DAMANHOUR UNIVERSITY
FACULTY OF SCIENCE

Internal Bylaws
Faculty of Science – Damanhour University
Postgraduate Studies
Credit Hour System

2023

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Introduction and Overview of Postgraduate Studies at the Faculty of Science, Damanhour University

Within the framework of Egypt Vision 2030 and in line with the seventeen Sustainable Development Goals adopted by the United Nations, and based on the belief of the administration of the Faculty of Science, Damanhour University, in the importance of the national vision, particularly with regard to the production and localization of science and knowledge, as well as research planning that is based on analyzing the present and anticipating future expectations and trends in order to achieve the desired objectives and identify the appropriate methods and means to achieve these objectives efficiently and effectively, it has become necessary for the Faculty to develop its internal bylaws for postgraduate studies according to carefully studied priorities. This aims to keep pace with the anticipated progress in scientific research and to introduce advanced academic programs that provide society with qualified competencies and specialized scientific cadres trained in all modern technologies, with the ability to conduct applied research to achieve development and welfare in various aspects of life, as one of the requirements for advancing society, serving it, and solving its problems.
Postgraduate studies at the Faculty of Science, Damanhour University, began with the issuance of Ministerial Decree No. 172 dated 15/1/2012 approving its internal bylaws under the credit hour system. Some additions were then made to the bylaws by Ministerial Decree No. 5340 dated 22/11/2018.
Vision of the Faculty of Science, Damanhour University
To achieve leadership in teaching and scientific research in the fields of basic sciences and their applications in order to serve the needs of society.
Mission of the Faculty of Science, Damanhour University
The Faculty of Science, Damanhour University, is committed to preparing distinguished researchers in basic and applied sciences who meet the needs of the labor market, as well as highly qualified researchers capable of contributing to scientific research and development, in light of the University's mission, national standards for quality and accreditation, and the values of society.
Strategic Objectives of Postgraduate Studies at the Faculty of Science, Damanhour University

- Distinguished researchers capable of competitiveness and innovation.

- Advancing the postgraduate studies system at the Faculty to meet society's needs for the required professional development.
- Advancing the system of scientific research and innovation at the Faculty in a manner that fulfills Egypt Vision 2030.
- Gaining society's trust through the enhancement and development of community services.
- Enhancing and developing administrative and organizational capacities in a manner that achieves the Faculty's vision and mission.
- Developing the Faculty's self-resources to support the educational and research processes.
- Ensuring the quality of institutional performance, continuous development, and sustainable development of human resources in order to obtain academic accreditation.

Chapter One

Regulatory Articles

First: General Provisions

Article (1): Higher Academic Degrees

Damanhour University, upon the proposal of the Faculty of Science Council, awards the following certificates and academic degrees:

1. Applied Studies Diploma (Table 1).
2. Professional Studies Diplomas (Table 2).
3. Specialized Studies Diplomas (Table 3).
4. Master of Science Degree (M.Sc.) (Table 4).
5. Doctor of Philosophy Degree in Science (Ph.D.) (Table 5).
6. Doctor of Science Degree (D.Sc.).

Postgraduate diplomas awarded by Damanhour University upon the recommendation of the Faculty of Science Council:

Table (1)

Applied Studies Diplomas

No.	Scientific Department	Study Program
1	Department of Mathematics and Computer Science	The Department of Mathematics and Computer Science awards the Applied Studies Diploma in:- Diploma in Analytical Statistics for Data- Diploma in Computer Systems Development
2	Department of Physics	The Department of Physics awards the Applied Studies Diploma in:- Diploma in Biophysics- Diploma in Radiation Physics- Diploma in Materials Physics and Nanoscience- Diploma in Solar Energy
3	Department of Chemistry	The Department of Chemistry awards the Applied Studies Diploma in:- Diploma in Forensic Chemistry (Special Program with Fees)- Diploma in Petrochemicals (Special Program with Fees)
4	Department of Botany and Microbiology	The Department of Botany and Microbiology awards the Applied Studies Diploma in:- Industrial Microbiology- Bioremediation- Microbiology and Immunology (Special Program with Fees)
5	Department of Zoology	The Department of Zoology awards the Applied Studies Diploma in:- Immunology and Parasitology- Embryology and Intracytoplasmic Sperm Injection Techniques (Special Program with Fees)- Biological Forensics (Special Program with Fees)- Hematology (Special Program with Fees)
6	Department of Earth Sciences	The Department of Earth Sciences awards the Applied Studies Diploma in:- Archaeological and Environmental Geology- Geographic Information Systems and Surveying (Special Program with Fees)- Engineering Geology and Mining (Special Program with Fees)
7	Department of Biochemistry	The Department of Biochemistry awards the Applied Studies Diploma in:- Biochemistry (Special Program with Fees)- Nutritional

		Biochemistry (Special Program with Fees)- Infection Control (Special Program with Fees)

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No.	Scientific Department	Study Program
1	Department of Chemistry	The Department of Chemistry awards the Professional Diploma in:- Industrial Chemistry
2	Department of Zoology	The Department of Zoology awards the Professional Diploma in:- Insect Control- Aquaculture
	Department of Earth Sciences	The Department of Earth Sciences awards the Professional Diploma in:- Water Technology- Climate Change and Coastal Protection

Table (3)
Specialized Studies Diplomas

No.	Scientific Department	Study Program
1	Department of Earth Sciences	The Department of Earth Sciences awards the Specialized Studies Diploma in:- Applied Geophysics

Table (4)
Master of Science degrees awarded by Damanhour University upon the recommendation of the Faculty of Science Council

No.	Scientific Department	Study Program
1	Department of Mathematics and Computer Science	The Department of Mathematics and Computer Science awards the Master of Science degree in the following specializations:- Pure Mathematics- Applied Mathematics- Statistics and Data Science- Computer Science
2	Department of Physics	The Department of Physics awards the Master of Science degree in the following specializations:- Solid State Physics- Materials Science- Nanotechnology- Theoretical Physics- Nuclear Physics- Biophysics- High Energy Physics and Cosmology- New and Renewable Energy Physics
3	Department of Chemistry	The Department of Chemistry awards the Master of Science degree in the following specializations:- Inorganic Chemistry- Analytical Chemistry- Physical Chemistry- Organic Chemistry
4	Department of Botany and Microbiology	The Department of Botany and Microbiology awards the Master of Science degree in the following specializations:1. Master of Science in Botany in: A. Plant Physiology. Phycology. Cytology and Genetics. Palynology and Taxonomy. Plant Ecology2. Master of Science in Microbiology
5	Department of Zoology	The Department of Zoology awards the Master of Science degree in the following specializations:- Physiology- Immunology- Invertebrates-

No.	Scientific Department	Study Program
		Parasitology- Cell Biology, Histology and Genetics- Animal Ecology- Comparative Anatomy and Embryology- Entomology- Molecular Biology
6	Department of Earth Sciences	The Department of Earth Sciences awards the Master of Science degree in the following specializations:- Applied Geology- Sedimentary Rocks and Paleontology- Hard Rocks and Geochemistry- Geophysics
7	Department of Biochemistry	The Department of Biochemistry awards the Master of Science degree in Biochemistry:- Biochemistry

Table (5)
Doctor of Philosophy degrees in Science awarded by Damanhour University upon the recommendation of the Faculty of Science Council

No.	Scientific Department	Study Program
1	Department of Mathematics and Computer Science	The Department of Mathematics and Computer Science awards the Doctor of Philosophy degree in Science in the following specializations:- Pure Mathematics- Applied Mathematics- Statistics and Data Science- Computer Science
2	Department of Physics	The Department of Physics awards the Doctor of Philosophy degree in Science in the following specializations:- Biophysics- Theoretical Physics- Nuclear Physics- Solid State Physics- High Energy Physics and Cosmology- New and Renewable Energy Physics- Materials Science- Nanotechnology
3	Department of Chemistry	The Department of Chemistry awards the Doctor of Philosophy degree in Science in the following specializations:- Inorganic Chemistry- Analytical Chemistry- Physical Chemistry- Organic Chemistry
4	Department of Botany and Microbiology	The Department of Botany and Microbiology awards the Doctor of Philosophy degree in Science in the following specializations:1. Doctor of Philosophy in Botany in: A. Plant PhysiologyB. PhycologyC. Cytology and GeneticsD. Palynology and TaxonomyE. Plant Ecology2. Doctor of Philosophy in Microbiology
5	Department of Zoology	The Department of Zoology awards the Doctor of Philosophy degree in Science in the following specializations:- Physiology- Immunology- Invertebrates- Parasitology- Cell Biology, Histology and Genetics- Animal Ecology- Comparative Anatomy and Embryology- Entomology- Molecular Biology
6	Department of Earth Sciences	The Department of Earth Sciences awards the Doctor of Philosophy degree in Science in the following specializations:- Applied Geology- Sedimentary Rocks and Paleontology- Hard Rocks and Geochemistry- Geophysics
7	Department of Biochemistry	The Department of Biochemistry awards the Doctor of Philosophy degree in Science in Biochemistry: - Biochemistry

Article (2): Scientific Departments and Specializations
The Faculty of Science, Damanhour University, comprises the following scientific departments:

Table (6)

Scientific Departments and the Code Symbol for Each Department

No.	Scientific Department	Specialization	Code
1	Mathematics and Computer Science	Mathematics	Math
		Computer Science	CS
		Statistics & Data Science	Stat
2	Physics	Physics	Phys
3	Chemistry	Chemistry	Chem
4	Earth Sciences	Geology	Geo
5	Botany and Microbiology	Botany	Bot
		Microbiology	Mic
6	Zoology	Zoology	Zoo
7	Biochemistry	Biochemistry	BCh

Article (3): General Requirements for Admission to Postgraduate Studies

1. Applications for admission to diploma, master's, and doctoral programs shall be submitted annually to the Faculty's Postgraduate Studies Department on the dates determined by the Faculty of Science Council and the University Council for Postgraduate Studies and Research.
2. The applicant must satisfy the admission requirements of the program to which he/she wishes to apply, as stated in the introduction to each program in these bylaws.
3. The applicant must complete all required documents requested by the Faculty's Postgraduate Studies and Research Department in accordance with the rules in force at the University.
4. Approval must be obtained from the relevant Department Council and the Faculty Council.
5. The prescribed enrollment fees must be paid on the date specified and announced by the faculty. These fees shall be paid annually for each semester of each program, or upon re-enrollment for the period during which the student was absent. Teaching assistants, assistant lecturers, scholarship students, and research centers having cooperation protocols with Damanhour University shall be exempted from this requirement.
6. The Department Council may determine the number of admitted students according to the available resources in the department and shall apply the selection criteria approved by the Faculty Council.
7. The relevant Department Council may add any other conditions it deems necessary for the admission of new students, subject to the approval of the Faculty Council, provided that such conditions do not conflict with the faculty's internal bylaws or the Universities Organization Law.
8. If the applicant is employed, approval from his/her employer must be obtained for enrollment in the academic degree for which he/she is applying.
9. Master's and doctoral research topics may be registered throughout the year after passing the preliminary courses.

Article (4): Suspension of Enrollment

The Faculty Council may, upon the proposal of the relevant Department Council and the Faculty's Postgraduate Studies and Research Committee, and after considering the opinion of the principal thesis supervisor, suspend the enrollment of a student registered in postgraduate studies (Diploma

– Master's – Doctor of Philosophy) for periods not exceeding twenty-four (24) months in total, provided that the suspension shall not apply to previous years and that it shall take place during the basic period of enrollment, not during enrollment extension periods, due to circumstances accepted by the Faculty Council.

Article (5): Attendance

1. A student shall be barred from sitting for the examination of any course if he/she fails to achieve an attendance rate of 75%, provided that the student has received at least two warnings. This shall be based on a report submitted by the course instructor. In such case, the student shall be deemed to have failed the course, and one examination attempt shall be counted against him/her. The students shall be notified accordingly through the Faculty's Postgraduate Studies and Research Department.
2. The excuse of a student who is absent from the final examination of a course or who fails to complete some of its requirements may be accepted for compelling reasons approved by the Postgraduate Studies and Research Committee and the Faculty Council, provided that the student has attended and completed at least 75% of the course requirements. The student must sit for the examination according to the schedule of excuse examinations determined by the Faculty's Postgraduate Studies and Research Committee; otherwise, the student shall be deemed to have failed the course.

Article (6): Course Coding System

1. Courses shall be coded by placing the code symbol of the general specialization (scientific department), followed by the number indicating the course.
2. Postgraduate courses are classified as follows:

A. Courses with Code 500 are mainly taught to diploma students.

B. Courses with Code 600 are mainly taught to master's students.

C. Courses with Code 700 are mainly taught to Doctor of Philosophy students in science.

3. The number indicating the course level shall be placed in the hundred ddigits followed by the course number in the tens and units' digits. It is preferable that odd numbers indicate first-semester courses, while even numbers indicate second-semester courses.
4. The Department Council has the right to add new courses to the list of courses within the limits of the numbers allocated to the program, subject to the approval of the Faculty Council.

Article (7): Courses

1. The postgraduate courses listed in each program of these bylaws and shown in the attached tables in Chapter Two (Study Program Curricula) shall be studied during one academic year over two semesters.
2. Scientific departments may propose supplementary courses, subject to the approval of the Department Council, the Faculty Council, and the University Council, with a maximum of two courses in the specialization required for enrollment in the preliminary study for the master's degree. These courses shall be selected from Codes 300 or 400 assigned to the bachelor's stage.
3. Scientific departments may propose supplementary courses from Code 600 when a student registers for a master's thesis in a specialization different from that of the preliminary master's study.
4. The number of supplementary courses shall not exceed four courses or eight credit hours. If the number exceeds this limit, the courses shall be distributed over two semesters. Passing these courses is required before enrollment or registration for the thesis.

Article (8): Study System and Student Registration

1. The study system in postgraduate programs shall be the credit hour system.
2. A credit hour is an academic unit of measurement used to determine the weight of each course in a single semester. The credit hour constitutes the basis for calculating the student's semester GPA and cumulative GPA.
3. For theoretical lectures: one credit hour shall be calculated for each lecture of one hour per week throughout one semester.
4. For practical classes and applied training: one credit hour shall be calculated for each practical or training session lasting two to three hours per week throughout one semester.
5. One hour of written examination shall be allocated for each credit hour, provided that the duration of the written examination for any course shall not exceed two hours.
6. An academic advisor shall be assigned to each group of students by the relevant Department Council.
7. Diploma students may register in the fall and spring semesters for a number of credit hours not exceeding 21 credit hours per semester. Master's students may register in the fall and spring semesters for a number of credit hours not exceeding 14 credit hours per semester. Doctoral students may register in the fall and spring semesters for a number of credit hours not exceeding 8 credit hours per semester. Students may also register in the summer semester for diploma students only.
8. Upon the approval of the academic advisor, a student may drop or add any course before the end of the second week from the beginning of the semester.
9. A student may withdraw from a course before the end of the sixth week from the beginning of the first or second semester, or before the end of the second week of the summer semester for diploma students. The credit hours of this course shall not be counted in the student's cumulative average, and the grade "Withdrawn (W)" shall appear on the student's transcript. In this case, the credit hours of the course shall not be counted in the student's Grade Point Average (GPA).
10. A student shall be forced to withdraw from any course in which he/she fails to achieve an attendance rate of 75%. The student shall be notified that he/she is barred from entering the final examination of the course, and the grade "Forced Withdrawal (FW)" shall be recorded in his/her academic record.
11. A student shall receive an "Incomplete (I)" grade in a course if he/she is unable to attend the final examination or complete some of its requirements due to compelling reasons accepted by the Department Council and approved by the Postgraduate Studies and Research Committee and the Faculty Council, provided that the student has attended and completed at least 75% of the course requirements.

