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SUBJECT: Differential Equations

DATE: Sept 9, 2020

Q1. Review of Integration Concept:

- Ans. It contains some major concepts of integration, including:
- Substitution method.
 - Integration by Parts.
 - Integration of Rational Function.

• SUBSTITUTION METHOD:

$\int f(g(x))g'(x)dx = \int f(u)du$
If the function $f(u)$ has an easily identifiable antiderivative then all is well. If not, another substitution method may be needed.

• INTEGRATION BY PARTS:

$$\begin{aligned} \Rightarrow [u(x)v(x)]' &= u'(x)v(x) + u(x)v'(x) \\ &= u(x)v'(x) = [u(x)v(x)]' - u'(x)v(x) \\ &= \int u(x)v'(x)dx = u(x)v(x) - \int u'(x)v(x)dx \\ &= \int u dv = uv - \int v du \end{aligned}$$

In case of definite integral we have

$$\int_a^b u(x)v'(x)dx = [u(x)v(x)]_{x=a}^{x=b} - \int_a^b u'(x)v(x)dx$$

• INTEGRATING RATIONAL FUNCTION:

$$\rightarrow \frac{3x+2}{2x^2+x-3} = \frac{3x+2}{(2x+3)(x-1)}$$

To integrate such a function, we use the method of partial fraction to split the fraction into easily integrable pieces.

$$\frac{3x+2}{(2x+3)(x-3)} = \frac{1}{2x+3} + \frac{1}{x-3}$$

Now

$$\int \frac{3x+2}{2x^2+x-3} dx = \frac{1}{2} \log(2x+3) + \log(x-3) + C$$

Q. Application of Trapezoidal Rule and Simpson's Rule in Engineering.

Ans: APPLICATION OF TRAPEZOIDAL RULE:

- * The trapezoidal rule is one of the family member of numerical integration formula.
- * The trapezoidal rule has faster convergence.
- * Moreover, the trapezoidal rule tends to become extremely accurate then periodic functions.

* APPLICATION OF SIMPSON'S RULE:

- * Simpson's Rule is a numerical method for approximating the integral of a function between two limits, a & b . - It's based on knowing the area under a parabola, or a plane curve.
- * It include the calculation of a vessel's displacement, total wetted surface area, and the calculation of the longitudinal center of buoyancy of the hull.
- * It is a weighted average that results in an even more accurate approximation.