

Course title	Introduction to Pedology and Fertilizers				
Course code	GALA1104				
Course type	Lectures and demonstrations with practical applications in the lab and the field.				
Level	Higher Diploma				
Year / Semester	1 st Year / 1 st Semester				
Teacher's name	Δημήτρης Τσιμούρης				
ECTS	6	Lectures / week	2	Laboratories / week	1
Course purpose and objectives	The goal of the course is to teach the students the fundamental functions of soil, including its phytochemical properties, and its fertility with the use of fertilisers, which influence the healthy growth of plants, trees, and shrubs. Additionally, the course aims to provide the students with the necessary knowledge and skills related to the use of fertilisers for enriching the soil with essential elements for optimal plant development. The course further encourages the students to understand the importance of maintaining soil sustainability and the challenges that arise for soils due to climate change.				
Learning outcomes	<p>Upon completion of the course, students are expected to:</p> <p>Theoretical Learning Outcomes:</p> <ol style="list-style-type: none"> Explain the physical and chemical properties of soil, the importance of soil organic matter, sources of soil pollution, and the impacts of pollution on agricultural soils and their fertility. Identify various microorganisms and the main nutrients present in soil. Analyse the significance of nutrients and the factors affecting them. Describe the effects of climate change on soils and suggest mitigation measures. Justify the need for the addition of nutrients to the soil. Explain the principles, mechanisms, and advantages of slow-release and controlled-release fertilizers compared to conventional fertilizers. Describe the types and classifications of biostimulants (microbial and non-microbial), their roles in plant growth, stress tolerance, and soil health. <p>Practical Learning Outcomes</p> <ol style="list-style-type: none"> Conduct various soil measurements. Apply fertilization methods 				
Prerequisites		Required			
Course content	<p>Week 1 Lecture</p> <ul style="list-style-type: none"> Introduction to Soil Science – Plant Nutrition. Definitions. Mineral composition of soil. Soil – soil formation. Physical and mechanical properties of soil. 				

- Soil Moisture.

Week 2

Lecture

- Soil chemical composition: major and trace elements
- Soil pH and nutrient availability
- Cation exchange capacity (CEC): clay and organic matter interactions with ions (Na^+ , K^+ , Ca^{2+} , Mg^{2+}).

Week 3

Laboratory Practice and field work:

- Physical structure and inorganic chemical composition of soil.
- Determination of soil texture, porosity, soil compaction (using soil penetrometer) and water-holding capacity.
- Analysis of soil pH and inorganic composition.

Week 4

Lecture

- The biological environment of soil.
- Soil microorganisms.
- Soil organic matter.

Laboratory Practice: Organic matter: Origin and composition of organic matter, effects of organic matter addition to soil, physical, chemical, and biological properties of organic matter

Week 5

Lecture

- Soils and environment – soil degradation.
- Soil Pollution – Soil sustainability and pollution management.
- Impacts of climate change on soils and mitigation measures.

Field Practice:

- Assessment of soil erosion indicators in the field.
- Soil pollution case study

Week 6

Lecture

- Soil fertility.
- Soil nutrients

Laboratory Practice: Green manuring and beneficial microorganisms: Applications of plant and microorganism interactions to improve soil fertility.

Week 7

Lecture

- Types of fertilizers and methods of application. Introduction to fertilizers – What is a fertilizer
- Types of Fertilizers (Organic and Inorganic fertilizers).
- Extended classification of fertilizers: Straight, complex, mixed fertilizers; liquid fertilizers; foliar fertilizers.

- Introduction to slow-release and controlled-release fertilizers: Mechanisms, advantages, limitations.
- Methods of application.

Field Practice:

- Comparative demonstration of fertilizer application methods (broadcasting, banding, fertigation, foliar application).
- Observation of physical characteristics of different fertilizer types.

Week 8

Lecture

- Organic fertilizers.
- Composting of organic fertilizers.
- Inorganic fertilizers – Nitrogenous, phosphatic, potassic.
- Symbols for inorganic fertilizers – Compound fertilizers.
- Methods of fertilizer composition (Natural and Synthetic fertilizers).
- Slow-release and controlled-release fertilizers: Coated fertilizers, chemically modified fertilizers, nanofertilizers.
- Biostimulants: Definition, role in plant growth and stress tolerance. Classification (microbial and non-microbial).