Article (9): Assessment of Passing and Failing Grades

1. The grade in courses, as well as the student's overall grade, shall be determined according to one of the following grades, as shown in the following table:

Mark / Grade	Letter Grade	Points	GPA / Grade Description	Student Status
90 to 100	A+	4.000	Excellent	PassingSuccess
85 to < 90	A	3.667		
80 to < 85	B+	3.333	Very Good	
75 to < 80	B	3.000		
70 to < 75	C+	2.667	Good	
65 to < 70	C	2.333		
60 to < 65	D	2.000	Pass	
00 to < 60	F	000	Fail	Failure

A student who withdraws from a course shall be assigned: Withdrawal ----- W
A student who is forced to withdraw from a course shall be assigned: Forced Withdrawal ---- FW
A student who has not completed the course requirements shall be assigned: Incomplete ----- I
A student who repeats a course due to the expiry of its validity period shall be assigned: Satisfactory ------ S
A student who successfully defends the scientific thesis shall be assigned: Approved ---- A
A student who fails the scientific thesis defense shall be assigned: Not Approved ---- NA

2. A diploma student shall be granted a certificate of course grades, in Arabic or English, upon his/her request, indicating the course names, grades, points, and the number of credit hours he/she has passed.
3. A master's or doctoral student shall be granted a statement of course grades, in Arabic or English, for the study program he/she has completed, upon his/her request, indicating the course name, grade, points, and the number of credit hours he/she has passed. He/she shall also be granted, upon request, a certificate indicating that he/she has obtained the academic degree in the program he/she has completed.
4. The final points of the course, the semester GPA, and the cumulative GPA for courses shall be calculated as follows:

• Final points of the course = Course points × Number of credit hours of the course

• Semester GPA = $\frac{\text{Total final points obtained by the student in all courses of one semester}}{\text{Total credit hours of these courses in one semester}}$

• Cumulative GPA = $\frac{\text{Total final points obtained by the student in the courses of all semesters}}{\text{Total credit hours of these courses in all semesters}}$

5. The student shall be assessed in theoretical and practical courses based on the following elements:

Course Type	Periodic Tests / Continuous Assessment	Applied	Oral	Practical Examination	Theoretical Examination	Total
Theoretical Courses	20%	10%	10%	-	60%	100%
Courses Including Theoretical and Practical Study	10%	10%	10%	20%	50%	100%
Practical Courses	20%	10%	10%	60%	-	100%
Project Course, Case Study, or Reference Research	20%	20%	60%	-	-	100%

Article (10): Examinations

1. The Faculty Council shall determine the dates of semester examinations at the beginning of each academic year.
2. The Faculty Council may accept a student's excuse for not sitting for the examination only twice during his/her study, provided that the student submits his/her request before the start of the examination or within 24 hours following the examination date, supported by an excuse accepted by the Department Council, approved by the Studies Committee, and endorsed by the Faculty Council.

Article (11): Re-enrollment

If a student's enrollment is cancelled for any of the reasons stated in Articles (18, 26, 35) of these bylaws, the Faculty Council may, upon the proposal of the relevant Department Council and the approval of the Postgraduate Studies Committee, re-enroll the student. It shall be taken into consideration that the rules applied to new students apply to him/her. The student may be exempted from some preliminary-year courses if no more than three years have passed since he/she successfully passed them, based on the approval of the relevant department. The student must submit an application for re-enrollment on the dates specified for this purpose, in accordance with the general enrollment requirements under Article (3) and the special enrollment requirements for each degree as stated in these bylaws.

Article (12): Academic Advising

1. The Vice Dean for Postgraduate Studies and Research, together with the general coordinator of each program, shall follow up on the implementation of registration rules and procedures, the preparation of student lists for study groups, the preparation of study schedules, and the distribution of students among academic advisors. Student registration shall be completed during the first week of the first and second semesters.
2. The Department Council and the Faculty shall appoint an academic advisor for postgraduate students to follow up on them during the preliminary year for the master's degree and the Doctor of Philosophy degree in science, as well as for diploma students at the faculty. The advisor shall be selected, whenever possible, from among faculty members in the same specialization, in order to provide advice and guidance to the student during his/her period of study in selecting courses in accordance with items (7, 8, 9, 10) of Article (8) of these bylaws.

Article (13): Scientific Theses

1. The Faculty Council shall, upon the proposal of the relevant Department Council and the recommendation of the Postgraduate Studies and Research Committee, appoint a principal supervisor for the student from among the professors in the faculty in the case of doctoral or master's degrees, or from among the assistant professors in the case of the master's degree. One lecturer may participate in supervision. The Faculty Council may also approve the participation in supervision of people of equivalent academic standing in the specialization from outside the Ffaculty In all cases, the number of supervisors shall not exceed three for the master's degree, and a fourth supervisor may be added after the approval of the Faculty Council, and four for the doctorate, taking into account the precise specialization of each of them in accordance with Article (98) of the Executive Regulations of the Universities Organization Law.
2. A foreign supervisor may be added to the supervision committee in the case of opening a scientific channel, after the approval of the University Council for Postgraduate Studies.
3. In the event that one of the supervisors' travels or issecondd abroad, the rules stipulated in the Universities Organization Law and the University Council shall apply.
4. The principal supervisor shall submit a report every six months to the relevant Department Council on the extent of the students' progress in his/her study. The principal supervisor may recommend the continuation or cancellation of enrollment.
5. A student enrolled for the master's or doctoral degree shall deliver a lecture on the thesis research plan (seminar) before registration, as well as a lecture on the results he/she has reached before the formation of the examination and defense committee.
6. The principal supervisor shall submit a proposal to the relevant Department Council for the formation of the thesis examination committee in accordance with items (1, 9) of this Article, in preparation for submission to the Faculty Council, supported by the following documents:

A. A report on the validity of the thesis for examination, indicating the thesis title in both Arabic and English and signed by all supervisors.

B. The master's thesis may not be submitted until one year has passed from the date of the University's approval of the thesis registration, and the doctoral thesis may not be submitted until two years have passed from the date of the University's approval of registration.

C. Before submitting the thesis to the relevant Department Council, the student shall provide evidence of the acceptance of publication of at least one research paper from the scientific results reached in the master's thesis in a specialized, indexed, peer-reviewed journal issued regularly by a scientific body. In the case of the doctorate, the student shall provide evidence of the acceptance for publication of at least one research paper from the scientific results reached from the thesis research in a Q1 journal, or two accepted research papers in an international peer-reviewed scientific journal issued regularly by a scientific body and indexed, before submitting the thesis to the relevant Department Council, in accordance with the decisions of the University Council in this regard.

7. The Faculty Council shall, upon the proposal of the principal supervisor and the approval of the relevant Department Council and the Postgraduate Studies and Research Committee, form a committee to examine the thesis, consisting of three members, one of whom shall be from the thesis supervision committee, and the other two members, one of whom shall be from outside the Faculty/University, from among professors and assistant professors at universities, centers, or specialized scientific research institutes from inside or outside the Republic. The chairperson of the committee shall be the most senior professor. In the event of multiple specializations of the thesis supervisors, the number of committee members may exceed three, taking into account the provisions of Article (104) of the Executive Regulations of the Universities Organization Law.

8. Each member of the examination committee shall prepare an individual report on the thesis within one month of receiving the thesis. All these reports shall be presented before the public defense, and a collective report shall be prepared and approved by the Head of the relevant Department Council and then by the Faculty Council, in preparation for submission to the University Council. The examiner may recommend in his/her report one of the following recommendations:

A. Acceptance of the thesis as it is.
B. Acceptance of the thesis after making some non-substantial corrections.
C. Postponement of the award of the degree for making corrections, for a maximum period of three months.
D. Rejection of the thesis.

9. Criteria for selecting examiners:

A. The academic rank of the external examiner shall be professor, and one of them may be an assistant professor in the case of the master's degree.
B. The number of these examined by one examiner shall not exceed three theses submitted by the same Faculty in one academic year.
C. The examiner's specialization shall be appropriate to the general specialization of the thesis.

10. The Faculty Council may, when necessary, amend the formation of the thesis examination committee if it deems this necessary.

Second: Postgraduate Diploma

Article (14): Enrollment Requirements

For the enrollment of a student in any postgraduate diploma, in addition to the requirements stated in Article (3), the following shall be required: the student must hold a Bachelor of Science degree from one of the faculties of science at Egyptian universities, or an equivalent degree from any other scientific institute recognized by the Supreme Council of Universities, in the specializations determined by the relevant Department Council. Students applying for the diploma who do not hold a Bachelor of Science degree may be accepted, but only in the appropriate specialization, after passing qualifying (supplementary) courses according to the requirements of the relevant department. These hours shall not be counted among the hours mentioned in Article (15).

Article (15): Duration of Study

The duration of study for obtaining any postgraduate diploma shall be one academic year, during which the student shall devote himself/herself to theoretical and practical study and training. The number of credit hours allocated to any postgraduate diploma shall not be less than 24 credit hours, divided over two semesters. The relevant Department Council may assign the students to study some undergraduate-level courses.

Article (16): Courses

1. These bylaws shall determine the courses, the number of examination hours, and the number of credit hours allocated to each diploma degree.
2. Courses shall be studied throughout the academic year, and the student shall sit for the examination at the end of each semester in the courses he/she has studied.
3. The relevant Department Council may assign the student to study some supplementary courses from the undergraduate stage, and they shall not be counted among the credit hours of the diploma.
4. These bylaws shall determine the courses with Code 500 allocated to each diploma degree, and some courses from Code 600 related to the master's degree may be studied.
5. The student shall be allowed to register in the fall and spring semesters for a number of hours not exceeding 21 credit hours per semester. The students shall also be allowed to register in the summer

semester for a number of hours not exceeding 9 hours, after the approval of the Department Council, the Postgraduate Studies Committee, and the Faculty Council.

Article (17): Course Equivalence

The Faculty Council may, upon the proposal of the Department Council and the recommendation of the Postgraduate Studies and Research Committee, count postgraduate-level courses previously studied by the student at the faculty or at any scientific institute recognized by the Supreme Council of Universities during the three years preceding his/her enrollment in the diploma, provided that such courses have not led to obtaining a previous/other degree.

Article (18): Cancellation of Enrollment

The enrollment of a diploma student shall be cancelled if he/she does not obtain the diploma within six regular semesters, excluding the summer semester, from the date of his/her enrollment, and in some other cases recommended by the Postgraduate Studies and Research Committee and approved by the Faculty Council.

Third: Master of Science Degree (M.Sc.)

Article (19): Fields of Study

Damanhour University, upon the proposal of the Faculty of Science Council, awards the Master of Science degree through study in the scientific departments shown in Table (3). The certificate shall indicate, according to the scientific department (specialization), the title of the thesis.

Article (20): Enrollment Requirements

The following requirements shall be fulfilled for the enrollment of a student for the master's degree, in addition to those stated in Article (3):

1. The student must hold a Bachelor of Science degree with a general grade of at least Good (C) from one of the faculties of science at Egyptian universities, or any equivalent degree from any other institute or university recognized, provided that it is equated by the Supreme Council of Universities. In the case of double specializations, the student must have obtained at least a Good (C) grade in the specialization subject, in addition to a general grade of Good (C).
2. The Faculty Council may, upon the approval of the relevant Department Council, accept the enrollment of a student for the master's degree if he/she holds a Bachelor of Science degree with a general grade lower than Good (C), in addition to one of the specialized postgraduate diplomas with a general grade of at least Very Good (B) in the appropriate specialization from one of the faculties of basic sciences recognized by the Supreme Council of Universities.
3. The Faculty Council may, upon the recommendation of the relevant Department Council, accept non-Egyptian students who hold a Bachelor of Science degree from any faculty or scientific institute recognized by the Supreme Council of Universities, provided that they have obtained a general grade of Good (C).
4. The student must devote himself/herself to studying for at least two days per week for a period of at least two years, after the approval of his/her employer.
5. Students who have obtained a general grade of at least Very Good (B) in the Bachelor of Science and Education or the Bachelor of Engineering may be accepted for enrollment in the Master of Science degree after successfully passing the supplementary courses for two years, as determined by the scientific departments and approved by the Faculty Council, or after obtaining a diploma in the field of specialization with a general grade of at least Very Good (B).
6. Students applying for registration for the master's degree who do not hold a Bachelor of Science degree may be accepted, but only in the appropriate specialization, namely specializations corresponding to the specialization of the program for which registration is requested, with the

assignment of supplementary courses according to the requirements of the relevant department. These hours shall not be counted among the hours mentioned in Article (22).

7. The student shall submit an application to the Postgraduate Studies and Research Department for enrollment in the master's degree. The application shall be presented to the relevant Department Council to determine the field and plan of research and the theoretical courses, in accordance with Article (22). Then, after all documents have been completed, the matter shall be presented to the Postgraduate Studies and Research Committee and then to the Faculty Council.
8. Payment of the prescribed tuition fees.

Article (21): Duration of Study

1. The minimum period for awarding the master's degree shall be two calendar years from the date of the University Council's approval of enrollment and one calendar year from the date of registration of the research point.
2. The maximum period for awarding the master's degree shall be five calendar years from the date of registration, taking into account cases of suspension of enrollment. Enrollment may be extended for a maximum of two years upon the request of the principal supervisor and the approval of the relevant Department Council, the Postgraduate Studies and Research Committee, and the Faculty Council.
3. For the registration of the master's thesis, no more than three years must have passed since the student passed the preliminary-year examinations for the master's degree.

Article (22): Courses for the master's degree

Before the beginning of study, the relevant Department Council shall determine the courses to be taught to the students during the academic year from among the list of courses with Code 600, according to the attached tables. These courses shall be approved by the Vice Dean for Postgraduate Studies and Research and the Faculty Council.

Article (23): Requirements for Obtaining the master's degree

1. The total number of credit hours required for obtaining the master's degree shall be 40 credit hours, consisting of 20 hours of coursework, namely 14 credit hours of compulsory courses plus 6 credit hours of elective courses, and 20 hours for the scientific thesis.
2. The relevant Department Council shall determine the student's courses according to his/her study program from among the list of courses in accordance with Article (22) of these bylaws, provided that the total number of hours that the master's student must study shall not be less than 20 credit hours from Code 600, to be studied over two semesters, provided that the number of these hours shall not exceed 14 credit hours in one semester.
3. The relevant department may determine a maximum of two courses from the undergraduate stage, Code 300, 400, or 500, according to the requirements of the thesis topic, and they shall not be counted among the credit hours of the master's degree mentioned in the previous paragraph.
4. The student shall conduct research on the topic of the thesis, which shall be determined by the principal supervisor and approved by the relevant Department Council, the Postgraduate Studies and Research Committee, and the Faculty Council. The student shall submit the thesis, for which 20 credit hours shall be allocated.

Article (24): Course Equivalence

The Faculty Council may, upon the proposal of the relevant Department Council and the recommendation of the Faculty's Postgraduate Studies and Research Committee, count postgraduate-level courses in the same specialization that the student has previously studied at the postgraduate stage at the Faculty or at a faculty or scientific institute recognized by the Supreme Council of Universities, and has passed during the three

years preceding enrollment in the master's degree, provided that such courses have not led to obtaining a previous/other degree.

Article (25): Requirements for Awarding the Degree

The Postgraduate Studies and Research Committee and the Faculty Council shall recommend awarding the Master of Science degree if the student fulfills the following requirements:

1. The student has successfully passed all courses.
2. At least one calendar year has passed since the beginning of the registration of the research point, namely the approval of the University Council for registration.
3. The student has passed the English language examination at the international or local TOEFL level, in accordance with the decisions issued by the University Council and their amendments in this regard.
4. The student shall provide evidence of the acceptance for publication of at least one research paper from the scientific results reached from the thesis research in a peer-reviewed scientific journal issued regularly by a scientific body and indexed, before submitting the thesis to the relevant Department Council.
5. The student shall submit a thesis including the results of his/her research, which is accepted by the examination committee and presented in the public oral defense.
6. The students shall provide evidence of successfully passing the courses determined by the Council for Postgraduate Studies and Research and the University Council with regard to computer skills.

Article (26): Cancellation of Enrollment

1. The Faculty Council shall cancel the enrollment of a student for the master's degree in the following cases:
2. If the student fails to pass the preliminary courses for the master's degree, taking into account Article (10). A student who fails in only one or two courses may be granted two opportunities, after paying the prescribed tuition fees in accordance with the governing rules, and after the approval of the Faculty Council and the University Council for Postgraduate Studies.
3. If the student discontinues his/her study or lacks seriousness in research, upon the approval of the relevant Department Council and the Postgraduate Studies and Research Committee, based on a report submitted by the principal supervisor and after warning the student.
4. If the degree is not awarded within the periods stipulated in Article (21) of these bylaws, taking into account cases of suspension of enrollment.
5. If a disciplinary penalty is imposed on the student.

Fourth: Doctor of Philosophy Degree in Science (Ph.D.)

Article (27): Branches of Study

Damanhour University, upon the proposal of the Faculty of Science Council, awards the Doctor of Philosophy degree in science through study in the scientific departments shown in Table (3). The certificate shall indicate the name of the scientific department, the specialization, and the title of the thesis.

