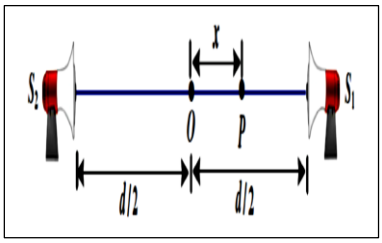
Tanta University

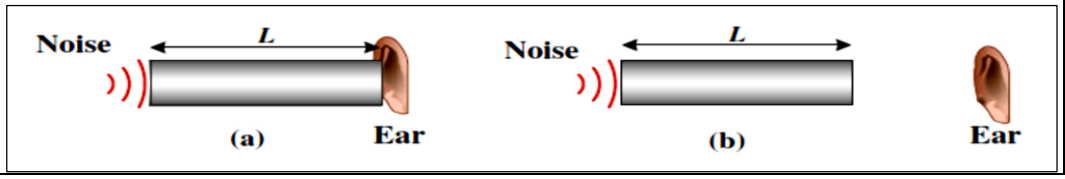
Energy and Electrical Systems Engineering Program
Mechatronics Engineering Program
Total Marks: **(50) Marks**
Final Exam

Faculty of Engineering

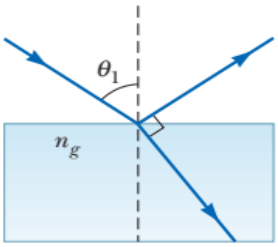
Course Title: Engineering Physics (3)	**Course Code:** EMP X43	**Year:** 2023/2024
Date: 25th of May 2024	**Allowed time:** (120) Min.	**No. of Pages:** (2)

Question No. 1 :(25) Marks

(A)	The wave function for a traveling wave on a taut string is (in SI units) $y(x, t) = 0.35 \sin(10\pi t - 3\pi x + \pi/4)$. **(1)** What are the speed and direction of travel of the wave? **(2)** What is the vertical position of an element of the string at $t = 0, x = 0.1$ m? What are **(3)** the wavelength and **(4)** the frequency of the wave? **(5)** What is the maximum transverse speed of an element of the string?	**4 Marks**
(B)	By measurement you determine that sound waves are spreading out equally in all directions from a point source and that the intensity is at $0.0026\ W/m^2$ a distance of **4.3 m** from the source. **(1)** What is the intensity at a distance of **3.1 m** from the source? **(2)** How much sound energy does the source emit in one hour if its power output remains constant?	**4 Marks**
(C)	At a frequency of **1,000 Hz,** the human ear can detect the loudest and faintest sounds with intensities of about $1.0\ W/m^2$ and $1.0 \times 10^{-12}\ W/m^2$, respectively. For sound waves traveling with a speed of $v = 343$ m/s, find the pressure amplitude ΔP_{max} for the faintest and the loudest sound waves, assuming the air's density is $\rho = 1.21\ kg/m^3$	**4 Marks**
(D)	prove that: the speed of sound in ideal gas is equal to $v = \sqrt{\gamma RT/M}$ where T is the Kelvin temperature, M is the molar mass, and R is gas constant where $\gamma =$ is the ratio of the specific heat capacity at constant pressure to the specific heat capacity at constant volume	**4 Marks**
(E)	Two identical speakers, S_1 and S_2, are placed horizontally at a distance $d = 2$m apart. Each emits sound waves of wavelength $\lambda = 80$ cm driven by the same oscillator. A listener is originally located at point O, which is midway between the two speakers. The listener walks to point P, which is a distance x from O, and reaches the first minimum in sound intensity. **Find x.** 	**3 Marks**
(F)	The siren is moving away from the listener with a speed of **45 m/s** relative to the air, and the listener is moving toward the siren with a speed of **15 m/s** relative to the air. What frequency does the listener hear? Given that $f_S = 300$ **Hz and the speed of sound is 340 m/s**	**3 Marks**

(G)	A background noise in a hall sets up a fundamental standing wave frequency in a tube of length L=0.7m. What is the value of this fundamental frequency if your ear blocks one end of the tube and when your ear is far from the tube Take v=343 m/s as the speed of sound in air.  	3 Marks

Question No. 2 :(25) Marks

(A)	In the corresponding figure, a ray of light falls from the air onto the surface of the Glass, and the refracted ray is perpendicular to the reflected ray. **Calculate the value of the incident angle, θ_1 and refracted angle ϕ_1 (note sin (90-ϕ) = cosθ), n_g=1.5.**  	5 Marks
(B)	Coherent light of frequency 6.32×10^{14} Hz passes through two thin slits and falls on a screen **85.0 cm away.** You observe that the **Fourth bright fringe** occurs at $\pm$3.11 cm on either side of the central bright fringe. (1) How far apart are the two slits? (2) At what distance from the central bright fringe will the **third dark fringe** occur?	5 Marks
(C)	We wish to coat flat glass (n = 1.5) with a transparent material (n =1.6) so that reflection of light at wavelength 550 nm is **eliminated** by interference. **Find (1) least and (2) second least thicknesses of the film can the coating have to do this?**	5 Marks
(D)	A two-slit Fraunhofer interference–diffraction pattern is observed using light that has a wavelength equal to **500 nm.** The slits have a separation of **0.1 mm** and an **unknown width. (1) Find the width** if the **Fourth interference maximum** is at the **same angle as the first diffraction minimum. (2)** For that case, how many bright interference fringes will be seen in the central diffraction maximum?	5 Marks
(E)	Using drawing and mathematical equations discuss in details : 1- **Intensity of Double-Slit Diffraction Patterns.** 2- **Polarization by Scattering.**	5 Marks

End of questions

Best wishes: Prof. Hatem Fouad & Assoc. Prof. Ayman Rabie