



Assignment 3 - Mathematics-I
Departments: ECE, CSE, ENE
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Due: Nov 27, 2025 (Thurs)

This assignment covers the syllabus for our second internal: Sections 13.1 - 13.10 for the rest of Unit II and Sections 5.6 - 5.16 for Unit III (Textbook: Engineering Mathematics by Bali and Manish Goyal, 9th edition and Lecture notes for annihilator method)

1. Solve the following LDEs by annihilator method, or inverse differential method.

(a) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = x^2e^{3x} + \sin 2x.$

(b) $(D^2 - 6D + 9)y = 25x^2e^{2x} \sin x$

2. Solve $(D^2 - 2D + 1)y = \frac{e^x}{x^2 + 1}$ using the method of variation of parameters.

3. Solve $(2x + 1)^2 \frac{d^2y}{dx^2} - 6(2x + 1) \frac{dy}{dx} + 16y = 4 \cos \log(1 + 2x).$

4. If $u = x^2 \tan^{-1} \frac{y}{x} - y^2 \tan^{-1} \frac{x}{y}$, show that $\frac{\partial^2 u}{\partial x \partial y} = \frac{x^2 - y^2}{x^2 + y^2}.$

5. If $x = e^u \tan v, y = e^u \sec v$, find the value of $\left(x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}\right) \cdot \left(x \frac{\partial v}{\partial x} + y \frac{\partial v}{\partial y}\right)$

(Hint: express u and v or a function of u or v as a homogenous function in x and y .)

6. If $u = \tan^{-1}(\frac{y}{x^2})$, prove that $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \sin 2u \cos^2 u.$

7. Let $u = f(x, y)$ and $x = x(s, t) = \frac{1}{2}s(e^t + e^{-t}), y = \frac{1}{2}s(e^t - e^{-t})$. Show that

$$u_{xx} - u_{yy} = u_{ss} + \frac{1}{s}u_s + \frac{1}{s^2}u_{tt}.$$

8. Expand $e^x \cos y$ at $(0, 0)$ using Taylor's theorem.