UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: FGE 1324
COURSE TITLE	: PHYSICS II
SEMESTER/SESSION	: 2-2024/2025 (JULY)
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 8 PRINTED PAGES INCLUDING COVER PAGE

INSTRUCTION : ANSWER **ALL** QUESTIONS

QUESTION 1

a) Three charges are arranged as shown in Figure 1. Point P is located at the middle between 3.00 nC charge and 2.00 nC charge. Calculate the magnitude and direction of force on 6 nC charge. (10 marks)

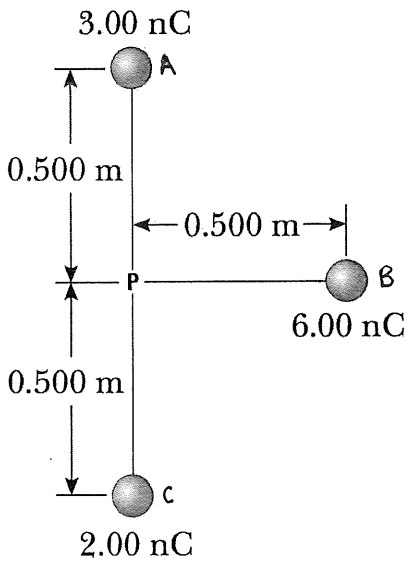

Figure 1

b) A potential difference between two large parallel metal plates is 120 V. The plate separation is 3.0 mm. An electron is released at negative plate at rest.

i. Calculate, electric field between the plates. (2 marks)

ii. Calculate different in potential energy for electron. (3 marks)

iii. Calculate, velocity of electron ($q = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg) released at negative plate before it hits the positive plate. (3 marks)

c) A proton is released from rest at x = -2.00 cm in a constant electric field with magnitude 1.5 x 10^3 N/C, pointing in the positive x-direction. Calculate the change in the electric potential energy and change in kinetic energy associated with the proton when it reaches x = 5.00 cm. (4 marks)

QUESTION 2

a) For a given a circuit in Figure 2 :-

i) Determine simplest equivalent circuit. (6 Marks)

ii) Calculate, total current in the circuit. (2 Marks)

iii) Calculate potential difference V_{de}. (2 Marks)

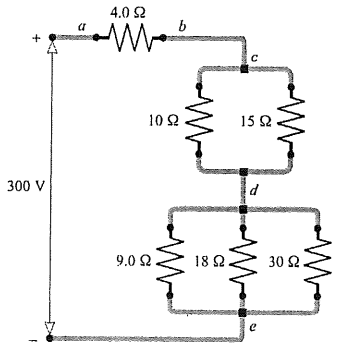

Figure 2

b) Using Kirchoff rule for circuit in Figure 3. If switch, S is closed, calculate current for I_1 , I_2 and I_3 . (7 marks)

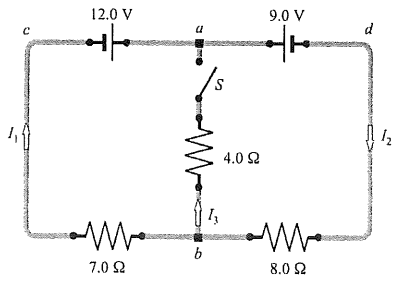

Figure 3

c) A DC circuit designed as in Figure 4. If the operating voltage between a and b is 12 V. Calculate the total power consumption of the circuit. (5 Marks)

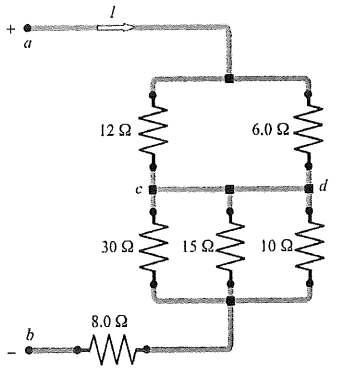

Figure 4

QUESTION 3

a) Define the following terms

i. Alternating current. (2 marks)

ii. Impedance. (2 marks)

iii. Phase angle. (2 marks)

b) A 500 Ω resistance is in a series circuit with a 0.200 H pure inductance and a 40.0 nF pure capacitance. The combination is placed across a 30.0 V, 500-Hz power supply. Calculate :-

i) Total current in the circuit. (6 Marks)

ii) Phase angle between source voltage and current. (2 Marks)

iii) Voltmeter reading across each element of the circuit. (3 Marks)

c) A RLC component connected in series is used to tune to a specific frequency of 50 Hz. Given the value of resistance, R = 5 Ω , inductance, L = 0.01 H and a variable capacitor C. The circuit is connected to a 10 V power supply in series. Calculate :-

i. Value of capacitance, C, so that the circuit is tuned to the frequency. (3 Marks)

ii. Current flowing inside the circuit at tuned frequency. (2 Marks)

QUESTION 4

a) Define the following terms

i. Light reflection. (2 marks)

ii. Light refraction. (2 marks)

b) A glass plate is 0.60 cm thick and has a refractive index of 1.55. Calculate time for a pulse of light to pass through the plate. (4 marks)

c) Light of wavelength 589 nm in vacuum passes through a piece of fused quartz of index of refraction n = 1.458. Calculate :-

i. Wavelength and frequency of this light in fused quartz. (4 marks)

ii. Speed of light in fused quartz. (2 marks)

d) A light beam traveling through a transparent medium (Figure 5) of index of refraction n_1 passes through a thick transparent slab with parallel faces and index of refraction n_2. Show that the emerging beam is parallel to the incident beam. (8 marks)

