

BIOTONOMY

ACADEMY 2023

NATURE-BASED SOLUTIONS FOR ARCHITECTURE & CONSTRUCTION

THEORETICAL & PRACTICAL COURSE

CURRICULUM

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NATURE BASED SOLUTIONS

NATURE-BASED SOLUTIONS FOR ARCHITECTURE & CONSTRUCTION



THEORETICAL & PRACTICAL COURSE

Overview of the Academy program

The Biotonomy Academy program is a comprehensive 4-week training program designed to equip students with both practical skills and theoretical knowledge on designing and building autonomous buildings with Nature Based Solutions (NBS). The program condenses over a decade of experience into 4 weeks, providing students with a deep understanding of NBS for architecture and construction projects. To ensure students make the most out of the program, introductory courses will be provided before starting the training. Throughout the construction process, our experienced teachers will provide a series of classes on fundamental topics of Autonomous buildings with NBS. In addition to the theoretical knowledge, students will get the opportunity to implement what they have learned through exercises and group assignments. This Curriculum has been developed to provide students with all the information necessary about the courses, modules, and exercises offered during the Academy program.

By the end of this course, you will learn:

By the end of the course, students will have a deep understanding of Nature Based Solutions and their application in architecture & construction. They will have developed an innovative way of thinking and designing, one that incorporates ecosystem services, natural resources, biological processes, physical laws, and natural cycles into the function of buildings. Students will gain practical skills and theoretical knowledge of how Autonomous buildings are designed and constructed with NBS, giving them the tools and knowledge to develop their own Nature Based Development (NBD) projects.

Who is the course aimed at?

The Biotonomy Academy program is aimed at everyone who wants to learn about designing and building autonomous buildings with NBS. The course is designed to be accessible to all, regardless of their background. It's perfect for both individuals with prior knowledge and experience in architecture and construction, as well as those without any prior background in the field. Whether you're a student, a professional, or just someone interested in Nature Based architecture and construction, this program is for you.



NATURE-BASED SOLUTIONS FOR ARCHITECTURE & CONSTRUCTION

THEORETICAL & PRACTICAL COURSE

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INTRODUCTION COURSES

1 - Introduction to Design and Construction Phases

This introductory course offers students a comprehensive overview of the design and construction phases of the building project. Through 3D illustrations and in-depth explanations, participants will gain a clear understanding of the various materials and systems that are incorporated into the design. By the end of the course, students will have a solid grasp of the construction process and will be prepared to start working hands-on.

2 - Guideline & Jobsite safety

The Guidelines and Jobsite Safety class provides an overview of the necessary safety measures and guidelines that are crucial to ensuring a safe and secure job site. This class is designed to help participants understand the importance of following safety protocols and identifying potential hazards in order to minimize accidents and injuries. Students will learn about the various safety standards and regulations that are relevant to their work and will be equipped with the necessary knowledge and skills to work safely and effectively on job sites.

3 - Construction Tools & Materials

This introduction course provides an introduction to the various tools and materials used in construction. Students will learn about the different types of hand and power tools, their uses, and how to operate them safely. They will also explore the properties and applications of various construction materials. This course will equip students with a basic understanding of the tools and materials necessary for construction projects.



MODULES

Module 1: The History of Nature Based Solution (NBS)

Module Description:

This course provides an overview of the history of NBS, from early human civilizations that relied on natural resources to modern approaches for managing natural resources. Students will learn how NBS have been used throughout history to maintain a harmonious relationship with the natural world. The course covers the evolution of human connection to the natural world and the growing recognition of the importance of NBS in promoting sustainable development.

Topics covered:

1. Early Human Civilization and the Use of NBS
2. Evolution of Human Connection to the Natural World
3. Introduction to Nature Based Solutions
4. NBS in Modern Times

1 - Early Human Civilization and the Use of NBS

This lesson explores how early human civilizations relied on NBS to meet their basic needs and how they developed a deep connection with the natural world. Students will learn about the techniques and strategies used by ancient civilizations to manage and maintain a balance with nature.

