"THE VALUE OF TEACHING PRIVATE TECHNOLOGY OF TEACHING HIGH-ORDER DIFFERENTIAL EQUATIONS DEPARTMENT OF THE SCIENCE OF DIFFERENTIAL EQUATIONS"

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Abstract: *Today, the differential equations section of mathematics is developing very much. Special attention is being paid in the field of education, and many problems are being solved through differential equations. It is widely used in various fields to solve problems related to differential equations. For example, education, medicine, construction and others. We will get a little deeper into the science of differential equations by reducing the order of higher-order differential equations and their ways, second-order differential equations with constant coefficients, and the methods and ways of solving homogeneous and non-homogeneous differential equations. we learn.*

Key words: *Differential equations, particular derivative, ordinary differential equations, order of the equation, linear differential equation, homogeneous linear differential equation.*

Differential equations are equations that contain unknown functions, their derivatives of different orders, and arbitrary variables. In these equations, the unknown function is defined by I , and in the first two, i depends on one independent variable t, and in the next, it depends on x, t and x, u, z, respectively.The theory of differential equations began to develop at the end of the 17 th century at the same time as differential and integral calculus. The differential equation is very important in mathematics, especially in its applications. The investigation of various problems of physics, mechanics, economics, engineering and other fields leads to the solution of the differential equation.

2. Particular differential equation The important feature of these equations, which differs from the ordinary differential equation, is that the set of all their solutions, that is, the "general solution", depends not on arbitrary constants, but on arbitrary functions; in general, the number of these arbitrary functions is equal to the order of the differential equation; and the number of their independent variables is one less than the number of variables of the sought solution. Solving a 1st-order partial differential equation in one unknown leads to solving a system of ordinary differential equations. In the theory of partial differential equations of order higher

than one, various boundary value problems are investigated along with the Cauchy problem.

To solve second-order differential equations, first divide them we need to know the shape.

Equations of the form y''= f(x) are simple, second-order differential are called equations.

Such equations are solved by introducing $y'= \frac{dy}{dx}= p$. In that case

$y'= \frac{dy}{dx} =f(x)$ *or* $dp=f(x)dx$ will be. If we take the integral from both sides:

$p =\int f(x)dx =F_1 (x)+C_1$.

From this

$p= \frac{dy}{dx} =F_1 (x)+C$

$dy = [F_1 (x) +C_1]dx$

if we take the integral once more:

$y = \int F_1 (x)dx + C_1 \int dx$ *Or*

$y = F_2 (x)+ C_1x+C_2$

This will be the general solution of the given second-order differential equation.

An example. Solve the equation y''= *sinx*. The solution. We define $y'= \frac{dy}{dx}= p$, as a result: $y'=\frac{dy}{dx}$ *or* $\frac{dy}{dx}=\sin x$ $p=\int sinxdx=-cosx+C_1$ $\frac{dy}{dx}=-cosx+C_1$, *from which*

$dy=(-cosx+C_1)dx$ If we take the integral: $y = -\int cosxdx+C_1\int dx$. So the general solution is:

$y = - sinx +C_1x + C_2$.

Check: $y'= + (- sinx +C_1x + C_1)'$ *or* $y'= - cosx + C$; $y''= sinx$. Homogeneous linear equations. This $a_0y''+ a_1 y'+ a_2y = f(x)$ (*where* a_0, a_1, a_2, $f(x)$ are functions of x or fixed numbers) of the form the equation is called a second-order linear differential equation. If $f(x) = 0$, the equation, i.*e* $y''+ a_1y'+ a_2y = f(x)$ (1) the equation is called a homogeneous linear equation. The left-hand side of equations (1) and (2). side is a first order homogeneous function with respect to y, y', y''.

Theorem 1. If y_1 and y_2 are homogeneous of the second order $y' + a_1y'' + a_2y = 0$. if a differential equation has two particular solutions, then so does $y_1 + y_2$ will be the solution of the equation.