Article (28): Enrollment and Registration Requirements

The following requirements shall be fulfilled for the enrollment of a student for the Doctor of Philosophy degree in science:

1. All general requirements stated in Article (3) of these bylaws.
2. The student must hold a Master of Science degree in the field of specialization from one of the faculties of science at Egyptian universities, or any equivalent degree from another scientific institute recognized by the Supreme Council of Universities.
3. A student may be enrolled in a specialization different from his/her master's specialization within the same scientific department, after the approval of the Department Council, by assigning the necessary supplementary courses determined by the scientific departments and approved by the Faculty Council, according to the requirements of the relevant department and upon the proposal of the principal supervisor. These hours shall not be counted among the hours mentioned in Article (30).

4. The student shall submit an application to the relevant Department Council expressing his/her desire to register in a specific specialization, determining the field and plan of research and the theoretical courses specified by the principal supervisor in accordance with Article (34). Then, after all documents have been completed, the matter shall be presented to the Postgraduate Studies and Research Committee and then to the Faculty Council.
5. Payment of the prescribed tuition fees.

Article (29): Duration of Study

1. The minimum period for obtaining the doctoral degree shall be two calendar years from the date of the University Council's approval of enrollment and registration of the research point.
2. The maximum period for obtaining the doctoral degree shall be five calendar years from the date of registration, taking into account cases of suspension of enrollment. Enrollment may be extended for a maximum of two calendar years upon the request of the supervisors and the approval of the relevant Department Council, the Studies Committee, the Faculty Council, and the University Council for Postgraduate Studies.
3. The research point for a doctoral student may be registered after the student has completed not less than 50% of the required coursework, equivalent to 6 credit hours; however, the student must pass all required courses, totaling 12 credit hours, as a condition for submitting the thesis for validity for defense.

Article (30): Courses and Supervision

1. The relevant Department Council may, upon the request of the principal supervisor, determine for the student the specialized courses from the list of courses with Code 700, from which the student select 12 credit hours in accordance with the rules of the relevant department.
2. The supervision of the student shall be subject to the provisions stated in Article (13).

Article (31): Requirements and Study Plan for the Doctor of Philosophy Degree in Science

1. The relevant Department Council, upon the proposal of the principal supervisor, shall determine the courses for the student according to his/her study program and precise specialization from among the list of courses in accordance with Article (30). These courses shall be approved by the Vice Dean for Postgraduate Studies and Research and the Faculty Council.
2. The total number of credit hours required for obtaining the Doctor of Philosophy degree in science shall be 60 credit hours, consisting of 12 credit hours of coursework, to be studied over two semesters with a maximum registration load of 8 hours per semester, and 48 credit hours for the scientific thesis.
3. The principal supervisor may select no more than one course from Code 600, according to the requirements of the thesis topic, and it shall not be counted among the credit hours required for the doctoral degree mentioned in the previous paragraph.
4. The students must pass the language courses and the prescribed courses in accordance with the decisions of the University Council in this regard.
5. The student shall conduct research on a topic determined by the principal supervisor, which shall be presented to the relevant Department Council, the Postgraduate Studies and Research Committee, and the Faculty Council. The student shall submit a scientific thesis containing the research results, representing a new contribution to the branches of specialization, taking into account the time periods stipulated in Article (29) of these bylaws.
6. The relevant Department Council may, upon a request from the principal supervisor, approve changing the research topic, but only once during the doctoral study. This may be done with or without changing the supervisors. Such change shall be approved by the Faculty Council and the University Council.

Article (32): Course Equivalence

The Faculty Council may, upon the proposal of the relevant Department Council and the recommendation of the Faculty's Postgraduate Studies and Research Committee, count courses from Code 700 in the same specialization that the student has previously studied in postgraduate studies or at any scientific institute recognized by the Supreme Council of Universities, and has passed during the three years preceding

enrollment for the doctoral degree, provided that such courses have not led to obtaining a previous/other degree.

Article (33): Rules Governing Courses for the Doctor of Philosophy Degree in Science

1. All courses shall be elective, according to the student's precise specialization.
2. The department has the right to add new courses in order to continuously keep pace with scientific development, after the approval of the Postgraduate Studies Committee and the Faculty Council.
3. The Faculty's Postgraduate Studies Department shall be notified, through the Department Council, of the courses that the student will study and the scientific content of each course, and these shall be attached to the student's registration file.
4. The student must successfully pass all courses before submitting the thesis validity request to the relevant Department Council.
5. The examination of theoretical doctoral courses shall be held periodically twice a year, according to the academic year timetable. Departments must notify the Faculty's Postgraduate Studies Department of the names of students and the courses for which they will sit the examinations at least two months before the examination date, so that the examination schedule can be prepared at an appropriate time.

Article (34): Requirements for Awarding the Doctor of Philosophy Degree in Science

The Faculty Council, on the recommendation of the relevant Department Council and the Faculty's Postgraduate Studies and Research Committee, shall recommend awarding the Doctor of Philosophy degree if the student fulfills the following requirements:

1. The student has successfully passed all courses.
2. At least two calendar years have passed from the date of registration, namely the approval of the University Council for registration.
3. The student has passed the examinations for the language courses and the prescribed courses in accordance with the decisions of the University Council for Postgraduate Studies and Research and the University Council, and their amendments in this regard.
4. The student shall provide evidence of the acceptance for publication of at least one research paper from the scientific results reached from the thesis research in a Q1 journal, or two accepted research papers in an international peer-reviewed scientific journal issued regularly by a scientific body and indexed, before submitting the thesis to the relevant Department Council, in accordance with the decisions of the University Council in this regard.
5. The student shall submit a thesis including the results of his/her research, and its acceptance by the examination committee with a recommendation that the submitted thesis is valid, followed by the public oral defense.

Article (35): Cancellation of Enrollment for the Doctor of Philosophy Degree in Science

The Faculty Council shall cancel the enrollment of a student for the Doctor of Philosophy degree in the following cases:

1. If the student fails to pass the preliminary doctoral courses, taking into account Article (9). A student who fails in one or two courses may be granted two opportunities, after paying the prescribed tuition fees in accordance with the governing rules, and after the approval of the Faculty Council and the Council for Postgraduate Studies and Research.
2. If the student discontinues his/her study or lacks seriousness in research, upon the approval of the relevant Department Council and the Postgraduate Studies and Research Committee, based on a report submitted by the principal supervisor and after warning the student.
3. If the examination committee rejects the thesis and recommends that the degree not be awarded.
4. If the degree is not awarded within the periods stipulated in Article (29) of these bylaws, taking into account cases of suspension of enrollment.
5. In the event that a disciplinary penalty is imposed on the student.

Fifth: Doctor of Science Degree (D.Sc.)

Article (36): Requirements for Applying for and Obtaining the Doctor of Science Degree (D.Sc.)

1. The applicant must have obtained the Doctor of Philosophy degree in science at least five years prior to the date of applying for the degree.
2. The applicant must submit innovative published research that has not previously been submitted to obtain any academic or occupational degree, taking into account the following:

A. The submitted scientific output must include research written in English.
B. The applicant must have an h-index of not less than 15 and a number of citations of not less than 1000 in Scopus, and a Google Scholar h-index of not less than 20 and a number of citations of not less than 1500 in Google Scholar.
C. The applicant shall submit a written statement in English of the scientific theses he/she has supervised and his/her role in supervision.

3. The applicant shall demonstrate the general trends of his/her research and the tangible benefit he/she has contributed to science through the research selected for obtaining the degree, in a manner that strengthens his/her position before the examiners, as well as the theses he/she has supervised.
4. In addition, the applicant may submit a statement of innovative and unpublished scientific and applied activities that indicate new contributions to science.
5. The applicant for the Doctor of Science degree (D.Sc.) shall submit his/her scientific output to the Dean of the Faculty. The Dean shall present it to the Faculty Council. The Council shall then refer the applicant's scientific output to a committee specialized in this degree to contact professors in the same specialization who hold the Doctor of Science degree (D.Sc.), or one of the specialized scientific societies outside the country, in order to obtain the approval of three examiners, approved by the Faculty Council, to evaluate the submitted scientific output.
6. The members of the examination committee shall submit individual reports on the originality of the applicant's research in his/her field of specialization and the suitability of the applicant's scientific output for recommending the award of the degree. The degree shall be awarded by the unanimous vote of the members of the examination committee.
7. The certificate of the Doctor of Science degree (D.Sc.) shall state the applicant's field of specialization.

Article (37): Application of the Bylaws

1. These bylaws shall apply to postgraduate students who are enrolled after the issuance of the ministerial decree approving these bylaws. As for students enrolled before this date, the provisions of the internal bylaws under which they were enrolled shall apply to them.
2. The Faculty Council may, after taking the opinion of the relevant Department Council, approve the opening of new postgraduate programs in accordance with the Universities Organization Law and under the same rules of these bylaws, provided that the legal procedures for amending the bylaws are undertaken through the official councils: the Faculty Council, the University Council, and the Supreme Council of Universities.

Chapter Two

Programs and Study Plans

First: Diplomas

A. Applied Studies Diplomas

Department of Mathematics

Applied Studies Diplomas at the Department of Mathematics:

- Diploma in Analytical Statistics for Data
- Diploma in Computer Systems Development
-

A. Diploma in Analytical Statistics for Data

Vision and Mission of the Statistics Diploma Program

The Diploma in Statistics and Data Science Program seeks to provide high-quality education in statistics and data science in various fields for students from diverse backgrounds. The program graduates' professional specialists in statistics and data science who are capable of dealing with various problems in population, social, economic, financial, health, and other sciences. It also aims to prepare scientific cadres with a distinguished academic and training background, and to develop scientific capabilities and practical skills in statistics and data science to meet the needs of the local and international labor market. Graduates shall have the ability to compete and deal with academic, research, and applied requirements within an ethical framework, and to contribute to the use of comprehensive and modern methods of knowledge for problem-solving. This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, preparing them to keep pace with advances in knowledge, and qualifying them to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the various sectors of Egyptian society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Diploma in Statistics and Data Science as a special fee-based program to the postgraduate studies bylaws of the Department of Mathematics, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Diploma in Statistics and Data Science Program

1. Preparing and graduating a specialist trained in modern and contemporary statistical methods, including computers and software, and qualified to use and apply these methods to work in statistical units in government departments, official institutions, and the private sector.
2. Qualifying and training students in the use of new tools to enable access to information at the local and global levels.
3. Providing the graduate with scientific, applied, and technical knowledge and skills in the field of statistics, qualifying him/her and providing him/her with modern theories, and preparing him/her to continue higher education and research in the field of statistics in accordance with future needs and recent developments in Egypt and the world.
4. Knowing and understanding the theoretical and practical aspects related to statistics.

5. Meeting the labor market need in the field of statistics and data science, as well as the desire of a large number of student beneficiaries of the program, according to opinion surveys, to continue studying this field.
6. The availability of material, laboratory, and human resources in the Department of Mathematics, Faculty of Science, Damanhour University, to open the Statistics Diploma Program and fulfill its laboratory and scientific requirements.

Material and Human Resources in the Laboratories of the Department of Mathematics

1. Student laboratories, computer laboratories, and research laboratories are available in the faculty's central laboratory.
2. Regarding human resources, the Department has:

- Professors
- Assistant Professors
- Lecturers
- Members of the supporting staff

In addition,seekingg thassistancef a suitable number of specialized faculty members.

2. The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.

General Requirements for Admission and Registration in the Diploma in Statistics and Data Science Program

The Diploma in Statistics and Data Science accepts graduates holding a Bachelor of Science degree in one of the following specializations: Mathematics (Special Mathematics – Mathematics/Physics – Mathematics/Computer Science – Statistics and Data Science).

The program also accepts graduates holding a bachelor's degree from the Institute of Statistics.

Study System and Requirements: 24 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Stat541	Probabilities and Their ApplicationsProbabilities and their Applications	2	-	-	2
2	Stat542	Statistical MethodsStatistical Methods	2	-	-	2
3	Stat543	Regression AnalysisRegression Analysis	2	-	-	2
4	Stat544	Simulation and Sampling TechniquesSimulation and Sampling Techniques	2	-	-	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
5	Stat545	Experimental Design and Non-Parametric StatisticsExperimental Design and Non-Parametric Statistics	2	-	-	2
6	Stat546	Statistical Software PackagesStatistical Software packages	2	-	-	2
7	Stat547	Statistical AnalysisStatistical Analysis	2	-	-	2
8	Stat548	Statistical Methods for Multiple VariablesStatistical methods for multiple variables	2	-	-	2
9	Stat549	Introduction to Operations ResearchIntroduction to Operations Research	2	-	-	2
10	Stat550	Applied Time SeriesApplied Time Series	2	-	-	2
11	Stat551	Applied Stochastic ProcessesApplied Stochastic Processes	2	-	-	2
12	Stat552	Queuing TheoryQueuing Theory	2	-	-	2

B. Diploma in Computer Systems Development

Objectives of the Computer Systems Development Diploma Programs

1. Providing the graduate with scientific, applied, and technical knowledge and skills in the field of computer systems development, so that the graduate shall be able to collect and analyze data and information to improve the efficiency and performance of systems and software. The graduate shall also design systems and software in accordance with future needs and recent developments in Egypt and the world.
2. Enriching knowledge and contributing to scientific developments in the field of computer science through scientific research and following up on developments in the field of science.
3. Providing students with a set of general skills to develop their scientific and personal abilities, including communication skills, citation skills, and research ethics. This also includes acquiring the skill of programming systems using different programming languages and under different operating systems.
4. Using theoretical and practical skills through group learning, conducting and designing innovative applications, and promoting new technologies.

5. Utilizing the laboratory and scientific capabilities of the Department of Mathematics and Computer Science, Faculty of Science, Damanhour University, to fulfill the requirements of this program, particularly the capabilities of its faculty members, while also seeking other expertise from inside and outside the University.

Justifications for Opening the Computer Systems Development Diploma Program

1. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a background of sound knowledge covering all aspects related to computer science and its various branches.
2. The strong need of the labor market in Beheira Governorate and its surrounding areas for specialists in the field of computer science, based on an opinion survey of a number of beneficiary bodies, such as universities, banks, companies, and various institutions in Beheira Governorate.
3. The desire of a large number of students, according to opinion surveys, to continue studying computer science.
4. Awarding graduates of the Faculty of Science and some other practical faculties higher academic certificates to increase their efficiency and opportunities in the labor market.
5. The availability of human, material, and laboratory resources to open the postgraduate studies program of the Department of Mathematics and Computer Science.

Accordingly, it was proposed to add the Diploma in Computer Systems Development as a special fee-based program to the postgraduate studies bylaws of the Department of Mathematics and Computer Science, Faculty of Science, Damanhour University.

Material and Human Resources in Computer Laboratories

1. The faculty has two student laboratories containing 50 fully equipped computers, data show projectors, and display screens.
2. Regarding human resources, there is one faculty member and two assistant lecturers who are about to complete their Ph.D. degrees, and two teaching assistants are being appointed in accordance with the University's five-year plan. In addition, the assistance of a suitable number of specialized faculty members seconded by different bodies shall be sought, which is considered appropriate for the teaching load at the beginning.
3. The faculty also has an electronic library that includes a distinguished number of books, in addition to a number of modern printed references.

General Requirements for Admission and Registration in Postgraduate Programs for Computer Systems Development

First: The Diploma in Computer Systems Development accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Computer Science, Mathematics, or

Statistics. The program also accepts graduates holding a bachelor's degree from faculties of Engineering and Computers.

Courses of the Computer Systems Development Diploma Program

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	CS561	Structured ProgrammingStructural Programming	2	1	-	2
2	CS562	Data StructuresData Structure	2	1	-	2
3	CS563	Operating SystemsOperating Systems	2	1	-	2
4	CS564	Object-Oriented ProgrammingObject Oriented Programming	2	1	-	2
5	CS564	Database Management SystemsDatabase Management Systems	2	1	-	2
6	CS566	Algorithm Analysis and DesignAlgorithms Analysis and Design	2	1	-	2
7	CS567	Computer Networks and Information SecurityComputer Networks and Information Security	2	1	-	2
8	CS568	Software Component DesignSoftware Component Design	2	1	-	2
9	CS569	Software EngineeringSoftware Engineering	2	1	-	2
10	CS570	Computer Organization and ArchitectureComputer Organization & Architecture	2	1	-	2
11	CS571	Software TestingSoftware Testing	2	1	-	2
12	CS572	Logic DesignLogic Design	2	1	-	2

Department of Physics

Applied Studies Diplomas at the Department of Physics:

1. Diploma in Materials Physics and Nanoscience
2. Diploma in Solar Energy
3. Diploma in Radiation Physics
4. Diploma in Biophysics

Diploma in Materials Physics and Nanoscience

The student studies 24 credit hours (20 compulsory hours + 4 elective hours), divided into 12 credit hours per semester.

