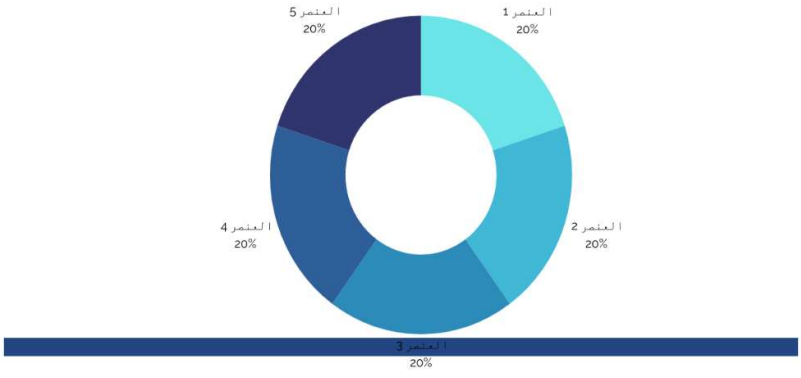
CURICULUM OVERVIEW

6.2: Course Descriptions with learning Hours and ECTS.



Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Biochemistry and Molecular Biology	611BIO-2	2	0	0	2	1st	1st	_	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	30		HW/Assignments	49
Laboratory	0		Case studies	0
Exams and quizzes	5		Study for exam	34
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	124
Total	36		Total	207
Total Learning Hours = 243			Equivalent ECTS points = Total LH/28 = 8.67	

(1) Brief Course Description:

This course covers the key concepts of biochemistry and molecular biology. At the end of the course, you will understand how proteins can catalyze the chemical reactions that allow cells to function. To get to this point, you will gain an understanding of the nature of chemical reactions in biological systems; how genetic information is used to direct protein synthesis; how the structure of proteins is determined; how structure determines function; and how we understand the properties of enzymes.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Explain biologically important compounds and compare their properties.
2. Discuss the metabolism carbohydrates, nitrogen, and lipids, explaining inputs, and output
3. Describe nucleic acids and compare their structure and function.
4. Identify genetic information on cellular, nuclear, and gene levels.
5. Express aspects and ethics of genetic engineering.

(3) Course Contents

- **Theoretical Content:**
  1. Carbohydrate Metabolism (Glycolysis, Gluconeogenesis, Glycogen, TCA Cycle, Electron transport and oxidative phosphorylation)
  2. Lipids (Fatty acids, Triglycerides, Isoprenoids, Phospholipids, Lipoproteins, Waxes)
  3. Lipid Metabolism (Synthesis, Degradation, α-oxidation, β-oxidation)
  4. Nitrogen Metabolism (Nitrogen Fixation, Amino acid synthesis and breakdown)
  5. Energy (Thermodynamics, Free energy, ATP)

6. Enzymes (Kinetics, Catalysis, Regulation).
7. Nucleic Acids DNA (Structure, Supercoiling, Chromosomes, Chromatin, Genome)
8. Nucleic acids RNA (t-RNA, rRNA, m-RNA, Noncoding RNA)
9. Genetic Information (DNA Replication, Repair, Recombination, Transcription, Gene Expression Prokaryotes/Eukaryotes/Regulation)
10. Translation (Protein Synthesis) Prokaryotes/Eukaryotes)
11. Mutation (Changes in Chromosome Number Euploidy, Polyploidy),
12. Mutation (Changes in Chromosome Structure, Deletion, Duplication, Inversion, Translocation)
13. Genetic Engineering (Gene Cloning, Vectors, Viruses, Plasmids, Restriction Enzymes, Complementary DNA, Reverse Transcriptase, DNA Sequencing, DNA Finger Print, Polymerase Chain Reaction, Ethics Issues in Genetic Engineering).

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Lundblad R.L., Macdonald F. (2010) Handbook of Biochemistry &Molecular Biology. CRC Press, New York .

(7) Reference Books

1. Heldt H., Piechulla B. (2010) Plant Biochemistry. Academic Press, London.
2. Kaplan (2015). Kaplan MCAT Biochemistry Review. Simon & Schuster.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Biostatistics	612BIO-2	2	0	0	2	1	1st	_	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	30		HW/Assignments	48
Laboratory	0		Case studies	0
Exams and quizzes	5		Study for exam	34
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	90
Total	35		Total	172
Total Learning Hours = 207			Equivalent ECTS points = Total LH/28 = 7.39	

(1) Brief Course Description:

This course covers the selecting appropriate statistical analysis methods for examining data from planned experimental studies and utilizing these analyses to draw meaningful conclusions about the study's hypotheses. This version captures the essence of both texts in a concise manner.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Apply statistical analysis tests to compare data of different experimental groups.
2. Assess and identify the statistical regression and correlation relationships for the experimental data groups.
3. Perform one, two, and three-factor analysis of variance to examine the effect of studied factors on the dependent factor or factors.
4. Select the appropriate statistical analysis method to evaluate the data of the experimental study.
5. Analyze experimental data using statistical software programs.

(3) Course Contents

- **Theoretical Content:**

1. Normal distribution, Arithmetic mean, standard deviation, standard error, confidence limits
2. Comparison of data means using student t-test
3. Comparison of data groups using Mann-Whitney U test
4. Wilcoxon's Signed Rank- Kurskal Wallis Test
5. Uses of chi-square test to analyze different types of data
6. Relationships between data using correlation and regression analysis
7. Analysis of variance: one factor, two factors, three factors
8. ANOVA

9. Statistical Software (Examples)
10. Normal distribution, Arithmetic mean, standard deviation, standard error, confidence limits
11. Comparison of data means using the student t-test.

(4) Assessment Criteria:

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Samuels M.L., Witmers J.A., Shaffner A.A. (2012) Statistics for the Life Sciences. Prentice Hall, London.
2. Sokal R.R., Rohlf F.J. (2011) Biometry. Freeman Publishers Inc., New York.
3. Zar J.H. (2009) Biostatistical Analysis, Pearson Inc., New York.

(7) Reference Books:

3. Regression Modeling Strategies, Author: Frank E. Harrell Jr., http://www.springer.com/series/692.
4. Applied Biostatistics for the Health Sciences, Author(s): Richard J. Rossi
5. First published:28 March 2022
6. Print ISBN:9781119722694 |Online ISBN:9781119722717 |DOI:10.1002/97811197227175

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Instrumental Analysis	613BIO-2	2	0	0	2	1st	1st	_	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	30		HW/Assignments	45
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	29
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	94
Total	33		Total	168
Total Learning Hours = 201			Equivalent ECTS points = Total LH/28 = 7.17	

(1) Brief Course Description:

This course covers the Studying of theoretical basis of instrumental analysis. Theory and practice of a number of modern techniques of chemical analysis including chromatography, spectroscopy, electrochemistry and computer interfacing. Laboratory work is designed to familiarize the student with the use of various instruments used in chemical analyses including infrared, ultraviolet-visible, atomic absorption, nuclear magnetic resonance and mass spectrometers and gas-liquid and high-pressure liquid chromatographs.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Develop an understanding of the function of basic components of chemical instrumentation
2. Interpret recorded data with standard statistical methods including noise analysis
3. Discuss how different chemical separation methods are used to analyze different compound classes.
4. Describe how optical spectroscopy is used to identify specific structural features of molecules.
5. Explain fundamental aspects of electrochemical analysis involving voltammetry, amperometry, and polarography.
6. Determine molecular weights, empirical formulas, and primary structural features of different molecules.
7. Recognize their experimental results consistent with chemical literature practices.

(3) Course Contents

- **Theoretical Content:**

1. Flame Photometry (Atomizer, Optics, Detectors).

2. Atomic Absorption Spectroscopy (Graphite Furnace Atomizer, Optics, Detectors).
3. Visible Spectroscopy (Absorptivity, Rotational/vibrational/electronic Transition, Absorption Laws, Optics, Absorption Spectra).
4. Chromatography (Paper, Thin-layer, Column, Gas, HPLC).
5. DNA Cloning
6. Gel Electrophoresis.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

2. Skoog D.A., Holler F.J., Crouch S.R. (2006) Principles of Instrumental Analysis. Sounders College, Philadelphia.

(7) Reference Books:

1. Miller H., Witherow D.S. (2011) Molecular Biology Techniques: A Classroom Laboratory Manual. Academic Press New York.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Host-Parasite Relationship	633MIC-3	3	0	0	3	1st	1st	_	Compulsory

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	63
Laboratory	0	Case studies	0
Exams and quizzes	5	Study for exam	32
Lab demo	0	Working on lab experiment	0
Oral Presentation	1	Preparation for classes	133
Total	51	Total	228
Total Learning Hours = 279		Equivalent ECTS points = Total LH/28 = 9.96	

(1) Brief Course Description:

This course covers the basic & comprehensive knowledge on Host Parasite Relationships, including types of symbiotic relationships, hosts, both in plants & animals, by different parasites.

(2) Course Objectives:

The main objectives of this course are focused to:

6. Describe methods of penetration of plants and animals by the pathogens.
7. Explain defense lines in the hosts against the pathogens .
8. Define host-parasite specificity.
9. Identify the factors affecting infection by plant diseases.
10. Discuss some parasitic relationships (like bats, wasps, etc.).

(3) Course Contents

- **Theoretical Content:**

12. Introduction; host-parasite specificity.
13. Types of Symbiosis.
14. Enzymes and plant diseases (Pectinase - Cellulase - Lignin enzymes – Protein enzymes - Fat enzymes - Inhibitors).
15. Toxins produced by pathogens and their role in host pathology.
16. Lines of host defenses.
17. Biochemical defense (Defense by proteins and enzymes).
18. Some parasitic relationships.

(4) Assessment Criteria

- Midterm: 25 %

- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

4. Flik and Wiegertjes (2004) Host-Parasite Interactions. Bios Scientific Publishers.

(7) Reference Books

7. Singh D.V. (2007) Introductory Plant Pathology. New Delhi, India.
8. Behind the Scenes of host-microbe interactions, Review, Mil. Med. Sci. Lett. (Voj. Zdrav. Listy) 2020, 89, 1-16.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Experimental Design and Analysis	614BIO-2	1	0	1	2	1st	2nd	_	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	15		HW/Assignments	48
Laboratory	30		Case studies	0
Exams and quizzes	8		Study for exam	46
Lab demo	0		Working on lab experiment	30
Oral Presentation	1		Preparation for classes	133
Total	54		Total	257
Total Learning Hours = 311			Equivalent ECTS points = Total LH/28 = 11.10	

(1) Brief Course Description:

This course covers the key concepts of experimental design and advanced study of data analysis.

(2) Course Objectives:

The main objectives of this course are focused to:

11. Design lab and field experiments.
12. Perform data statistical analysis.
13. Explain field experiment data using computer software.
14. Represent data using computer software.

(3) Course Contents

- **Theoretical Content:**
  1. Experimental Design.
  2. Randomization.
  3. Data Analysis.
  4. Graphic Display.
  5. ANOVA.
  6. T-Test.
  7. Least Significant Differences.
  8. Confidence Limits.
  9. Software (Excel, Microcal Origin, SPSS, TWINSPAN, Origin, …..).

