



University of Ruhuna- Faculty of Technology
Bachelor of Engineering Technology Honours
Level 1 (Semester II) Examination, December 2025
Academic year 2023/2024

Course Unit: ENT1253/TMS 1253 Engineering Properties of Matter (Written)
Duration: 03 hours



- Answer all the questions.
- All answers should be in appropriate units to earn full marks.

1)

- I. Briefly explain the Bernoulli's principle. (04 marks)
- II. The speed of the air across the top of an airplane wing is 251 m/s while the speed of the air below that wing is 225 m/s. Compute the lifting force on the airplane wing which has an area of 24 m². (Assume that the density of air is 1.29 kg/m³) (08 marks)

2)

- I. A metal rod with an initial length L_0 , at a starting temperature T_i is heated to final temperature T_f . Given that the coefficient of linear expansion of the material of the metal rod is α , the temperature difference $\Delta T = T_f - T_i$ and the change in the length ΔL , derive an equation for the linear thermal expansion for the final length L_f of the rod in terms of L_0 , α , and ΔT . (04 marks)
- II.
 - a) A steel railroad track has a length of 35 m at the temperature of 0°C. Calculate its length on a hot day with a temperature of 30.0°C? (Assume that the coefficient of linear expansion α is $11 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ for the material). (04 marks)
 - b) Suppose the railroad track is nailed down so that it can't be expanded. Calculate the amount of applied stress results on the track due to the temperature change? (Assume that the Young's modulus of the track is $1.9 \times 10^{11} \text{ Pa}$). (04 marks)

3)

I. Tabulate the differences between the longitudinal waves and transverse waves. (02 marks)

II.

a) A steel wire of 1.00 m in length has a 1.80×10^{-3} kg/m mass per unit length. The wire is under the tension of 70N. Calculate the speed of the waves on the wire. ($V = \sqrt{T/\mu}$). (02 marks)

b) Find the frequencies of the fundamental, second, and third harmonics of the waves produced by the steel wire. (04 marks)

c) Evaluate the wavelengths of the sound waves created by the vibrating wire for fundamental, second, and third harmonics. Assume that the speed of sound in air is 345 m/s. (04 marks)

4)

I. Write four applications of Doppler effect. (04 marks)

II. A submarine (sub-A) travels through water at a speed of 7 m/s, emitting a sonar wave at a frequency of 1400 Hz. The speed of sound in the water is 1533 m/s. A second submarine (sub-B) is located such that both submarines are traveling directly toward each other. The second submarine is moving at 10 m/s. (Hint: $f' = ((v \pm v_o)/(v \pm v_s)) \times f$).

a) What frequency is detected by an observer riding on sub-B as the submarines approach each other? (04 marks)

b) The submarines barely miss each other and pass. What frequency is detected by an observer riding on sub-B when it is moving away from sub-A? (04 marks)

5)

I. Draw the ray diagram for an object which is located in between a convex lens and the focal point of the convex lens. (02 marks)

II. A convex lens has a focal length of 10 cm, and an object is placed in front of this lens at an object distance of 25 cm. Determine the image distance for the image formed by the lens and describe the properties of this image. (Hint: $1/f = 1/d_o + 1/d_i$, $M = -d_i/d_o$) (04 marks)

III. An object of 2 cm height is held 7 cm from the focal point of a concave mirror. The focal length is 4 cm.

a) Draw a ray diagram for this scenario. (04 marks)

b) Is the image formed on the same or opposite side of the mirror as the object? (02 marks)