Thesis Title	Experimental Set for Measurement of Fluid Flow Rate using Laser Doppler Method
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Candidate	Flt.Lt. Chatchalong Apiputikul
Thesis Advisor	Asst. Prof. Dr. Kheamrutai Thamaphat
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Department	Physics
Faculty	Science
B.E.	2555

Abstract

The objectives of this research were to design and construct a cost effective and easy module for measurement of fluid flow rate using laser Doppler anemometry (LDA). Generally, LDA can be classified into 3 types: reference beam, single beam, and dual beam methods. In this work, dual beam method was used to determine the water flow rate. A He-Ne laser with a wavelength of 632.8 nm was used as a light source. The laser was passed through a beam splitter and divided into two beams with identical intensity and coherence. Subsequently, the two laser beams travelled to a focusing lens with a focal length of 100 mm and were focused on a center of water flow channel in quartz aqueduct with a dimension of $1 \times 1 \times 5$ cm^3. The beam angle was set as 4.96°. Tap water with a temperature of 26 ± 1 °C was used as a sample. When the seeding particles (bubbles and microorganism) in water moved through the intersection point of two beams, the light was scattered. The scattered light was collected by photodetector connected to analysis and processing unit. The frequency of scattered light is shifted according to the Doppler shift relations due to effect of Rayleigh scattering. The data of Doppler shift frequency and its corresponding water flow rate was taken in the experiment. Then, the plot between the Doppler frequency (f_D) and the flow rate (Q) showed the linear relationship with the line of best fit ($R^2 = 0.993$) given by $Q = 0.630\, f_D$. To check the accuracy of this proposed system, three flow rate values were set at 26.728, 26.781 and 27.271 mL/s. The calculated flow rates obtained by substituting measured Doppler frequency into calibration curve equation were 26.749, 26.804 and 27.298 mL/s, respectively. The errors were 0.079%, 0.086% and 0.099% respectively. The results indicated that this developed system has a

high accuracy and it can be applied to measure the fluid flow rate in laboratory scale or industry. Furthermore, the constructed experimental set can be used to demonstrate physics principle such as fluids mechanics and optics for high school students and undergraduates.

Keywords : Doppler Frequency / Dual Beam / Flow Rate / Laser Doppler / Physics Education