- **Practical Content:**

  Applications on:

1. Data statistical analysis
2. Computer software in data analysis
3. Computer software in data representation.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, laboratory work, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

9. Scheiner S.M., Gurevitch J. (2001) Design and Analysis of Ecological Experiments, Oxford University Press, Oxford.

(7) Reference Books:

1. Montgomry (2005) Design and Analysis of Experiments. John Wiley and Sons, New York.
2. Dean M., Voss D. (2001) Design and Analysis of Experiments. Springer, Berlin.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Seminar	615BIO-1	1	0	0	1	1st	2nd	–	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	30		HW/Assignments	90
Laboratory	0		Case studies	170
Exams and quizzes	1		Study for exam	30
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	81
Total	32		Total	371
Total Learning Hours = 403			Equivalent ECTS points = Total LH/28 = 14.39	

(1) Brief Course Description:

This course covers the PowerPoint presentation of a subject related to the thesis.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Describe scientific writing.
2. Explain literature search.
3. Prepare PowerPoint presentation.
4. Define a case of the thesis subject.
5. Discuss and defend the thesis subject.

(3) Course Contents

- **Theoretical Content:**

To be determined by the supervisor and approved by the Department Board.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

To be determined by the supervisor and approved by the Department Board.

(7) Reference Books:

1. Giba J. Ribes R. (2011) Preparing and Delivering Scientific Presentations. Springer, Berlin.
2. Dawah, Hasan (2015). A Comprehensive Guide to Writing and Defending Scientific Projects. Administration of Adabemic Pub. and Press.
3. Elrowayati, Ali (2015). HOW TO WRITE PUBLISHABLE ARTICLES. (PPT file).

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Genetics	654ZOO-3	3	0	0	3	1st	2nd	--	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	48
Laboratory	0		Case studies	0
Exams and quizzes	5		Study for exam	32
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	107
Total	51		Total	187
Total Learning Hours = 238			Equivalent ECTS points = Total LH/28 = 8.50	

(1) Brief Course Description

This course covers important issues in genetics such as the chromosome structure of prokaryotes and Eukaryote organisms, gene expression and the genetics analysis of chromosomes and assigning loci to human chromosomes. The course will give emphasis to different chromosomal aberrations and their effects. Finally, the relation between chromosomal aberrations and incidence of cancer will be discussed in relating to advanced techniques in cytogenetics.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Describe the complex structure of chromosomes and the methods used.
2. Compare the methods for distinguishing between different types.
3. Discuss different types of chromosomal abnormalities and its significance and the resulting diseases.
4. Explain the chromosome changes and its relation to cancer.

(3) Course Contents

- **Theoretical**

1. Chromosomes and cell cycle
2. The cytological basis of inheritance
3. Chromosomal aberrations
4. Karyological (Chromosomal) studies
5. The genetic material
6. Genetic expression
7. Regulation of protein synthesis

8. Genetics and animal Diseases
9. The genetics of Cancer
10. The genetic manipulation and genetic engineering
11. Methods for studying the genome

(4) Assessment Criteria

- Mid Term exams: 25%
- Oral presentations, Essays, and oral tests: 25%
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1- Genetics: Analysis and Principles (5th ed.), 2016 by R. J. Brooker. Mc Graw Companies, Inc., USA.

(7) Reference Books:

1. Genetics: A Conceptual Approach (4th Ed) (2016) by B. A. Pierce. W. H. Freeman and Company. N.Y., USA.
2. Genetics: Analysis of Genes and Genomes (2013) by Daniel L. Hartl and Elizabeth W. Jones (8th ed.).

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Soil Science	647 BOT-3	2	0	2	3	2nd	4th	-	Compulsory

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	30	HW/Assignments	33
Laboratory	30	Case studies	0
Exams and quizzes	8	Study for exam	40
Lab demo	0	Working on lab experiment	25
Oral Presentation	1	Preparation for classes	94
Total	69	Total	192
Total Learning Hours = 261		Equivalent ECTS points = Total LH/28 = 9.32	

(1) Brief Course Description:

This course covers advanced knowledge on soil characteristics and factors affecting soil properties. Also, this Course designed to provide an overview of the fundamental concepts in soil science: Genesis, Classification and Morphology, Physics, Chemistry, Fertility, Biology, and Land Use. Instructors will use the Fundamentals Performance Objectives (POs) as a guide for discussing topics within each section, but will not go through each objective individually. However, students are encouraged to ask questions regarding specific POs if needed.

(2) Course Objectives:

The main objectives of this course are focused to:

1 . Discuss physical soil chemical properties.
2 . Explain aspects of soil water content.
3 . Define aspects of soil mineral content.
4 . Compare soil organic matter in different types of soil.
5 . Relate soil geomorphology to landforms.
6. Interpret aspects of soil erosion.

(3) Course Content

- **Theoretical Content:**

1. Introduction to Soil science.
2. Soil Physical Properties: Components.
3. Soil Texture, Surface Area.
4. Soil Structure, Pores, Temperature, Air, Color.
5. Soil Chemical Properties (Chemical Composition) part1.
6. Soil Chemical Properties (Availability of Chemicals) part2.

7. Soil Chemical Properties (Cations, Anions, Soluble Salts) part3.
8. Soil Water: Moisture Retention, Measuring Soil Moisture.
9. Soil Water: Soil Water Content, Soil Water Potential.
10. Soil organic Matter: Types of Soil Organic Matter.
11. Soil organic Matter: Function of Soil Organic Matter, Humus.
12. Soil Formation – Soil Morphology – Soil Taxonomy and Nomenclature
13. Soil Erosion: Erosion by Wind, Erosion by Water, Degradation
14. Recent and Advanced topics in soil science part 1.
15. Recent and Advanced topics in soil science part 2.

- **Practical Content:**
  1. Collect soil samples and preserve Soil Formation – Soil Morphology – Soil Taxonomy.
  2. Soil Physical Properties: Components, Soil Texture, Surface Area.
  3. Soil Structure, Pores, Temperature, Air, Color.
  4. Soil Chemical Properties (Chemical Composition -Availability of Chemicals)
  5. Soil Chemical Properties (Cations, Anions, Soluble Salts).
  6. Soil Water: Moisture Retention, Measuring Soil Moisture, soil Water Content and Potential.
  7. Types of Soil Organic Matter, Soil organic Matter: Function of Soil Organic Matter, Humus.
  8. Soil Formation – Soil Morphology – Soil Taxonomy and Nomenclature.
  9. Soil Erosion: Erosion by Wind, Erosion by Water, Degradation.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, Essay Assignments, Homework, Web-based Assignments, and Field trips.

(6) Textbook:

1. Brady, N.C. and R.R. Weil. 2009. Elements of the Nature and Properties of Soils. 3rd Ed. Pearson Education, Upper Saddle River, 14 NJ, USA.
2. Shukla, R.S. and Chandel, P.S. (1989). Plant Ecology and Soil Science. S. Chand & Company LTD. Ram Nagar, New Delhi.
3. Plaster E. (2008). Soil Science and Management. Delmar, New York.
4. Singer, M.J. and D.N. Munns. 2002. Soils- An Introduction. 5th Ed. Prentice-Hall, Inc., Upper Saddle River, NJ, USA.

(7) Reference Books:

1. Das, D.K. (2011). Introductory Soil Science. 3rd ed. Kalyani Publ. New Delhi.
2. Hillel, D. (2008). Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.
3. Hillel, D. (2004). Introduction to Environmental Soil Physics. Elsevier, San Diego, CA, USA.
4. Jury, W. A. and R. Horton (2004). Soil Physics. 6th Ed. John Wiley & Sons. Inc., NY, USA.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Microbial Physiology	631MIC-3	2	0	0	2	1st	1st	_	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	48
Laboratory	0		Case studies	0
Exams and quizzes	5		Study for exam	32
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	107
Total	51		Total	187
Total Learning Hours = 238			Equivalent ECTS points = Total LH/28 = 8.5	

(1) Brief Course Description:

Knowledge of metabolism of different types of micro-organisms to illustrate different approaches used by these micro-organisms to get energy, and the role of microbial enzymes. The course is about the biochemical structure of microbial cells and the explanation of the typical growth curve of most microbes and their effects, as well as the study of microbial metabolism and enzymes related in detail. Through the lectures, students will gain a deep understanding of microbial growth, energy production, biosynthesis, and stress responses. The course will also cover modern research techniques in microbial physiology, including genomics, proteomics, and metabolomics, providing students with the skills required to analyze and interpret physiological data.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Discuss metabolic processes that occur in microorganisms.
2 - Discuss the role of microbial enzymes in anabolism and catabolism in micro-organisms.
3-Gain a fundamental understanding of cellular composition, membrane transport, genomic diversity, horizontal gene transfer, diversity of metabolic processes, growth and cell death, communication, and techniques used to elucidate physiological processes .
ways microbes live and respond to the environment .
4 .Develop scientific writing skills and critical thinking about scientific research .

(3) Course Contents

- **Theoretical Content:**

1. Catabolic and Anabolic Reactions of Microorganisms (Collision Theory, Microbial Enzymes, Factors Influencing Enzymatic Activity, Ribozymes).

2. Energy Production in Microorganisms (Oxidation-Reduction Reactions, The Generation of ATP, Alternatives to Glycolysis, Cellular Respiration, Fermentations).
3. Lipid and Protein Catabolism.
4. Photosynthetic Microorganisms (The light-dependent Reactions, Phosphorylation, The light-independent reactions.
5. Metabolic Diversity among Microorganisms (Photoautotrophs, Photohetrotrophs, Chemoautotrophs, Chemoheterotrophs).
6. Anabolism of Microorganisms (Polysaccharide Biosynthesis, Lipid Biosynthesis, Amino Acid and Protein Biosynthesis, Purine and Pyrimidine Biosynthesis. The Integration of Metabolism.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. White D., Drummond J. (2011) The Physiology and Biochemistry of Prokaryotes. Oxford University Press, Oxford.
2. Ann M. Stevens, Jayna L. Ditty, Rebecca E. Parales, Susan M. Merkel (2024). Microbial Physiology: Unity and Diversity. Publisher, American Society for Microbiology.

(7) Reference Books

1. Robert K. Poole, David J. Kelly (2024). Advances in Microbial Physiology. Publisher, Since direct.

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Comparative Animal Physiology	658ZOO-3	3	0	0	3	1st	2nd	---	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	48
Laboratory	0		Case studies	0
Exams and quizzes	5		Study for exam	30
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	94
Total	51		Total	172
Total Learning Hours = 223			Equivalent ECTS points = Total LH/28 = 7.96	

(1) Brief Course Description

This course covers the basic knowledge about the physiology of the main systems in the body. In addition, this course focuses on the relationship between the structure and function of the organs, tissues, and cells.

(2) Course Objectives

The main objectives of this course are focused to:

1. Define the concept of homeostasis.
2. Discuss physiological principles by studying structure and function relationships.
3. Explain physiological systems (molecular/cellular events to whole animal level in selected invertebrates and vertebrate species).
4. Define how organisms interact with environments and how environmental conditions modulate physiological regulatory mechanisms.
5. Interpret the use of scientific methods to advance our knowledge of animal physiology.
6. Perform analysis, presentation, and interpretation of laboratory results and practice scientific writing through data collection

(3) Course Contents

- **Theoretical:**

1. Central themes in animal physiology and Membrane transport of ions/water.
2. Nervous system (synapse and organization).
3. Sensory (photoreceptors, chemoreceptors, mechanoreceptors).
4. Muscles- Cardiovascular physiology.
5. blood function.

