ABSTRACT

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Function $f(x)$ defined in interval $(-L, L)$, periodic function with period $2L$, and piecewise continuous in its interval, can be expressed in the Fourier Series form as follows

$$a_0 + \sum_{n=1}^{\infty} \left(a_n \cos \frac{n\pi}{L} x + b_n \sin \frac{n\pi}{L} x \right),$$

$$a_0 = \frac{1}{2L} \int_{-L}^{L} f(x)\,dx, \quad a_n = \frac{1}{L} \int_{-L}^{L} f(x) \cos \frac{n\pi x}{L}\,dx, \quad \text{and} \quad b_n = \frac{1}{L} \int_{-L}^{L} f(x) \sin \frac{n\pi x}{L}\,dx$$

for n is a positive integer.

An important theorem discussed in this thesis is a theorem about convergence of Fourier series. The theorem defined that the Fourier series of $f(x)$ that have period 2π, piecewise continuous in interval $-\pi \le x \le \pi$, and left derivative and right derivative of $f(x)$ at each point in the interval exist converges to $f(x)$ if x is continuity point, and converges to $\frac{f(x_+) + f(x_-)}{2}$ if x is discontinuity point.

This study discussed the use of the Fourier series in physics, particularly forced oscillations, heat conduction, and string vibration. Ordinary differential equation from forced oscillations is of the form $m\,y'' + c\,y' + k\,y = F(t)$, $F(t)$ is a piecewise continuous function in an interval. It is second order nonhomogeneous linear differential equation with constant coefficients. In the forced oscillations, the Fourier series is used to represent the external force $(F(t))$ acting on a spring-mass system so it is obtained the solution of ordinary differential equation from forced oscillations. Partial differential equation from heat conduction is of the form $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$. Moreover, partial differential equation from string vibration is of the form $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$. In the heat conduction and string vibration, the Fourier series is used to decide the solution for two ordinary differential equations in which the equations are obtained from product of two functions method, so it is obtained the solution of the boundary value problem in the partial differential equation from the heat conduction and string vibration.