

V3.1. ODE. List of problems.

V3.1.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$(xy^2 + 4x)dx - (x + 2)dy = 0; \quad y(-1) = 2 .$$

V3.1.2. Find the general solution of the ODE

$$(17xy - 8x^2 - 10y^2)dx + (7x^2 - 14xy + 9y^2)dy = 0 .$$

V3.1.3. Solve the initial condition problem for the ODE.

$$y' + y \operatorname{tg} x = \cos^4 x; \quad y(\pi/4) = 1 .$$

V3.1.4. Find the general solution of the ODE

$$xy' + y = -x^4 y^3 .$$

V3.1.5. Find the general solution of the ODE

$$\left(\frac{x}{\sqrt{x^2 + y^2}} + y - 2 \right) dx + \left(\frac{y}{\sqrt{x^2 + y^2}} + x \right) dy = 0 .$$

V3.1.6. Find the general solution of the second order ODE

$$xy'' - y' = 0 .$$

V3.1.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 2y' + 3y = x^2 .$$

V3.1.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 5y' + 4y = (2x - 1)e^x .$$

V3.1.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 2\dot{x} + 5x = 2t; \quad x(0) = 1, \dot{x}(0) = 0.$$

V3.1.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = x + 3y; & x(0) = -1, y(0) = 2 \\ \dot{y} = x - y. \end{cases}$$

V3.2. ODE. List of problems.

V3.2.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$y' = \frac{y}{(x+1)(x+2)}; \quad y(0) = 2.$$

V3.2.2. Find the general solution of the ODE

$$(3x + 11y)dx + 10y dy = 0.$$

V3.2.3. Solve the initial condition problem for the following ODE

$$y' - y \operatorname{ctg} x = \frac{1}{\sin x}, \quad y(\pi/6) = 1.$$

V3.2.4. Find the general solution of the ODE

$$y' - 2 \operatorname{tg} x \cdot y + \frac{2y\sqrt{y}}{\cos x} = 0.$$

V3.2.5. Find the general solution of the ODE

$$(2y \cos(xy) + \sin(x+y))dx + (2x \cos(xy) + \sin(x+y) + 8y)dy = 0.$$

V3.2.6. Find the general solution of the second order ODE

$$x^2 y'' = 2x + 1.$$

V3.2.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 4y' + 9y = x + 1.$$

V3.2.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 2y' - 3y = e^{-3x}.$$

V3.2.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 4\dot{x} - 5x = 2e^t; \quad x(0) = 1, \quad \dot{x}(0) = -1.$$

V3.2.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = -x + 3y; & x(0) = 1, y(0) = 2 \\ \dot{y} = x + y. \end{cases}$$

V3.3. ODE. List of problems.

V3.3.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$x\sqrt{y^2 + 9} dx - (x^2 + 1)dy = 0; \quad y(0) = 0 .$$

V3.3.2. Find the general solution of the ODE

$$(xy - 8y^2 - x^2) dy + (xy - y^2 + x^2) dx = 0 .$$

V3.3.3. Solve the initial condition problem for the following ODE

$$y' + y \operatorname{tg} x = \sin^2 x; \quad y(0) = 2 .$$

V3.3.4. Find the general solution of the ODE

$$3x^2y^2y' + xy^3 + 1 = 0 .$$

V3.3.5. Find the general solution of the ODE

$$(9x^2y^2 + 10xy^2 - 2y)dx + (6x^3y + 10x^2y - 2x + 1)dy = 0 .$$

V3.3.6. Find the general solution of the second order ODE

$$y'' = 1 + \frac{y'}{x} .$$

V3.3.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 6y' + 9y = 2x - 1 .$$

V3.3.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 4y' + 3y = xe^{-x} .$$

V3.3.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} - 6\dot{x} + 10x = \sin t; \quad x(0) = 1, \dot{x}(0) = 1.$$

V3.3.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = x + 4y; & x(0) = 1, y(0) = 0 \\ \dot{y} = 2x - y. \end{cases}$$

V3.4. ODE. List of problems.

