46) that will result in constructive interference in the reflected light if the film is illuminated with light whose wavelength in free space is 600nm.. **(5 marks)**

c) Light of wavelength 500 nm, near the center of the visible spectrum, enters a human eye. Although pupil diameter varies from person to person, assume a daytime diameter of 2 mm.

(i) Estimate the limiting angle of resolution for this eye, assuming its resolution is limited only by diffraction.

(ii) Determine the minimum separation distance *d* between two point sources that the eye can distinguish if the point sources are a distance L = 25 cm from the observer **(5 marks)**

4. a. Show that in Fraunhoper diffraction, the intensity of the interference pattern observed on a screen placed far from slit is given by $I = {A^2}_0 \frac{sin^2\beta}{\beta^2}$ and reduces away from central fringe. **(10 marks)**

b. Parallel light of λ= $6563\text{x}10^{-10}$m is incident on a slit of width 0.385mm. A lens of focal length 50 cm is located just behind the slit to focus the diffraction pattern on the screen. Find the distance from the center of the principle max;

i) to 1^{st} min

ii) to 5^{th} min **(6 marks)**

b) Plane waves of blue light of λ= $4340\text{x}10^{-10}$m fall on a slit, then passes through a lens of focal length 80 cm. If the central max of diffraction has a width of 3.45mm, find the width of the slit. **(4 marks)**