University of Tehran

College of Science

School of Biology

Description of program and course syllabi

Biology- Plant Systematics

Ph.D.

Table 1- Specialized- elective courses

Major: Biology- Plant Systematics Program: Ph.D

No.	Course name	Unit			Hours			Prerequisite/ Corequisite
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	Theoretical Systematics	2	0	2	32	0	32	None
2	Plant Biosystematics	2	0	2	32	0	32	None
3	Phylogenetic analysis	1	1	2	16	32	48	None
5	Plant Phytogeography	2	0	2	32	0	32	None
6	Flora and Ecology of Iranian Forests	2	0	2	32	0	32	None
7	Geobotany of Iranian Deserts	2	0	2	32	0	32	None
8	Molecular Plant Taxonomy	2	0	2	32	0	32	None
9	Application of Bioinformatics in Plants	2	0	2	32	0	32	None
10	Plant Cytogenetics	2	0	2	32	0	32	None
11	Plant Breeding Systems	2	0	2	32	0	32	None
12	Trees and Shrubs of Iran	2	0	2	32	0	32	None
13	The Origin of Land Plants	2	0	2	32	0	32	None
14	Palaeoecology and Palynology	2	0	2	32	0	32	None
15	Botanical Latin	2	0	2	32	0	32	None
16	Molecular Plant Ecology	2	0	2	32	0	32	None
17	Plant Molecular Development	2	0	2	32	0	32	None
18	Special Topics in Plant Systematics	2	0	2	32	0	32	None
	Seminar	2	0	2				None
Total		36	2	38	544	64	608	-

Prerequisites for Ph.D. degree in Biology-Plant Systematics.

The student's supervisor requires the student to take up to 6 units of lower level courses.

Topics of specialized - elective courses

Major: Biology- Plant Systematics

Program: Ph.D

Course title: Theortical Systematics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** no

The overall objectives of the course:
This course design to introduce the philosophical and theoretical aspects of plant taxonomy.

Topics of the course:

1- Concepts and definitions in classification
2- Concepts in taxonomy, systematics, nomenclature, identification, biosystematics, principals of the "Code"
3- The relevance of systematics
4- Natural classification systems: Natural classification vs. phyletic classification
5- Phylogenetic classification systems
6- The phenetics approach
7- The cladistics approach
8- Plant taxonomy and nomenclature

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

- Plant Taxonomy: The Systematic Evaluation of Comparative Data. Stuessy T. F. Columbia University Press. 2008.

- Plant Systematics. 2nd ed. Simpson, M.G. Elsevier, Amsterdam. 2013.

Course title: Plant Biosystematics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
The aim of this course is to explain in general terms the nature of plant biosystematics, using where appropriate, particular examples without any previous knowledge of systematics. It is designed to present taxonomy as contemporary science by describing the current aspirations of taxonomists the principles and methods which underlie them.

Topics of the course:
1- The basis of plant taxonomy (scope of taxonomy, need for classification, terminology, genetic diversity, gene pool, biodiversity, genetic drift, population genetics,…)
2- Species, speciation and species concept
3- Ploidy in plants and its role in speciation: role of hybridization in speciation
4- Chromosomal information: chromosome number, structure and behavior
5- Molecular cytogenetics: FISH and GISH
6- The use of isoenzymes in biosystematics
7- Plant molecular systematics: restriction site analyses (RFLPs), random amplified polymorphic DNA (RAPD), amplified fragment length polymorphism (AFLPs)
8- Plant molecular systematics: microsatellite DNA (SSR and STR)
9- The phenetics approach

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:
- Plant taxonomy and biosystematics. Stace, C., Edward Arnold, London, 1989.
- Molecular Systematics of Plants II- DNA Sequencing. Soltis, P. S., Soltis, D. E., Doyle, J.J., Springer, Stuttgart. 1998.
- Plant systematics- a phylogenetic approach. Judd, W.S., Cambell, C.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. Sinauer Associates Inc., Sunderland. 2002.
- Plant systematics. Simpson, M.G., Elsevier, Amsterdam. 2013.