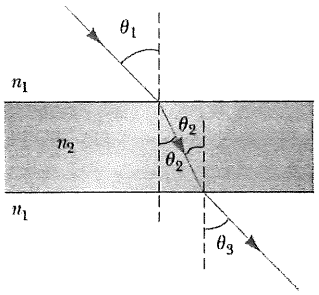

Figure 5

e) Two mirrors, M1 and M2 make an angle of 120° with each other, as in Figure 6. A ray is incident on mirror M1 at an angle of 65° to the normal.

i. Determine, the ray deflection on both mirror M1 and M2. (redraw the rays in your answer booklet) (2 marks)

ii. Calculate all incident and reflection angle in both mirrors (4 marks)

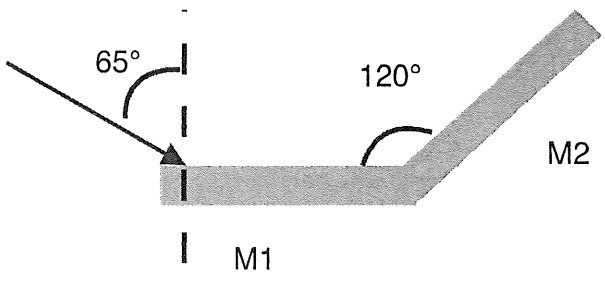

Figure 6

f) A rectangular glass block (index n_1 = 1.2) is coupled with semi-cylindrical glass block (index n_2 = 1.7) as in figure 7. The incident light beam enter the rectangular glass block at 20° and the refracted beam exit at the centre of semi-cylindrical glass block and be refracted again by the semi-cylindrical glass block and forming an image at the screen. Determine location of the beam at the screen.

(6 marks)

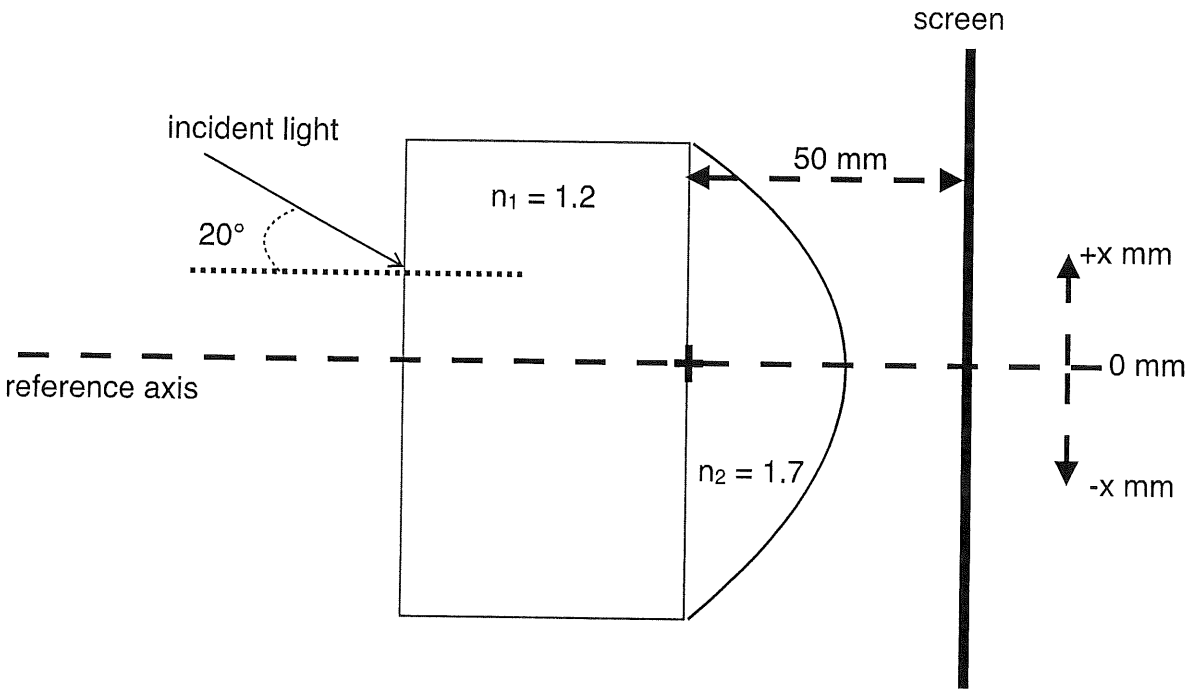

Figure 7

**********END OF QUESTIONS**********

TOTAL MARKS = 100

APPENDICES

Electrical charges

$$F=\frac{k_e q_1 q_2}{r^2} \qquad \Delta PE+\Delta KE=0 \qquad \Delta PE=W_{AB}=-qE_x\Delta x$$

where $\Delta x=x_f-x_i$ $\Delta PE=W_{AB}=qE_x\left(x_f-x_i\right)$

$$\Delta KE=\frac{1}{2}mv_f^2-\frac{1}{2}mv_i^2=\frac{1}{2}m\left(v_f^2-v_i^2\right)$$

Electric potential / field between 2 plates $\Delta V=-\frac{\Delta KE}{q}=-E\Delta x$

Electric field by point charge $E=\frac{k_e q}{r^2}$

AC CIRCUIT

$X_c=\frac{1}{2\pi fc}$, $X_L=2\pi fL$, $Z=\sqrt{R^2+(X_L-X_C)}$

phase angle $\phi=\mathrm{Tan}^{-1}\left(\frac{X_L-X_C}{R}\right)$

resonans frequency $f_o=\frac{1}{2\pi}\sqrt{\frac{1}{LC}}$

DC CIRCUIT

V = IR

P = IV = I^2R = V^2/R

Optic Principle

Snell's rule $n_1\sin\theta_1=n_2\sin\theta_2$

$n=\frac{\text{speed of light in vaccum}}{\text{speed of light in medium}}=\frac{c}{v}$ $\lambda_1 n_1=\lambda_2 n_2$