Kliuchnyk I.G. – Candidate of Physical and Mathematical Sciences, Senior Lecturer, Kirovohrad Volodymyr Vynnychenko State Pedagogical Universit;

Zavgorodnya T.M. – Candidate of Physical and Mathematical Sciences, Senior Lecturer, National University of Life and Environmental Sciences of Ukraine

SOME FEATURES OF TEACHING OF DIFFERENTIAL EQUATIONS

To generate highly qualified specialist, teachers need to improve and diversify the learning process. In addition to traditional methods in the practice we use new effective ways of modern teaching. One of these main methods is the computerization of the educational process. But the use of information technology in learning by mathematics requires some "caution". This is due to the fact that the creative process that is uses in fundamentals of mathematics can be reduced to mechanical pressing of keyboard.

Today there are many software tools that support mathematical research: Mathematica, MathCAD, Matlab, Maple, Statistica. This article on the solution of the differential equation shows how you can effectively use the software package Matlab. In doing so, we save time on finding integral and plotting. So the teacher can spend more time for the methods for solving various types of differential equation.

Keywords: Matlab, effective ways of teaching, innovative methods.

Introduction. Finding effective ways of learning still relevant. For today's graduate’s high requirements of knowledge and skills, this determines the ability of a specialist on the modern labor market. Questions about the effectiveness of the learning process important for each university. In order to generate highly qualified specialists, teachers need to improve and diversify the learning process. To this end, the search and implementation of new methods and means of learning process continues. In addition to traditional methods, introducing new effective techniques of modern class. One of the main is the computerization of the educational process. But the use of computer technology in the study of mathematics requires some

"caution". This is due to the fact that the creative process in the study of fundamentals of mathematics can be reduced to mechanical keystrokes. To avoid this, it is necessary to use mathematical packages to automate routine calculations, conversions, and more.

Since the one of the main objectives of education – to teach students themselves obtain knowledge, we believe that automation of routine operations will greatly help them in this. An important basis for self-study should be a lecture in which the teacher not simply call for self-study, but also gives problems, offers specific tasks, recommends a literature or systems of computer mathematics, determines the time for the job, informs on the types and terms of control, emphasizes the opportunity to receive advice [1,p.126].

The main material. For today there are many software tools that support mathematical research: Mathematica, MathCAD, Matlab, Maple, Statistica, etc.. In [2] described the possibility of using Mathematica, MathCAD and Matlab to solve certain classes of problems. Dwell more in detail for a package of applications Matlab. Its main advantages are the relative ease of manipulation of different data types and convenient tools construction of various graphs. Formulating and solving problems by means of Matlab are given understandable mathematical expressions that are similar to traditional formulas [3]. For example, the operations of addition (+), subtraction (–), multiplication (*), division (/), and exponentiation (^). Also, some basic mathematical functions in Matlab are given as follows:

- abs(x) – absolute value;
- sqrt(x) – square root;
- exp(x) – exponent;
- log(x) – natural logarithm;
- log10(x) – logarithm;
- sin(x) – sine;
- cos(x) – cosine;
- tan(x) – tangent;
- cot(x) – cotangent;

- asin(x) – arcsine;
- acos(x) – arccosine;
- atan(x) – arctangent;
- acot(x) – arc cotangent.

We will show on a concrete example as it is possible to use a package of the applied programs Matlab effectively. Thus, we will significantly save time on finding of integral and creation of a function graph when studying a course of the differential equations.

Example. Solve the equation [4]

$$\frac{dy}{dx} = \frac{1}{x\cos y + \sin 2y}.$$

Solution. The equation which is considered, is linear if to consider x as function from y:

$$\frac{dx}{dy} - x\cos y = \sin 2y. \qquad (1)$$

Find the general solution of this equation in the form

$$x = u(y)v(y).$$

We have

$$\frac{dx}{dy} = v\frac{du}{dy} + u\frac{dv}{dy}.$$

Substituting x and $\frac{dx}{dy}$ in equation (1), we obtain

$$v\frac{du}{dy} + u(\frac{dv}{dy} - v\cos y) = \sin 2y.$$

We will find function of $v(y)$ from a condition

$$\frac{dv}{dy} - v\cos y = 0.$$

Take an arbitrary particular solution of the equation $v(y) = e^{\sin y}$ and obtain

$$e^{\sin y}\frac{du}{dy} = \sin 2y,$$

from where

$$u = \int e^{-\sin y} \sin 2y dy \qquad (2)$$

For finding of integral (2) we will use Matlab software package. Calculation of uncertain integrals in Matlab is carried out by means of function: int (f,x), where *f* – the symbolical expression representing integrand function, and *x* – a variable of integration [5]. For finding of integral (2) at first in the command line Matlab we will define a symbolical variable of integration (in our example it is a variable y):

```
syms y;
```

Further, using the rules of a task of the main mathematical functions given above in Matlab system, we will define integrand function:

```
f=exp(-sin(y))*sin(2*y);
```

and calculate the integral:

```
int(f,y)
```

As introduction of function doesn't come to the end with a semicolon, the Matlab package will automatically remove the received value of integral:

```
ans = -2*exp(-sin(y))*sin(y)-2*exp(-sin(y)).
```

Therefore,

$$u = -2e^{-\sin y} \times \sin y - 2e^{-\sin y} = -2e^{-\sin y}(1+\sin y).$$

In Fig.1 we can see the Matlab environment with the method described above finding of integral (2) in a command window.