6. Respiratory physiology.
7. Metabolism and thermal regulation.
8. Digestion and feeding.
9. Endocrinology.
10. Water balance/renal function.

(4) Assessment Criteria

- Mid Term1 exams: 25 %
- Oral presentations, Essays, and oral tests 25%
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1- Guyton and Hall textbook of Medical Physiology, (2020). 14th edition.

(7) Reference Books:

1-Animal Physiology: From Genes to Organisms, 2nd Edition (2011). By: Sherwood, L., Klandorf, H. and Yancey, P. Publisher: Brooks Cole, USA (ISBN: 13-978-0840068651).

2-Functional Anatomy and Physiology of Domestic Animals, 4th Edition (2015). By: Reece, W. O., Published by: Wiley- Blackwell (ISBN – 13: 978-0-8138-1451).

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Special Topics in Microbiology	639MIC-3	3	0	0	3	2nd	3rd	631MIC-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	49
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	34
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	108
Total	49		Total	191
Total Learning Hours = 240			Equivalent ECTS points = Total LH/28 = 8.57	

(1) Brief Course Description:

Advanced topic on Thesis subject matter. The course provides advanced scientific and technological topics in microbiology (bacteria - fungi – algae and viruses) compatible with the specialization of the student and thesis subject matter.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Provide students with efficient Knowledge.
2. Explain professional skills in the thesis subject field (defined by the supervisor) .
3. Motivate the responsibilities of students in an ethical framework for scientific research .
4. Analysis, problem-solving, and scientific reasoning capabilities.

(3) Course Contents

- **Theoretical Content:**

1. Special topic related and relevant to thesis: To be described by the supervisor.
2. Practical (if applicable) and/or Oral Presentation: To be defined by the supervisor.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

Textbooks, references, and other resource materials (defined by supervisor).

(7) Reference Books:

Textbooks, references, and other resource materials (defined by supervisor).

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Special Topics in Botany	649 BOT-3	3	0	0	3	2nd	4th	647 BOT-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	48
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	34
Lab demo	0		Working on lab experiment	0
Oral Presentation	1		Preparation for classes	120
Total	49		Total	202
Total Learning Hours = 251			Equivalent ECTS points = Total LH/28 = 8.96	

(1) Brief Course Description:

This course covers the advanced topics in Botany selected by students in line with the topic of the researcher. The special topics courses vary from semester to semester, and always have something interesting to study (Advanced topic on Thesis subject matter), Giving the student an in-depth study on one or more topics and focusing on the latest developments. Giving the students methods of searching for scientific information and writing reports.

(2) Course Objectives:

The main objectives of this course are focused to:

1- provide the way to build their fundamental knowledge and skills within The Special Topics in (Botany-Zoology-Microbiology).
2- Describe knowledge in the areas of his/her research and acquire the students with the skills of writing of research paper.
3- Critique results and review literature.

(3) Course Content

- **Theoretical Content:**

1. Methods of gathering information defined by the Supervisor.
2. How to write a report (introduction, lecture view).
3. Designed scientific experiments
4. How to write the results.
5. How to write a discussion.
6. How to write a reference.
7. Final presentation.

8. Methods of gathering information defined by the Supervisor.

(4) Assessment Criteria:

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, Essay Assignments, Homework, Web-based Assignments, and Field trips.

(6) Textbook

Journals, databases, Thesis, Dissertation, Books, etc.

(7) Reference Books

Web Sites, Facebook, YouTube, Twitter, etc. Botanical record-Computer-based programs/CD, professional standards or regulations, and software. Media software's.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre- requisites
		Theo.	Tut.	Lab.	Credit			
Special Topic in Zoology	ZOOL659-3	3	0	0	3	2nd	3rd	ZOOL658-3

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	49
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	34
Lab demo	0	Working on lab experiment	0
Oral Presentation	1	Preparation for classes	122
Total	49	Total	205
Total Learning Hours = 254		Equivalent ECTS points = Total LH/28 = 9.07	

(1) Brief Course Description:

A specialized course whose topics are determined by the supervisor to serve the scientific thesis.

(2) Course Objectives:

The objectives are variable and determined by the supervisor to serve the subject of the scientific thesis.

(3) Course Contents:

Special contents related and relevant to the Thesis to be determined by the supervisor.

(4) Assessment Criteria:

- Mid Term exams: 25%
- Lab. Work and Exams: 25 %
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

To be defined by the supervisor.

(7) Reference Books:

To be defined by the supervisor

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Molecular Plant Physiology	640 BOT-3	3	0	0	3	2nd	4th	647 BOT3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	49
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	34
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	121
Total	48		Total	204
Total Learning Hours = 252			Equivalent ECTS points = Total LH/28 = 9.00	

(1) Brief Course Description:

This course covers the principal focus of the existing course is on the molecular aspects of the physiological and metabolic processes in plants. Preliminary knowledge of plant physiology and metabolism would be imparted. Critical knowledge of Phyto-hormone biosynthesis, mode and mechanism of action will be highlighted. Students will be oriented into developing a molecular understanding of the principles of photosynthesis and photomorphogenesis, the molecular basis of nutrient uptake and utilization with emphasis on plant stress physiology and pathology.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Compare the structure of conjugated and unconjugated polysaccharides and proteins.
2. Analyze the quaternary structure of proteins.
3. Relate the structure and function of chloroplast electron transport complexes.
4. Relate the structure and function of mitochondrial electron transport complexes.
5. Explain the synthesis of energy compounds.
6. Analyze aspects of the Chemiosmotic theory.

(3) Course Contents

- **Theoretical Content:**
  - Photo-Morphogenesis: Role of Light in Growth and Development, Establishing Circadian Rhythms, Phytochromes and Cryptochromes.

- Phytohormones: Biosynthesis, Mode and Mechanism of Action, Biological functions, Perception and Signalling (Auxins, Cytokinins, Gibberellins, Ethylene, Absicic Acid, Brassinosteroids).
- Plant nutrients: Uptake and utilization, Solute Transport, Plant water relationship.
- Plant Stress Physiology: Morphological, Physiological and Biochemical Traits in Stress Tolerance Mechanism. Role of Polyamines, Jasmonic Acid and Salicylic acid. Stress adaptation responses.
- Plant Pathogen Interactions: Introduction to Plant Pathology, Types of biotic stress, Phytohormone signalling in plant defence Molecular Plant Pathogen Interactions.
- Metabolism and Regulation - An overview, of metabolic diversity, catabolism and anabolism, Intermediary metabolism is tightly regulated, integrated processes, and Anaplerotic reactions. Respiration (TCA cycle, electron transport chain, alternate respiration), Storing and Transducing Energy. Photosynthesis, Physiological and Ecological Considerations.
- Secondary Metabolism: Categories of Secondary Compounds Phenolics, Terpenoids and Alkaloids Amino Acid Metabolism (synthesis) and Urea Cycle (degradation & recyclization).

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2000) Biochemistry and molecular biology of plants. American Society of Plant Physiology.
2. Nelson, David L., and Michael M. Cox. (2017). Lehninger Principles of Biochemistry. 7th ed., W.H. Freeman, New York.

(7) Reference Books

1. Agrios, G. (2005) Plant Pathology. 5th Edition, Elsevier Academic Press, Amsterdam.
2. Taiz, L. and Zeiger, E. (2006) Plant physiology. 4th Edition, Sinauer Associates, Inc., Sunderland.
3. Taiz, L., Zeiger, P. E. E., Mller, P. E. I. M., & Murphy, P. A. C. A. (2018). Fundamentals of plant physiology. Sinauer Associates. Sunderland.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Plant Ecophysiology	**641 BOT-3**	**3**	**0**	**0**	**3**	**2nd**	**4th**	**647 BOT3**	**Elective**

Student's workload			
In-class activities	**Contact Hours**	**Self-learning/study**	**Hours**
Lectures	**45**	HW/Assignments	**49**
Laboratory	**0**	Case studies	**0**
Exams and quizzes	**3**	Study for exam	**40**
Lab demo	**0**	Working on lab experiment	**0**
Oral Presentation	**0**	Preparation for classes	**108**
Total	**48**	Total	**197**
Total Learning Hours = **245**		Equivalent **ECTS points** = Total LH/28 = **8.75**	

(1) Brief Course Description:

This course covers the concern and knowledge with the function and performance of plants in their natural environment and bridges the gap between plant physiology and ecology. The course will consider physiological and ecological aspects of adaptation to different environments. Plants are remarkably well adapted to growing in a range of environments from the Antartic to hot dry deserts especially in Saudi Arabia. Ecophysiology is the scientific study of the processes that enable them to do so. By the end of the course, you should be able to discuss analytically the key physiological processes affecting plants growing in the natural environment. Examples are drawn from forests, agricultural systems and the natural environment and most will relate to plants at the individual or stand scale. Sessions will cover plant water relations, stomatal physiology, transpiration, photosynthesis, global change, below-ground processes and predictive modeling. Also care about the advanced knowledge on biochemical processes in relation to environmental conditions in plant's natural habitats.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Explain the concepts of plant resource acquisition, plant energy budgets and plant water relations, and plant-to-symbionts and parasite interactions.
2. Explain how these concepts help understand ecological systems with a particular focus on the South Saudi Arabian context.
3. Acquire and then demonstrate the skills to design and undertake experiments in the laboratory and in the field using cutting-edge analytical equipment.

4. Work collaboratively to undertake experiments in the laboratory and in the field, produce written reports, and deliver oral reports.

(3) Course Contents

- **Theoretical Content:**
  1. Introduction, Abiotic Stress 1 – Salinity.
  2. Abiotic Stress 2 Plant and Soil Analysis.
  3. Abiotic Stress 3 – Heavy metals.
  4. Plant Stress – Light- Global Change - CO2 and T.
  5. Plant Growth (Seasonality, Phenology).
  6. Mycorrhizas - Structure and Function- Ecological Impacts.
  7. Energy Budget in Leaves.
  8. Water Relations.
  9. Transpiration - Leaf, Stem, and Root, Cavitation & Embolism.
  10. Parasitic Plants – Physiology-Ecological Roles.
  11. Plant Adaptation to Stress (Morphological, Physiological, Phenological.
  12. Presentations.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Leclerc, J.C. (2003). Plant Ecophysiology (1st ed.). CRC Press, Florida, USA.
2. Fitter A. H., Hay R. K. M 2002. Environmental Physiology of the Plants, Academic Press, London.
3. Maynard G. Hale and David M. Orcutt. (1987). The Physiology of Plants Under Stress John Wiley and Sons, Inc., New York.