Proof. Since y_1 and y_2 are solutions of the equation

$y_1 +a_1y_1 + a_2y_1 = 0$

$y_2 + a_1y_2 + a_2y_2 = 0$

Theorem 2. If y_1 is a solution of equation (2), C is an arbitrary constant is a quantity, then Cy_1 is also a solution of equation (2).

Theorem 3. If y_1 and y_2 are two linear discrete solutions of equation (2), then $y=C_1y_1+C_2y_2$ (where C1 and C2 are arbitrary constants) and (2) will be the general solution of the equation. The proof of this theorem comes from Theorems 1 and 2. Homogeneous linear equations of the second order with constant coefficients.

Description: As a homogeneous differential equation with constant coefficients: $y''+py'+qy=0$ (4) is referred to the equation of the form In this case, the general solution of this equation is based on the above theorems it is sufficient to find its two linear free eigenvalues. To solve the equation, we assume $y=e^{kx}$, where k is zero is a non-changing number. We find the derivatives:

$y'=ke^{kx}$, $y''=k^2e^{kx}$.

We add these to equation (4):

$k2e^{kx}+pke^{kx}+q\ e^{kx}=0$ (5)

Since $e^{kx}\neq 0$, in equation (5).

$k^2+pk+q=0$ (6) will be.

So, if k satisfies the equation (2), e^{kx} is the solution of the equation. Characteristic equation. Equation (6) is called the characteristic equation of equation (4). Equation (5). will have two roots, denoted by $k_1$and k_2:

$k_1=-p/2+\sqrt{((p2/4)-q)}$; $k_2=-p/2-\sqrt{((p2/4)-q)}$;

The following cases may occur here:

1. k_1 and k_2 are real and not equal to each other ($k_1\neq k_2$):

2. k_1 and k_2 are real and equal to each other $k_1 = k_2$):

3. $k_1$and k_2 are complex numbers;

We will consider each case separately:

a) the roots of the characteristic equation are real and different ($k_1\neq k_2$).

In this case $y_1=e^{k_1x}$, $y_2=e^{k_2x}$ functions are particular solutions, and the general solution of the equation $y=C\ e^{k_1x}, +C_2\ e^{k_1x}$, it will be visible.

An example. $y''- 8y' + 15y = 0$ is the characteristic equation of the equation $k_1=5$; $k_2=3$ to the root have So, the general solution of the equation is as follows $y=C_1e^{5x} +C_2e^{3x}$. b) the roots of the characteristic equation are real and equal. In this case k = k_2 = p/2, $2k_1$= -p Or $2k_1+p=0$ will be. One particular solution y1 = ek1x is known. The second private solution y_2 = u(x)eq1x we look for it in appearance. Here u(x)=u is the unknown to be determined function. To determine u(x), we find y_1' *and* y_2'' :

$y_2'=u'e^{k_1x} +uk1e^{k_1x} = e^{k_1x}\ (u'+uk_1)$,

$y_2''= u'e^{k_1x} + u'k_1e^{k_1x}+ u'k_1e^{k_1x} + uk_2e^{k_1x} =(u'+2k_1\ u'+ uk_2)$.

We add these to equation : $e^{k_1x}\ [(u'' + 2k_1\ u' + k_1u) + pe^{k_1x}\ (u '+ k_1u) + qu] =$ 0

$e^{k_1x}\ [u'' + (2\ k + p)u\ ' + (k_2 + k_1\ p + q)u] = 0$

Since k is a multiple root of the characteristic equation and k_1+p=0, $e^{k_1x}u'' = 0$ or u''=0 should be. Integrating it u(x)=Ax+B we find . In particular, if we take B=0, A=1, u(x)=x. Thus, $y = xe^{k_1x}$, as the second particular solution. Considering these, the general solutiony $= (C_1e^{k_1x}, + C_2xe^{k_1x}, = e^{k_1x}, (Cx + C 2x)$

The constant coefficient of the differential equations of the students is high the roots of the characteristic equation in teaching the subject of differential equations it is very important to know how to find its general solution in different cases. In this article, there are ways to fully and clearly explain these cases. So, knowledge of these situations helps students to solve examples related to this topic helps to overcome difficulties.

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