Note that the Matlab program doesn't include an integration constant; the result of a conclusion represents only anti-derivative of subintegral expression.

So, the integral (2) has an appearance

$$u = -2e^{-\sin y}(1+\sin y) + c.$$

So, the common decision of the equation (1) will have an appearance

$$x = ce^{\sin y} - 2\sin y - 2.$$

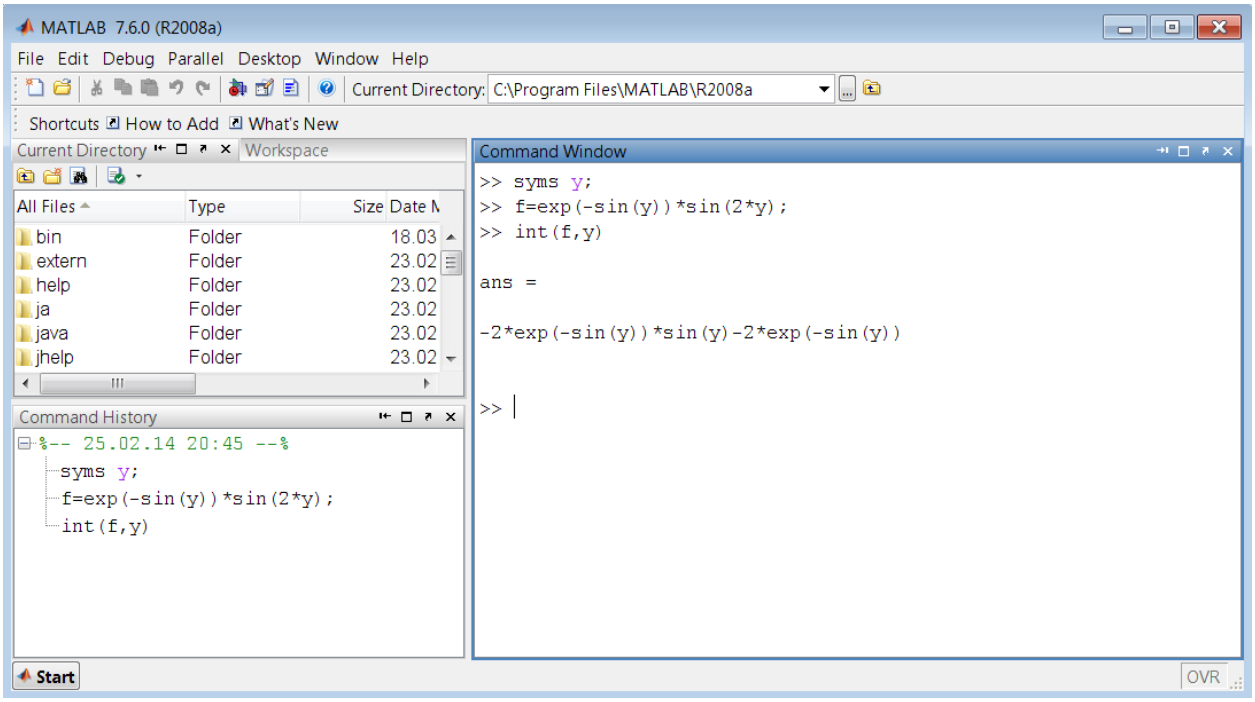

Fig.1

We will construct an integrated curve, using Matlab opportunities for visualization of data. We won't go into all details of powerful and various graphic opportunities of Matlab system. In our case we are interested in the principle of plotting functions of one variable.

The package of the applied Matlab programs builds function graphs on a number of points, connecting them pieces of straight lines. Therefore, for creation of a function graph it is necessary to create, first, two vectors of identical dimension - a vector of values of arguments *y* and a vector of the corresponding values of function *x(y)*. Secondly, to address to the plot() function which builds two-dimensional graphics. As a result we will receive two arrays *x* and *y* which contain values of arguments and the corresponding values of function, and the plot command will create with *i* -elements of arrays of a point with coordinates (y_i, x_i) and will connect them straight lines.

We can set a vector *y* of values of argument as follows:

y = [initial value of argument: step: final value of argument].

To prevent a conclusion in a command window of values of a vector *y* and function evaluations, introduction of the corresponding commands we will finish a

semicolon. As the plot command displays nothing in a command window, after it the semicolon can be not put.