(7) Reference Books

1. Duan, Chensong, Zhifeng Wu, Hu Liao, and Yin Ren. (2023). Interaction Processes of Environment and Plant Ecophysiology with BVOC Emissions from Dominant Greening Trees" *Forests* 14, no. 3: 523. https://doi.org/10.3390/f14030523
2. Lambers H., Chapin III, F. S., Pons, T. L. (1998). Plant Physiological Ecology. Springer.
3. Marschner, H., (1995). Mineral nutrition of higher plants. Academic Press, London.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Plant Population Ecology	642 BOT-3	3	0	0	3	2nd	4th	647 BOT-3	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	47
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	24
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	145
Total	48	Total	216
Total Learning Hours = 264		Equivalent ECTS points = Total LH/28 = 9.42	

(1) Brief Course Description:

This course covers the advanced knowledge of diversity, interactions and dynamics of plant communities along with the ability to compare internal and external interaction and relate the changes that occur in plants against different environmental conditions.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Discuss the diversity of plant communities.
2. Analyze the dynamics of plant communities
3. Compare internal and external interactions of plant communities.
4. Describe environmental conditions to characteristics of plant communities in the Kingdom.

(3) Course Contents

- **Theoretical Content:**

1. Plant Populations Part 1 – Variation and Inheritance in Plant Populations: Traits, Genotype, Phenotype.
2. Plant Populations Part 2 – Intraspecific Interactions (Density, Size, Fitness, Regulation).
3. Plants as indicators.
4. Population Dynamics: Demographic Parameters, Density-dependent Dynamic, Climax stage.
5. Age-structured and Stage-structured Populations: Stochasticity, Disturbance, Recruitment, Models with Age and Stage.

6. Interspecific Interactions: Competition, Coexistence.
7. Regional Dynamics: Geographical Range Limits, Extinction, Invasion.
8. Recent and advanced topics in plant population Ecology.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Gibson, David J. 2015. Methods in comparative plant population ecology, 2d ed.: Oxford Univ. Press. Oxford and New York.
2. Silvertown J., Charlesworth D. (2005) Plant Population Biology, Blackwell Science, Oxford.

(7) Reference Books

1. Gurevitch J., Scheiner S.M., Fox G.A. (2006). The Ecology of Plants, Sinauer Associates, Massachusetts.
2. Michael Begon, Martin Mortimer and David J. Thompson. (1996). Population ecology: a unified study of animals and plants, Blackwell Science, Oxford.
3. Lehmann, C., Rebele, F., Starfinger, U. (1999). Plant Population Ecology. In: Esser, K., Kadereit, J.W., Lüttge, U., Runge, M. (eds) Progress in Botany. Progress in Botany, vol 60. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-59940-8_18.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Plant Taxonomy	643 BOT-3	3	0	0	3	2nd	4th	–	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	48
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	24
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	106
Total	48	Total	178
Total Learning Hours = 226		Equivalent ECTS points = Total LH/28 = 8.07	

(1) Brief Course Description:

This course covers the principles and concepts of plant systematics. The course will help to understand the Plant classification (Pre-Linnaean, Linnaean, Post Linnaean systems, and APG Classification. It discusses Hierarchical classification (Taxonomic groups and categories). It describes Variation and Speciation besides the Source of Taxonomic Characters; (Morphology, anatomy, Embryology, palynology, micromorphology and others). It illustrates the recent aspects of plant taxonomy as Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy, Molecular Taxonomy, and Botanical Nomenclature. This course lets the students to use Taxonomic methods for plant identification; (Herbaria, Botanical gardens, Plant preservation, Taxonomic Literature, plant Identification, Taxonomic Keys).

(2) Course Objectives:

The main objectives of this course are focused on:

1. Explain the various systems of plant classifications.
2. Develop knowledge and skills in various concepts and techniques associated with plant classification.
3. Discuss plant evolutionary relationships.
4. Illustrate the use of chromosomes in plant taxonomy.
5. Discuss plant numerical taxonomy Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy, and Molecular Taxonomy.
6. Define the principles of Botanical Nomenclature.

(3) Course Contents

- **Theoretical Content:**

1. An Overview of Plant Classification (Pre-Linnaean, Linnaean, Post Linnaean systems and Angiosperm Phylogeny Group Classification)
2. Hierarchical classification (Taxonomic groups and categories)
3. Variation and Speciation
4. Source of Taxonomic Characters or evidences (Morphology, anatomy, Embryology, palynology, micromorphology and others)
5. Cytotaxonomy and Chemotaxonomy
6. Numerical Taxonomy
7. Botanical Nomenclature
8. Molecular Taxonomy
9. Herbaria, Botanical gardens, Plant preservation
10. economic Literature, plant Identification, Taxonomic Keys

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Michael George Simpson. (2010). Plant Systematics. Academic Press, Elsevier, Amsterdam.
2. Gurcharan Singh. (2019). Plant Systematics an Integrated Approach, Fourth Edition. CRC Press.The USA.

(7) Reference Books:

1. Zack E. Murrell and Emily L. Gillepsie. (2021). Vascular Plant Taxonomy, 7th edition. Kendall/Hunt Publishing Co, U.S.
2. Stuessy, T. (1994). Case Studies in Plant Taxonomy. Columbia University Press,
3. NY Walters, D.R., and D. J. Keil. (1998). Vascular Plant Taxonomy. 4th Edition. Kendal/Hunt Publishing Company, Dubuque, Iowa.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Palynology	644 BOT-3	3	0	0	3	2nd	4th	-	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	36
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	36
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	108
Total	48	Total	216
Total Learning Hours = 228		Equivalent ECTS points = Total LH/28 = 8.14	

(1) Brief Course Description:

This course covers the basic knowledge on methods and applications of pollen and spores. Ability to read and interpret a Quaternary pollen record and compare it with other paleoclimatic proxies. Knowledge of pollen dispersal strategies of woody plants and herbs. Develop concepts, importance, scope, and applications of palynology in other fields, Techniques used to isolate palynomorphs, their technical description, and evaluation of palynological data.

(2) Course Objectives:

The main objectives of this course are focused on:

1. Define the concepts and scope of Palynology.
2. Summarize the methods and application of pollens and spores.
3. Explain branches of palynology and their Importance.
4. Develop the pollen dispersal strategies of woody plants and herbs.
5. Interpret types of pollination.
6. Describe the structure and types of pollen.

(3) Course Contents

- **Theoretical Content:**

1. Introduction to Palynology, nature and scope, pollination. Types of Pollen Grains, Pollen Morphology (Pores, ornamentation, dimensions).
2. Production and Dispersal of Spores and Pollen, Ultra-structure and Stratification of Exine.

3. Environmental Palynology, Occurrence and Significance of Airborne Pollen concerning Allergies and Asthma, Control Measures.
4. Melissopalynology.
5. Archaeopalynology.
6. Palynology in medicine and Criminology.
7. Palaeopalynology.
8. Palynomorphs as Sedimentary Particles, Preservation in Sediment, Post Depositional Hazards.
9. Palynomorphs communities Oil and Gas Exploration Geochronology, Stratigraphic Correlation, Reconstruction of Past Plant Communities, Index Palynomorphs and Organic Thermal Maturity.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Bhattacharya, K., Majumdar, M. R., Bhattacharya, S. G., Bhattacharya, K. (2014). A Textbook of Palynology. New Central Book Agency (P) Ltd, New Delhi.
2. Erdtman G. (1969). Handbook of palynology. Morphology, taxonomy, ecology. An introduction to the study of pollen grains and spores., Hafner New York.

(7) Reference Books

1. Backhouse J.1988. Late Jurassic and Early Cretaceous palynology of the Perth Basin, Western Australia. Bull. Geol. Surv. West. Aust., 135:1-233.
2. Moore, P.D., Webb, J.A. and Collinson, M.E. (1991). Pollen Analysis. 2nd Edition, Blackwell, Oxford.
3. Saxena, M.R.(1993). Palynology: A Treatise. Oxford & IBH Publishing Company, New Delhi.
4. Traverse, Alfred. (2007). Paleopalynology, 2nd ed. Dordrecht: Springer. DOI:10.1007/978-1-4020-5610-9.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Plant Geography	645 BOT-3	3	0	0	3	2nd	4th	-	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	47
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	40
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	108
Total	48	Total	195
Total Learning Hours = 243		Equivalent ECTS points = Total LH/28 = 8.67	

(1) Brief Course Description:

This course covers the theories principles and mechanisms associated with occurrence and distribution of plants in the Earth. Theoretical Development of Regional Floras (Endemic Plants), Vegetation Structure, Tropical Biomes (Tropical Rainforests, Tropical Mountains), Tropical Biomes (Savannas, Woodlands, Deserts, Arid Lands), Temperate Biomes (Mediterranean Woodlands, Mediterranean Shrublands), Temperate Grasslands, Temperate Forests (Evergreen Forests, Temperate Rainforests, Coniferous Forests, Boreal Forests, Continental Montane Forests, Pacific Rainforests, Taiga, Tundra, Alpine Vegetation) Phytogeographical regions in the Kingdom.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Discuss characteristics and components of tropical rain forests, Savanna, Deserts, Arid regions, Temperate forests, Taiga, and Tundra.
2. Explain the characteristics of tropical rainforests and temperate forests.
3. Differentiate characteristics and components of Taiga and tundra.
4. Estimate characteristics and components of Plant geographical regions in the Kingdom.

(3) Course Contents

- **Theoretical Content:**
  1. Introduction to Phytogeography.
  2. Geological History and theories of the origin of land masses.
  3. Floristic realms, units and zone.
  4. Environmental factors.
  5. Vegetation types

6. Endemism.
7. Origin of Cultivated plants and distribution of crops.
8. Dispersal of plants, Resistance of Plants and Plant indicators.
9. Bioclimatic types of Asia and Middle East.
10. Phytogeographical regions in the Kingdom of Saudi Arabia.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Kellman, M. (1993). Plant Geography (1st ed.). Routledge. https://doi.org/10.4324/9781003391104
2. Mark V. Lomolino, Brett R. Riddle, and Robert J. Whittaker.(2016). Biogeography. Oxford University Press. Oxford.

(7) Reference Books:

1. Alfarhan A.H. 1999. A phytogeographical analysis of the floristic elements in Saudi Arabia. Pak. J. of Bio. Sci., 2(3): 702-711.
2. Al-Nafie A.H. (2008). Phytogeography of Saudi Arabia. Saudi Journal of Biological Science, 15 (1): 159-176.
3. Bharucha F. R. A.(1983). Textbook of Plant Geography in India. Oxford University Press, Bombay.
4. Woodward S.L. (2003) Biomes of Earth: Terrestrial, Aquatic, and Human-Dominated. Greenwood, London.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Saudi Flora	646 BOT-3	2	0	2	3	2nd	4th	-	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	30		HW/Assignments	48
Laboratory	30		Case studies	0
Exams and quizzes	8		Study for exam	20
Lab demo	0		Working on lab experiment	30
Oral Presentation	0		Preparation for classes	121
Total	68		Total	219
Total Learning Hours = 287			Equivalent ECTS points = Total LH/28 = 10.25	

(1) Brief Course Description:

This course covers advanced knowledge of the Flora of Saudi Arabia and important plant families of Saudi Flora. Develop knowledge of the Flora of diverse habitats of Saudi Arabia. Also provides information on the historical evolution of Saudi Arabia Flora, as well as the geographical and environmental divisions within the Kingdom of Saudi Arabia. Students will gain knowledge about the types of conservation and forest reserves in Saudi Arabia and the importance of natural protected areas. Information on the flora of Saudi Arabia and the vegetation of the Kingdom in a global context. The course includes the study of some wild plant examples from different geographical regions of Saudi Arabia including the Jazan Region. Also, knowledge of methods for collecting samples of standard herbarium preparation. Skills and knowledge from field trips to different areas of Saudi Arabia to study the different environments and habitats.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Understand the information on plant biodiversity in Saudi Arabia, in terms of endemic, endangered, and rare plants, number and distribution of plant species in the Kingdom, and special reference to the Jazan Region.
2. Explain the topography and vegetation of different regions of Saudi Arabia.
3. Describe the collection, preservation of plant specimens, and preparation of herbarium.
4. Identify the plant species from different regions of Saudi Arabia.
5. Understand the different ecotypes of Saudi Arabia.
6. Identify the basic features of some important dicots and monocots families.