V3.4.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$\cos x \sin^2 y dx - \frac{\cos^3 y}{\sin 2x} dy = 0; \quad y\left(\frac{\pi}{4}\right) = \frac{\pi}{4}.$$

V3.4.2. Find the general solution of the ODE

$$2y dx + (x + 2y) dy = 0.$$

V3.4.3. Solve the initial condition problem for the following ODE

$$y' + xy = e^{-x^2/2} \cdot \cos^2 x; \quad y(0) = 4.$$

V3.4.4. Find the general solution of the ODE

$$y' - 4xy = 4x^3 \sqrt{y}.$$

V3.4.5. Find the general solution of the ODE

$$\left(5 - \frac{3}{y} + \frac{2x}{y^3}\right) dx + \left(\frac{3x}{y^2} - \frac{3x^2}{y^4} - 4\right) dy = 0.$$

V3.4.6. Find the general solution of the second order ODE

$$y'' = \frac{x + y'}{2x}.$$

V3.4.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 8y' + 20y = 40x.$$

V3.4.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 8y' + 15y = xe^{5x}.$$

V3.4.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 5\dot{x} + 6x = -e^{-2t}; \quad x(0) = 1, \dot{x}(0) = 0.$$

V3.4.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = x + 2y; & x(0) = 0, y(0) = 1 \\ \dot{y} = 4x - y. \end{cases}$$

V3.5. ODE. List of problems.

V3.5.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$x \sin x + (\operatorname{tg}^2 y - 1) y' = 0; \quad y(\pi/2) = 0 .$$

V3.5.2. Find the general solution of the ODE

$$(y^2 - x^2 + xy) y' = 8x^2 - xy + y^2 .$$

V3.5.3. Solve the initial condition problem for the following ODE

$$y' + 2xy = x^3; \quad y(0) = 3/2 .$$

V3.5.4. Find the general solution of the ODE

$$xy' - (x + 1)y + 3x^2 e^{-x} \cdot y^2 = 0 .$$

V3.5.5. Find the general solution of the ODE

$$\left(\frac{1}{y} + \frac{3}{x}\right) dy - \left(\frac{1}{x} + \frac{3y}{x^2}\right) dx = 0 .$$

V3.5.6. Find the general solution of the second order ODE

$$x = 2 \arcsin \frac{y''}{x} .$$

V3.5.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - y' + y = 2x + 3 .$$

V3.5.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 4y = 3 \sin 2x .$$

V3.5.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 6\dot{x} - 16x = 3e^{2t}; \quad x(0) = 1, \dot{x}(0) = -1.$$

V3.5.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = 2x + 5y; & x(0) = 1, y(0) = 1 \\ \dot{y} = x - 2y. \end{cases}$$

V3.6. ODE. List of problems.

V3.6.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$(x^2y^2 - x^2) dx - (x^3 + 1) dy = 0; \quad y(0) = 2.$$

V3.6.2. Find the general solution of the ODE

$$(2x - 7y) dx + (4x + y) dy = 0.$$

V3.6.3. Solve the initial condition problem for the following ODE

$$(x + 1)y' - 2x(x + 1)y = x e^{x^2}; \quad y(0) = -1.$$

V3.6.4. Find the general solution of the ODE

$$(2x + 1)y' - 4y = 8x\sqrt{y}.$$

V3.6.5. Find the general solution of the ODE

$$(ye^{xy} + 2xy - 1) dx + (x^2 + xe^{xy}) dy = 0.$$

V3.6.6. Find the general solution of the third order ODE

$$y''' = 3y'' + e^{2x}.$$

V3.6.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 4y' + 4y = x - 1.$$

V3.6.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 4y' - 5y = 8 \cos x.$$

V3.6.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} - 5\dot{x} + 6x = -2e^{3t}; \quad x(0) = 1, \dot{x}(0) = -2.$$

V3.6.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = -2x + 5y; & x(0) = 0, y(0) = 2 \\ \dot{y} = x + 2y. \end{cases}$$

V3.7. ODE. List of problems.

