

## MATH 1121 (Calculus for Engineering Technology) Course Outline

### 1.3 Rectangular Coordinates

- Illustrate the following concepts:
  - rectangular coordinate system,
  - $x$ -axis,
  - $y$ -axis,
  - origin,
  - quadrants,
  - coordinates
- Examples:
  - (Example 1) Plot  $A = (2, 1)$  and  $B = (-4, -3)$ .
  - (Example 3) Three vertices of a rectangle are  $A = (-3, -2)$ ,  $B = (4, -2)$ ,  $C = (4, 1)$ . What is the fourth vertex?
- HW: 1-9, 15-16, 21-24

### 2.1 Some Basic Definitions

- Distance Formula
  - $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
  - (Example 2) Find the distance between  $(3, -1)$  and  $(-2, -5)$ .
- Slope Formula
  - $m = \frac{y_2 - y_1}{x_2 - x_1}$
  - (Example 3) Find the slope of the line joining  $(3, -5)$ ,  $(-2, -6)$ .
  - (Example 4) Find the slope of the line joining  $(3, 4)$ ,  $(4, -6)$ .
- Identify parallel/perpendicular lines by slopes.
  - Parallel:  $m_1 = m_2$
  - Perpendicular:  $m_1 = -\frac{1}{m_2}$
  - (Example 7) Prove that the triangle with vertices  $A = (-5, 3)$ ,  $B = (6, 0)$ , and  $C = (5, 5)$  is a right triangle.
- Suggested HW: 1-20, 29-36

## 2.2 The Straight Line

- Point-slope form
  - $y - y_1 = m(x - x_1)$
  - (Example 2) Find the equation of the line passing through  $(2, -1)$  and  $(6, 2)$ .
- Slope-intercept form
  - $y = mx + b$
  - (Example 4) Find the slope and  $y$ -intercept of the straight line with equation  $2y + 4x - 5 = 0$ .
- *Suggested HW: 1-21, 33-40*

## 2.3 The Circle

- Definition
  - A circle is a collection of points equidistant from its center.
- Standard form
  - $(x - h)^2 + (y - k)^2 = r^2$
  - (Example 1) Sketch  $(x - 1)^2 + (y + 2)^2 = 16$ .
  - (Example 2) Find an equation for the circle with center  $(2, 1)$  which passes through  $(4, 8)$ .
- General form
  - $x^2 + y^2 + Dx + Ey + F = 0$
  - (Example 4) Find the center and radius of the circle  $x^2 + y^2 - 6x + 8y - 24 = 0$ .
  - (Example) Find two functions whose graphs represent the circle with the previous equation.
- *HW: 1-32, 37-38*

## 2.4 The Parabola

- Definition
  - A parabola is a collection of points equidistant from a focus point and a directrix line.

- (Example 6) Find an equation for the parabola with focus  $(2, 3)$  and directrix  $(y = -1)$
- Standard forms with vertex at origin and horizontal/vertical directrix
  - $y^2 = 4px$  with directrix at  $x = -p$  and focus at  $(p, 0)$
  - $y^2 = -4px$  with directrix at  $x = p$  and focus at  $(-p, 0)$
  - $x^2 = 4py$  with directrix at  $y = -p$  and focus at  $(0, p)$
  - $x^2 = -4py$  with directrix at  $y = p$  and focus at  $(0, -p)$
  - (Example 2) Find an equation for the parabola with focus  $(-2, 0)$  and directrix  $(x = 2)$ .
  - (Example 4) Find the focus and directrix of the parabola with equation  $2x^2 = -9y$ .
- HW: 1-28

## 2.5 The Ellipse

- Definition
  - An ellipse is a collection of points where the sum of distances from two fixed points (called foci) is constant.
  - The two points furthest/closest apart from each other on an ellipse are the end-points of the major/minor axis.
  - The sum of distances between each point and the foci is the same as the length of the major axis. The major axis passes through both foci.
  - (Example 6) Find an equation for the ellipse with foci at  $(1, 3)$  and  $(9, 3)$ , and a major axis of length 10.
- Standard form with center at the origin
  - $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ , with foci given by either  $(c, 0), (-c, 0)$  or  $(0, c), (0, -c)$  where  $a^2 + b^2 = c^2$
  - (Example 3) Sketch the ellipse with equation  $4x^2 + 16y^2 = 64$ , and compute the locations of its foci.
  - (Example 5) Find the equation of the ellipse centered at the origin with an end of its minor axis at  $(2, 0)$  and containing the point  $(-1, \sqrt{6})$ .
- HW: 1-26

## Remaining Topics

- 2.6 The Hyperbola
- 2.7 Translation of Axes
- 1.2 Algebraic Functions
- 1.4 The Graph of a Function
- 3.1 Limits
- 3.2 The Slope of a Tangent to a Curve
- 3.3 The Derivative
- 3.4 The Derivative as an Instantaneous Rate of Change
- 3.5 Derivatives of Polynomials
- 3.6 Derivatives of Products and Quotients of Functions
- 3.7 The Derivative of a Power of a Function
- 3.8 Differentiation of Implicit Functions
- 3.9 Higher Derivatives
- 4.1 Tangents and Normals
- 4.4 Related Rates
- 4.5 Using Derivatives in Curve Sketching
- 4.6 More on Curve Sketching
- 4.7 Applied Maximum and Minimum Problems
- 4.8 Differentials and Linear Approximations
- 5.1 Antiderivatives
- 5.2 The Indefinite Integral
- 5.3 The Area Under a Curve
- 5.4 The Definite Integral
- 7.1 The Trigonometric Functions
- 7.2 Basic Trigonometric Relations

- 7.3 Derivatives of the Sine and Cosine Functions
- 7.4 Derivatives of the Other Trigonometric Functions
- 8.1 Exponential and Logarithmic Functions
- 8.2 Derivative of the Logarithmic Functions
- 8.3 Derivative of the Exponentials Function
- 9.1 The General Power Formula
- 9.2 Basic Logarithmic Form
- 9.3 Exponential Form
- 9.4 Basic Trigonometric Forms