International Master's Programs of Chemical Engineering in the Graduate School of Engineering, Kyushu University (Academic Year from October, 2025)

Subject : Mathematics （1 sheet）

1. (25 points)
Solve the following differential equations.

(1.1) $y'' - 2y' - 3y = 0$

(1.2) $y'' + 4y = \cos(2x)$

(1.3) $y''' - 3y'' + 4y = 0$

(1.4) $y''' - 3y'' + 4y = 5x + 8e^{3x}$

2. (25 points)
Answer the following questions.

(2.1) Let A and B be the points where the tangent to $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ intersects with the x-axis and y-axis, respectively. Find the minimum length of the line segment AB.

(2.2) Calculate the following equation. $\iint_D \sqrt{\frac{1-x^2-y^2}{1+x^2+y^2}}\, dxdy, \quad D : x^2 + y^2 \leqq 1$