Course title: Phylogenetic analysis
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** yes **Lab:** no **Seminar:** yes

The overall objectives of the course:
The aim of this course is to trace the major changes in this rapidly evolving field, in terms of both the new theories and new methodologies available for the computational analysis of gene sequence evolution.

Topics of the theoretical course:

1. Sequence databases and database searching: GenBank, nucleotides, polypeptides and genome
2. Electrophorograms and how to interpret electrophorograms
3. Phylogeny inference based on parsimony and other methods: parsimony analysis (background and methodology), calculating the length of a given tree under the parsimony criterion, searching for optimal trees, exact methods and approximate methods.
4. Phylogenetic inference using maximum likelihood methods: theory, introduction and the formal framework, maximum-likelihood tree, computing the probability of an alignment for a fixed tree and finding a maximum-likelihood tree
5. Bayesian phylogenetic analysis using MrBayes: theory, introduction and Bayesian phylogenetic inference, Markov chain Monte Carlo sampling, Burn-in, mixing and convergence, summarizing the results, an introduction to phylogenetic models, Bayesian model choice and model averaging and prior probability distributions

1- Sequence editing, principles of methods in Bioedit, Geneious and MESTRO
2- Multiples alignment: Clustal, MAFFT, MUSCLE, Bioedit, Mesquite

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	**-**	**80%- written**	**20%**

References:
- Plant taxonomy and biosystematics. Stace, C., Edward Arnold, London, 1989.
- Molecular Systematics of Plants II- DNA Sequencing. Soltis, P. S., Soltis, D. E., Doyle, J.J., Springer, Stuttgart. 1998.
- Plant systematics- a phylogenetic approach. Judd, W.S., Cambell, C.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. Sinauer Associates Inc., Sunderland. 2002.
- Plant systematics. Simpson, M.G., Elsevier, Amsterdam. 2013.

Course title: Plant Phylogeography
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
Conceptual background of phylogeography, micro- and macro-evolution concepts, comparative phylogeography and coalescent theory will be studied.

Topics of the course:
1- History and conceptual background of phylogeography
2- Concept of micro and macro-evolution
3- Phylogeny: species tree versus gene tree
4- Molecular markers in phylogeography (overview and understanding molecular markers)
5- Comparative phylogeography
6- Coalescent theory
7- Principles of phylogeographic analysis: useful website and software (Ima, DIYABC,…)

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:
- Phylogeography: The History and Formation of Species. Arbogast, B.S. Oxford Academic. 2001.
- Phylogeography: The History and Formation of Species. Avise, J.C. Harvard University Press.
- Biogeography: An Ecological and Evolutionary Approach. Cox, C.B., Peter D. Moore, P.D., Ladle, R. John Wiley & Sons, 8th ed., 2016.

Course title: Phytosociology
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:

Concepts of plant communities, dynamic relationship with the environment, various methods of vegetation analysis with emphasis on standard central European method (Braun-Blanquet) and preparing a dataset by various multivariate and univariate statistical methods will be studied.

Topics of the course:

1. Definitions: plant communities, their floristic composition
2. Relationships between plants within communities, and place communities into a dynamic relationship with the environment
3. Concept of plant communities
4. Various methods of vegetation analysis with emphasis on standard central European method (Braun-Blanquet)
5. Structure and ecological circumstances of plant community, classification and description of plant communities
6. Dynamics of communities, vegetation as an indicator for environmental circumstances, spatial distribution of plant communities (mapping)
7. Build a database and elaborating it by various multivariate and univariate statistical methods
8. Vegetation types and evaluation of their ecological circumstances, structure and origin by bio-indicator values and life forms.

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

- Vegetationsokolgie. Glavač, V. Gustav Fischer. 1996.
- Vegetation description and analysis: A practical approch. Kent, M. Wiley-Blackwell. 2012.
- Aims and Methods of Vegetation Ecology. Mueller-Dombois, D., Ellenberg, H. Wiley. 1974.
- Vegetation Ecology. van der Maarel, E. Mc Graw Hil. 2005.

