ME 326 - Intermediate Fluid Mechanics

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Review of Differential Equations

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Outline

- Constant Coefficient Equations
- Euler Equation
- Total Differentials
- Separable Equations

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Constant Coefficient Equations

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 8y = 0$$

Boundary Conditions

$$x = 0, \quad y = 1$$
$$x = \infty, \quad y = 0$$

Solution

$$y = Ae^{mx}$$

$$m^2 + 2m - 8 = 0$$

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Constant Coefficient Equations (Continued)

$$m = -1 \pm \sqrt{1+8}$$
$$m = -4,\ 2$$

Solution ⇒ $y = Ae^{2x} + Be^{-4x}$

B.C. ⇒ $A = 0, \quad B = 1$

Final Solution ⇒ $y = e^{-4x}$

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Euler Equation

$$x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}-y=0$$

Solution

$$y=x^m \quad \Rightarrow \quad m(m-1)+m-1=0, \quad m=1,\ -1$$

Final Solution

$$y=Ax+\frac{B}{x}$$

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Total Differentials

$$\frac{d}{dx}\left(x\frac{dy}{dx}\right)=0$$

Solution

$$x\frac{dy}{dx}=C \qquad \frac{dy}{dx}=\frac{C}{x}$$

$$y=C\ln x+D$$

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Separable Equations

$$(x+1)+y^2\frac{dy}{dx}=0$$

Solution

$$(x+1)dx+y^2dy=0$$

$$\frac{(x+1)^2}{2}+\frac{y^3}{3}=C$$

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Thank you!

Questions?