Week 9

Field Practice:

- Compost preparation and monitoring (temperature, moisture, maturity indicators).
- Soil sampling and preparation of samples for laboratory analysis.
- Soil pH measurement (field vs. lab methods).
- Demonstration of nutrient release rates: comparison of soluble vs. slow-release fertilizers (incubation and measurement of nutrient leaching in soil columns).

Weeks 10

Lecture

- Fertilizer requirements for plant types.
- Selection of the appropriate fertilizer and quantity (Factors to be considered).
- Timing of fertilization.
- Methods of fertilizer application.
- Problems of over-fertilization and its consequences.
- Crop Rotation: Benefits of crop rotation, improving soil fertility, pest management.
- Green Manuring: Characteristics of green manuring plants, suitable plant species for green manuring, recommended green manuring species for various soils.
- Rocks: Application of rocks to improve soil.

Week 11

Field Practice:

- Calculation of fertilizer requirements for selected plant types (fertilizer recommendation exercises).
- Garden maintenance: fertilizer and soil amendment application, observation of plant responses.
- Case study: diagnosing nutrient deficiency and over-fertilization symptoms.

Week 12

Lecture

- Fertilizer requirements for ornamental plants.
- Use of biostimulants and specialty fertilizers in ornamental horticulture.

Practical:

- Preparation of fertilizer and biostimulant schedules for ornamental plants.

Course Breakdown

Week	Content	Teaching Process
Week 1	Introduction to Soil Science – Plant Nutrition. Definitions, soil formation, mineral composition, physical/mechanical properties, soil moisture.	Lecture
Weeks 2	Chemical properties of soil.	Lecture
Week 3	Practice: Soil structure, texture, pH, inorganic composition.	Field Practice
Week 4	Biological environment of soil, soil microorganisms, soil organic matter. Practice: Laboratory exercise on organic matter: origin, composition, and effects on soil.	Lecture + Laboratory Practice
Week 5	Soils and the environment, soil degradation and pollution, sustainability, climate change impacts, mitigation measures. Practice: Soil erosion indicators, soil pollution sampling.	Lecture + Field Practice
Week 6	Soil fertility and nutrients. Practice: Green manuring and beneficial microorganisms to improve fertility.	Lecture + Field Practice
Week 7	Introduction to fertilizers, types (organic and inorganic), classification (straight, complex, mixed, liquid, foliar), intro to slow-release fertilizers, methods of application. Practice: Fertilizer application method demos, fertilizer type observations.	Lecture + Field Practice

	Weeks 8	Organic fertilizers, composting, inorganic fertilizers (N, P, K), symbols, compound fertilizers, natural/synthetic composition, slow-release fertilizers, biostimulants.	Lecture
	Week 9	Field Practice: Compost making, soil sampling, pH testing, nutrient release comparisons, application of biostimulants.	Field Practice
	Week 10	Fertilizer needs, selection and application, over-fertilization issues, crop rotation, green manuring, rock application.	Lecture
	Week 11	Field Practice: Fertilizer calculation, crop rotation demo, garden maintenance, nutrient deficiency diagnosis.	Field Practice
	Week 12	Fertilizer requirements for ornamental plants. biostimulants in horticulture. Practice: Preparation of fert/biostimulant schedules, plant quality assessment.	Lecture + Field Practice
Teaching methodology	<p>Theoretical Instruction: The lectures will be delivered through an interactive, student-centered approach, encouraging active participation. Each session will begin with a brief introduction to the theoretical concepts, followed by in-depth discussions of key principles. Visual aids, including slides and videos will be used to enhance understanding and stimulate creative thinking. Students will be encouraged to engage with the material through group discussions and problem-solving activities.</p> <p>Practical Instruction: The laboratory component of the course provides students with hands-on experience in applying theoretical concepts. Activities include soil sampling, mechanical analysis, pH testing and more. Students develop essential skills in fertilizer and soil amendment application while reinforcing theoretical knowledge through guided experimentation and practical problem-solving in a controlled lab environment and field work.</p>		
Bibliography	<p>Greek Bibliography</p> <ul style="list-style-type: none"> • Σινάνης, Κ. (2019). Έδαφος, διαχείριση, περιβάλλον. Ψύχαλος. ISBN-13: 978-960-5049-68-3 • Προδρόμου, Κ. Π. (2011). Εφαρμοσμένη εδαφολογία: Γένεση εδαφών. 3η Έκδοση. Ζήτη. ISBN: 9789604563012. • Ασημακόπουλος, Ιωάννης Η. (2014), Λιπάσματα λιπάνσεις. 2η Έκδοση. Έμβροο. ISBN 978-960-8002-67-8. • Μπόλα, Α. (2014). Εισαγωγή στην εδαφολογία χημεία εδάφους και λιπάσματα : Εγχειρίδιο Κηπουρικής. KES College • Αριστείδης, Χ. (2009). Καλλιεργώ βιολογικά: Έδαφος, λίπανση, φυτοπροστασία. [Organic farming: Soil, fertilisation, plant protection]. Φλούδας. ISBN 978-960-8069-74-9. 		