V3.7.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$x dx + (3 - 2y - y^3) e^{x^2} dy = 0; \quad y(1) = 0 .$$

V3.7.2. Find the general solution of the ODE

$$(9x^2 + 5xy + 2y^2) dx + (7x^2 + 4xy + y^2) dy = 0 .$$

V3.7.3. Solve the initial condition problem for the following ODE

$$xy' + y = xe^{2x}; \quad y(1) = e^2 .$$

V3.7.4. Find the general solution of the ODE

$$y' + y = -e^x y^2 .$$

V3.7.5. Find the general solution of the ODE

$$(x^2 y^3 - 2xy^2 + y - 2) dx + (x^3 y^2 - 2x^2 y + x) dy = 0 .$$

V3.7.6. Find the general solution of the second order ODE

$$(x^2 - 1)y'' = 2xy' .$$

V3.7.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 8y' + 18y = 6x^2 .$$

V3.7.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + y' - 2y = xe^{-2x} .$$

V3.7.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 6\dot{x} + 18x = \sin 2t; \quad x(0) = 0, \dot{x}(0) = 1 .$$

V3.7.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = 3x + y; & x(0) = 2, y(0) = 0 \\ \dot{y} = -5x - 3y. \end{cases}$$

V3.8. ODE. List of problems.

V3.8.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$(y - 1)^3 dx + x(4 + x^2)(y + 1) dy = 0; \quad y(-1) = 2 .$$

V3.8.2. Find the general solution of the ODE

$$(2y - x) dy + (32x - 19y) dx = 0 .$$

V3.8.3. Solve the initial condition problem for the following ODE

$$y dx + (x - y \ln y) dy = 0; \quad y(0) = 1 .$$

V3.8.4. Find the general solution of the ODE

$$xy' - 2y = 2x^2 \cos x \sqrt{y} .$$

V3.8.5. Find the general solution of the ODE

$$(4x^3y^2 + 3x^2y^3 - 2y) dx + (2x^4y + 3x^3y^2 - 2x) dy = 0 .$$

V3.8.6. Find the general solution of the second order ODE

$$x = 2e^{-y''/x} .$$

V3.8.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 2y' + y = 3x - 1 .$$

V3.8.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 6y' + 8y = e^{2x} .$$

V3.8.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 4\dot{x} + 13x = 2 \cos t; \quad x(0) = 0, \dot{x}(0) = 1.$$

V3.8.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = -3x + 4y; & x(0) = 0, y(0) = -2 \\ \dot{y} = -2x + 3y. \end{cases}$$

V3.9. ODE. List of problems.

V3.9.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$dx = xy \ln^2 x \sqrt{1 - y^2} dy; \quad y(e) = 0 .$$

V3.9.2. Find the general solution of the ODE

$$xy' - 2x = y + xe^{y/x} .$$

V3.9.3. Solve the initial condition problem for the following ODE

$$xy' + y = x^3 + x^2 + x; \quad y(2) = 5 .$$

V3.9.4. Find the general solution of the ODE

$$4x \ln x \cdot y' + 2y = -\ln x \cdot y^5 .$$

V3.9.5. Find the general solution of the ODE

$$(e^{x+y} + 2x) dx + (e^{x+y} + 1) dy = 0 .$$

V3.9.6. Find the general solution of the second order ODE

$$xy'' - y' = x^3 \sin x .$$

V3.9.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 3y' + 3y = 2x .$$

V3.9.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 5y' + 6y = 4e^{3x} .$$

V3.9.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} - 2\dot{x} + 17x = 3t; \quad x(0) = 1, \dot{x}(0) = -1.$$

V3.9.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = -2x + 6y; & x(0) = -1, y(0) = -1 \\ \dot{y} = 2x . \end{cases}$$

V3.10. ODE. List of problems.