2 - Evolution of Human Connection to the Natural World

This lesson delves into how human connection to the natural world has evolved over time, from hunter-gatherer societies to modern urbanization. Students will learn about the impact of industrialization on the natural world and how it has led to the degradation of the environment.

3 - Introduction to Nature Based Solutions

This lesson provides an overview of Nature Based Solutions, including what they are, how they work, and the benefits they provide. Students will learn about the different types of NBS, and their applications in promoting sustainable development.



Module 2: The Intelligence of Nature

Module Description:

This course provides an in-depth look into the intelligence of Nature, encompassing the natural systems and processes that sustain life on Earth. Participants will explore how organisms are ingeniously crafted to function within the infrastructure and laws of nature, in order to meet their basic needs and thrive. The course highlights the significance of comprehending and valuing nature's intelligence, and how it can be leveraged to develop sustainable solutions for human needs. Students will gain a profound understanding of the connection between organisms and the infrastructure of nature, and how it can shape our approach toward sustainable living.

Topics covered:

1. Introduction to the Infrastructure of Nature
2. Organisms and Nature's Intelligence
3. Human based vs Nature based Design
4. Case Studies of Ancient Civilizations

1 - Introduction to the Infrastructure of Nature

In this lesson, students will learn about the different elements that make up the infrastructure of nature. They will explore the laws of nature that govern these elements and how they interact with each other to sustain life on Earth.

2 - Organisms and Nature's Intelligence

In this lesson, students will explore the various ways in which organisms have adapted to operate within the infrastructure and laws of nature. They will learn about how different species have evolved to meet their basic needs and how these adaptations demonstrate the intelligence of nature.

3 - Human based vs Nature based Design

In this lesson, students will compare and contrast the differences between human based solutions and NBS. They will examine how human made solutions can have unintended consequences on the environment and explore how we can leverage nature's intelligence to develop more sustainable solutions for our needs.



4 - Case Studies of Ancient Civilizations

This lesson delves into the ways ancient civilizations used NBS to develop their societies. Throughout the course, students will explore the NBS implemented by civilizations such as the Mayans, Romans, Persians, and Egyptians, including their construction techniques, use of natural resources, and management of the environment. By examining specific examples of ancient NBS, students will gain insight into the resourcefulness and ingenuity of these societies and how their practices continue to influence modern sustainable development. The course will highlight the significance of understanding and valuing NBS as a means of promoting sustainable development and environmental stewardship.



Module 3: Natural Heating and Cooling

Module Description:

This module will provide students with an in-depth understanding of how to naturally heat and cool buildings without relying on mechanical or electrical systems. The focus will be on the integration of the laws of nature into architectural design, covering important concepts such as thermodynamics, thermal mass, passive design, and microclimates. Students will learn how to design self-sufficient buildings that maintain a comfortable temperature year-round without relying on external energy sources. By the end of this module, students will have a solid grasp of how Nature Based Solutions can be integrated into building operations and functions for natural heating and cooling.

Topics covered:

1. Introduction to Natural Heating and Cooling
2. Thermodynamics and Building Design
3. Thermal Mass and Passive Design
4. Microclimates and Site Analysis

1 - Introduction to Natural Heating and Cooling

In this lesson, students will be introduced to the concept of natural heating and cooling and its importance in autonomous building design. They will learn about the laws of nature that govern temperature regulation and explore how they can be utilized in building design.

2 - Thermodynamics and Building Design

In this lesson, students will delve deeper into the science of thermodynamics and its relevance to building design. They will learn about the different principles of thermodynamics and how they relate to the transfer of heat in buildings. The lesson will explore how students can apply these principles to create autonomous buildings.

3 - Thermal Mass and Passive Design

In this lesson, students will learn about the importance of thermal mass in building design and how it can be utilized to store temperatures naturally. They will explore different materials that possess high thermal mass and learn how to integrate them into building design. The lesson will also cover passive design strategies such as shading, orientation, and ventilation.