	<ul style="list-style-type: none"> • Πασχαλίδης, Χ. (2006). Λιπασματολογία, εργαστηριακές ασκήσεις: Γονιμότητα εδαφών, θρέψη φυτών, φυλλοδιαγνωστική, λιπάσματα, ποιοτικά χαρακτηριστικά σοδειάς. [Fertiliser, laboratory exercises: Soil fertility, plant nutrition, foliar diagnostics, fertilisers, quality crop characteristics]. 2η Έκδοση. Εκδόσεις Έμβρο. ISBN: 9789608002418. <p>English Bibliography</p> <ul style="list-style-type: none"> • Motuzova, G. V. (2012). Soil Organic Matter and Their Interactions with Metals : Processes, Factors, Ecological Significance. Hauppauge, N.Y. : Nova Science Publishers, Inc. 2012. ISBN:9781614709473. EBSCOHost • Chatzistathis, Theocharis (2014). Micronutrients Deficiency in Soils and Plants. Sharjah : Bentham Science Publishers. 2014. ISBN: 9781608059355. EBSCOHost • Western Plant Health Association (2010). Western Fertilizer Handbook. 9th Edition. Waveland Pr Inc, ISBN: 978-1577666790. • Zimmer, G. E. , Zimmer-Durand, L. (2011). Advancing biological farming: Practicing mineralized, balanced agriculture to improve soils and crops. Acres U.S.A. ISBN: 9781601730190 • Lownfels, J. (2013). Teaming with nutrients: The organic gardener's guide to optimizing plant nutrition. Timber Press. ISBN: 978-1604693140. • Singh, R. P. (2012). Organic Fertilizers: Types, Production and Environmental Impact. Hauppauge, N.Y.: Nova Science Publishers, Inc. ISBN: 9781620814222. EBSCOHost. • Hanuman Singh Jatav (2021). Sustainable Soil Fertility Management. Hauppauge, New York : Nova. ISBN:9781536190557. EBSCO Host • Motuzova, G. V. (2012). Soil Organic Matter and Their Interactions with Metals : Processes, Factors, Ecological Significance. Hauppauge, N.Y.: Nova Science Publishers, Inc. ISBN:9781614709473. EBSCOHost
<p>Assessment</p>	<ul style="list-style-type: none"> • Attendance and course participation: 10% • Individual assignments/reports related to the nature of the Practical/Lab training: 40% • Final Written Examination: 50% <p>Student performance in this course will be evaluated through a combination of continuous and summative assessments. Attendance and active participation in class will contribute 10% to the final grade, reflecting the importance of consistent engagement. A portfolio of individual lab reports compiled from the various practical sessions will account for 40%, assessing students' ability to document their work systematically, demonstrate applied skills, and reflect on their learning throughout the semester. The final written examination, weighted at 50%, will include both closed-ended questions (e.g., multiple-choice, matching, true/false) and open-ended questions (e.g., short-answer, essay-type, case studies). The examination will have a duration of two academic periods and will evaluate students' overall understanding of the course content, their ability to synthesize theoretical and practical knowledge, and their critical thinking skills.</p> <p>Student performance is evaluated on a scale of 0 to 100, with a minimum overall passing grade of 60. The final grade is calculated as a weighted average of the assessment components described above.</p>
<p>Language</p>	<p>Greek or English</p>