(3) Course Content

- **Theoretical Content:**

1. Introduction to the Flora of the Arabian Peninsula
2. History of the Flora of the Arabian Peninsula
3. Plant Identification Systems part 1.
4. Plant Identification Systems part 2.
5. Geographical Distribution of the Flora of Saudi Arabia.
6. Features of the Flora of Saudi Arabia (Endemism).
7. Features of the Flora of Saudi Arabia (Invasive Plants).
8. Features of the Flora of Saudi Arabia (Endangered Plants).
9. Floristic Composition of the Flora of Saudi Arabia (Economic Plants).
10. Floristic Composition of the Flora of Saudi Arabia (Medicinal Plants).
11. Floristic Composition of the Flora of Saudi Arabia (Grazing Plants).
12. Floristic Composition of the Flora of Saudi Arabia (Poisonous Plants).
13. Detailed Study of the Flora of Jazan Region with different Habitats part 1.
14. Detailed Study of the Flora of the Jazan Region with different habitats part 2.
15. Detailed Study of the Flora of Jazan Region with different habitats part 3.

- **Practical Content:**

The course introduces the concepts of flora and vegetation, which include the following topics:

1. Identifying plant species of different regions of Saudi Arabia.
2. Visit and fieldwork training.
3. Identifying the basic features of some important dicots and monocots families.
4. Comparing the phytogeography of Saudi Arabia.
5. Study the different environments and habitats.
6. Collect and preserve plant specimens and prepare herbarium sheets.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, Web-based Assignments, and Field trips.

(6) Textbook:

1. Collenette, I. S. (1999). Wildflowers of Saudi Arabia. National Commission for Wildlife Conservation, Riyadh.
2. Alfarhan, A.H., T.A. Al-Turki and A.Y. Basahy. (2005). Flora of Jazan Region Vol. 1-2, King Abdulaziz City for Science and Technology, Riyadh.

(7) Reference Books

1. Alfarhan A.H. (1999). A phytogeographical analysis of the floristic elements in Saudi Arabia. Pak. J. of Bio. Sci., 2(3): 702-711.
2. Chaudhary, S. (1999). Flora of the Kingdom of Saudi Arabia. vol 1, Ministry of Agri. & Water, Riaydh.
3. Chaudhary, S.A.(2000). Flora of the Kingdom of Saudi Arabia. vol 2 (part 1), Ministry of Agri. & Water, Riyadh.
4. Chaudhary, S.A. (2000). Flora of the Kingdom of Saudi Arabia. vol 2 (part 2), Ministry of Agri. & Water, Riyadh.
5. Chaudhary, S. (2000). Flora of the Kingdom of Saudi Arabia. vol 2 (part 3), Ministry of Agri. & Water, Riyadh.
6. Chaudhary, S.A. (2001). Flora of the Kingdom of Saudi Arabia. Vol III, Ministry of Agri. and Water, Riyadh.
7. Al-Nafie A.H. (2008). Phytogeography of Saudi Arabia. Saudi Journal of Biological Science, 15 (1): 159-176.
8. Masrahi, Y.S. 2012. Illustrated Guide to the Flora of Jazan Region, Saudi Arabia. Jeddah: Al-Sarawat Publishing(In Arabic).
9. Abdul Latif Hamoud Al-Nafeh (2018). Components of the wild vegetation cover in the Kingdom of Saudi Arabia, Al-Mutanabbi Library, Kingdom of Saudi Arabia (in Arabic).

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Basics of Plant Analysis	648 BOT-3	2	0	2	3	2nd	4th	647 BOT-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	30		HW/Assignments	75
Laboratory	30		Case studies	0
Exams and quizzes	8		Study for exam	44
Lab demo	0		Working on lab experiment	24
Oral Presentation	1		Preparation for classes	84
Total	69		Total	227
Total Learning Hours = 296			Equivalent ECTS points = Total LH/28 = 10.57	

(1) Brief Course Description:

This course provides advanced knowledge on plant characteristics and factors affecting on Fundamentals science of operating instruments and equipment the sampling and preparation plant analysis laboratory. Theories and procedures for chemical, physical, mineralogical, and biological analysis of plant materials. Applications of analysis methods in evaluation of soil plant material. Interpretation and discussion of results, and report writing and recommendations. Instructors will use the Fundamentals Performance Objectives (POs) as a guide for discussing topics within each section, but will not go through each objective individually. However, students are encouraged to ask questions regarding specific POs if needed.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Describe methods of sampling and preparation of plant material.
2. Discuss and compare methods of digestion and water extraction of plant material.
3. Determine the mineral element content of plant material by flame photometry.
4. Illustrate the mineral element content of plant material by Atomic Absorption Spectroscopy.
5. Differentiate nitrogen and Sulphur content of plant material by Spectroscopic techniques.
6. Estimate the pigment content of plant material by visible Spectroscopy and reflectance techniques.

(3) Course Content

- **Theoretical Content:**
    1. Introduction to Plant analysis.
    2. Sampling Properties and preparing.

3. Preparing Ashing from plants.
4. Digestion (Sulfuric Acid, Nitric Acid).
5. Digestion (Hydrogen Peroxide, Hydrofluoric Acid).
6. Compare methods of digestion and water extraction of plant material part 1.
7. Compare methods of digestion and water extraction of plant material part2.
8. Determine the mineral element content of plant material by flame photometry part 1.
9. Determine the mineral element content of plant material by flame photometry part 2.
10. Determine the mineral element content of plant material by atomic absorption spectroscopy part 1.
11. Determine the mineral element content of plant material by atomic absorption spectroscopy part 2.
12. Determine nitrogen and sulfur content of plant material by spectroscopic techniques part 1.
13. Determine the nitrogen and sulfur content of plant material by spectroscopic techniques in part 2.
14. Determine the pigment content of plant material by visible spectroscopy and reflectance techniques in part 1.
15. Determine the pigment content of plant material by visible spectroscopy and reflectance technique's part 2.

- **Practical Content:**
  1. Collection of plant samples and preservation.
  2. Preparing Ashing from plants.
  3. Plant Digestion (Sulfuric Acid, Nitric Acid).
  4. Plant Digestion (Hydrogen Peroxide, Hydrofluoric Acid).
  5. Methods of plant water extraction of plant material.
  6. Determine the mineral element content of plant material by flame photometry.
  7. Determine the mineral element content of plant material by atomic absorption spectroscopy.
  8. Determine the nitrogen and sulfur content of plant material by spectroscopic techniques.
  9. Determine the pigment content of plant material by visible spectroscopy and reflectance techniques.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %
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(5) Course Teaching Strategies:

Lectures, Reports, Essay Assignments, Homework, Web-based Assignments, and Field trips.

(6) Textbook

1. Gretchen M. Bryson, Harry A. Mills, David N. Sasseville, J. Benton Jones (Jr.), Allen V. Barker (2014). Plant Analysis Handbook III: A Guide to Sampling, Preparation, Analysis, Interpretation and Use of Results of Agronomic and Horticultural Crop Plant Tissue. Micro-Macro Publishing, Incorporated. Athens.

2. Jones, Jr., J. Benton. (2012). Plant Nutrition and Soil Fertility Manual. (2nd edition). CRC
Press: Boca Raton, FL.
3. Temminghoff E.J., Houba V.J. (2004). Plant Analysis Procedures, Kluwer Academic Publishers, Amsterdam.

(7) Reference Books

1. Leo M. Walsh and James D. Beaton eds (1973). Soil Testing and Plant Analysis. Soil Science Society of America, Inc. Madison, Wisconsin USA.
2. Sibilia J.P. (1996). A Guide to Materials Characterization and Chemical Analysis. Wiley, New York.
3. Yash Kalra (1997). Handbook of Reference Methods for Plant Analysis. CRC Press, Boca Raton.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Bacteriology	630MIC-3	3	0	0	3	2nd	3rd	-	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	49
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	30
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	119
Total	48		Total	198
Total Learning Hours = 246			Equivalent ECTS points = Total LH/28 = 8.78	

(1) Brief Course Description:

Study modern methods in the classification of bacteria and the role of bacteria in nature. This course deals with the occurrence of bacteria in the environment, Bacterial cell structure, and the classification of bacterial groups based on morphological, physiological, and genetic characterization. Study key characteristics, sources, and biology of many commonly encountered and/or taxonomically interesting bacterial groups. It will be considered, how molecular approaches, particularly 16S ribosomal RNA sequence analysis, allow diverse organisms to be grouped based on phylogenetic relationships. Methods and approaches for the isolation and identification of bacteria are considered in the laboratory. Also, the study of the factors affecting bacterial growth and nutrition of bacteria will be covered.

(2) Course Objectives:

The main objectives of this course are focused to:

1, List the roles of bacteria in life and in different applications
2 .Explain the principles and keys of bacterial taxonomy
3 .Identify the positive and negative roles of bacterial in life
4 .Estimate the fine structure of bacterial cells .
5 .Estimate the different methods for bacterial staining
6 .Summarize the factors' effect on bacterial growth

(3) Course Contents

- **Theoretical Content:**

1. Classification of bacteria. Bergey's modern classification bacteria. Genetic classification of bacteria. Serological classification of bacteria. Examples of different groups of bacteria. Bacterial Metabolism .
2. An overview of the role of bacteria in the environment and their applications in different fields.
3. Growth of bacteria.
4. Bacterial taxonomy.
5. Bacterial cell structure and their functions.
6. Bacterial reproduction.
7. Bacterial Nutrition.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Systematic Bacteriology of Bergey's Manual Second Edition Volume Five. 2012
2. Parija S.C. Textbook of Microbiology and Immunology 4Ed (2024). Springer

(7) Reference Books

1. Tortora Gerard; Funke – Good. Microbiology, An introduction (2018). Pearson Education publisher.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Algal Physiology	632MIC-3	3	0	0	3	2nd	3rd	631MIC	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	48
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	36
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	110
Total	48		Total	194
Total Learning Hours = 242			Equivalent ECTS points = Total LH/28 = 8.64	

(1) Brief Course Description:

Study the different physiological pathways in algae.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Discuss the theoretical bases of the different metabolic pathways in the algal cell .
2. Describe the Algal physiology theories and hypothesis.
3. List all features, principles, concepts, and steps related to all Algal physiology approaches.
4. Apply specialized theories, principles, and concepts in advanced contexts in Algal physiology, profession, or field of work .
5. Interpret different Algal physiology concepts, mechanisms, and processes by using critical thinking Course Contents.

(3) Course Contents

- **Theoretical Content:**

1. Economic Importance.
2. Life Cycle.
3. Photosynthesis and Light Harvesting.
4. Carbohydrate and protein metabolism.
5. Lipid Metabolism in Microalgae.
6. Hydrogen Production.
7. Nitrogen Fixation.
8. Respiration.
9. Micronutrients Coping with High Salinity Exocellular Polysaccharides.