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 531	Basic Sciences of NanotechnologyBasic Science of Nanotechnology	2	------	-----	2
2	Phys 539	Quantum DotsQuantum Dots	2	-----	-----	2
3	Phys 533	Nanotechnology and Alternative and Renewable EnergyNanotechnology and Alternative and Renewable Energy	2	--------	-------	2
4	Phys 543	Mechanical Properties of NanomaterialsMechanical Properties of Nanomaterials	2	------	1	2
5	Phys 519	Laboratory Studies (1) Laboratory Studies (1)	2	1	-----	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Phys 537	Selected Topics in Nanoscience and NanotechnologySelected Topics in Nanoscience and Nanotechnology	2	--------	----	2
7	Phys 541	Laboratory ExercisesLaboratory Exercises	2	------	-------	2
8	Phys 553	Materials ScienceMaterials Science	2	--------	-------	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 532	Characterization of NanomaterialsCharacterization of Nanomaterials	2	-----	-----	2
2	Phys 534	Nanoscale Physics and SurfacesNanoscale Physics and Surfaces	2	----	-------	2
3	Phys 536	Physics and Technology of Semiconductor DevicesPhysics and Technology of Semiconductor Devices	2	------	1	2
4	Phys 538	Fabrication of NanomaterialsFabrication of Nanomaterials	2	------	1	2
5	Phys 522	Laboratory Studies (2) Laboratory Studies (2)	2	1	------	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Phys 540	SeminarSeminar	2	-------	-------	2
7	Phys 542	Use of Computers in NanoscienceUse of Computers in Nanoscience	2	-----	1	2
8	Phys 535	Management and Economics of NanotechnologyManagement and Economics of Nanotechnology	2	------	-----	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

2. Diploma in Solar Energy

The student studies 24 credit hours (20 compulsory hours + 4 elective hours), divided into 12 credit hours per semester.

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 545	Photovoltaic ConversionPhotovoltaic Conversion	2	-----	-----	2
2	Phys 547	Energy UsesEnergy Uses	2	----	-------	2
3	Phys 549	Energy StorageEnergy Storage	2	------	1	2
4	Phys 551	Nature of RadiationNature of Radiation	2	------	1	2
5	Phys 519	Laboratory Studies (1) Laboratory Studies (1)	2	1	-----	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Phys 553	Materials ScienceMaterials Science	2	--------	-------	2
7	Phys 555	Atomic and Molecular SpectraAtomic and Molecular Spectra	2	-----	1	2
8	Phys 541	Laboratory ExercisesLaboratory Exercises	2	------	-------	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 544	SemiconductorsSemiconductors	2	------	-----	2
2	Phys 546	Thin Films AThin Films A	2	--------	-------	2
3	Phys 548	Thermal ConversionThermal Conversion	2	------	-----	2
4	Phys 550	Mass TransferMass Transfer	2	--------	----	2
5	Phys 522	Laboratory Studies (2) Laboratory Studies (2)	2	1	------	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Phys 552	Heating and Cooling TechnologyHeating and Cooling Technology	2	-----	-----	2
7	Phys 554	Properties of Superconducting MaterialsProperties of Superconducting Materials	2	------	-------	2
8	Phys 528	Radiation DosimetryRadiation Dosimetry	2	------	1	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

3. Diploma in Radiation Physics

The student studies 24 credit hours (20 compulsory hours + 4 elective hours), divided into 12 credit hours per semester.

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 517	RadiologyRadiology	2	-----	-----	2
2	Phys 521	Radiological Medical DevicesRadiological Medical Devices	2	------	1	2
3	Phys 523	Plasma PhysicsPlasma Physics	2	------	1	2
4	Phys 525	Nuclear FissionNuclear Fission	2	------	1	2
5	Phys 519	Laboratory Studies (1) Laboratory Studies (1)	2	1	-------	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Phys 527	Nuclear Detectors and DevicesNuclear Detectors and Devices	2	--------	-------	2
7	Phys 529	Radiation ProtectionRadiation Protection	2	-----	1	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
8	B. Phys 505	Fundamentals of Radiation Biophysics and DosimetryFundamentals of Radiation Biophysics and Dosimetry	2	-----	1	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 516	Nuclear PhysicsNuclear Physics	2	------	-----	2
2	Phys 518	Neutron PhysicsNeutron Physics	2	--------	-------	2
3	Phys 520	Radiation DetectorsRadiation Detectors	2	-----	1	2
4	Phys 524	Nuclear Forces and ReactorsNuclear Forces and Reactors	2	--------	----	2
5	Phys 522	Laboratory Studies (2) Laboratory Studies (2)	2	1	-----	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Phys 526	Ionizing Radiation Dosimetry TechnologyIonizing Radiation Dosimetry Technology	2	-----	-----	2
7	Phys 528	Radiation DosimetryRadiation Dosimetry	2	------	-------	2
8	Phys 530	Reactors and NeutronsReactors and Neutrons	2	------	1	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

4. Diploma in Biophysics

The student studies 24 credit hours (20 compulsory hours + 4 elective hours), divided into 12 credit hours per semester.

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	B. Phys 501	Medical ImagingMedical Imaging	2	------	-----	2
2	B. Phys 503	Radiation Dose MeasurementRadiation Dose Measurement	2	--------	-------	2
3	B. Phys 505	Fundamentals of Radiation Biophysics and DosimetryFundamentals of Radiation Biophysics and Dosimetry	2	-----	1	2
4	B. Phys 507	Technologies for Drug Delivery Systems and BiomoleculesTechnologies for Drug Delivery Systems and Biomolecules	2	------	1	2
5	B. Phys 509	Histochemistry and Cell BiologyHistochemistry and Cell Biology	2	------	1	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	B. Phys 511	Ionizing Radiation Dosimetry TechnologyIonizing Radiation Dosimetry Technology	2	-----	-----	2
7	B. Phys 513	Molecular BiophysicsMolecular Biophysics	2	------	-------	2
8	B. Phys 515	Communication and Control TechnologyCommunication and Control Technology	2	------	1	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	B. Phys 502	Magnetic Resonance ImagingMagnetic Resonance Imaging	2	-----	-----	2
2	B. Phys 504	Environmental Health and SafetyEnvironmental Health and Safety	2	------	-------	2
3	B. Phys 506	Alternative BiomaterialsAlternative Biomaterials	2	------	1	2
4	B. Phys 508	Fundamentals of Therapeutic Medical DevicesFundamentals of Therapeutic Medical Devices	2	------	1	2
5	B. Phys 510	Medical StatisticsMedical Statistics	2	------	1	2

Total credit hours for compulsory courses: 10 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	B. Phys 512	Radiation BiologyRadiation Biology	2	-------	-------	2
7	B. Phys 514	BioenergeticsBioenergetics	2	----	1	2
8	Phys 528	Radiation DosimetryRadiation Dosimetry	2	------	-------	2

Total credit hours for elective courses: 2 credit hours. The student chooses one course from serial numbers 6 to 8.

Total credit hours: 12 credit hours.

Department of Chemistry

Applied Studies Diplomas at the Department of Chemistry:

1- Diploma in Applied Studies in Forensic Chemistry
2- Diploma in Applied Studies in Petrochemicals

1. Diploma in Applied Studies in Forensic Chemistry

Courses of the Diploma in Applied Studies in Forensic Chemistry
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Chem 508	Instrumental Analysis (1)	2	-	-	2
2	BCh 521	Molecular Biology	2	-	-	2
3	BCh 522	Biological Fluids	2	3	-	3
4	BCh 523	Practical Biochemistry (1)	-	4	-	2
5	BCh 524	Practical Biochemistry (2)	-	4	-	2
6	Chem 510	Instrumental Analysis (2)	2	-	-	2
7	Chem 511	Introduction to Forensic Chemistry	2	-	-	2
8	Chem 512	Chemical Analysis (1)	2	-	-	2
9	Chem 513	Practical Forensic Chemistry	-	4	-	2
10	Chem 514	Training in Forensic Science	2	-	-	2
11	Chem 515	Chemical Analysis (2)	2	-	-	2
12	BCh 525	Bioinformatics	1	-	-	1

Total Number of Credit Hours: 24

2. Diploma in Applied Studies in Petrochemicals

Courses of the Diploma in Applied Studies in Petrochemicals
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 520	Chromatographic Separation Techniques	2	-	2
2	Chem 521	Chemistry of Petroleum Refining and Petroleum Additives	2	-	2
3	Chem 522	Chemistry of Petrochemical Industries	2	-	2
4	Chem 523	Chemistry of Paints and Inks Industries	2	-	2
5	Chem 524	Chemistry of Polymer and Fiber Industries	2	-	2
6	Chem 525	Chemistry of Detergents Industry	2	-	2
7	Chem 526	Industrial Applications of Polymers	2	-	2
8	Chem 527	Environmental Pollution and Water Treatment	2	-	2
9	Chem 528	Applications for Organometallic Chemistry	2	-	2
10	Chem 529	Applied Spectroscopy	2	-	2
11	Chem 530	Analysis of Results and Quality Codes	2	-	2
12	Chem 531	Laboratory Safety and Security	2	-	2

Total Number of Credit Hours: 24

Department of Botany and Microbiology

Applied Studies Diplomas at the Department of Botany and Microbiology:

A. Applied Diploma in Industrial Microbiology

B. Applied Diploma in Bioremediation

C. Applied Diploma in Microbiology and Immunology

A. Applied Diploma in Industrial Microbiology

Vision and Mission of the Industrial Microbiology Diploma Program

The program aims to prepare scientific cadres with a distinguished academic and training background, who are capable of competing in the local and international labor market. It also seeks to develop their scientific capabilities and practical skills in the field of industrial microbiology.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the multiple and diverse sectors of society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Industrial Microbiology Diploma as a program in the postgraduate studies bylaws of the Department of Botany and Microbiology, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Industrial Microbiology Diploma Program

The program aims to prepare a graduate equipped with the skills and abilities that qualify him/her to compete in the labor market for available opportunities in factories producing food, chemical, and industrial products that rely in their production on living organisms or their components. It also qualifies the graduate to work in food industries, agricultural product development companies, food companies, analysis laboratories, hospitals, blood banks, the Forensic Medicine Authority, the Serum and Vaccine Authority, pharmaceutical companies, branches of the Environmental Affairs Agency, water treatment plants, public and private universities, and research centers spread throughout the Republic.

More importantly, the program aims to prepare a trained and qualified graduate capable of applying what he/she studies in establishing his/her own private project for the production or manufacture of new products using biotechnology applications, which he/she studies in depth and trains on efficiently through the theoretical and practical study and field training received throughout the period of study. It also grants graduates of the Faculty of Science and some other practical faculties higher academic certificates to increase their efficiency and opportunities in the labor market.

This study program has been designed so that learning takes place through lectures, applied practical classes, and training in factories, research centers, and governmental and private laboratories in the field of applied microbiology, in addition to the courses and training programs offered, as well as cooperation with the external community.

Justifications for Opening the Industrial Microbiology Diploma Program

Providing students with scientific, applied, and technical knowledge and skills in the field of industrial microbiology, qualifying them and providing them with modern theories, as well as developing their competencies in using biological and chemical analyses in accordance with future needs and recent developments in Egypt and the world.

Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge reference in the branches of microbiology, including industrial microbiology, and granting students higher academic degrees to increase their efficiency and opportunities in the labor market.

Knowing and understanding the theoretical and practical aspects related to industrial microbiology sciences.
The availability of material, laboratory, and human resources in the Department of Botany and Microbiology, Faculty of Science, Damanhour University, to open the Industrial Microbiology Diploma Program and fulfill its requirements.
Material and Human Resources in the Laboratories of the Department of Botany and Microbiology
Regarding human resources, the Department has 8 faculty members: 2 professors, 2 assistant professors, and 4 lecturers, in addition to 10 members of the supporting staff in the Microbiology Division, which is considered suitable for the teaching load. In addition, the assistance of a suitable number of specialized faculty members should be sought.
The Department has three student laboratories and a research laboratory. The faculty will also provide a laboratory for students of the Microbiology Diploma. The Department has some laboratory equipment, such as an autoclave, a spectrophotometer, a centrifuge, an incubator, a shaking incubator, a thermal oven, light microscopes, a water bath, a distillation apparatus, and micropipettes of different capacities. In addition, there are some advanced devices available in the faculty's central laboratories and the central laboratory funded by the Academy of Scientific Research through the Science Up initiative, the program for upgrading research and development laboratories at public universities, which the faculty has obtained. These devices include a microscope for cell imaging, a CO_2 incubator, a sterile separation unit, in addition to a complete electrophoresis unit for proteins and genetic material, including an imaging device, a quantitative PCR device, a stem cell separation device, a CO_2 incubator, an electrophoresis unit, a shaking incubator, and a high-precision spectrophotometer covering the visible and ultraviolet spectrum, among others.
The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.
General Requirements for Admission and Registration in the Industrial Microbiology Diploma Program
The Industrial Microbiology Diploma accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Biochemistry, Microbiology, Chemistry, Biotechnology, Zoology, Botany, or Molecular Biology.
Study System and Requirements for the Industrial Microbiology Diploma: 24 credit hours distributed over two semesters.

Courses: 24 Credit Hours

ب- The student of the Applied Diploma studies 24 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Mic501	Microbial Quality Control and Risk Assessment	2	2	-	3
2	Mic502	Introduction to Fermentation Technology	2	2	-	3
3	Mic503	Microbial Enzymes	2	-	-	2
4	Mic504	Industrial Biotechnology	2	2	-	3
5	Mic505	Methods in Microbial Molecular Biology	1	2	-	2
6	Mic506	Principles of Microbial Ecology	2	-	-	2
7	Mic507	Diagnostic Microbiology	1	2	-	2
8	Mic508	Advanced Analytical Biochemistry	1	2	-	2
9	Mic509	Water Disinfection and Assessment of Water Quality	2	2	-	3
10	Mic511	Food Microbiology	1	2	-	2

B. Applied Diploma in Bioremediation

Vision and Mission of the Bioremediation Diploma Program

The program aims to prepare scientific cadres with a distinguished academic and training background, who are capable of competing in the local and international labor market. It also seeks to develop their scientific capabilities and practical skills in the field of bioremediation.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the multiple and diverse sectors of society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research

bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Bioremediation Diploma as a program in the postgraduate studies bylaws of the Department of Botany and Microbiology, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Bioremediation Diploma Program

1. The program aims to prepare a graduate equipped with the skills and abilities that qualify him/her to compete in the labor market for available opportunities in factories producing food, chemical, and industrial products that rely in their production on living organisms or their components. It also qualifies the graduate to work in water treatment plants, water purification and treatment companies, and water analysis companies; drinking water purification plants; analysis laboratories at ports and quarantine facilities; branches of the Environmental Affairs Agency; water treatment plants; research authorities and centers; and scientific research academies spread throughout the Republic.
2. The program aims to prepare a trained and qualified graduate capable of applying what he/she studies, and who is trained efficiently through the theoretical and practical study and field training received throughout the period of study.
3. Granting graduates of the Faculty of Science and some other practical faculties higher academic certificates to increase their efficiency and opportunities in the labor market.

This study program has been designed so that learning takes place through lectures, applied practical classes, and training in the field of bioremediation, in addition to the courses and training programs offered, as well as cooperation with the external community.

Justifications for Opening the Bioremediation Diploma Program

1. Providing students with scientific, applied, and technical knowledge and skills in the field of bioremediation, qualifying them and providing them with modern theories, as well as developing their competencies in using biological and chemical analyses in accordance with future needs and recent developments in Egypt and the world.
2. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge reference in the branches of microbiology, including bioremediation, and granting students higher academic degrees to increase their efficiency and opportunities in the labor market.
3. Using theoretical and practical skills through group learning, conducting experiments, interpreting problems related to bioremediation, and providing students with a set of general skills to develop their scientific and personal abilities, including communication skills and research ethics.

4. The availability of material, laboratory, and human resources in the Department of Botany and Microbiology, Faculty of Science, Damanhour University, to open the Bioremediation Diploma Program and fulfill its requirements.