So, for creation of an integrated curve $x = ce^{\sin y} - 2\sin y - 2$ we will set an interval of change of an independent variable *y* from -10 to 10 with a step 0.05:

```
y = [-10:0.05:10];
```

We will set value of a constant *c*, we will calculate the corresponding values of function *x(y)* and we will construct its graph:

```
C = 1;
X = c*exp(sin(y))-2*sin(y)-2;
plot(y,x)
```

After execution of commands on the screen in Matlab system there will be a Figure1 window with a function graph (Fig.2).

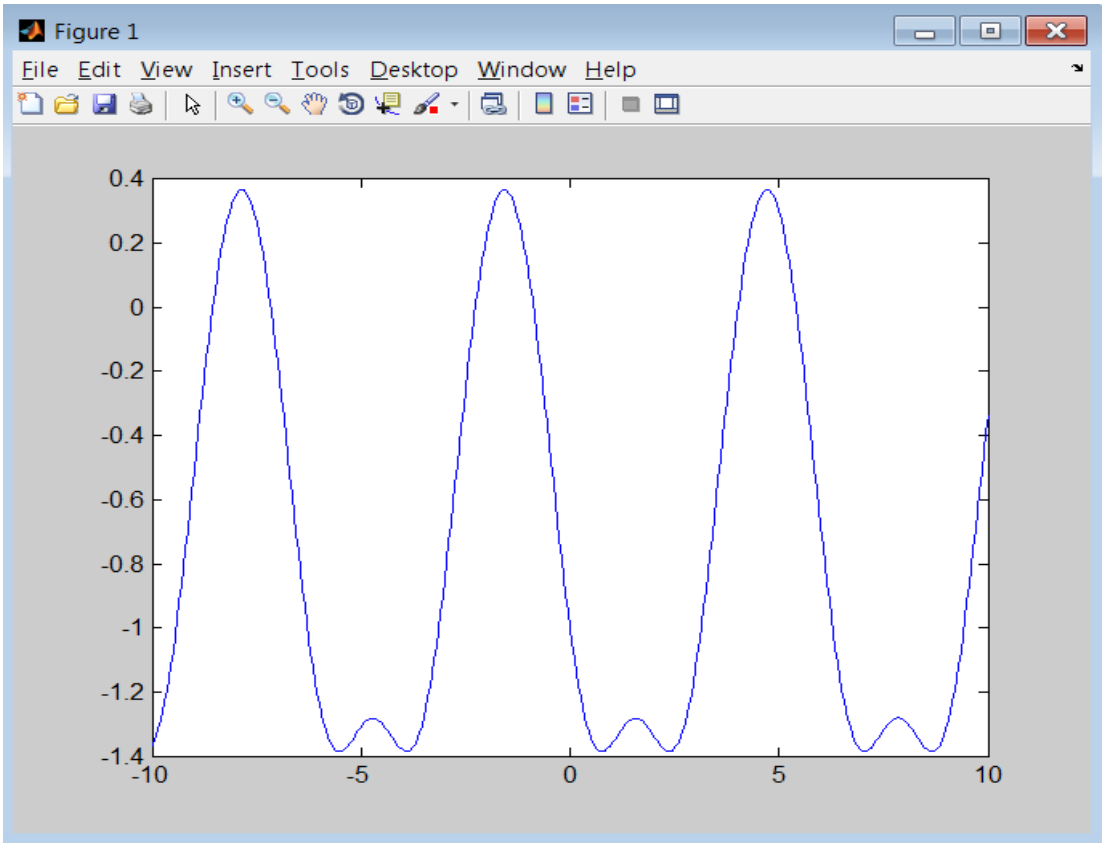

Fig.2

Conclusions. Matlab use when studying a course of the differential equations gives the chance to save time on routine calculations of integrals and

creation of integrated curves, and to find more time for methods of the solution of various types of the differential equations.

Literature

1. Слєпкань З.І. Наукові засади педагогічного процесу у вищій школі. – Навчальний посібник. – К.:Вища шк., 2005. – 239с.

2. Жалдак М.І. Основні теорії і методи оптимізації: навчальний посібник / М.І. Жалдак, Ю.В. Триус. – Черкаси:Брама-Україна, 2005. – 608с.

3. Кетков Ю.Л. MATLAB 7: программирование, численные методы / Ю.Л.Кетков, А.Ю.Кетков, М.М.Шульц. – СПб.: БХВ-Петербург, 2005. – 752с.

4. Самойленко А.М. Диференціальні рівняння в задачах. – Навчальний посібник / А.М.Самойленко, С.А. Кривошея, М.О. Перестюк. – К.:Либідь, 2003. – 504с.

5. Мартынов Н.Н. Matlab 7. Элементарное введение. – М: "Кудиц-Образ", 2005. – 416с.