(4) Assessment Criteria:

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Borowitzka, Michael A., Beardall, John, Raven, John A. (2016) The Physiology of Microalgae, Springer International Publishing AG Switzerland.

(7) Reference Books

1. Physiology of Algae: An Insight Harshita Mishra, Ashutosh Pathak, P. V. Subba Rao, K. Suresh Kumar

Course Title	Course Code	Number of Sty Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Plant Pathology	634MIC-3	2	0	0	2	2nd	3rd	631MIC	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	48
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	30
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	117
Total	48	Total	195
Total Learning Hours = 243		Equivalent ECTS points = Total LH/28 = 8.67	

(1) Brief Course Description:

The course will provide recent knowledge tools for the identification, prevention and management of diseases associated with the main plant pathogens . This course deals with studying plant diseases and their causes (biotic and abiotic agents), direct and indirect losses from plant diseases, symptoms of plant infections, inoculums of microbial infection, environmental conditions that cause the spread of microbial infectious, disease cycles and methods used in diagnosis and controlling plant diseases. Symptoms of viral infection in plants and methods of transmission - Viral plant diseases (Stone Trees, Solanaceae, Legumes, Cucurbits, Citrus, Bananas, Ornamental Plants, Cereals). Bacterial plant diseases (Spots, blights, Rots, Wilts, Galls) - Fungal plant diseases (Ring mold, Black mold, Scabs, Necrosis, Gummosis) - Effect of environmental conditions on the occurrence of plant diseases (Temperature, Humidity, Wind, Light, Soil) – Plant resistance to microbial diseases - Economic impact of microbial plant diseases.

(2) Course Objectives:

The main objectives of this course are focused to:

1 .Define symptoms of viral bacterial and fungal diseases in plants.
2 .Relate environmental conditions to injury and infection in plant diseases.
3 .Explain the transmission of plant diseases.
4 .Interpret mechanisms of injury in plant diseases.
5 .Discuss methods of plant disease control of some viral and bacterial diseases
6 .Differentiate the economic impact of microbial plant diseases .

(3) Course Contents

- **Theoretical Content:**

1. The history of Phytopathology-Principles of Plant Pathology-Plant disease losses and distribution of pathogens .

2. Viral plant diseases symptoms of viral infection in plants and methods of transmission (Stone Trees, Solanaceae, Legumes, Cucurbits, Citrus, Bananas, Ornamental Plants, Cereals).
3. Bacterial and Phytoplasma plant diseases (importance, nature) Examples of the most important bacterial and Phytoplasma plant diseases. Bacterial plant diseases (Spots, blights, Rots, Wilts, Galls.
4. Fungal plant diseases (Ring mold, Black mold, Scabs, Necrosis, Gummosis), Fungal plant diseases: Blights and leaf spots diseases - post-harvest and storage diseases and their disease cycles, Downy and Powdery mildew diseases and their disease cycles.
5. Effect of environmental conditions on the occurrence of plant diseases, Biotic and abiotic agents (Temperature, Humidity, Wind, Light, Soil).
6. Plant resistance to microbial diseases .
7. Selection/production of crop varieties resistant against plant pathogens: screening of varieties with different susceptibility versus the pathogens .
8. Identification of genes involved in host/pathogen interactions; genome editing for the production of resistant varieties .
9. Sustainable strategies for managing plant pathogens: preventive techniques; integrated multidisciplinary approach; design/utilization of molecules/living organisms for plant pathogen control.
10. Economic impact of microbial plant diseases

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Anne Marte Tronsmo et al (2020) Plant Pathology and Plant Diseases, Publisher CAB International, Wallingford, Oxfordshire, UK ISBN 9781789243208

(7) Reference Books:

1. Agrios, G.N. (2005). Plant Pathology. 5th Edition, Academic Press, NY, USA.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Microbial Genetics	635MIC-3	3	0	0	3	2nd	3rd	631MIC-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	51
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	32
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	107
Total	48		Total	190
Total Learning Hours = 238			Equivalent ECTS points = Total LH/28 = 8.50	

(1) Brief Course Description:

This course will focus on the genetic structure of the microorganisms, exploring the transmission of heritable traits and the principles used to investigate this phenomenon. Genetic variation and its role in driving microbial evolution will be a key theme throughout the course. We will delve into the natural genetic processes that occur in bacteria, such as conjugation, transformation, and transduction, and examine how they have been utilized to produce desirable traits under controlled conditions. In addition, we will explore cutting-edge concepts developed in recent years that are transforming our understanding of essential genes necessary for life, comparative genomics, metagenomics, and other factors that influence genetic and physiological diversity.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Explain a comprehensive grasp of the fundamental principles, paradigms, and distinctive features of microbial genetics.
2. Define research techniques used in microbial genetics throughout history, as well as contemporary and cutting-edge methods.
3. Enhance critical thinking skills, ability to integrate and synthesize concepts and ideas, and scientific problem-solving skills.
4. Discuss comprehension of gene transfer mechanisms, mutations, and the life cycle of phages.
5. Discuss the regulation of gene expression and responses to changing environments.
6. illustrate the acquisition of knowledge about gene transfer.

(3) Course Contents

- **Theoretical Content:**

1. Over review of genetic
2. Bacterial Genetics analysis and mutations
3. Genetics of Bacteriophage
4. Extra-chromosomal and moveable elements
5. Gene Transfer
6. Moveable genetic elements
7. Mutations (Types, Mutagens, Frequency), Identifying mutants, Identifying chemical carcinogens.

(4) Assessment Criteria:

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Clark D.P. (2010). Molecular Biology. Academic Press, New York.
2. Shulph Ink (2024). Microbial Genetics. Taylor & Francis Ltd

(7) Reference Books:

1. Sylwia Okoń, Beata Zimowska, Mahendra Rai (2024). Microbial Genetics. Taylor & Francis Ltd.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre- requisites
		Theo.	Tut.	Lab.	Credit			
Microbial Ecology	MICR636-3	3	0	0	3	2nd	3rd	MICR631-3

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	36
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	28
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	110
Total	48		Total	174
Total Learning Hours = 222			Equivalent ECTS points = Total LH/28 = 7.92	

(1) Brief Course Description:

This course is designed to introduce students to the fundamental concepts of microbial communities, their interactions within ecosystems, and their behaviors. It emphasizes the diversity of microbes across various natural habitats (air, water, and soil), explores factors influencing microbial growth and survival strategies, examines the crucial roles of microbes in food webs and biogeochemical cycles. Additionally, the course will cover the application of microbes in bioremediation processes.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Explain the ecological principles governing microbial communities.
2. Identify the significant roles of microbes in their natural habitats.
3. Analyze the interactions between microbes with both biotic and abiotic factors within ecosystems.
4. Discuss the vital functions of microbes in biogeochemical cycles.
5. Recognize microbes as indicators of environmental changes and alterations.
6. Demonstrate the roles of microbes in bioremediation processes.

(3) Course Contents

- **Theoretical Content:**

1. Fundamental Concepts of Microbial Ecology.
2. Physical and Chemical Factors Affecting Microbial Growth
3. Microbial Community Structure.
4. Microbial Metabolism and Biogeochemical Cycles.

5. Microbial Primary Production and Phototrophy.
6. Microbial Interactions with Biotic and Abiotic Factors.
7. The Extreme Conditions of Life on the Planet.
8. Microbial Ecology in Extreme Environments.
9. Thermophilic and Psychrophilic Prokaryotes.
10. Metabolic and Phylogenetic Overview of Thermophilic and Psychrophilic Prokaryotes.
11. Principles of Microbial Bioremediation.
12. Applications of Microbial Bioremediation,

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Barton, Larry L., and Diana E. Northup. Microbial ecology. John Wiley & Sons, 2011.

(7) Reference Books:

1. Maier R.M., Pepper I.L., Gerba C.P. (2008) Environmental Microbiology. Academic Press, San Diego.
2. Madsen E.L. (2008) Environmental Microbiology. Blackwell Publishing, Malden, MA, USA.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Food Microbiology	637MICR-3	3	0	0	3	2nd	3rd	MICR631	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	45
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	34
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	108
Total	48		Total	187
Total Learning Hours = 235			Equivalent ECTS points = Total LH/28 = 8.39	

(1) Brief Course Description:

Food Microbiology is a comprehensive course that focuses on the study of microorganisms in relation to food and its safety. The course provides students with a strong foundation in microbiology principles, with a specific emphasis on the application of these principles in food-related contexts. Students will develop a deep understanding of the various microorganisms present in foods, their roles in food spoilage and foodborne illnesses, and strategies for their control.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Define the fundamental concepts and principles of microbiology as they relate to food safety and quality.
2. Summarize the identification, characteristics, and classification of microorganisms commonly found in food.
3. Provide the knowledge of microbial growth, metabolism, and factors influencing microbial survival and reproduction in food environments.
4. Explore the principles and methods of food preservation, including traditional and emerging techniques, and their impact on microbial growth.
5. Define foodborne pathogens, their sources, transmission routes, and control strategies.
6. Discuss with students to food safety regulations, Hazard Analysis and Critical Control Points (HACCP) systems, and good manufacturing practices (GMP) in the food industry.
9. Develop critical thinking and problem-solving skills in assessing and mitigating microbiological risks in food production and processing.

(3) Course Contents

- **Theoretical Content:**

1. Introduction to Food Microbiology; Basic microbiology concepts, Microbial classification, function, growth, and reproduction. Factors influencing microbial survival and growth in food environments.
2. Microorganisms in Foods; Bacteria: morphology, physiology, and classification. Yeasts and molds: characteristics and significance in food. Viruses and their impact on food safety. Parasites and their transmission through food.
3. Microbial Analysis in food; Isolation and cultivation. Identification methods: biochemical and molecular techniques .
4. Microbial Growth and Control in Food; (1): Factors influencing microbial growth. Intrinsic and extrinsic factors affecting microbial survival .
5. Microbial Growth and Control in food; (2): Food spoilage: causes, signs, and prevention. Food preservation techniques: heat processing, refrigeration, freezing, dehydration, and preservatives .
6. Foodborne Pathogens; (1): Common foodborne pathogens: bacteria, viruses, and parasites. Routes of transmission and their impact on food safety .
7. Foodborne Pathogens; (2): Epidemiology and surveillance of foodborne illnesses. Strategies for prevention and control of foodborne pathogens.
8. Food Safety and Regulations; Food safety regulations and guidelines. Hazard Analysis and Critical Control Points (HACCP). Good Manufacturing Practices (GMP) in the food industry Food labeling and allergen control
9. Microorganisms in Food Production; (1): Microorganisms in dairy products: cheese, yogurt, and fermented milk. Role of microorganisms in meat and poultry processing.
Microorganisms in Food Production; (2): Fermentation processes and their applications in food production. Probiotics and prebiotics in functional foods.
10. Emerging Trends in Food Microbiology; (1): Bio-preservation and natural antimicrobials. Applications of beneficial microorganisms in food processing. Nanotechnology in food safety and quality. Genetically modified microorganisms in food production
11. Field Trips Organizing field trips to food processing facilities, quality control laboratories, or regulatory agencies allows students to observe practical applications of food microbiology principles.

