



**Mansoura University**  
**Faculty of Engineering**  
**Mechatronics Engineering Program**



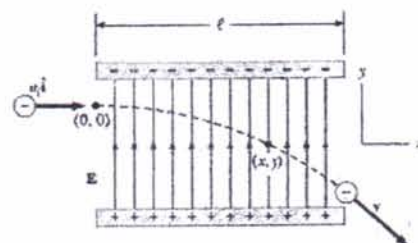
<b>Course Title:</b> Physics-2	<b>Course Code:</b> PHYS012	<b>Level:</b> 000 MTE
<b>Date:</b> 24 August 2019	<b>Allowed Time:</b> 2 hours	<b>Total Marks:</b> 50 Marks
<b>summer Semester</b>	<b>Final Term Exam</b>	<b>No. of Pages:</b> 2 pages

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2, k = 9 \times 10^9 \text{ N.m}^2/\text{C}^2, e = 1.6 \times 10^{-19} \text{ C}, m_e = 9.11 \times 10^{-31} \text{ Kg}$$

**Question (1) [25 marks]**

(a) Derive the electric field due to an infinite line charge distribution. [5 marks]

(b) An electron enters the region of a uniform electric field as shown in Figure, with  $v_i = 4 \times 10^6 \text{ m/s}$  and  $E = 911 \text{ N/C}$ . The horizontal length of the plates is  $\ell = 0.2 \text{ m}$ . (i) Find the acceleration of the electron while it is in the electric field. (ii) Assuming the vertical position of the electron as it enters the field is  $y = 0$ , what is its vertical position when it leaves the field?



[5 marks]

(c) A cylindrical shell of radius **7 cm** and length **3 m** has its charge uniformly distributed on its curved surface. The magnitude of the electric field at a point **20 cm** radially inward to its axis (measured from the midpoint of the shell) is **60 kN/C**. Find (i) the net charge on the shell and (ii) the electric field at a point **4 cm** from the axis, measured radially outward from the midpoint of the shell. [5 marks]

(d) Two spherical conductors of radii **1 cm** and **3 cm** are separated by a distance much greater than the radius of either sphere. The spheres are connected by a conducting wire. A total charge of **40  $\mu\text{C}$**  is placed on this combination of the two spheres. Calculate the electric potential at the surfaces of the spheres. [5 marks]

(e) Electronic flash units for cameras contain a capacitor for storing the energy used to produce the flash. In one such unit, the flash lasts for  $\frac{1}{675} \text{ s}$  with an average light power output of  **$2.7 \times 10^5 \text{ W}$** . (i) If the conversion of electrical energy to light is **80%** efficient (the rest of the energy goes to thermal energy), how much energy must be stored in the capacitor for one flash? (ii) The capacitor has a potential difference between its plates of **100 V** when the stored energy equals the value calculated in part (i). What is the capacitance? [5 marks]

**Question (2)** [25 marks]

- (a) Derive the formula for the acceptance angle for a step index optical fiber. [5 marks]
- (b) A beam of light is incident at the polarizing angle on a plate of flint glass ( $n = 1.6$ ).  
(i) What is angle of refraction? (ii) What is the speed of light in flint glass?  
Taking  $c = 3 \times 10^8$  m/s. [5 marks]
- (c) A soap bubble ( $n = 1.3$ ) is illuminated by white light. The soap film is 300 nm thick. Find the dominant observed color in the reflected light. (The visible light wavelength band is from 400 nm to 700 nm). [5 marks] (من فضلك وضع اجابتك بالرسم)
- (d) When a liquid is introduced into the space between the lens and the plate in Newton's-rings arrangement, the radius of the **tenth dark** ring decreases from 1.5 cm to 1.3 cm. What is the refractive index of the liquid? [5 marks]
- (e) Unpolarized beam of light is sent into a system of three polarizing sheets whose polarizing directions makes angles of  $\theta_1 = 0^\circ$ ,  $\theta_2 = 45^\circ$ ,  $\theta_3 = 90^\circ$  with the vertical.  
(i) What percentage of the light's initial intensity is transmitted by the system? [4 marks] (من فضلك وضع اجابتك بالرسم)  
(ii) If  $\theta_1 = \theta_2 = \theta_3 = 45^\circ$ , what percentage of the light's initial intensity is transmitted by the system? [1 mark]  
[5 marks]