Course title: Flora and ecology of Iranian forests
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
Different types of Iranian forests focusing on their geography, geobotany and their indicator species will be studied.

Topics of the course:

1. Introduction: different types of Iranian forests focusing on their geography and geobotany
2. Hyrcanian and Arasbaran forests: geography, pedology, climate, phytosociology, indicator woody species, common shrubs and subshrubs, endemism and conservation
3. *Juniperus* and *Cuppressus* forests: geography, climate, indicator species, endemism and conservation
4. Irano-Turanian forests
5. *Quercus* forest: geography, pedology, climate, indicator species, endemism and conservation
6. *Amygdalus* and *Pistacia* forests: geography, pedology, geobotany, climate, indicator species, endemism and conservation
7. Mangrove forests: geography, geobotany, climate, indicator species, endemism and conservation
8. Shrublands: *Haloxylon* shrublands, geography, geobotany, indicator species, endemism and conservation

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	80%- written	20%

References:
- Caspian Hyrcanian Mixed Forests. Frederic P. Miller, Agnes F. Vandome, McBrewster John, 2010. VDM Publishing, Saarbrücken (Germany).
- Trees and Shrubs of Iran. Mozaffarian, V. 2005. Farhang Moaser Publisher (Tehran).[in Persian]
- Forests of Iran: A Treasure from the Past, a Hope for the Future. Sagheb Talebi, Kh., Sajedi, T., Pourhashemi, M. 2013. Springer Verlag (Germany)

Course title: Geobotany of Iranian Deserts
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Distribution, climate and flora of the sand and saline deserts of Iran with adaptive features of desert plants will be studied.

Topics of the course:

1. Overview of distribution, climate and flora of the sand deserts of Iran
2. Adaptive features of desert plants: Structure and anatomy
3. Adaptive features of desert plants: Photosynthetic pathway
4. Vegetation of desert area: Halophytic vegetation, steppes, sandy vegetations
5. Flora of the sand deserts of Iran

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

- Biodiversity of halophytic and Sabkha ecosystems in Iran. In M. Ajmal Khan et al. (eds.). Sabkha Ecosystems Volume II: West and Central Asia. Akhani H, Springer, Stuttgart.
- Halophytic vegetation of Iran: Towards a syntaxonomical classification. Ann. Bot. nuo ser (Rome) 4: 66-82. Akhani H. 2004
- Temperate Deserts and semi-deserts of Afghanistan and Iran. In N West (ed). Ecosystems of the world. Elsevier, Amsterdam. 5: 271-319. Breckle S-W., 1983.
- Notes on the Distribution, Climate and Flora of the Sand Deserts of Iran and Afghanistan. Proceedings of the Royal Society of Edinburgh Section B-Biological Sciences 89:135-146. Freitag H., 1986.
- Contribution a l'etude de la flore et de la vegetation des deserts d'Iran, fasc. 1-10. Jard. Bot. Nat. Belq. Meise. Léonard J., 1981-1992.

Course title: Molecular Plant Taxonomy
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
A thorough historical overview of plant taxonomy is provided in this course. Strengths, limitations and the future of molecular techniques with regard to plant taxonomy are also explored and compared with application of classical morphological and anatomical data. The advantages of molecular techniques for plant taxonomy with special focus on objectivity of the analyses will be performed.

Topics of the course:

1. Plant taxonomy: a historical, current challenges and perspective
2. Guidelines for the choice of markers in Molecular Plant Taxonomy
3. Leaf tissue sampling and extraction protocols
4. DNA extraction from herbarium specimens
5. Analysis of variation in chloroplast DNA sequence
6. Mitochondrial genome and plant taxonomy
7. Nuclear Ribosomal RNA genes
8. Low and single copy nuclear markers
9. On the relevance of molecular tools for taxonomic revision
10. What has molecular systematics contributed?