(4) Assessment Criteria:

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Rajeswari Anburaj (2020): Textbook on Food Microbiology. Publisher: Ryan Publishers. Editor: P.F. Steffi. ISBN: 978-81-947191-6-8, 978-81-947191-7-5.

(7) Reference Books:

1. Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill (2019): Food Microbiology: Fundamentals and Frontiers. 5th Edition. First published: 29 May 2019. Print ISBN:9781555819965. Online ISBN:9781683670476 |DOI:10.1128/9781555819972

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Microbial Biotechnology	638MIC-3	3	0	0	3	2nd	3rd	MICR631	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	47
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	28
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	110
Total	48		Total	185
Total Learning Hours = 233			Equivalent ECTS points = Total LH/28 = 8.32	

(1) Brief Course Description:

This course covers the Role of microbial biotechnology in agriculture, industry, environment and medicine. The basic scientific knowledge and its application in biotechnology field. Fundamental molecular biology & practical applications, some historical examples, modern applications of biotechnology will be discussed to provide tools and basic knowledge in order to understand biotechnology. The emerging areas of biotechnology, for example agricultural biotechnology, protein, bioremediation, regulatory agencies and issues that impact biotechnology industry will be discussed as well. In addition to that genetically modified food, concepts in microbial biotechnology including fermentation processes, control and use of microorganisms in the food industry, water quality and bioremediation will be incorporated.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Describe the microbes that at are used in biotechnology.
2. Solve environmental problems by biotechnology.
3. Define medical and therapeutic problems using biotechnology.
4. Improve and increase industrial and agricultural products.

(3) Course Contents

- **Theoretical Content:**
  1. Bacteria used in biotechnology. Heterologous
  2. Proteins for human therapeutics.
  3. Microbial biotechnology in agriculture.

4. Food technology.
5. Single cell protein.
6. Microbial biotechnology in (Environment, Organic chemistry).
7. Production of proteins by bacteria and yeast. Recombinant vaccines.
8. Microbial insecticides.
9. Production of antibiotics.
10. Microbial transformation of steroids and sterols.
11. Enzymes production.
12. Ethanol and biomass.
13. Microbial biotechnology in oil recovery.

(4) Assessment Criteria

- Midterm: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50 %

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

5. Alexander G.N., Nikaido H. (2007) Microbial Biotechnology. Cambridge University Press, Cambridge.

(7) Reference Books:

1. Thieman, W.J. and Palladino, M.A. (2013): Introduction to Biotechnology, 3rd edition. Pearson. ISBN-13: 978-0321766113.
2. John E. Smith. (2009): Biotechnology. Fifth edition. CAMBRIDGE UNIVERSITY PRESS
3. Singh U.S. and Kapoor K. (2010). Microbial biotechnology, Oxford Book Company, Jaipur, India

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Invertebrates	650ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	47
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	30
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	119
Total	48		Total	196
Total Learning Hours = 244			Equivalent ECTS points = Total LH/28 = 8.71	

(1) Brief Course Description

This course covers the study of minor invertebrate phyla and their classes and to follow the complexity in morphological and anatomical features for different minor invertebrate groups. It also studies phylogenetic relationship of minor invertebrates related to major invertebrate groups. their classes and to follow the complexity in morphological and anatomical features for different minor invertebrate groups. It also studies phylogenetic relationship of minor invertebrates related to major invertebrate groups.

(2) Course Objectives

The main objectives of this course are focused to:

1. Explain the recent methods in invertebrate taxonomy and different taxonomic clades.
2. Recall the general characters and classification of minor invertebrate phyla.
3. Describe and classify minor invertebrates inhabiting freshwater, marine, and terrestrial habitats.
4. Define larval stages and larval development of different minor invertebrate groups.
5. Discuss the adaptive diversification, and morphological changes adapted to habitat in minor invertebrates.
6. Define the phylogenetic relationship according to the structural complexity of minor invertebrates about the major invertebrates

(3) Course Contents

- **Theoretical:**

1. The recent methods in Taxonomy, cladistics taxonomy, and Taxonomic terms; paraphyletic, monophyletic, and polyphyletic taxa. Protostomes and Deutrostomes.

2. The general characters and classification of Subkingdom Protozoa, Different groups of Sarcodina, Rhizopoda, Heliozoa, Foraminifera
3. Different groups of Phytomastigophora, Zoomastigophora, Ciliophora, Opalinata
4. Phylum: Labrynthomorpha, Phylum Apicomplexa, Phylum: Ascetospora.
5. Phylum Microsporidia, Phylum Myxozoa, Phylum Euglenozoa
6. Phylum Placozoa, Phylum: Ctenophora, discussing adaptive diversification,
7. Phylum: Rotifera, Phylum Gnathostomulida, Phylum Micrognathozoa
8. Phylum Acanthocephala, Phylum: Cycilophora, Phylum Gastrotricha
9. Phylum: Nematomorpha, Phylum Kinorhyncha, Phylum priapulids,
10. Phylum Tardigrada, Phylum Loricifera,
11. Phylogeny and adaptive diversification
12. adaptive morphological characters and behavior of minor invertebrates
13. Phylum: Onychophora, Phylum: Chetognatha,

(4) Assessment Criteria

- Mid Term1 exams: 25 %
- Oral presentations, Essays and oral tests 25%
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

Rupert E.E., Fox R.S., Barnes R.D. (2003): Invertebrate Zoology: A Functional Evolutionary Approach. Cengage Learning, New York.

(7) Reference Books

Hickman C.P., Roberts L.S., Keen S.L., Larson A., H. Eisenhour D.J. (2011) Integrated Zoology. McGraw Hill, New York.

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Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Parasitology	651ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	48
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	28
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	120
Total	48	Total	196
Total Learning Hours = 244		Equivalent ECTS points = Total LH/28 = 8.71	

(1) Brief Course Description

This course covers the basics of parasitology, the basic principles of parasitism and the mode of parasitic invasion and host adaptation, describes the host reaction to invading parasites, and the classification of protozoa, parasitic helminths, and parasitic arthropods. The course also includes the study of morphology, life cycle patterns, and epidemiology. It also determines the role of intermediate host and vectors in disease transmission, and the method of controlling and preventing the spread of parasitic disease.

(2) Course Objectives:

The main objectives of this course are focused to:

1. Describe the concept of parasitism and the general concept of parasitology.
2. Explain the different biological inter-relationships and the host-parasite relationships.
3. Identify some parasitic diseases that can be transmitted between animals and humans (Zoonotic diseases).
4. Discuss how to protect man and domestic animals from parasites and their treatment.
5. Summarize various parasites from all phyla (Protozoa, helminths, and arthropods), their morphology, biology, life cycles, diagnosis, treatment & control.
6. Differentiate health awareness of these parasitic diseases.

(1) Course Contents

- **Theoretical:**

1. Host-parasite relationship, types of parasite, types of host and the effect of parasite on the host, general characteristics of parasites from different phyla (Protozoa, Helminths, and Arthropods).

2. Classification of Protozoan parasites, Phylum Sarcomastigophora (Entamoeba histolytica Acanthamoeba, Neiglaria fowleri, Giardia, Trichomonas vaginalis, Trypanosoma, Leishmania. Ciliophora (Balantidium coli) Apicomplexa (Plasmodium), Cryptosporidium (examples of parasites in some fish, amphibians, reptiles, birds, and mammals)
3. Parasitic ciliates, Apicomplexan parasites; Plasmodium, Babesia, and other reptilian, fish, birds and mammalian species) coccidiosis and different animal and human coccidian parasites (Monocystis, Eimeria, Cytoisopora, Glogia, and other reptilian, fish, birds, and mammalian species) microsporidian parasites and myxosporidian parasites.
4. Classification of Helminths: Trematodes: (examples of parasites in some fish, amphibians, reptiles, birds, and mammals)
5. Nematodes (examples of nematode parasites on fish, amphibian, reptilian, bird, and mammalian species).
6. Cestodes (examples of parasitism on fish, amphibian, reptilian, bird, and mammalian species)
7. Medical Arthropods: Biology of medical Arthropods and its importance in parasitology, Classification of medical Arthropods (Flies, mosquitoes, Fleas, lice, Bugs, Ticks and mites), Methods of vector control (Mechanical control methods, Chemical control, biological control, and Genetic control).
8. Immunology: Immunopathology of parasitic infections, immune evasion of parasites, and Immunological diagnosis of parasitic infection.

(2) Assessment Criteria:

- Mid Term exams: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50%

(3) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(4) Textbook:

1- Eric S. Loker & Bruce V. Hovkin (2022). Parasitology, A Conceptual Approach 2nd edition, 668 pages. Garland Science, Taylor & Francis Group, New York, USA.
2- Cox F.E.G. (2009) Modern Parasitology A Textbook of Parasitology, 2nd Edition, 292 pages, Wiley-Blackwell, New York.

(5) Reference Books:

1- Dawit Assafa, Ephrem kiru and Jemal Ali (2004). Medical Parasitology (Degree and Diploma Programs for Health Science Students.
2- Gerald D. Schmidt & Larry S. Roberts (1999) Foundations of Parasitology 6th Edition, 704 pages, William C Brown Publishers.
3- J.D.Smyth (1994) Introduction to Animal Parasitology. Third edition, Cambridge University Press.

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Embryology	652ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	46
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	32
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	123
Total	48		Total	201
Total Learning Hours = 249			Equivalent ECTS points = Total LH/28 = 8.89	

(1) Brief Course Description

This course covers a comprehensive introduction to the field of developmental biology, which explores the processes and mechanisms underlying the growth, differentiation, and organization of complex multicellular organisms from a single fertilized egg. The course is designed to provide students with a solid foundation in the principles and concepts of developmental biology, covering key topics such as embryonic development, cell differentiation, morphogenesis, and organogenesis. It also explores the genetic, molecular, cellular, and environmental factors that influence the development of organisms.

(2) Course Objectives

The main objectives of this course are focused to:

1) Define the fundamental principles and concepts of developmental biology, including the processes and mechanisms underlying the growth, differentiation, and organization of multicellular organisms.
2) Explain knowledge of key developmental processes, such as embryonic development, cell differentiation, morphogenesis, and organogenesis, and how they are regulated.
3) Explore the genetic, molecular, cellular, and environmental factors that influence the development of organisms.
4) Summarize with various model organisms commonly used in developmental biology research, and understand their advantages and limitations.
5) Explore the latest advancements in the field of developmental biology, including stem cell biology and regenerative medicine.
6) Enhance critical thinking and analytical skills through the evaluation and interpretation of experimental data, research papers, and case studies related to developmental biology.

(3) Course Contents

- **Theoretical**

1. Introduction to Developmental Biology.
2. Early Development and Gametogenesis.
3. Gametogenesis.
4. Developmental Genetics and Epigenetics.
5. Embryonic Development and Axis Formation.
6. Cell Differentiation.
7. Tissue Development.
8. Morphogenesis and Tissue Remodeling.
9. Developmental Signaling Pathways.
10. Regeneration.
11. Developmental Plasticity.
12. Developmental Disorders and Birth Defects.
13. Stem Cells.
14. Developmental Potential.
15. Evolutionary Developmental Biology (Evo-Devo).

