If you get \( \leq 15 \) points on the Midterm N1 you must take this test. Please return it to me before November 10.

1. Compute the sum

\[
\cos x + 2 \cos 2x + 3 \cos 3x + \ldots + n \cos nx.
\]

2. Determine the shortest distance between the line \( L \) and the 2-dimensional plane \( P \) in \( \mathbb{R}^4 \), which are given, respectively, by the parametric equations

\[
r = A_0 + tA_1
\]

and

\[
r = uA_2 + vA_3,
\]

where \( t, u, v \in \mathbb{R} \), and \( A_0 = (1, 1, 0, 2), A_1 = (1, 1, -1, 1), A_2 = (0, 1, 0, 0), A_3 = (0, 0, 0, 1) \).

3. Prove that the following two conditions for a curve in \( \mathbb{R}^3 \) are equivalent:
   a) all tangent lines to a curve \( C \subset \mathbb{R}^n \) form a constant angle with a certain direction;
   b) all principal normal vectors are parallel to a certain plane.

4. Find parametric equations of a curve formed by the centers of curvature of the ellipse

\[
\begin{align*}
x &= a \cos t, \\
y &= b \sin t,
\end{align*}
\]

where \( t \in [0, 2\pi] \). Give a sketch of this curve.

ALL PROBLEMS ARE 10 POINTS EACH.