$$
\begin{aligned}
\frac{\sin(x)}{x} &= 1 - \frac{x^2}{3!} + \frac{x^4}{5!} - \frac{x^6}{7!} + \cdots \\
&= \left(1 - \frac{x}{\pi}\right)\left(1 + \frac{x}{\pi}\right)\left(1 - \frac{x}{2\pi}\right)\left(1 + \frac{x}{2\pi}\right)\left(1 - \frac{x}{3\pi}\right)\left(1 + \frac{x}{3\pi}\right)\cdots \\
&= \left(1 - \frac{x^2}{\pi^2}\right)\left(1 - \frac{x^2}{4\pi^2}\right)\left(1 - \frac{x^2}{9\pi^2}\right)\cdots
\end{aligned}
$$

$$
-\left(\frac{1}{\pi^2} + \frac{1}{4\pi^2} + \frac{1}{9\pi^2} + \cdots\right) = -\frac{1}{\pi^2}\sum_{n=1}^{\infty}\frac{1}{n^2}
$$

$$
\sum_{n=1}^{\infty}\frac{1}{n^2} = \frac{\pi^2}{6}.
$$

$$
\lim_{n=\infty}\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + ... + \frac{1}{n^2}
$$

$$
\zeta(2n) = \frac{(2\pi)^{2n}(-1)^{n+1}B_{2n}}{2\cdot(2n)!}\ (*)
$$

$$
f(x) = \frac{\pi^2}{3} + \sum_{n=1}^{\infty}\left((-1)^n\frac{4}{n^2}\cos nx\right) \tag{1}
$$

$$
\because \sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots \tag{2}
$$

$$
\begin{aligned}
a_n &= \frac{1}{\pi}\int_{-\pi}^{\pi} x^2\cos nx\ dx = \frac{2}{\pi}\int_0^{\pi} x^2\cos nx\ dx \\
&= \frac{2}{\pi}\times\frac{2\pi}{n^2}(-1)^n = (-1)^n\frac{4}{n^2} \\
b_n &= \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin nx\ dx = 0
\end{aligned}
$$

$$
\because \int_0^{2\pi} x^2\cos nx\ dx = \left[\frac{2x}{n^2}\cos nx + \left(\frac{x^2}{n} - \frac{2}{n^3}\right)\sin nx\right]|_0^{2\pi} = \frac{2\pi}{n^2}(-1)^n.
$$

$$
\therefore \phi = \frac{\sqrt{5}-1}{2}
$$