(4) Assessment Criteria

- Mid Term1 exams: 25 %
- Oral presentations, Essays, and oral tests 25%
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

Scott F. Gilbert (2020): Developmental Biology, 12th edition.

(7) Reference Books

Principles of Development Lewis Wolpert, Cheryll Tickle, Alfonso Martinez Arias, 2019.

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Advanced Animal Ecology	653ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	45
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	28
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	120
Total	48		Total	193
Total Learning Hours = 241			Equivalent ECTS points = Total LH/28 = 8.60	

(1) Brief Course Description

This course covers a broad introduction to the major, current themes in animal ecology. The areas to be covered will range in scale between the level of the individual within its environment, the dynamics of populations particularly in relation to regulating factors and conservation, the composition of communities, as well as world-encompassing themes such as global climate change. The intermeshing of these levels will be stressed.

(2) Course Objectives

The main objectives of this course are focused to:

1. Discuss the biotic and abiotic factors and their effects on animals.
2. Explain biological control and its application.
3. Describe the ecological distribution of animals and the morphological, physiological and behavioral acclimatization of animals living in different environments
4. Interpret the migration as a factor affecting the distribution of animals.
5. Define Saudi fauna and its distribution.

(3) Course Contents

- **Theoretical**

1. The themes and fields of ecology.
2. Effects of abiotic factors on animals.
3. Effects of biotic factors on animals.
4. Ecological distribution of animals.
5. Application of biological control.
6. Migration as a factor affecting the distribution of animals.

7. Ecological distribution of Saudi fauna.
8. Ecological distribution of animals.
9. Migration as a factor affecting the distribution of animals.

(4) Assessment Criteria

- Mid Term exams: 25 %
- Oral presentations, Essays, and oral tests: 25 %
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1-Quinn G.P., Keough M.J. (2002): Experimental design and data analysis for biologists. Cambridge University Press, Cambridge.

(7) Reference Books:

1-Begon M.E., Harper C.A., Townsend J. L. (2006): Ecology from individuals to ecosystems. Blackwell, Oxford.

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Insect Taxonomy	655ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	49
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	32
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	121
Total	48	Total	202
Total Learning Hours = 250		Equivalent ECTS points = Total LH/28 = 8.92	

(1) Brief Course Description

This course covers Insect taxonomy. Taxonomy levels and categories. Taxonomic characteristics (Physiological, environmental). Sample preparation. Scientific drawing. Taxonomic keys. This course explores the economic significance of insect taxonomy and the role of workers in the field. It covers foundational concepts, levels and categories of taxonomy, taxonomic characteristics (physiological and environmental), sample preparation, scientific drawing, verbal descriptions, taxonomic keys, and naming rules. Briefly, the course focuses on insect taxonomy's economic importance, covering levels and categories, taxonomic characteristics, sample preparation, scientific drawing, and naming rules.

(2) Course Objectives

The main objectives of this course are focused to:

1. Explain the economic importance of insect taxonomy.
2. Discuss the Objectives of taxonomy science.
3. Compare between the old and new taxonomy.
4. Apply drawing skills to scientific samples of insects.
5. Compare between the taxonomic keys.
6. Investigate the most common and simple rules of ICZN to give names for selected items.

(3) Course Contents

- **Theoretical**

1. Economic importance of insect taxonomy- worker role in insect taxonomy.
2. The foundations of taxonomy - levels taxonomy - taxonomy old and new.
3. Taxonomic categories - isolated species - taxonomic characteristics.
4. physiological characteristics - environmental characteristics.
5. Description - Sample preparation - scientific drawing of samples of insects.

6. Verbal description - taxonomic keys.
7. international rules for naming insects.
8. General rules in the taxonomy.
9. Characteristics of insect orders.
10. Diagnostic characters of some families in each order, with examples.
11. Diptera Taxonomy.
12. Mosquito Taxonomy.
13. Hymenoptera Taxonomy.

(4) Assessment Criteria

- Mid Term exams: 25%
- Oral presentations, Essays, and oral tests: 30 %
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook

1. Neerja Aggarwal (2024), Insect Classification and Systematics.
2. Kaplan (2015). Kaplan MCAT Biochemistry Review. Simon & Schuster.

(7) Reference Books

1. Mayer E. (1982) Systematics and the Origin of Species. Colombia University Press. New York.
2. Insect Taxonomy Practical Manual.
3. Authors: Vijay Kumar Mishra et al. Published: 2023.
4. Descriptive and Objective Insect Taxonomy Hardcover – May 27, 2022. by Anil Kumar.

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo	Tut.	Lab.	Credit				
Insects Physiology	656ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	45		HW/Assignments	51
Laboratory	0		Case studies	0
Exams and quizzes	3		Study for exam	32
Lab demo	0		Working on lab experiment	0
Oral Presentation	0		Preparation for classes	127
Total	48		Total	210
Total Learning Hours = 258			Equivalent ECTS points = Total LH/28 = 9.21	

(1) Brief Course Description:

This course covers the structure and function of insect internal systems. Molting, growth, glandular system, nerve chemistry. Growth and evolution of insects. This course provides an understanding of insect physiology, covering nutrient flow (capture, digestion, absorption, circulation, metabolism, detoxification, excretion, and homeostasis) as well as developmental, reproductive, neurophysiological systems, respiration, and diapause. Briefly, the course covers insect physiology, including nutrient flow, internal systems (molting, growth, glandular, nerve chemistry), and the growth and evolution of insects.

(2) Course Objectives:

The main objectives of this course are focused to:

1 .Describe the histology of the digestive system and how Nutrients flow through the insect's body.
2 .Discuss the digestion, and absorption of protein lipids and carbohydrates
3 .Define the Respiration of aquatic insects.
4 .interpret detoxification, excretion, and electrolyte homeostasis.
5. Explain the endocrine system of insects.

(3) Course Contents:

- **Theoretical**

1. Introduction to insect physiology.
2. The bioenergetics of flight muscles and metabolic control.
3. The physiology of the integument and muscles – Molting or Ecdysis.
4. Respiratory System - mechanism of respiration.
5. Respiration of aquatic insects.

6. Digestive system- digestion –absorption and the associated tissues Salivary glands.
7. The endocrine system of insects.
8. Excretory Systems.
9. Circulatory System- Haemolymph and Blood circulation.

(4) Assessment Criteria:

- Mid Term exams: 25%
- Oral presentations, Essays, and oral tests: 25%
- Final Exam: 50%

(5) Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Cedric Gillott (2015): Entomology (3rd ed.) Pub. Springer, The Netherlands.
2. Marc J. Klowden, Subba Palli (20222): Physiological Systems in Insects, 4th Edition.

(7) Reference Books:

1. Jurenka, Russell A. “Insect physiology.” Access Science, McGraw Hill, Oct. 2021. - Insect Physiology and Biochemistry
2. Advances in Insect Physiology (Volume 63) 1st Edition, by Russell Jurenka , Publisher : Academic Press; 1st edition (December 8, 2022).

Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Comparative Vertebrate Anatomy	657ZOO-3	3	0	0	3	2nd	3rd	658ZOO-3	Elective

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	HW/Assignments	49
Laboratory	0	Case studies	0
Exams and quizzes	3	Study for exam	33
Lab demo	0	Working on lab experiment	0
Oral Presentation	0	Preparation for classes	123
Total	48	Total	205
Total Learning Hours = 253		Equivalent ECTS points = Total LH/28 = 9.03	

(1): Brief Course Description

This course covers the study of the vertebrate body structure, function and evolution. Relationships between the structural and functional adaptations of the different vertebrate groups and their environment.

(2): Course Objectives

The main objectives of this course are focused to:

1. Describe the integumentary system in Vertebrates
2. Epidermal and dermal scales, feathers, hair, and teeth
3. Discuss the development of theskeletal system in vertebrates.
4. Explain therespiratory and excretory systems of different vertebrates.
5. Compare the structure of theheart and circulatory system in different vertebrate groups.

(3): Course Contents:

- **Theoretical**

1. Introduction, skeletal system, and Skull
2. Skin in different vertebrate classes and development of hair, teeth, feathers, and scales
3. Compare the structure of theheart and circulatory system in different vertebrate groups
4. Comparative study for respiration and respiratory system
5. Kidney and excretory system at different vertebrate classes
6. Brain, nervous system, and sensory organs.
7. Male and female reproductive systems in different classes

(4): Assessment Criteria

- Mid Term exams: 25 %
- Oral presentations, Essays and oral tests: 25 %
- Final Exam: 50%

(5): Course Teaching Strategies:

Lectures, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6): Textbook:

1- Kardong, K.V. (2011): Vertebrates: Comparative Anatomy, Function, Evolution. 6th edition, McGraw-Hill Companies, Inc., New York, USA.

(7): **Reference Books:**

1. Wallace, R.L. and Taylor, W.K. (2002): Invertebrate Zoology Lab Manual, Benjamin Cummings, New York.
2. Hickman, C.P.; Roberts, L.S.; Keen, S.L.; I'Anson, H. and Eisenhour D.J. (2011): Integrated Principles of Zoology. McGraw Hill, New York.Cox F.E.G.

Course Title	Course Code	Number of Study Hours				Year	Level	Pre-requisites	Compulsory / Elective
		Theo.	Tut.	Lab.	Credit				
Thesis	699BIO-8	8	0	0	8	2nd	4th	_	Compulsory

Student's workload				
In-class activities	Contact Hours		Self-learning/study	Hours
Lectures	120		HW/Assignments	0
Laboratory	0		Case studies	810
Exams and quizzes	3		Study for exam	
Lab demo	0		Working on lab experiment	96
Oral Presentation	0		Preparation for classes	87
Total	123		Total	993
Total Learning Hours = 1116			Equivalent ECTS points = Total LH/28 = 39.85	

(1) Brief Course Description:

This course covers an opportunity for students to learn and research scientific studies in the program, which contributes to the enrichment of the student's scientific and cognitive background. This course also includes the student preparing for the Master's program, this study includes a field study in the field of specialization based on the use of the scientific method and scientific and regulatory standards used in the preparation of Theses.

(2) Course Objectives:

The main objectives of this course are to:

1. Describe original inquiry or investigation in the form of a creative, applied, or scholarly research project.
2. Apply disciplinary methods and frameworks.
3. Develop an approach to investigate a meaningful relationship with the thesis mentor to engagein the writing and revision process.
4. provide students with up-to-date knowledge and cutting-edge techniques in the thesis subject matter.

(3) Course Contents:

- **Theoretical Content:**

To be determined by the supervisor and approved by the department Board.

- **Practical Content:**

To be determined by the supervisor and approved by the department Board.

(4) Assessment Criteria:

- Research proposal:40%
- Presentation of research proposal: 10 %
- Thesis presentation: 10 %
- Thesis defense: 40%

(5) Course Teaching Strategies:

Lectures, laboratory work, Reports, and Essay Assignments, Homework, and Web-based Assignments.

(6) Textbook:

1. Turabian K.L, W.C. Booth, G.G. Colomb, and J.M. Williams 2013. A manual for writers of research papers, theses, and dissertations. 8th ed. Chicago, IL: University of Chicago Press.

(7) Reference Books

1. Yvonne N. Bui. How to Write a Master's Thesis. Third Edition. SAGE Publications, Inc. 2020. p.298. ISBN-13: 978-1506336091, ISBN-10: 1506336094.