4 - Microclimates and Site Analysis

In this lesson, students will gain a deeper understanding of the concept of microclimates in the context of building design. They will learn how microclimates can be utilized to enhance natural heating and cooling strategies, leading to a more sustainable and cost-effective building design. Through site analysis, students will identify microclimates and explore how they can be incorporated into building design. The lesson will also cover the significance of building placement and orientation in relation to microclimates. By the end of this lesson, students will have the knowledge and skills to utilize microclimates as a Nature Based Solution in their building design projects



Module 4: Water Production

Module description:

In this course, students will learn about the principles of designing and engineering buildings to operate with the water infrastructure of nature. The course will cover design principles for water harvesting, engineering principles for filtration and supply, and strategies for producing clean and drinkable water. Through this course, students will gain an understanding of how to design buildings and landscapes to harvest, filter, and produce clean water efficiently.

Topics covered:

1. Introduction to Water production in Building Design
2. Water Harvesting Techniques
3. Filtration and Treatment of Harvested Water
4. Solar hot water system

1 - Introduction to Water production in Building Design

In this lesson, students will be introduced to the principles of designing buildings and landscapes to work with natural water infrastructure. They will learn about the water cycle and the importance of understanding water availability, usage, and waste. Students will be introduced to the concept of water harvesting and filtration and how it can be used to produce clean drinking water.

2 - Water Harvesting Techniques

This lesson will focus on the different techniques that can be used to harvest water from buildings and landscapes. Students will learn about the design principles involved in water harvesting, including the selection of appropriate materials and the consideration of site conditions. They will also explore case studies of successful water harvesting projects.

3 - Filtration and Treatment of Harvested Water

In this lesson, students will learn about the engineering principles involved in the filtration and treatment of harvested water. They will explore different types of filtration systems, and the considerations involved in selecting and sizing these systems. Students will also learn about the treatment of harvested water to produce clean, drinkable water.



4 - Solar hot water system

In this lesson, students will learn about the basics of solar water heating systems. They will explore how solar thermal collectors work to convert sunlight into heat and how this heat can be used to provide hot water for homes and buildings. The lesson will cover the different types of solar collectors and the components of a solar water heating system. Students will also learn about the advantages and limitations of solar water heating and how to calculate the potential energy savings from using such systems.



Module 5: Biological Sewage Treatment

Module description:

This module will explore the concept of Biological Sewage Treatment, providing students with an understanding of how to treat wastewater using natural processes effectively. Students will learn about the various types of biological sewage treatment systems, including constructed wetlands and botanical planters. The module will cover the design principles for these systems, as well as the biological processes that occur within them. Through this exploration, students will gain a deeper understanding of how biology can be harnessed to treat wastewater in an environmentally sustainable way.

Topics covered:

1. Introduction to Biological Sewage Treatment system
2. How to treat greywater
3. How to treat blackwater
4. How to restore natural ecosystems with wastewater

1 - Introduction to Biological Sewage Treatment system

In this lesson, students will learn about botanical wastewater treatment systems and their benefits for both the environment and human health. They will explore the principles behind the system and why it is becoming an increasingly popular alternative to traditional wastewater treatment methods.

2 - How to treat greywater

In this lesson, students will learn how to treat greywater from showers and sinks using a botanical system. They will explore the different components of the system and how they work together to remove impurities and contaminants from the water.

3 - How to treat blackwater

In this lesson, students will learn how to treat blackwater from toilets using a botanical system. They will explore the different techniques and processes involved in the treatment, including how to separate solids and liquids and how to eliminate harmful pathogens.

4 - How to restore natural ecosystems with wastewater

In this lesson, students will learn how biological wastewater treatment systems can help restore natural ecosystems. They will explore the benefits of using treated wastewater to irrigate plants and crops, how it can help replenish groundwater resources, and how it can provide a sustainable source of water for communities.