V3.10.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$xe^{y+x} dx - dy = 0; \quad y(1) = 2.$$

V3.10.2. Find the general solution of the ODE

$$x dy - (6x - y) dx = 0.$$

V3.10.3. Solve the initial condition problem for the following ODE

$$xy' - y = x^2 \cos 2x; \quad y(\pi/2) = 0.$$

V3.10.4. Find the general solution of the ODE

$$2xy' - 9y + 3x^2 \sqrt[3]{y} = 0.$$

V3.10.5. Find the general solution of the ODE

$$\left(1 - \frac{2y}{(x+y)^3}\right) dy - \frac{x+3y}{(x+y)^3} dx = 0.$$

V3.10.6. Find the general solution of the second order ODE

$$y'' \sin x - y' \cos x = 1.$$

V3.10.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 2y' + y = x^2.$$

V3.10.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 7y' + 12y = xe^{4x}.$$

V3.10.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 4\dot{x} + 8x = 3 \sin t; \quad x(0) = 2, \dot{x}(0) = 1.$$

V3.10.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = 2x - 2y; & x(0) = 3, y(0) = 1 \\ \dot{y} = -4x. \end{cases}$$

V3.11. ODE. List of problems.

V3.11.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$x^2 e^{-x-y} dx - y dy = 0; \quad y(0) = 1 .$$

V3.11.2. Find the general solution of the ODE

$$(2x^2 - xy + y^2) dx + (4x^2 + 2xy + y^2) dy = 0 .$$

V3.11.3. Solve the initial condition problem for the following ODE

$$xy' + 2y = x \operatorname{arctg} x; \quad y(1) = \frac{\pi}{12} + \frac{\ln 2}{6} .$$

V3.11.4. Find the general solution of the ODE

$$x \ln x \cdot y' - 4y = 2 \ln x \cdot \sqrt{y} .$$

V3.11.5. Find the general solution of the ODE

$$\left(\frac{x}{x^2 + y^2} - 3x \right) dx + \left(\frac{y}{x^2 + y^2} + 3y^2 \right) dy = 0 .$$

V3.11.6. Find the general solution of the second order ODE

$$xy'' + y' = x^3 .$$

V3.11.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - 8y' + 21y = 6x .$$

V3.11.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' - y' - 2y = 3e^{2x} .$$

V3.11.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 6\dot{x} + 10x = \sin t; \quad x(0) = 1, \dot{x}(0) = 0.$$

V3.11.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = 2x + 3y; & x(0) = 1, y(0) = 0 \\ \dot{y} = 4x - 2y. \end{cases}$$

V3.12. ODE. List of problems.

V3.12.1. Solve the initial condition problem for the following ODE. Plot the direction field and the corresponding integral curve.

$$e^{1/x} \sqrt{y^2 - 1} dx - x^2 y dy = 0; \quad y(1) = 1 .$$

V3.12.2. Find the general solution of the ODE

$$(2x - 3y) dx + (2y - x) dy = 0 .$$

V3.12.3. Solve the initial condition problem for the following ODE

$$y' - y \cos x = \cos^3 x; \quad y(0) = 1 .$$

V3.12.4. Find the general solution of the ODE

$$2xy y' - 3y^2 + x^2 = 0 .$$

V3.12.5. Find the general solution of the ODE

$$\left(\frac{1}{x+1} - 3x^2 + y \right) dx + \left(x + 3y^2 - \frac{1}{y+2} \right) dy = 0 .$$

V3.12.6. Find the general solution of the second order ODE

$$x^2 y'' = x^2 + 1 .$$

V3.12.7. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 2y' + 4y = 10x + 1 .$$

V3.12.8. Find the roots of characteristic polynomial and the general solution of the linear ODE

$$y'' + 5y' + 6y = 4e^{-3x} .$$

V3.12.9. Find the roots of characteristic polynomial and solve the initial condition problem for the ODE.

$$\ddot{x} + 4\dot{x} + 5x = 3 \sin 2t; \quad x(0) = 0, \quad \dot{x}(0) = 2.$$

V3.12.10. Solve the initial condition problem for the following system of linear ODEs. Plot the phase portrait, plot the corresponding phase curve and determine the classification type of the stationary point $(0, 0)$.

$$\begin{cases} \dot{x} = x + 2y; & x(0) = 2, y(0) = 1 \\ \dot{y} = x - y. \end{cases}$$