Material and Human Resources in the Laboratories of the Department of Botany and Microbiology

1. Regarding human resources, the Department has 8 faculty members: 2 professors, 2 assistant professors, and 4 lecturers, in addition to 10 members of the supporting staff in the Microbiology Division, which is considered suitable for the teaching load. In addition, the assistance of a suitable number of specialized faculty members should be sought.
2. The Department has three student laboratories and a research laboratory. The faculty will also provide a laboratory for students of the Microbiology Diplomas. The Department has some laboratory equipment, such as an autoclave, a spectrophotometer, a centrifuge, an incubator, a shaking incubator, a thermal oven, light microscopes, a water bath, a distillation apparatus, and micropipettes of different capacities. In addition, there are some advanced devices available in the faculty's central laboratories and the central laboratory funded by the Academy of Scientific Research through the Science Up initiative, the program for upgrading research and development laboratories at public universities, which the faculty has obtained. These devices include a microscope for cell imaging, a CO_2 incubator, a sterile separation unit, in addition to a complete electrophoresis unit for proteins and genetic material, including an imaging device, a quantitative PCR device, a stem cell separation device, a CO_2 incubator, an electrophoresis unit, a shaking incubator, and a high-precision spectrophotometer covering the visible and ultraviolet spectrum, among others.
3. The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.

General Requirements for Admission and Registration in the Bioremediation Diploma Program

The Bioremediation Diploma accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Biochemistry, Microbiology, Chemistry, Biotechnology, Zoology, Botany, or Molecular Biology.

Study System and Requirements for the Bioremediation Diploma: 24 credit hours distributed over two semesters.

Courses: 24 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Mic505	Methods in Microbial Molecular Biology	1	2	-	2
2	Mic507	Diagnostic Microbiology	1	2	-	2
3	Mic509	Water Disinfection and Assessment of Water Quality	2	2	-	3
5	Mic512	Toxicology and Pollutants	2	-	-	2
6	Mic513	Environmental Biotechnology	2	2	-	3
7	Mic514	Bioremediation of Pollutants	2	2	-	3
8	Mic515	Introduction to Phytoremediation	2	-	-	2
10	Mic516	Pollution Assessment and Waste Remediation	2	2	-	3
11	Mic517	Introduction to In-Situ Remediation Technology	2	-	-	2
12	Mic519	Environmental Law	2	-	-	2

C. Applied Diploma in Microbiology and Immunology
"Special Fee-Based Program"

Vision and Mission of the Microbiology and Immunology Diploma Program

The program aims to prepare scientific cadres with a distinguished academic and training background, who are capable of competing in the local and international labor market. It also seeks to develop their scientific capabilities and practical skills in the field of microbiology and immunology.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the

Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the multiple and diverse sectors of society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Microbiology and Immunology Diploma as a special fee-based program to the postgraduate studies bylaws of the Department of Botany and Microbiology, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Microbiology and Immunology Diploma Program

1. The program aims to prepare a graduate equipped with scientific, applied, and technical skills in the fields of microbiology and immunology, qualifying him/her and providing him/her with modern theories and capabilities that enable him/her to compete in the labor market, and preparing him/her to continue higher education and research in both fields, in accordance with future needs and recent developments in Egypt and the world.
2. Providing students with a set of general skills to develop their scientific and personal abilities, including communication skills, citation skills, and research ethics.
3. Preparing the graduate for available opportunities that rely in their production on living organisms or their components. It also qualifies the graduate to work in advanced medical analysis laboratories, hospitals, blood banks, the Serum and Vaccine Authority, pharmaceutical production and development companies, cell culture laboratories, tumor detection laboratories in medical centers and hospitals, public and private universities, and research centers spread throughout the Republic.
4. Utilizing the laboratory and human resources of the Departments of Botany and Microbiology and Zoology, Faculty of Science, Damanhour University, to fulfill the requirements of this program.
5. This study program has been designed so that learning takes place through lectures, applied practical classes, and training in laboratories, research centers, and governmental and private laboratories in the field of microbiology and immunology, in addition to the courses and training programs offered, as well as cooperation with the external community.
6. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge reference in the branches of microbiology and immunology.
7. Granting graduates of scientific faculties, a higher academic degree to increase their efficiency and opportunities in the labor market.

8. The availability of material, laboratories, and human resources in the Department of Botany and Microbiology and the Department of Zoology, Faculty of Science, Damanhour University, to open the Microbiology and Immunology Diploma Program.

Material and Human Resources in the Department of Botany and Microbiology and the Department of Zoology

1. Regarding human resources, the Microbiology Division has 8 faculty members: 2 professors, 2 assistant professors, and 4 lecturers, in addition to 10 members of the supporting staff. Moreover, the Department of Zoology has 24 faculty members: 5 professors, 5 assistant professors, and 14 lecturers, in addition to 8 members of the supporting staff, which is considered suitable for the teaching load. In addition, the assistance of specialized faculty members shall be sought.
2. Each department has three student laboratories and a research laboratory. The faculty will also provide a laboratory for students of the Microbiology Diplomas. The Department has some laboratory equipment, such as an autoclave, a spectrophotometer, a centrifuge, an incubator, a shaking incubator, a thermal oven, light microscopes, a water bath, a distillation apparatus, and micropipettes of different capacities. The Department of Zoology also has a complete imaging unit, a dissecting microscope, hemoglobin measuring devices, blood-counting slides, an AutoMACS stem cell separation device, a homogenizer, an electrophoresis unit, a UV imaging unit, PCR, a spectrophotometer, an incubator, a centrifuge, and a water distillator. In addition, there are some advanced devices available in the faculty's central laboratories and the central laboratory funded by the Academy of Scientific Research through the Science Up initiative, the program for upgrading research and development laboratories at public universities, which the faculty has obtained. These devices include a microscope for cell imaging, a CO_2 incubator, a sterile separation unit, in addition to a complete electrophoresis unit for proteins and genetic material, including an imaging device and a quantitative PCR device, a CO_2 incubator, an electrophoresis unit, a shaking incubator, and a high-precision spectrophotometer covering the visible and ultraviolet spectrum, among others.
3. The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.

General Requirements for Admission and Registration in the Microbiology and Immunology Diploma Program

The Microbiology and Immunology Diploma accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Biochemistry, Microbiology, Chemistry, Biotechnology, Zoology, Botany, or Molecular Biology, in addition to graduates of the Faculties of Medicine, Pharmacy, Physical Therapy, and Veterinary Medicine.

Study System and Requirements for the Microbiology and Immunology Diploma: 26 credit hours distributed over two semesters.

Courses: 26 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Mic521	Advanced Microbiology and Biotechnology	2	1	-	2
2	Mic 501	Microbial Quality Control and Risk Assessment in Work Environments	2	2	-	3
3	Mic522	Medical and Diagnostic Microbiology	2	2	-	3
4	Mic523	Virology and Viral Immunological Diseases	2	2	-	3
5	Mic524	Toxicology	2	-	-	2
6	Zoo 549	Clinical Chemistry Techniques	2	-	-	2
7	Zoo 550	Diagnostic Immunology and Serology	1	2	-	2
8	Zoo 551	Genetic Immune Disorders	2	-	-	2
9	Zoo 552	Immunohematology Disorders	1	2	-	2
10	Zoo 573	Organ Physiology, Immune System, and Reproduction	3	-	-	3
11	Zoo 554	Cancer Immunology	2	-	-	2

Department of Zoology

Applied Studies Diplomas at the Department of Zoology:

A. Diploma in Immunology and Parasitology
B. Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques (Special Fee-Based Program)
C. Diploma in Biological Forensics (Special Fee-Based Program)
D. Diploma in Hematology (Special Fee-Based Program)

A. Diploma in Immunology and Parasitology

Courses of the Diploma in Immunology and Parasitology
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 549	Clinical Chemistry Techniques	2	-	-	2
2	Zoo 550	Diagnostic Immunology and Serology	1	2	-	2
3	Zoo 551	Genetic Immune Disorders	2	-	-	2
4	Zoo 552	Immunohematologic Disorders	1	2	-	2
5	Zoo 553	Viral Immunological Diseases	2	-	-	2
6	Zoo 554	Cancer Immunology	2	-	-	2
7	Zoo 555	Advanced Parasitology	2	-	-	2
8	Zoo 556	Platyhelminth Biology	2	-	-	2
9	Zoo 557	Nematode Biology	2	-	-	2
10	Zoo 558	Biology of Parasitic Protozoa	2	-	-	2
11	Zoo 559	Resistance to Parasitic Infections and Epidemics	2	-	-	2
12	Zoo 560	Laboratory Techniques in Parasitology	-	4	-	2

Total Number of Credit Hours: 24

B. Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques
“Special Fee-Based Program”

Mission of the Embryology and Intracytoplasmic Sperm Injection Techniques Diploma Program

The program aims to prepare scientific cadres with a distinguished academic and training background, who are capable of competing in the local and international labor market. It also seeks to develop their scientific capabilities and practical skills in the field of embryology and intracytoplasmic sperm injection techniques.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative,

technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the various sectors of Egyptian society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques as a special fee-based program to the postgraduate studies bylaws of the Department of Zoology, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques Program

1. Providing students with scientific, applied, and technical knowledge and skills in the field of embryology and intracytoplasmic sperm injection techniques, qualifying them and providing them with modern theories, as well as developing their competencies in using biological and chemical analyses in accordance with future needs and recent developments in Egypt and the world.
2. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge background in the branches of zoology, including embryology and intracytoplasmic sperm injection techniques, and granting students higher academic degrees to increase their efficiency and opportunities in the labor market.
3. Knowing and understanding the theoretical and practical aspects related to embryology and intracytoplasmic sperm injection techniques.
4. Providing students with skills and accuracy in semen analysis, oocyte examination and denudation, and the fertilization process.
5. Meeting the labor market need in the field of embryology and intracytoplasmic sperm injection techniques, as well as the desire of a large number of student beneficiaries of the program, according to opinion surveys, to continue studying this field.
6. The availability of material, laboratory, and human resources in the Department of Zoology, Faculty of Science, Damanhour University, to open the Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques Program and fulfill its requirements.

Material and Human Resources in the Laboratories of the Department of Zoology

1. The faculty has four student laboratories and a research laboratory equipped with a complete imaging unit, a dissecting microscope, hemoglobin measuring devices, blood-

counting slides, an AutoMACS stem cell separation device, a homogenizer, an electrophoresis unit, a UV imaging unit, PCR, a spectrophotometer, an incubator, a centrifuge, and a water distillator.

2. Regarding human resources, the Department has:

- Five professors
- Five assistant professors
- Fourteen lecturers
- Eight members of the supporting staff

In addition,seekingg thassistancef a suitable number of specialized faculty members.

3. The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.

General Requirements for Admission and Registration in the Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques Program

The Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques accepts graduates holding a Bachelor of Science degree in one of the following specializations:

Bachelor of Science in Zoology and Entomology; Special Zoology; Chemistry/Zoology; Zoology/Chemistry; Pharmacy; Human Medicine; Veterinary Medicine.

Fields of Work and Potential Employment Opportunities

Graduates of the Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques will be able to work in the field of assisted reproductive technologies, as the student will be qualified to work in the following fields:

1. Fertility centers.
2. Infertility assessment centers.
3. Intracytoplasmic sperm injection centers.
4. Gamete banks.

Courses of the Diploma in Embryology and Intracytoplasmic Sperm Injection Techniques
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 521	Early Embryonic Development of Mammals	2	-	-	2
2	Zoo 522	In Vitro Fertilization Techniques	3	-	-	3
3	Zoo 523	Congenital Anomalies	3	-	-	3
4	Zoo 524	Mechanism of Fertilization	2	-	-	2
5	Zoo 525	Laboratory Training (1)	-	4	-	2
6	Zoo 526	Reproductive Physiology	3	-	-	3
7	Zoo 527	Diseases of the Reproductive System	3	-	-	3
8	Zoo 528	Chronic Diseases and Fertilization	2	-	-	2
9	Zoo 529	Fertility Analysis	2	-	-	2
10	Zoo 530	Laboratory Training (2)	-	4	-	2

Total Number of Credit Hours: 24

C. Diploma in Biological Forensics
“Special Fee-Based Program”

Vision and Mission of the Biological Forensics Diploma Program

The program aims to prepare scientific cadres with a distinguished academic and training background, who are capable of competing in the local and international labor market. It also seeks to develop their scientific capabilities and practical skills in the field of biological forensics.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the various sectors of Egyptian society, and contributes to

finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Diploma in Biological Forensics as a special fee-based program to the postgraduate studies bylaws of the Department of Zoology, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Biological Forensics Diploma Program

1. Providing students with scientific, applied, and technical knowledge and skills in the field of biological forensics, qualifying them and providing them with modern theories, as well as developing their competencies in using biological and chemical analyses in accordance with future needs and recent developments in Egypt and the world.
2. Completing the mission of the faculty through the educational programs it offers, provide graduates of the Faculty of Science with a sound knowledge background in the branches of zoology, including biological forensics, and granting students higher academic degrees to increase their efficiency and opportunities in the labor market.
3. Knowing and understanding the theoretical and practical aspects related to biological forensics.
4. Providing students with skills and accuracy in collecting, analyzing, handling, and evaluating evidence, such as examining and analyzing different samples, including blood, saliva, semen, hair, living organisms, and insects found at the crime scene, to determine the causes and time of death and the location of the crime.
5. Meeting the labor market need in the field of biological forensics, as well as the desire of a large number of student beneficiaries of the program, according to opinion surveys, to continue studying this field.
6. Clarifying and demonstrating the relationship between different living organisms and different ecosystems, and the impact of this relationship on solving criminal cases.
7. Providing students with comprehensive and modern knowledge in analyzing all types of data using statistical analysis programs used in investigative research to detect crimes and solve cases, as well as using technology in image processing and analysis, in addition to using bioinformatics to solve cases.
8. Establishing ethical principles and understanding the legal aspects of making decisions related to investigation and analysis as a forensic specialist, through familiarity with legal provisions and texts, and writing and drafting technical reports in a legal manner.

9. Acquiring practical skills through courses and training programs provided by experts from the Forensic Medicine Authority, forensic evidence officers, professors of forensic medicine and clinical toxicology at faculties of medicine, and relevant bodies in the fields of work.
10. The availability of material, laboratory, and human resources in the Department of Zoology, Faculty of Science, Damanhour University, to open the Biological Forensics Diploma Program and fulfill its requirements.

Material and Human Resources in the Laboratories of the Department of Zoology

The faculty has four student laboratories and a research laboratory equipped with a complete imaging unit, a dissecting microscope, hemoglobin measuring devices, blood-counting slides, an AutoMACS stem cell separation device, a homogenizer, an electrophoresis unit, a UV imaging unit, PCR, a spectrophotometer, an incubator, a centrifuge, and a water distillator.

Regarding human resources, the Department has:

• Five professors
• Five assistant professors
• Fourteen lecturers
• Eight members of the supporting staff

In addition,seekingg thassistancef a suitable number of specialized faculty members.

The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.

General Requirements for Admission and Registration in the Biological Forensics Diploma Program

The Biological Forensics Diploma accepts graduates holding a Bachelor of Science degree in one of the following specializations:

Bachelor of Science in Zoology and Entomology; Special Zoology; Chemistry/Zoology; Zoology/Chemistry; Chemistry/Entomology; Biochemistry; Pharmacy; Human Medicine; Veterinary Medicine.

Fields of Work and Potential Employment Opportunities

Graduates of the Diploma in Biological Forensics will be able to work in the field of investigation or in laboratories, as the student will be qualified to work in the following fields:

1. The Forensic Medicine Authority affiliated with the Ministry of Justice.
2. The Forensic Evidence Department is affiliated with the Ministry of Interior.
3. Toxicology and narcotics detection laboratories affiliated with the Ministry of Health.
4. Customs Administration and quarantine at land, sea, and airports.
5. Fire departments.

6. The General Organization for Export and Import Control.
7. Food factories.
8. Academic settings such as universities and research centers, including the National Research Centre and the National Center for Social and Criminological Research.

Courses of the Diploma in Biological Forensics
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 531	Applied Forensic Entomology	2	2	-	3
2	Zoo 532	Forensic Molecular Biology	2	-	-	2
3	Zoo 533	Cytogenetics	2	-	-	2
4	Zoo 534	Biological Fluids	2	2	-	3
5	Zoo 535	Forensic Toxicology	2	-	-	2
6	Zoo 536	Carrion Ecology	2	-	-	2
7	Zoo 537	Stored-Product Insects	2	-	-	2
8	Chem 511	Introduction to Forensic Chemistry	2	-	-	2
9	Zoo 538	Forensic Bioinformatics	2	-	-	2
10	Zoo 562	Crime Scene and Physical Evidence	2	-	-	2
11	Chem 514	Training in Forensic Science	2	-	-	2

Total Number of Credit Hours: 24

D. Diploma in Hematology
“Special Fee-Based Program”

Vision and Mission of the Hematology Diploma Program

The program aims to prepare scientific cadres with a distinguished academic and training background, and to develop their scientific capabilities and practical skills in hematology in order to meet the needs of the local and international labor market. Graduates shall have the ability to compete and deal with academic, research, and applied requirements within an ethical framework, and to contribute to the use of comprehensive and modern methods of knowledge to solve health

and societal problems in the field of hematology, as well as to address the shortage in this specialization in Beheira Governorate and its surrounding areas.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the various sectors of Egyptian society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Hematology Diploma as a special fee-based program to the postgraduate studies bylaws of the Department of Zoology, Faculty of Science, Damanhour University.