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	80%- written	**20%**

References:
- Molecular plant taxonomy- Methods and protocols. Besse P., Humana press. 2014.
- Molecular Systematics of Plants II- DNA Sequencing. Soltis, P. S., Soltis, D. E., Doyle, J.J., Springer, Stuttgart. 1998.
- Plant Systematics- a phylogenetic approach. Judd, W.S., Cambell, C.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. Sinauer Associates Inc., Sunderland. 2002.
- Plant Systematics. 2nd ed. Simpson, M.G., Elsevier, Amsterdam. 2013.

Course title: Applied Bioinformatics in Plant Biology
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:

Bioinformatics as an important discipline within the biological sciences which allow scientists to decipher and manage the vast quantities of data will be studied. It consists of two subfields: the development of computational tools and databases, and the application of these tools and databases in generating biological knowledge to better understand plant systems.

Topics of the course:

1. Concepts of bioinformatics in plant biology
2. The EMBL nucleotide sequence and genome review databases
3. Using GenBank
4. A collection of plant-specific genome data and resources at NCBI
5. Methods for analyses of gene expression in plants using MPSS
6. Metabolomics data analyses, visualization and integration
7. KEGG bioinformatics resource for plant
8. International C rop Information System (ICIS) for germplasm

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

- Plant Bioinformatics– Methods and Protocols. Edwards, D. Humana Press Inc. NY, USA. 2007.
- Plant bioinformatics: from genome to phenome. Edwards, D., Batley, J. Trends in Biotechnology. 22(5): 232–237. 2004.
- Bioinformatics and its applications in plant biology. Rhee, S.Y., Dickerson, J., Xu, D. 2006. Annu. Rev. Plant. Biol. 57: 335-360. 2006.

Course title: Plant Cytogenetics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
Cell cycle, B chromosomes, variations in chromosome structure, changes in chromosome number, and tools of cytogenetics: G-banding, C-banding, Q-banding, Immunostaining, CGH, ISH, GISH and FISH and molecular cytogenetics will be studied.

Topics of the course:

1. Introduction to structure and function of chromosomes: telomeres, centromeres and kinetochores, nucleolar organizers, euchromatin and heterochromatin
2. Cell cycle, banded chromosomes, lampbrush chromosomes, polytene chromosomes, B chromosomes
3. Polymorphism and variations in chromosome structure: duplications, deletions, inversions, and translocations, isochromosomes, ring chromosomes, centric fusions and fissions
4. Polymorphism and changes in chromosome number - aneuploidy and euploidy in plants, their origins
5. Methods and tools of cytogenetics: G-banding, C-banding, Q-banding, Immunostaining, CGH, ISH, GISH and FISH
6. Molecular cytogenetics: synthetic chromosome and the impacts of cytogenetic and biotechnology on crop breeding
7. Cytogenetics and systematics

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

- Cytogenetics: An Advanced Study. Gupta, P.K., 1st ed. (7th Reprint) 2013-14
- Plant Taxonomy and Biosystematics. Stace, C.A. Cambridge University Press, Cambridge, UK. 1989.

Course title: Plant Breeding Systems
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
Plant breeding systems, patterns in autogamy, allogamy and parthenogenesis will be studied.

Topics of the course:

1. Introduction and information from breeding systems
2. Autogamy: introduction, potential advantages and disadvantages of autogamy, phenotypic (morphological) variation among inbreeders
3. Allogamy: introduction, potential advantages and disadvantages of allogamy, mechanisms of allogamy
4. Patterns in plant parthenogenesis: examples of different mechanisms in plant taxa
5. Speciation and plant breeding: Mechanisms of speciation and distribution of speciation in inbreeders
6. Patterns of breeding in mosses
7. Patterns of breeding in pteridophytes
8. Patterns of breeding in gymnosperms
9. Patterns of breeding in flowering plants

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	**-**	**80%- written**	**20%**

References:

- Plant Breeding Systems. 2nd ed. Richards, A.G. Chapmann & Hall, London, UK. 1997.
- Plant Systematics- A Phylogenetic Approach. Judd, W.S., Cambell, C.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. Sinauer Associates Inc., Sunderland. 2002.
- Plant Systematics.2nd ed. Simpson, M.G., Elsevier, Amsterdam. 2013.
- Plant Taxonomy and Biosystematics. Stace, C.A. Cambridge University Press, Cambridge, UK. 1989.

