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ASSIGNMENT:

DIFFERENTIAL EQUATIONS

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"PARTIAL DIFFERENTIAL EQUATION"

1. It is defined as an equation involving two or more independent variables like x, y....., a dependent variable like u and its partial differentiation, derivatives.

2. Partial differential equation can be formed either by elimination of arbitrary constants or by the elimination of arbitrary functions from a relation involving three or more variables.

APPLICATIONS:

TANGENT PLANES AND LINEAR APPROXIMATIONS:

Suppose a surface 'S' has equation $z = f(x, y)$ where f has continuous first partial

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derivatives and let $P(x_0, y_0, z_0)$ be a Point on "S". Let C_1 and C_2 be the two curves obtaind by the intersection the vertical planes $y = y_0$ and $x = x_0$ with the surface. Thus point P les on both C_1 and C_2 let T_1 and T_2 be the tangents lines to the curves C_1 and C_2 at the Point P. Then the tangent plane to the surface S at the Point P is defined to the plane that contains both tangent line T_1 and T_2.

• Suppose a surface S has equation $z = f(x,y)$ where f has continuous first Partial differential derivatives.

• let $P(x_0, y_0, z_0)$ be at Point S.

• $P(x_0, y_0, z_0)$ has an equcation of the form.

$$z - z_0 = f_x(x_0, y_0)(x - x_0) + f_y(x_0, y_0)(y - y_0).$$

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LINEAR APPROXIMATION AND LINEARIZATION:

The linearization of f at (a, b) is the linear functions whose graph is the tangent plane namely.

- $L(x, y) = f(a, b) + f_x(a, b)(x-a) + f_y(a, b)(y-b)$

- The approximation.

$$f(x, y) = f(a, b) + f_x(a, b)(x-a)\ f_y(a, b)(y-b)$$

- is called the linear approximation of f ~~and~~ at (a, b).

- Recall that Δx and Δy are increments of x and y. respectively. If $z = f(x, y)$ is a function of two variables the Δz the increment of z is defined to be

- $\Delta z = f(x + \Delta x, y + \Delta y) - f(x, y)$

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- If $z = f(x,y)$ the f is differentiable at (a,b) if Δz can be expressed in the form.

- where ε_1 and $\varepsilon_2 \to 0$ as $(\Delta x, \Delta y) \to (0,0)$.

THEOREM:

$$dz = f_x(a,b)dx + f_y(a,b)\,dy = \frac{dz}{dx}dx + \frac{dz}{dy}dy$$

TAYLOR EXPANSION:

Let $f(x)$ be given as the sum of power series in the convergence interval of the power series.

$$f(x) = \sum^{\infty} a_n (x - x_0)^n$$

- Then such power series is unique and its cofficent are given by formula.

$$a_n = \frac{f^{(n)}(x_0)}{n!}$$

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- If function $f(x)$ has derivatives of all orders at x_0 then we can formally write the corresponding Taylor series as.

$$f(x) = f(x_0) \frac{f'(x_0)}{1!}(x-x_0) + \frac{f''(x_0)}{2!}(x-x_0)^2 + \ldots\ldots$$

- The power series when create in in this way is then called the TAYLOR SERIES. of function $f(x)$.

- There are function $f(x)$.

TAYLOR SERIES OF SOME FUNCTION:

- $$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots\ldots$$

- $$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots\ldots$$

- $$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots$$

MAXIMA AND MINIMA:

- The least and the greatest.

- Many problems that arises in mathematics call for finding the largest and smallest values that a differentiable function can assume on a particular domain.

- There is a strategy for solving these applied problems.

- STRATEGY FOR MAXI-MIN PROBLEM:

- Draw picture.

- Label the parts that are important for the problem.

- Keep track of what variable represent.

- Use a Known a formula for the quantity to be maximized or minimized.

- Write an equation. Try to express the quantity that is to be maximized or minimized as a function of single variable say $y = f(x)$

LAGRANGE METHOD:

Many time a stationary value of the function of several variables which are not all independent but connected by some relationship is needed to be known. Generally we do convert the given functions to the one having least number of independent variables with the help of these relation. then it solved.

- Lagrange method Proved to be very convinient. which is explained on the ongoing lines.