Targeted Learning Outcomes and Justifications for Opening the Hematology Diploma Program

1. Providing the graduate with scientific, applied, and technical knowledge and skills in the field of hematology, qualifying him/her and providing him/her with modern theories, and preparing him/her to continue higher education and research in the field of hematology in accordance with future needs and recent developments in Egypt and the world.
2. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge background in the branches of zoology, including hematology, and granting students higher academic degrees to increase their efficiency and opportunities in the labor market.
3. Knowing and understanding the theoretical and practical aspects related to hematology.
4. Meeting the labor market need in the field of hematology, as well as the desire of a large number of student beneficiaries of the program, according to opinion surveys, to continue studying this field.
5. Enriching students with comprehensive and modern knowledge in the field of hematology through scientific research and following up on developments in the field of science.
6. Using theoretical and practical skills through group learning, conducting experiments, interpreting problems related to hematology, and providing students with a set of general skills to develop their scientific and personal abilities, including communication skills, citation skills, and research ethics.

7. The availability of material, laboratory, and human resources in the Department of Zoology, Faculty of Science, Damanhour University, to open the Hematology Diploma Program and fulfill its laboratory and scientific requirements.

Material and Human Resources in the Laboratories of the Department of Zoology

1. The Faculty has four student laboratories and two physiology research laboratories equipped with a complete imaging unit, 6 light microscopes, hemoglobin and erythrocyte sedimentation rate measuring devices, blood-counting slides, a prothrombin time measuring device, a gel electrophoresis device, a visible and ultraviolet spectrophotometer, centrifuges, incubators, thermal ovens, water baths, condensers, and micropipettes of different capacities, in addition to some advanced devices available in the Faculty's central laboratory, such as a stem cell separation device and a quantitative PCR device.
2. Regarding human resources, the Department has:

• Five professors
• Five assistant professors
• Fourteen lecturers
• Eight members of the supporting staff

In addition,seekingg thassistancef a suitable number of specialized faculty members.

3. The faculty also has an electronic library that includes a distinguished number of books, in addition to modern printed references.

General Requirements for Admission and Registration in the Hematology Diploma Program

The Hematology Diploma accepts graduates holding a Bachelor of Science degree in one of the following specializations: Zoology (Special Zoology – Chemistry/Zoology – Zoology/Chemistry – Chemistry/Entomology), Chemistry/Microbiology, Microbiology/Chemistry, Chemistry/Botany, Botany/Chemistry, and Biochemistry as a special, major, or minor specialization.

The program also accepts graduates holding a bachelor's degree from the Faculties of Human Medicine, Pharmacy, and Veterinary Medicine.

Courses of the Hematology Diploma
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 539	Hematological Immunology	2	-	-	2
2	Zoo 540	Physiology of the Circulatory System, Blood, and Lymph	2	-	-	2
3	Zoo 541	Parasitic Blood Diseases	2	-	-	2
4	Zoo 542	Basic Laboratory Techniques	1	2	-	2
5	Zoo 543	Hematological Molecular Biology	2	-	-	2
6	Zoo 544	Fetal and Neonatal Hematology	2	-	-	2
7	BCh 510	Clinical Biochemistry	2	-	-	2
8	Zoo 545	Laboratory Hematology	1	2	-	2
9	CS 575	Computer Science	2	-	-	2
10	Zoo 546	Blood Cell Biology	2	-	-	2
11	Zoo 547	Experimental Hematology	2	-	-	2
12	Zoo 548	Benign and Malignant Blood Diseases	2	-	-	2

Total Number of Credit Hours: 24

Department of Earth

Applied Studies Diplomas at the Department of Earth Sciences:

1. Archaeological and Environmental Geology
2. Geographic Information Systems and Surveying (Special Fee-Based Program)
3. Engineering Geology and Mining (Special Fee-Based Program)

1. Diploma in Archaeological and Environmental Geology

Objective of Offering the Program

Antiquities of all types and from different eras are considered a mirror that narrates the stages of progress and advancement of peoples, as well as records the causes of decline and collapse. The Arab Republic of Egypt possesses approximately one-third of the world's antiquities and is distinguished by great diversity in its antiquities, including Pharaonic, Greek, Roman, Christian, and Islamic antiquities. Rocks and minerals are among the most widely used materials by ancient man in making many antiquities, and they represent about 95% of fixed antiquities that have endured over long periods of time. Therefore, geologists are the most knowledgeable about the impact of environmental factors on these antiquities through the influence of the aerial, aquatic, and human environments, which may lead to the deterioration or destruction of antiquities. Accordingly, there must be integration between geology and archaeology, which is now known as Archaeological Geology.

With the advancement of the tourism industry in Egypt and the role it plays on the global tourism map, and in view of the damage or destruction to which Egyptian antiquities are exposed due to the effects of the aerial, aquatic, and human environments that cause chemical and physical decomposition of antiquities, it has become a national dimension and an obligation for the University to supply the labor market with cadres of geologists and geophysicists specialized in applied geological studies as well as archaeological geology.

Since one of the objectives of the Faculty of Science, Damanhour University, is to develop programs and establish new programs that keep pace with new changes and developments, and to graduate scientists capable of assuming responsibility and meeting the burdens and requirements of workplaces and the labor market in Egypt, one of the objectives of this program is to prepare a graduate capable of assuming responsibility and working in the field of archaeological geology in Egypt and the Arab and African countries.

Teaching in this program shall be carried out by specialized professors from the Faculty and the University in cooperation with some specialists from the Antiquities Authority. The practical study related to geology courses in this program shall take place in the faculty laboratories, while the practical study related to archaeology courses shall take place in archaeological sites that can be visited easily and without excessive financial costs and expenses, since Egypt has many such archaeological sites spread throughout the Republic.

Expected Outcomes

1. The ability to comprehend the basic sciences in geology, geophysics, and the environment.
2. The ability to conduct practical study and extract and analyze results.
3. Practical training at the Antiquities Authority during the study period.

4. The ability to work in a team of different specializations.
5. Conviction of the need for continuing education as a basis for the graduate's professional advancement.
6. The ability to use modern technological methods, skills, and practical applications.

General Framework of the Program

♣ The language of study in the program is English.

♣ The faculty bylaws for the diploma stage under the credit hour system shall apply to this program.

♣ To obtain the diploma, the student must successfully pass 24 credit hours distributed over two semesters. In order to achieve maximum benefit and prepare a graduate who keeps pace with changes in the field of science and technology, this program has been designed to:

- Provide opportunities to offer specialized courses in geology, archaeological geology, environment, and geophysics.
- Provide a number of elective courses for study in order to highlight the student's talents and assist him/her in specialization.
- Provide the opportunity to update the program with recent and new developments in theoretical and applied study.
- Seek the assistance of specialists from outside the University, which will further strengthen the relationship between scientific and practical life and prepare a graduate who is familiar with applications.
- Introduce the applied graduation project.
- Give attention to languages, computer science, and their applications.

Therefore, the graduate will be able to face the labor market in the fields of geology, archaeological geology, and geophysics locally, regionally, and internationally.

Overview of the Study Plan of the Program

This program differs from all programs offered by the faculty, and even from those offered by faculties of science in Egypt and the Arab world, as the study plan and teaching method will depend on the credit hour system, as well as on the use of modern teaching methods, with the student being an active and essential participant in the educational process through:

1. Using modern references via the Internet.
2. Relying on the student in methods of independent research.
3. Continuous assessment of the student.

4. Changing the systems for determining the student's level.
5. Scientific and academic advising.

- This program is distinguished by its uniqueness in forming and providing applied scientific cadres in the field of archaeological geology, a field that is not available in any Egyptian, Arab, or international universities, or in private universities in Egypt.

Faculty/University Capabilities that Contribute to the Success of the Program

- The Faculty of Science in Damanhour includes many laboratories that can be used to serve the educational process in the proposed program without conflicting with the current study system. The faculty also has several lecture halls with small seating capacities that can be used for theoretical teaching without conflicting with the theoretical study of the current programs. In addition, the faculty laboratories contain some specialized scientific equipment that will contribute significantly to practical study.
- Benefiting from Damanhour University's computer network, which is connected to the international information network.
- Benefiting from the Faculty's main library, as well as the Bibliotheca Alexandrina, in addition to the digital library available at the University.
- Practical study shall take place in the faculty laboratories and in archaeological sites spread throughout the Republic, which can be visited easily and without excessive financial costs.
- Benefiting from the central laboratories for analysis and measurement available at the University.
- In addition, part of the financial return shall be used to update and develop laboratories, establish new specialized laboratories, and update the library with books and references.
- Benefiting from human resources, especially faculty members in the scientific departments of the faculty.

Relationship with the Program to the Labor Market

- In view of the increasing need for graduates of the Faculty of Science, especially in the fields of geology and geophysics, and since the current study system is unable to keep pace with changes and updates in the field of archaeological geology, the newly introduced program will meet the needs of the labor market, as the graduate will be specialized in both archaeological geology and geophysics.
- The graduate will meet the increasing labor market demand in Egypt and the Arab countries, because most foreigners working in this specialization are currently reluctant to work in these countries, and because this specialization is not available in public or private universities in Egypt and the Arab countries.

Program Courses

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 533	Environmental Geology	2	------	------	2
2	Geo 534	Archaeological Geology	2	-----	-----	2
3	Geo 535	Shallow Subsurface Imaging	2	-------	-------	2
4	Geo 536	Quaternary Deposits	2	------	-------	2
5	Geo 537	Archaeological Stratigraphy	2	-----	------	2
6	Geo 524	Field Geology	2	------	------	2

Total Number of Credit Hours = 12

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 538	Environmental Pollution	2	------	------	2
2	Geo 539	Remote Sensing and GIS Applications	2	-----	-----	2
3	Geo 540	Archaeological Geophysics	2	-------	-------	2
4	Geo 541	Monuments and Sculpture Restoration	2	------	-------	2
5	Geo 542	Geohazards	2	-----	------	2
6	Geo 543	Environmental Protection Project	2	------	------	2

Total Number of Credit Hours = 12

2. Diploma in Geographic Information Systems and Surveying
   Distinguished Fee-Based Program

Objective of Offering the Program

Continuous development of study curricula in line with the nature of the specialization and labor market requirements, especially newly introduced scientific courses, including geographic information systems, cartography, and development.

Deepening the concept of training through intensive field study, adopting applied projects, and deepening the concept of practical studies in maps, surveying, and geographic information systems.

Adopting a clear strategy for scientific research in the Department by focusing on the problems of society and the environment, whether in physical geography, human geography, maps and surveying, or geographic information systems.

Deepening the culture of academic dialogue among faculty members and graduates through holding research seminars, conferences, and symposia, which the Department has followed for more than twelve years and continues to follow at present, God willing.

Achieving the practical value of specialization through assessing available resources and inveinvesting indents' abilities in understanding the environment and deepening loyalty to the homeland, by developing a precise future strategy to be taken into consideration as follows:

1. Developing the current computer laboratory by equipping it with the latest devices and programs.

B. Establishing a geographic information systems laboratory, a geomorphology laboratory, and an educational climate observatory.

C. Establishing a digital library for the Department and linking it to international libraries.

D. Activating cultural agreements between the faculty and other universities.

E. Expanding external missions in rare and newly introduced specializations for which there are no cadres among the current faculty members.

F. Holding training courses for faculty members to follow up scientific and technical developments in the field of specialization.

Expected Outcomes

♣ The ability to comprehend the basic sciences in information systems, surveying, geography, and geomorphology.

♣ The ability to conduct practical study and extract and analyze results.

♣ The ability to work in a team of different specializations.

♣ Conviction of the need for continuing education as a basis for the graduate's professional advancement.

♣ The ability to use modern technological methods, skills, and practical applications.

General Framework of the Program

♣ The language of study in the program is English.

♣ The faculty bylaws for the bachelor's stage under the credit hour system shall apply to this program.

♣ To obtain the diploma degree, the student must successfully pass 24 hours.

♣ The program consists of two semesters with 24 credit hours divided over two semesters.

In order to achieve maximum benefit and prepare a graduate who keeps pace with changes in the field of science and technology, the program has been designed to:

♣ Provide opportunities to offer specialized courses in geographic information systems and surveying.

♣ Provide the opportunity to update the program with recent and new developments in theoretical and applied study.

♣ Seek the assistance of specialists from outside the University, which will further strengthen the relationship between scientific and practical life and prepare a graduate who is familiar with applications.

♣ Introduce the applied graduation project.

♣ Give attention to languages, computer science, and their applications.

♣ Therefore, the graduate will be able to face the labor market in the field of geographic information systems and surveying locally, regionally, and internationally.

Overview of the Study Plan of the Program

This program differs from all programs offered by the faculty, and even from those offered by faculties of science in Egypt and the Arab world, as the study plan and teaching method will depend on the credit hour system, as well as on the use of modern teaching methods, with the student being an active and essential participant in the educational process through:

1. Using modern references via the Internet.
2. Relying on the student in methods of independent research.
3. Continuous assessment of the student.
4. Changing the systems for determining the student's level.
5. Scientific and academic advising.

This program is distinguished by its uniqueness in forming and providing applied scientific cadres in geographic information systems and surveying.

Faculty/University Capabilities that Contribute to the Success of the Program

• The Faculty of Science in Damanhour includes many laboratories that can be used to serve the educational process in the proposed program without conflicting with the current study system. The faculty also has several lecture halls with small seating capacities that can be used for theoretical teaching without conflicting with the theoretical study of the current programs. In addition, the faculty laboratories contain some specialized scientific equipment that will contribute significantly to practical study.

• Benefiting from Damanhour University's computer network, which is connected to the international information network.

• Benefiting from the Faculty's main library, as well as the Bibliotheca Alexandrina, in addition to the digital library available at the University.

• Benefiting from the central laboratories for analysis and measurement available at the University.

• In addition, part of the financial return shall be used to update and develop laboratories, establish new specialized laboratories, and update the library with books and references.

• Benefiting from human resources, especially faculty members in the scientific departments of the faculty.

Relationship with the Program to the Labor Market

In view of the increasing need for graduates of the Faculty of Science, especially in the field of geographic information systems and surveying, and since the current study system is unable to keep pace with changes and updates in the field of geographic information systems and surveying, the newly introduced program will meet the needs of the labor market, as the graduate will be specialized in the field of geographic information systems and surveying.

The graduate will meet the increasing labor market demand in Egypt and the Arab countries, because most foreigners working in this specialization are currently reluctant to work in these countries, and because this specialization is not available in public or private universities in Egypt and the Arab countries.

Program Structure

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 523	Structural Geology	2	------	------	2
2	Geo 524	Field Geology	2	-----	-----	2
3	Geo 554	Principles of Remote Sensing and Its Applications	2	-------	-------	2
4	Geo 504	Fundamentals of Geographic Information Systems (GIS) and Their Applications	2	------	-------	2
5	Geo 525	Introduction to Mine Surveying	2	-----	------	2
6	Geo 526	Global Positioning System (GPS) Technique and Applications	2	------	------	2

Total Number of Credit Hours = 12

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 527	Topographic Surveying and Photogrammetry	2	------	------	2
2	Geo 528	Advanced Surveying	2	-----	-----	2
3	Geo 529	Applications for Geodetic Surveying	2	-------	-------	2
4	Geo 530	Aerial and Space Digital Photogrammetry	2	------	-------	2
5	Geo 531	Advanced GIS Programming and Modeling	2	-----	------	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
6	Geo 532	Satellite Image Interpretation for Environmental Analysis	2	------	------	2

Total Number of Credit Hours = 12

3. Diploma in Engineering Geology and Mining
   Distinguished Fee-Based Program

Objective of Offering the Program

Engineering geology and mining is simply one of the branches of applied sciences that integrates geology (Earth sciences) and civil engineering, in which geological sciences are applied to the field of engineering studies to ensure that geological factors related to the site, design, construction, operation, and maintenance of engineering works are taken into account.