Module 6: Solar & Wind Energy System

Module description:

This course will provide students with a comprehensive introduction to solar and wind energy systems. Students will learn about the basic principles and components of these systems, including solar panels, wind turbines, batteries, inverters, and charge controllers. They will also explore the benefits and challenges of using solar and wind energy, as well as the differences between off-grid and grid-tied systems. By the end of this course, students will have a solid foundation in the principles of solar and wind energy systems and be able to make informed decisions about their own energy needs.

Topics covered:

1. Introduction to Solar Energy
2. Introduction to Wind Energy
3. Designing Solar and Wind Systems

1 - Introduction to Solar Energy

In this class, students will learn the basics of solar energy, including how solar panels work, different types of solar panels, and the advantages and disadvantages of solar energy.

2 - Introduction to Wind Energy

In this class, students will learn the basics of wind energy, including how wind turbines work, different types of wind turbines, and the advantages and disadvantages of wind energy.

3 - Designing Solar and Wind Systems

In this class, students will learn how to design solar and wind energy systems, including how to calculate energy needs, select the right components and design a system that meets specific energy goals.



Module 7: Food Production

Module description:

In this module, students will learn how to produce their own food using various techniques. The course will cover the basics of food production, including the principles of botany and the use of botanical planters. Students will also learn about the aquaponics system, which combines aquaculture and hydroponics to create a sustainable and self-sufficient food production system. Through this course, students will develop the skills and knowledge necessary to grow their own food and make informed choices about the food they consume. They will also gain a deeper understanding of the environmental and social impact of industrial food production and the potential of sustainable food production to address these challenges.

Topics covered:

1. Introduction to Food Production
2. Food production with Botanical Planters
3. Food production with Aquaponics

1 - Introduction to Food Production

In this class, students will learn about the basics of food production and the different methods of growing food. They will explore the benefits and challenges of producing their own food and the potential of sustainable food production to address food security and environmental issues.

2 - Foodproduction with Botanical Planters

In this class, students will learn about the principles of using botanical planters for food production. They will explore different types of planters, their benefits, and how to select and care for plants.

3 - Foodproduction with Aquaponics

In this class, students will learn about the aquaponics system and how it combines aquaculture and hydroponics to create a sustainable and self-sufficient food production system. They will explore the different components of the system and how to set up and maintain an aquaponics system.



Module 8: Vertical Gardens

Module description:

In this course, students will learn about the design and construction of Vertical Gardens. The course will cover the structural and engineering components of vertical gardens, including materials, plant selection, and irrigation systems. Students will explore the benefits of vertical gardens and learn how to incorporate them into urban environments. By the end of the course, students will have the knowledge and skills of how vertical gardens are designed and built.

Topics covered:

1. Introduction to Vertical Gardens
2. Materials & Structure
3. Plant Selection
4. Hydroponic System

1 - Introduction to Vertical Gardens

In this lesson, students will learn about the benefits and challenges of vertical gardens, as well as the different types of systems used in vertical gardening. They will also explore the advantages of using hydroponic systems for vertical gardens compared to traditional soil-based gardening methods.

2 - Materials & Structure

This lesson will focus on the structural and engineering components of vertical gardens. Students will learn about the different materials used in building vertical gardens. They will also learn about the design principles for constructing a successful vertical garden.

3 - Plant Selection

In this lesson, students will learn about plant selection for vertical gardens, including the benefits and challenges of growing different types of plants in this system. They will explore the different factors to consider when selecting plants for vertical gardens.

4 - Hydroponic Systems

In this lesson, students will learn about the engineering components of hydroponic systems for vertical gardens. They will explore the engineering principles required for building and maintaining these systems. The lesson will also cover the importance of selecting appropriate components for optimal plant growth and productivity.



