# 國立成功大學

# 112學年度碩士班招生考試試題

編　號：179、187、201

系　所：電機工程學系<br>電腦與通信工程研究所<br>電機資訊學院-微電、奈米聯招

科　目：工程數學

日　期：0206

節　次：第 3 節

備　註：不可使用計算機

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**第 1 頁，共 1 頁**

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (20%) (a)(10%) Find the fundamental sets $y_1(x)$ and $y_2(x)$ of the general solutions to $y'' - 7xy' + 16y = 0$ for $x \in (-8,8)$. (b)(10%) Show that $y_1(x)$ and $y_2(x)$ are linearly independent with $W(x) = y_1(x)y_2'(x) - y_2(x)y_1'(x) = 0$ at $x = 0$ and explain why it is not contradict to the Wronskian test.

2. (20%) Let a function $f(x)$ defined over $[-L, L]$. (a)(5%) What are the conditions for the Fourier series to uniformly and absolutely converge to $f(x)$? (b)(15%) Under the conditions you give in (a), prove that the uniformly and absolutely convergence of the Fourier series.

3. (10%) Determine the Laplace transform of $e^{-3t}\int_0^t e^{3x}\cos(2x)dx$.

4. Let $r(x)$ be a periodic triangular wave function with fundamental period $P_a$ as shown in Figure 1 below, and then the *phase angle form* of the Fourier series of the function $r$ can be known.

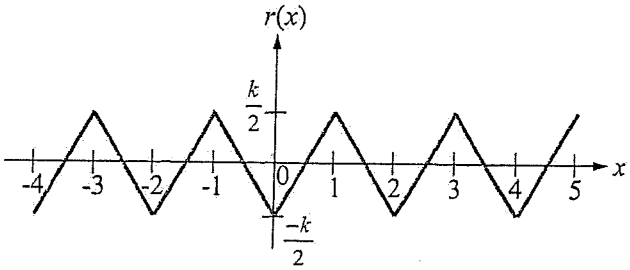


**Figure 1.** Periodic triangular wave function $r(x)$.

(a) Here we want to approximate the function $r$ with a partial sum of the Fourier series of $r$. In order to build the partial sum, the strategy here is to include a group of n$^{th}$ harmonics $c_n\cos(n\omega_0 x + \delta_n)$ with amplitudes *not smaller than* 15% of the largest amplitude, where $c_n$ is the n$^{th}$ harmonic amplitude, $\delta_n$ is the n$^{th}$ phase angle, and $\omega_0 = \frac{2\pi}{P_a}$. Suggest what frequencies $n\omega_0$ should be included in this partial sum. The frequency $n\omega_0$ can be zero or positive. Show the details. (25%)

(b) Now we have a nonhomogeneous 2$^{nd}$-order differential equation $y''(x) + 3y'(x) + 2y(x) = r(x)$, where $r(x)$ is illustrated in Figure 1. Our strategy here is to first approximate the periodic function $r$ with the partial sum of the Fourier series of $r$ obtained in (a) and then to solve this differential equation. If $P_b$ is fundamental period of the particular solution obtained based on this approach, find the value of $\frac{2\pi}{P_b}$. Show the details. (25%)