Engineering geology and mining is concerned with providing geological and geotechnical studies and analyses related to the sites of real estate development operations and the construction of various types of structural facilities belonging to major civil projects such as dams, bridges, and large buildings. Engineering geology and mining studies can be conducted during the stages of planning, environmental impact analysis, and engineering design when initiating various construction projects. These studies are also needed during the construction stages of public and private works projects and post-construction stages. In all of this, a complete geological analysis of sites is required.

Since one of the objectives of the Faculty of Science, Damanhour University, is to develop programs and establish new programs that keep pace with new changes and developments, and to graduate scientists capable of assuming responsibility and meeting the burdens and requirements of workplaces and the labor market in Egypt, one of the objectives of this program is to prepare a graduate capable of assuming responsibility and working in the field of engineering geology and mining in Egypt and the Arab and African countries.

Teaching in this program shall be carried out by specialized professors from the Faculty and the University in cooperation with some specialists from engineering and mining authorities in Egypt. The practical study related to geology courses in this program shall take place in the faculty laboratories, while the practical study related to engineering geology and mining courses shall take place in engineering and mining project sites that can be visited easily and without excessive financial costs and expenses, since Egypt has many such places spread throughout the Republic.

Expected Outcomes

1. The ability to comprehend the basic sciences in chemistry, mathematics, physics, geology, and geophysics.

2. The ability to conduct practical study and extract and analyze results.
3. Practical training at engineering, surveying, and mining authorities during the study period.
4. The ability to work in a team of different specializations.
5. Conviction of the need for continuing education as a basis for the graduate's professional advancement.
6. The ability to use modern technological methods, skills, and practical applications.

General Framework of the Program

♣ The language of study in the program is English.

♣ The faculty bylaws for the diploma stage under the credit hour system shall apply to this program.

♣ To obtain the diploma, the student must successfully pass 24 credit hours.

♣ The academic year consists of two semesters.

In order to achieve maximum benefit and prepare a graduate who keeps pace with changes in the field of science and technology, the program has been designed to:

♣ Provide opportunities to offer specialized courses in geology, engineering geology and mining, groundwater, and geophysics.

♣ Provide a number of elective courses for study in order to highlight the student's talents and assist him/her in specialization.

♣ Provide the opportunity to update the program with recent and new developments in theoretical and applied study.

♣ Seek the assistance of specialists from outside the University, which will further strengthen the relationship between scientific and practical life and prepare a graduate who is familiar with applications.

♣ Introduce the applied graduation project.

♣ Give attention to languages, computer science, and their applications.

♣ Therefore, the graduate will be able to face the labor market in the fields of geology, engineering geology and mining, and geophysics locally, regionally, and internationally.

Overview of the Study Plan of the Program

This program differs from all programs offered by the faculty, and even from those offered by faculties of science in Egypt and the Arab world, as the study plan and teaching method will depend

on the credit hour system, as well as on the use of modern teaching methods, with the student being an active and essential participant in the educational process through:

1. Using modern references via the Internet.
2. Relying on the student in methods of independent research.
3. Continuous assessment of the student.
4. Changing the systems for determining the student's level.
5. Scientific and academic advising.

This program is distinguished by its uniqueness in forming and providing applied scientific cadres in the field of engineering geology and mining, a field that is not available in any Egyptian, Arab, or international universities, or in private universities in Egypt.

The admission requirements for this program are the same requirements applied by the Coordination Office for admission to the Faculty of Science, except for the tuition fees, which are proposed to be EGP 300 per credit hour.

Faculty/University Capabilities that Contribute to the Success of the Program

- The Faculty of Science in Damanhour includes many laboratories that can be used to serve the educational process in the proposed program without conflicting with the current study system. The faculty also has several lecture halls with small seating capacities that can be used for theoretical teaching without conflicting with the theoretical study of the current programs. In addition, the faculty laboratories contain some specialized scientific equipment that will contribute significantly to practical study.
- Benefiting from Damanhour University's computer network, which is connected to the international information network.
- Benefiting from the Faculty's main library, as well as the Bibliotheca Alexandrina, in addition to the digital library available at the University.
- Practical study shall take place in the faculty laboratories and in engineering and mining sites spread throughout the Republic, which can be visited easily and without excessive financial costs.
- Benefiting from the central laboratories for analysis and measurement available at the University.
- In addition, part of the financial return shall be used to update and develop laboratories, establish new specialized laboratories, and update the library with books and references.
- Benefiting from human resources, especially faculty members in the scientific departments of the faculty.

Relationship with the Program to the Labor Market

- In view of the increasing need for graduates of the Faculty of Science, especially in the fields of geology and geophysics, and since the current study system is unable to keep pace with changes and updates in the field of engineering geology and mining, the newly introduced program will meet the needs of the labor market, as the graduate will be specialized in the field of engineering geology and mining.
- The graduate will meet the increasing labor market demand in Egypt and the Arab countries, because most foreigners working in this specialization are currently reluctant to work in these countries, and because this specialization is not available in public or private universities in Egypt and the Arab countries.

Program Structure

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 523	Structural Geology	2	------	------	2
2	Geo 524	Field Geology	2	-----	-----	2
3	Geo 555	Subsurface Geology	2	-------	-------	2
4	Geo 556	Engineering Geology	2	------	-------	2
5	Geo 525	Ore Deposits	2	-----	------	2
6	Geo 526	Industrial Minerals	2	------	------	2

Total Number of Credit Hours = 12

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 548	Geochemical Exploration	2	------	------	2
2	Geo 549	Mining Geology	2	-----	-----	2
3	Geo 550	Ore Dressing	2	-------	-------	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
4	Geo 551	Geophysics and Remote Sensing	2	------	-------	2
5	Geo 552	Geology of Egypt	2	-----	------	2
6	Geo 553	Introduction to Mine Surveying	2	------	------	2

Total Number of Credit Hours = 12

Department of Biochemistry

Applied Studies Diplomas at the Department of Biochemistry:

1. Diploma in Applied Studies in Biochemistry
2. Diploma in Applied Studies in Nutritional Biochemistry
3. Diploma in Applied Studies in Infection Control

1. Diploma in Applied Studies in Biochemistry
   Special Fee-Based Program

Objectives of the Applied Studies Diploma Programs in Biochemistry

1. Providing the graduate with scientific, applied, and technical knowledge and skills in the field of biochemistry, qualifying him/her and providing him/her with modern theories, and preparing him/her to continue higher education and research in the field of various laboratory biochemical analyses, in accordance with future needs and recent developments in Egypt and the world.
2. Enriching knowledge and contributing to scientific developments in the field of biochemistry through scientific research and following up on developments in the field of science.
3. Providing students with a set of general skills to develop their scientific and personal abilities, including communication skills, citation skills, and research ethics.
4. Using theoretical and practical skills through group learning, conducting experiments, and interpreting problems related to bioanalytical processes.
5. Utilizing the laboratory and scientific capabilities of the Department of Biochemistry, Faculty of Science, Damanhour University, to fulfill the requirements of this program, particularly the capabilities of its faculty members, while also seeking other expertise from inside and outside the University.

Justifications for Opening the Biochemistry Diploma Program

1. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge background covering all aspects of biochemistry and its various branches.
2. The strong need of the labor market in Beheira Governorate and its surrounding areas for specialists in the field of biochemistry, laboratory analyses, and chemical analyses, based on an opinion survey of a number of beneficiary bodies such as educational, governmental, and private hospitals, medical centers, and a number of private laboratories in Beheira Governorate.
3. The desire of a large number of students, according to opinion surveys, to continue studying biochemistry and laboratory analyses.
4. Granting graduates of the Faculty of Science and some other practical faculties higher academic certificates to increase their efficiency and opportunities in the labor market.
5. The availability of human material, and laboratory resources to open the postgraduate studies program of the Department of Biochemistry.

Accordingly, it was proposed to add the Biochemistry Diploma as a special fee-based program to the postgraduate studies bylaws of Biochemistry, Faculty of Science, Damanhour University.

Material and Human Resources in Biochemistry Laboratories

1. The Faculty has five student laboratories and a laboratory specialized in biochemistry research, equipped with a complete cell culture unit including a microscope for cell imaging, a CO_2 incubator, and a sterile separation unit, in addition to a complete electrophoresis unit for proteins and genetic material, including an imaging device and semi-quantitative gel estimation. It also has six spectrophotometers covering the ultraviolet and visible spectrum, an ELISA device, six centrifuges, five tissue homogenizers, incubators, thermal ovens, twenty light microscopes, water baths, balances, condensers, micropipettes of different capacities, and burettes. In addition, there are some advanced devices available in the faculty's central laboratory, such as a stem cell separation device and a quantitative PCR device.
2. Regarding human resources, there are three faculty members and seven members of the supporting staff, and two teaching assistants are being appointed in accordance with the University's five-year plan. In addition, the assistance of a suitable number of specialized faculty members seconded by different bodies shall be sought, which is considered appropriate for the teaching load at the beginning.
3. The faculty also has an electronic library that includes a distinguished number of books, in addition to a number of modern printed references.

General Requirements for Admission and Registration in Postgraduate Programs in Biochemistry

First: The Biochemistry Diploma accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Biochemistry, Chemistry, Zoology, Botany, Microbiology, Biotechnology, or Molecular Biology. The program also accepts graduates holding a bachelor's degree from the Faculties of Human Medicine, Veterinary Medicine, Pharmacy, and Agriculture.

First: Diploma Requirements for Students Who Do Not Hold a Bachelor of Science Degree in Biochemistry as a Special, Major, or Minor Specialization
32 Credit Hours Distributed over Two Semesters

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 501	Biomolecules	2	2	3
2	BCh 503	Hormones	2	-	2
3	BCh 504	Cancer Biology	2	-	2
4	BCh 505	Histology and Immunohistochemistry	2	2	2
5	BCh 506	Metabolism and Genetic Disorders	2	-	2
6	BCh 507	Hematology and Parasitology	2	2	3
7	BCh 508	Nanotechnology and Its Bioapplications	1	-	1
8	BCh 509	Quality Control	1	-	1

Total Credit Hours: Theoretical 14 – Practical 3 – Credit Hours 17

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 502	Enzymology	2	2	3
2	BCh 510	Clinical Biochemistry	2	2	3
3	BCh 511	Forensic Biochemistry and Toxicology	2	-	2
4	BCh 512	Basis of Immunology	2	-	2
5	BCh 513	Microbiology and Biotechnology	2	-	2
6	BCh 514	Instrumental and Analytical Methods	2	1	2
7	BCh 515	Essay	1	-	1

Total Credit Hours: Theoretical 13 – Practical 2 – Credit Hours 15

Second: Diploma Requirements for Students Holding a Bachelor of Science Degree in Biochemistry as a Special, Major, or Minor Specialization
24 Credit Hours Divided Over Two Semesters, Each Semester Consisting of 12 Credit Hours

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 504	Cancer Biology	2	-	2
2	BCh 505	Histology and Immunohistochemistry	2	2	2
3	BCh 506	Metabolism and Genetic Disorders	2	-	2
4	BCh 507	Hematology and Parasitology	2	2	3
5	BCh 508	Nanotechnology and Its Bioapplications	1	-	1
6	BCh 509	Quality Control	1	-	1

Total Credit Hours: Theoretical 10 – Practical 2 – Credit Hours 12

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 510	Clinical Biochemistry	2	2	3
2	BCh 511	Forensic Biochemistry and Toxicology	2	-	2
3	BCh 512	Basis of Immunology	2	-	2
4	BCh 513	Microbiology and Biotechnology	2	-	2
5	BCh 514	Instrumental and Analytical Methods	2	1	2
6	BCh 515	Essay	1	-	1

Total Credit Hours: Theoretical 11 – Practical 1 – Credit Hours 12

2. Diploma in Applied Studies in Nutritional Biochemistry
   Special Fee-Based Program

Vision of the Nutritional Biochemistry Diploma Program

1. Preparing highly qualified scientific and applied cadres who have an excellent academic and training background and are equipped with scientific and practical knowledge and skills in biochemistry and nutrition.
2. Preparing qualified cadres to meet the needs of the local and international labor market, with the ability to compete and deal with academic, research, and applied requirements within an ethical framework.

Mission of the Nutritional Biochemistry Diploma Program

1. Contributing to solving health, societal, and environmental problems, and monitoring health problems related to nutrition in the local community in Beheira Governorate and its surrounding areas.
2. Providing the graduate with the basic principles of nutrition in terms of understanding and skill, in addition to in-depth study in the fields of biochemistry and nutrition.
3. Identifying the different nutrients and the principles of planning diets for healthy individuals and patients, in addition to planning and applying appropriate nutritional programs for different age groups.

This vision and mission are fully consistent with the vision and mission of the Faculty of Science in particular and Damanhour University in general, as it is one of the Egyptian public universities whose mission centers on contributing to the cognitive, cultural, human, skill-based, creative, technical, and ethical development of students and members of the Egyptian community, and preparing them to keep pace with advances in knowledge and to participate in achieving the Sustainable Development Goals within a stimulating environment for learning, research, innovation, and creativity. Through this environment, the University presents models of effective partnership between the University and the various sectors of Egyptian society, and contributes to finding forms of cooperation, exchange, and interaction with sources of knowledge, research bodies, hospitals, and local, regional, and international centers of expertise within a framework of competitiveness in quality and excellence.

Accordingly, it was proposed to add the Nutritional Biochemistry Diploma as a special fee-based program to the postgraduate studies bylaws of Biochemistry, Faculty of Science, Damanhour University.

The opinions of stakeholders from different bodies were surveyed.

The questionnaire included 5 specialists from several governmental and private hospitals in Damanhour City, 5 food specialists in various food companies such as the Egyptian Canning Company and Al-Ahram Food Company, and 5 researchers from several research centers and institutes such as the National Research Centre and the Agricultural Research Center. The analysis of the questionnaire results indicated the following:

- The importance of adding the Nutritional Biochemistry Diploma to the educational programs of Damanhour University, provided that it includes courses on the fundamentals of proper nutrition, food fermentation, probiotics, food additives, dietary supplements and their relationship to diseases, food analysis, and how to extract natural nutritional products.
- The possibility that the diploma program can accommodate a considerable number of graduates from different specializations and faculties in Beheira Governorate, where there are a fair number of hospitals, private health centers, food companies, and concerned bodies that may benefit from these graduates.

Targeted Learning Outcomes and Justifications for Opening the Nutritional Biochemistry Diploma Program

1. Providing the graduate with scientific, applied, and technical knowledge and skills in the fields of nutrition and biochemistry, qualifying him/her and providing him/her with modern theories, and preparing him/her to continue higher education and research in the field of nutrition, in accordance with future needs and recent developments in Egypt and the world.
2. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge background in the branches of biochemistry, including nutrition, and granting students a higher academic certificate to increase their efficiency and opportunities in the labor market.
3. The strong need of the labor market in Beheira Governorate and its surrounding areas for specialists in the fields of nutrition, and the desire of a large number of student beneficiaries of the program, as well as owners of hospitals and private health centers, according to opinion surveys, to continue studying this field.
4. Enriching knowledge and contributing to scientific developments in the fields of biochemistry and nutrition through studying and following up on developments in scientific research in both fields.
5. Using theoretical and practical skills through group learning, conducting experiments, interpreting problems related to nutritional biochemistry, and providing students with a set of general skills to develop their scientific and personal abilities, including communication skills, citation skills, and research ethics.
6. The availability of material, laboratory, and human resources in the Biochemistry Division, Faculty of Science, Damanhour University, to open the Nutritional Biochemistry Diploma Program and fulfill its requirements.

Material and Human Resources in Biochemistry Laboratories

1. The Faculty has five student laboratories and a laboratory specialized in biochemistry research, equipped with a complete cell culture unit including a microscope for cell imaging, a CO_2 incubator, and a sterile separation unit, in addition to a complete electrophoresis unit for proteins and genetic material, including an imaging device and semi-quantitative gel estimation. It also has six spectrophotometers covering the ultraviolet and visible spectrum, an ELISA device, six centrifuges, five tissue homogenizers, incubators, thermal ovens, twenty light microscopes, water baths, balances, condensers, micropipettes of different capacities, and burettes. In addition, there are some advanced devices available in the faculty's central laboratory, such as a stem cell separation device and a quantitative PCR device.
2. Regarding human resources, there are three faculty members and seven members of the supporting staff, and two teaching assistants are being appointed in accordance with the University's five-year plan. In addition, the assistance of a suitable number of specialized

faculty members seconded by different bodies shall be sought, which is considered appropriate for the teaching load at the beginning.

3. The faculty also has an electronic library that includes a distinguished number of books, in addition to a number of modern printed references.