Module 9: Reforming Existing Building with NBS

Module description:

In this module, students will learn how to transform existing buildings to operate with Nature Based Solutions (NBS). They will learn to analyze and assess the feasibility of integrating NBS to improve the function of existing buildings. Students will explore how to redesign and engineer buildings to reduce their reliance on mechanical systems, leading to more environmentally friendly and cost-effective building design.

Topics covered:

1. How to analyze the feasibility of integrating NBS
2. How to integrate natural heating & cooling
3. How to integrate water harvesting, storage & filtration
4. How to integrate biological sewage methods

1 - How to analyze the feasibility of integrating Nature Based Solutions

Students will learn how to assess the feasibility of integrating NBS into an existing building. They will explore the benefits of NBS and understand how it can improve the function of a building. Students will also learn how to identify potential challenges and limitations of implementing NBS in existing buildings.

2 - How to integrate natural heating & cooling

This topic will focus on natural heating and cooling techniques that can be integrated into existing buildings. Students will learn about passive solar design, and other methods to reduce the need for mechanical heating and cooling systems. They will also explore the advantages of natural heating and cooling and how it can improve the energy efficiency of buildings.

3 - How to integrate water harvesting, storage & filtration

In this topic, Students will learn how to integrate water harvesting, storage, and filtration systems into existing buildings to reduce water consumption and increase sustainability.

4 - How to integrate Biological sewage methods

In this topic, students will explore how to integrate biological sewage methods into existing building designs to improve wastewater management and reduce environmental impact.



Module 10: 3D Modeling for Autonomous Buildings

Module description:

In this module, students will learn how to create 3D models of autonomous buildings. They will gain an understanding of the key design principles and workflows when designing autonomous buildings. Students will learn to create accurate and detailed 3D models of these buildings to visualize and analyze their design, as well as to communicate their ideas to others. By the end of the course, students will have the skills and knowledge to start creating their own 3D models of autonomous buildings.

Topics covered:

1. Introduction to 3D Modeling
2. 3D Modeling Autonomous Buildings
3. Solar studies
4. Presenting designs

1 - Introduction to 3D Modeling:

In this lesson, students will be introduced to the world of 3D modeling. They will learn about the importance of 3D modeling and will be familiarized with the key concepts and terminologies used in the field.

2 - 3D Modeling Autonomous Buildings

In this lesson, students will learn how to create 3D models of autonomous buildings and will gain an understanding of the key design principles to consider when creating 3D models. They will explore various design elements and learn how to incorporate them into their models.

3 - Solar Studies

In this lesson, students will learn how to perform solar studies in 3D modeling software to analyze and optimize the performance of their designs. They will gain an understanding of how to use the software tools to determine the best orientation and shading strategies for their buildings.

4 - Presenting Designs

In this lesson, students will learn how to present their 3D models effectively. They will learn about the different types of presentations, such as 2D and 3D drawings, and will gain an understanding of how to prepare their models for different types of presentations.



EXERCISES

Exercise 1 - Design Exercise

Exercise Description:

In this exercise, students will get the opportunity to apply all the knowledge they have gained in the academy to develop a design for an autonomous building in a specific climate. Students will be assigned to groups, where they will collaborate to develop a conceptual design plan for an autonomous building. They will work together to integrate design principles, such as passive design, natural ventilation, and solar studies, in order to create an autonomous building.

Once the group has developed its design, they will present it for feedback. The presentation will be an opportunity for the group to showcase their design and demonstrate their understanding of the concepts learned in the academy. The teachers will provide constructive feedback to help the group improve their design and ensure that it meets the required standards.

Exercise 2 - Final examination

Exercise Description:

At the end of the Biotonomy Academy program, students will need to complete a final examination. This exam is designed to help students remember the key takeaways from the program and test their ability to apply their knowledge. The exam will ensure that each student can demonstrate their understanding of the course material. Students who successfully complete all the courses, including all the Exercises, will gain certification for completing the Biotonomy Academy program.

BIOTONOMY ACADEMY

SHAPING THE FUTURE BY EMPOWERING THE NEXT GENERATION OF LEADERS



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