Course title: Trees and Shrubs of Iran
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
Forests of Iran (Hyrcanian, Arasbaran, Irano-Turanian and Saharo-Sindian regions) focusing on indicator trees and shrubs species will be studied.

Topics of the course:

1. Introduction to forests of Iran: the importance of trees and shrubs species, Euxino-Hyrcanian province: the importance of the Hyrcanian forests, vegetation focusing on indicator trees and shrubs
2. Arasbaran province: the importance of the Arasbaran forests, vegetation focusing on indicator trees and shrubs, primary and secondary woodlands
3. Irano-Turanian province: the importance of the Irano-Turanian province, vegetation focusing on indicator trees and shrubs
4. The *Tamarix* sp. Association, the *Haloxylon* sp. vegetation, association of *Pistacia* and *Juniperus excelsa* zone
5. Saharo-Sindian province: the importance of the Saharo-Sindian province, vegetation focusing on indicator trees and shrubs
6. Trees and shrubs of Pseudosavannah region
7. Trees and shrubs of gymnosperms in Iran
8. Trees and shrubs of Fabaceae and spiny *Astragalus* community

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

درختان و درختچه‌های ایران. مظفریان، و. انتشارات فرهنگ معاصر، تهران. ۱۳۹۳.

- Flora Iranica, vols. 1-182. Rechinger, K.H. (ed.) 1963-2016. Naturhistorisches Museum, Wien (Austria)

Course title: The Origin of Land plants
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Plant diversity and classification, the origin of main clades in Bryophytes, Pteridophytes as well as the origin and ancestor of gymnosperms and angiosperms will be studied.

Topics of the course:

1. Introduction: plant diversity and classification, the origin of main clades in Bryophytes, transition from water to land
2. The fern allies and origin of the vascular plants: Pteridophytes fossils, the origin of Pteridophytes, general characteristics of Tracheophyta (Psilopsida, Lycopsida, Euisetopsida) and major clades of leptosporangiate Pteridophytes and their origin
3. Seed Plants: the origin and ancestor of Pteridosperms, the origin and ancestor of gymnosperms and angiosperms
4. Flowering plants: the origin and ancestor of flowering plants (angiosperms) an their main clades

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:

- The Diversity and Evolution of Plants. Pearson, L.C. 1995. CRC Press, Portland, USA.
- Paleobotany and the Evolution of Plants. Stewart, W.N., Rothwell, G.W. 1993. Cambridge University Press, Cambridge, UK.
- The Evolution and Classification of Flowering Plants. Cronquist, A. 1988 New York Botanical Garden, USA.
- Green Plants: Their Origin and Diversity. Bell, P.R., Hemsley, A.R. 2000. Cambridge University Press, Cambridge, UK.
- Plant Systematics- A Phylogenetic Approach. Judd, W.S., Cambell, C.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. Sinauer Associates Inc., Sunderland. 2002.
- Plant Systematics. 2nd ed. Simpson, M.G., Elsevier, Amsterdam. 2013.
- Plant Taxonomy and Biosystematics. Stace, C.A. Cambridge University Press, Cambridge, UK. 1989.

Course title: Paleoecology and Palynology
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** yes **Seminar:** yes

The overall objectives of the course:
Fundamentals and concepts of palynology and paleontology with special focus on fossil plants, pollen structure and diversity will be studied in different clades of land plants. Points such as modeling of past climates and ecology of paleo-ecosystems will be specifically addressed.

Topics of the course:

1. An introduction to Quaternary ecology
2. Pollen analyses
3. Pollen diagrams in Iran and in the World
4. Pollen morphology
5. Implication of pollen data in agriculture, health and criminology
6. Dendrochronology
7. Coal analysis and assay
8. Pollen morphology laboratory and data analyses
9. Seminar

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**70%- written**	**30%**

References:
- Pollen Analysis. Moore, P. D.;Webb, J. A.;Collison, M. E. Blackwell London. 1991.
- Aspects of Palynology and Palaeoecology. Tonkov, S. 2003. Pensoft Publishers, Sofia (Bulgaria).
-

Course title: Botanical Latin
No. of units: 2
No. of hours: 32
Unit type: theoretical and practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
Botanical latin- vocab, adjective, adverbs, numbers, verbs, preposition and prefix and suffixes will be studied.

Topics of the course:

1. Introduction to botanical latin
2. Subtantivum: nominativus, vocativus, accusativus, genetivous, dativus, ablativus (separationis, instrumentalis and locativus)
3. Adjective (adjectivum): gradus adjectivorum
4. Adverb (adverbium)
5. Pronoun (pronomen): pronomina (personalia, reflexivum, demonstrative, possesiva, definitum,…)
6. Numbers (numeralia): numeralia (cardinalia, ordinalia, distributive, adverbial)
7. Verb (verbium)
8. Preposition, conjunction, interjection (praepositiones, conjunction, interjection)
9. Prefix and suffix (Praefixum and suffixum)
10. Common symbols and abbreviations in botany
11. Student exercises

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	70%- written	30%

References:

- Botanical Latin. Stearn, W. T. Timber Press, Portland, USA. 2004.
- Names of Plants, 4th ed. Gledhill, D. Cambridge University Press, Cambridge, UK. 2008.
- CRC World Dictionary of Plant Names: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. Quattrocchi, U., CRC Press, USA. 2000.

Course title: Molecular Plant Ecology
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** yes **Lab:** no **Seminar:** yes

The overall objectives of the course:
Genetic analyses of single and multiple populations, phylogeography, behavioral ecology and conservation genetics will be studied.

Topics of the course:

1. Molecular genetics and molecular markers in ecology
2. Genetic analyses of single population
3. Genetic analyses of multiple populations
4. Studying ecologically important traits
5. Phylogeography
6. Behavioral ecology
7. Conservation genetics

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	**-**	**80%- written**	**20%**

References:

- - Molecular Ecology, 2nd ed. Freeland, J.R., Petersen S.D., Kirk, H. John Wiley & Sons, Chichester, West Sussex, UK. 2011.
- - An Introduction to Molecular Ecology. Beebee, T.J.C., Rowe, G.. Oxford University Press, New York, 2008.

Course title: Plant Development: A Molecular Approach
No. of units: 2
No. of hours: 32
Unit type: theoretical- practical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
This course is about the mechanisms that regulate plant development and how each cell in multicellular organism acquires and maintains its specialized function.

Topics of the course:

1. An introduction to the life cycle of flowering plants: development of the sporophyte, characteristics of plant development
2. Cell- intrinsic information: plant cell, relationship between age and position
3. Primary axis development: embryonic axes
4. Axial patterning, polar transport of auxin, root meristem development, shoot meristem development
5. Radial patterning and its development
6. Hormones and their effects on plant development, signal transduction
7. Meristems: initiation of organogenesis, meristem initials and their control
8. Leaf, stem and root development, symmetry of plant organs
9. Flower development, ABC models and homeotic box genes
10. Epidermis development: stomata, hairs and patterns of epidermal cells in plants
11. Plant development and biotechnology

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	**-**	**80%- written**	**20%**

References:

- Mechanisms in Plant Development. Leyser, O., Day, S., Blackwell Publishing, USA. 2003.
- Plant Physiology and Development. Taiz, L., Zeiger, E. Sinauer Associates Inc., USA. 2014.

Course title: Special Topics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: specialized - elective
Prerequisites: none
Additional training: no
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:
New topics and titles relating to plant systematics referring to new methodologies, concepts, techniques and applications will be presented and studied.

Topics of the course:
The topics will be selected by one of the academic members of the department or scientists working abroad before beginning of the semester. The scientific committee of the department will discuss about the proposed topics and the syllabus will be selected after committee decision.

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
-	-	**80%- written**	**20%**

References:
- Topics will be selected from high quality journals in the field of systematic botany.