General Requirements for Admission and Registration in the Nutritional Biochemistry Diploma Program

The Nutritional Biochemistry Diploma accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Biochemistry, Microbiology, Chemistry, Biotechnology, Zoology, Botany, or Molecular Biology, in addition to graduates of the Faculties of Human Medicine, Pharmacy, Physical Therapy, and Agriculture.

Study System and Requirements for the Nutritional Biochemistry Diploma: 24 credit hours distributed over two semesters.

First Semester Courses: 12 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 550	Principles of Proper Nutrition	2	2	3
2	BCh 551	Nutritional Biomolecules Metabolism	2	2	3
3	BCh 552	Nutrition across the Life Span and Malnutrition	3	--	3
4	BCh 553	Food Fermentation and Probiotics	2	2	3

Total Number of Credit Hours: 12

Second Semester Courses: 12 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BC 554	Nutritional Supplements and Functional Food	2	--	2
2	BC 555	Analysis and Quality of Food	2	2	3
3	BC 556	Genetic Metabolic Disorders	2	--	2
4	BC 557	Nutritional Natural Product Extraction	2	2	3
5	BCh 558	Therapeutic Nutrition	2	--	2

Total Number of Credit Hours: 12

3. Diploma in Applied Studies in Infection Control
   Special Fee-Based Program

Objectives of the Infection Control Diploma Programs

1. Providing the graduate with scientific, applied, and technical knowledge and skills in the fields of biochemistry and microbiology, qualifying him/her and providing him/her with modern theories, and preparing him/her to continue higher education and research in both fields, in accordance with future needs and recent developments in Egypt and the world.
2. Providing students with a set of general skills to develop their scientific and personal abilities, including communication skills, citation skills, and research ethics.
3. Preparing students to resist and control the occurrence of any infection, especially in hospitals and medical centers, thereby limiting the occurrence of an epidemic disaster in such centers.
4. Utilizing the laboratory and human resources of the Departments of Biochemistry, Botany and Microbiology, Faculty of Science, Damanhour University, to fulfill the requirements of this program.

Justifications for Opening the Infection Control Diploma Program

5. Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound knowledge background covering all aspects of biochemistry and microbiology and their various branches.
6. The strong need of the labor market in Beheira Governorate and its surrounding areas for specialists in the field of infection control, based on an opinion survey of a number of beneficiary bodies such as many educational, governmental, and private hospitals, medical centers, and a number of private laboratories in Beheira Governorate.
7. The desire of a large number of students, according to opinion surveys, to continue studying the various branches of biochemistry and microbiology.
8. Granting graduates of scientific faculties higher academic certificates to increase their efficiency and opportunities in the labor market.
9. The availability of human material, and laboratory resources to open the postgraduate studies program of the Departments of Biochemistry and Microbiology.

Accordingly, it was proposed to add the Infection Control Diploma as a special fee-based program to the postgraduate studies bylaws of Biochemistry, Faculty of Science, Damanhour University.

Material and Human Resources in Biochemistry Laboratories and Botany and Microbiology Laboratories

- The faculty has five student laboratories and a laboratory specialized in biochemistry research, as well as three student laboratories in the Department of Botany and Microbiology and a research laboratory, equipped with a complete cell culture unit including a microscope for cell imaging, and a complete electrophoresis unit for proteins and genetic material, including an imaging device and semi-quantitative gel estimation. It also has five spectrophotometers covering the ultraviolet and visible spectrum, an ELISA device, six centrifuges, five tissue homogenizers, incubators, thermal ovens, eight light microscopes, water baths, balances, condensers, micropipettes of different capacities, and burettes. In addition, there are some advanced devices available in the faculty's central laboratory, such as a stem cell separation device, a quantitative PCR device, and a CO_2 incubator.
- Regarding human resources in the Department of Biochemistry, there are three faculty members, one of whom is a professor, and seven members of the supporting staff, and two teaching assistants are being appointed in accordance with the University's five-year plan. In addition, there are 2 professors of microbiology, 3 assistant professors, 6 lecturers, and 4 teaching assistants in the Department of Botany and Microbiology, which is considered appropriate for the teaching load.
- The faculty also has an electronic library that includes a distinguished number of books, in addition to a number of modern printed references.

General Requirements for Admission and Registration in the Infection Control Diploma Program

First: The Infection Control Diploma accepts graduates holding a Bachelor of Science degree from an Egyptian university or its equivalent, provided that the graduate holds a bachelor's degree in a special, major, or minor specialization in Biochemistry, Chemistry, Zoology, Botany, Microbiology, Biotechnology, or Molecular Biology. The program also accepts graduates holding a bachelor's degree from the Faculties of Human Medicine, Pharmacy, Physical Therapy, and Nursing.

Study System and Requirements for the Infection Control Diploma: 24 credit hours distributed over two semesters.

First Semester Courses: 12 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 530	General Aspects of Infection Control	2	-	2
2	BCh 531	Sterilization Techniques	2	2	3
3	BCh 532	Immunity and Vaccinations	2	--	2
4	BCh 533	Microbiology and Infection	2	2	3
5	BCh 534	Disease Transmission Chain	2	--	2

Total Number of Credit Hours: 12

Second Semester Courses: 12 Credit Hours

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 535	Antibiotic Resistance	2	--	2
2	BCh 536	Healthcare-Associated Infection	2	--	2
3	BCh 537	Microbial Metabolomics	2	--	2
4	BCh 538	Quality of Infection Control	2	--	2
5	BCh 539	Safety Accreditation and Improvement Techniques	2	--	2
6	BCh 540	Topics in Epidemiology	2	--	2

Total Number of Credit Hours: 12

B. Professional Diplomas

Department of Chemistry

Professional Diploma in Industrial Chemistry

Professional Diploma in Industrial Chemistry

Targeted Learning Outcomes and Justifications for Opening the Professional Diploma Program in Industrial Chemistry

♣ Enhancing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound theoretical and applied knowledge background in the branches of applied chemistry, including industrial chemistry, and granting students higher academic degrees to increase their practical and applied competence and enhance their opportunities in the current labor market.

♣ Meeting the labor market needs in the field of industrial chemistry, as well as the desire of a large number of student beneficiaries of the program, according to opinion surveys, to continue studying this field.

♣ The availability of laboratory and human resources in the Department of Chemistry, Faculty of Science, Damanhour University, to open the Industrial Chemistry Diploma Program and fulfill its requirements in relation to labor market needs and the needs of the student beneficiaries.

♣ The availability of a large number of factories working in the field of industrial chemistry and its various branches in the North and West Delta region, within the scope of Damanhour University, was one of the motivations for establishing the Industrial Chemistry Program.

♣ Linking the theoretical and laboratory knowledge acquired by students during the study of various chemistry courses to the applied and practical field of chemical industries.

♣ Encouraging students to establish small and micro-projects in the field of industrial chemistry in order to provide job opportunities in the same field.

♣ Providing students with scientific, applied, and technical knowledge and skills in the field of industrial chemistry in order to reduce the phenomenon of importing chemical materials.

♣ Introducing the beneficiaries to the laboratory equipment used in various chemical industries in order to bridge the gap between theoretical study and practical reality in companies and factories.

♣ Providing beneficiaries with development and creativity skills in the field of chemical industries.

Targeted Learning Outcomes and Justifications for Opening the Applied Studies Diploma Program in Forensic Chemistry

♣ Completing the mission of the faculty through the educational programs it offers, which provide graduates of the Faculty of Science with a sound theoretical and applied knowledge background in the branches of applied chemistry, including forensic chemistry, and granting students higher academic degrees to increase their practical and applied competence and enhance their opportunities in the current labor market.

♣ Meeting the labor market needs in the various fields of chemistry, as well as the desire of a large number of beneficiaries of this modern specialized program, according to opinion surveys, to continue studying this field.

♣ The laboratory and human resources, including faculty members and supporting staff in the Department of Chemistry, Faculty of Science, Damanhour University, were among the qualifying motivations for opening the Forensic Chemistry Diploma Program and fulfilling its requirements in relation to labor market needs and the needs of the student beneficiaries.

♣ The increasing demand from state sectors, especially the Ministry of Justice and various port authorities, was one of the main motivations for opening such a specialized program in the field of forensic chemistry.

♣ Acquiring practical skills through courses and training programs provided by experts from the Forensic Medicine Authority, forensic evidence officers, professors of forensic medicine and clinical toxicology at faculties of medicine, and relevant bodies in the fields of work.

♣ Providing beneficiaries with special skills to adapt the various sciences of chemistry to identify different methods of forgery and detect methods of concealing various crimes, in order to confront illegal acts and reduce organized and sophisticated crime.

♣ Introducing students to how to deal with crime detection tools and different crime scenes according to the nature of the surrounding environment.

♣ Knowing and understanding the theoretical and practical aspects related to chemical forensic sciences.

♣ Qualifying beneficiaries to work as part of an integrated research team in the field of forensic chemistry with different specializations, including law professionals, physicians, pharmacists, engineers, etc.

Targeted Learning Outcomes and Justifications for Opening the Applied Studies Diploma Program in Petrochemicals

♣ In view of the state’s orientation toward reducing the importation of intermediate raw materials used to operate factories by establishing projects for the production of intermediate petrochemicals, this was one of the main motivations for opening this program.

♣ The increasing demand for petrochemicals and their derivatives to enrich the manufacturing process in various fields.

♣ Meeting the labor market needs in the various fields of chemistry, as well as the desire of a large number of beneficiaries of this modern specialized program, according to opinion surveys, to continue studying this field.

♣ Linking theoretical study in the various sciences of chemistry to methods of manufacturing, developing, and updating modern petrochemicals.

♣ Benefiting from industry experts in the various fields of petrochemicals to link beneficiaries to practical and applied reality.

♣ The laboratory and human resources, including faculty members and supporting staff in the Department of Chemistry, Faculty of Science, Damanhour University, were among the qualifying motivations for opening the Petrochemical Chemistry Diploma Program and fulfilling its requirements in relation to labor market needs and the needs of the student beneficiaries.

♣ Providing students with various methods for developing petrochemical materials, studying their different properties, and learning how to benefit from these properties in industry.

♣ Meeting the labor market needs for specialists with theoretical, laboratory, practical, and applied competence.

♣ The availability of factories working in the field of petrochemicals in the North and West Delta region, which falls within the scope of Damanhour University, was one of the motivations for opening the program.

Courses of the Professional Diploma in Industrial Chemistry
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Chem 501	Inorganic Industrial Chemistry	2	2	-	3
2	Chem 502	Food Industries	2	2	-	3
3	Chem 503	Environmental Pollutants	2	2	-	3
4	Chem 504	Petroleum and Petrochemical Industries	2	-	-	2
5	Chem 505	Polymer Industries	2	2	-	3
6	Chem 506	Unit Chemical Processes	2	-	-	2
7	Chem 507	Safety and Handling of Hazardous Materials	2	-	-	2
8	Chem 508	Instrumental Analysis (1)	2	2	-	3
9	Chem 509	Processing of Oils and Fats into Utility Products	2	2	-	3

Total Number of Credit Hours: 24

Department of Zoology

Professional Diplomas

Professional Diplomas at the Department of Zoology:

1. Diploma in Insect Control
2. Diploma in Aquaculture

1. Professional Diploma in Insect Control

A. Courses of the Professional Diploma in Insect Control
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 500	Biological Control of Insects	2	2	-	3
2	Bot 500	Plant Pathology	2	-	-	2
3	Zoo 501	Agricultural Parasitic Pests	2	-	-	2
4	Zoo 502	Medical and Forensic Entomology	2	2	-	3
5	Zoo 503	Advanced Insect Physiology	2	-	-	2
6	Zoo 504	Insect Ecology	2	-	-	2
7	Zoo 505	Integrated Pest Management	2	-	-	2
8	Zoo 506	Stored-Product Pest Control	2	-	-	2
9	Zoo 507	Toxicology and Insecticides	2	-	-	2
10	Zoo 508	Bioinformatics	2	-	-	2
11	Zoo 509	Arthropod Vectors	2	-	-	2

Total Number of Credit Hours: 24

2. Professional Diploma in Aquaculture

B. Courses of the Professional Diploma in Aquaculture
(24 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 510	Biology of Marine Invertebrate Animals	2	-	-	2
2	Zoo 511	Aquaculture of Economic Fish and Crustaceans in Egypt	2	2	-	3
3	Zoo 512	Fish Biology	2	-	-	2
4	Zoo 513	Physiology of Fish and Aquatic Invertebrates	2	-	-	3
5	Zoo 514	Marine Fisheries Management	2	-	-	2
6	Zoo 515	Diseases of Fish and Aquatic Invertebrates	2	-	-	2
7	Zoo 516	Fish Breeding and Propagation	2	2	-	3
8	Zoo 517	Natural Marine Products	2	-	-	2
9	Zoo 518	Marine Environmental Pollution	2	-	-	2
10	Zoo 519	Marine Resources	2	-	-	2
11	Zoo 520	Aquatic Ecology	2	-	-	2

Total Number of Credit Hours: 24

Department of Earth Sciences

Professional Diplomas

Professional Diplomas at the Department of Earth Sciences:

1. Diploma in Water Technology
2. Diploma in Climate Change and Coastal Protection

1. Diploma in Water Technology

Objective of Offering the Program

Water technology is considered a fundamental point in environmental geology and, therefore, an essential part of our future. Due to environmental pollution, climate change, and the increasing global population, challenges related to water issues, such as water supply, are increasing. The Water Technology Program focuses on these topics: it covers the problem of mitigating climate change in relation to issues such as flood protection, water desalination technologies, and, of course, aspects such as sustainability and energy. Therefore, water technology includes topics ranging from “resource-oriented sanitation in developing countries” to “industrial wastewater treatment” and “water as a source of energy”.

Since one of the objectives of the Faculty of Science, Damanhour University, is to develop programs and establish new programs that keep pace with new changes and developments, and to graduate scientists capable of assuming responsibility and meeting the burdens and requirements of workplaces and the labor market in Egypt, one of the objectives of this program is to prepare a graduate capable of assuming responsibility and working in the field of water technology in Egypt and the Arab and African countries.

Teaching in this program shall be carried out by specialized professors from the Faculty and the University. The practical study related to geology courses in this program shall take place in the faculty laboratories, while the practical study related to water technology courses shall take place in sites related to water technology that can be visited easily and without excessive financial costs and expenses, since Egypt has many such sites spread throughout the Republic.

Expected Outcomes

1. The ability to comprehend the basic sciences in chemistry, mathematics, physics, geology, and geophysics.
2. The ability to conduct practical study and extract and analyze results.
3. Practical training during the study period.
4. The ability to work in a team of different specializations.
5. Conviction of the need for continuing education as a basis for the graduate’s professional advancement.
6. The ability to use modern technological methods, skills, and practical applications.

General Framework of the Program

• The language of study in the program is English.

• The faculty Bylaws for the diploma stage under the credit hour system shall apply to this program.

• To obtain the diploma, the student must successfully pass 24 credit hours distributed over two semesters. In order to achieve maximum benefit and prepare a graduate who keeps pace with changes in the field of science and technology, this program has been designed to:

- Provide opportunities to offer specialized courses in the field of water technology.
- Provide a number of elective courses for study in order to highlight the student's talents and assist him/her in specialization.
- Provide the opportunity to update the program with recent and new developments in theoretical and applied study.
- Seek the assistance of specialists from outside the University, which will further strengthen the relationship between scientific and practical life and prepare a graduate who is familiar with applications.
- Introduce the applied graduation project.
- Give attention to languages, computer science, and their applications.

Therefore, the graduate will be able to face the labor market in the field of water technology locally, regionally, and internationally.

Overview of the Study Plan of the Program

This program differs from all programs offered by the faculty, and even from those offered by faculties of science in Egypt and the Arab world, as the study plan and teaching method will depend on the credit hour system, as well as on the use of modern teaching methods, with the student being an active and essential participant in the educational process through:

1. Using modern references via the Internet.
2. Relying on the student in methods of independent research.
3. Continuous assessment of the student.
4. Changing the systems for determining the student's level.
5. Scientific and academic advising.

This program is distinguished by its uniqueness in forming and providing applied scientific cadres in the field of water technology, a field that is not available in any Egyptian, Arab, or international universities, or in private universities in Egypt.

Faculty/University Capabilities that Contribute to the Success of the Program

- The Faculty of Science in Damanhour includes many laboratories that can be used to serve the educational process in the proposed program without conflicting with the current study system. The faculty also has several lecture halls with small seating capacities that can be used for theoretical teaching without conflicting with the theoretical study of the current

programs. In addition, the faculty laboratories contain some specialized scientific equipment that will contribute significantly to practical study.

- Benefiting from Damanhour University's computer network, which is connected to the international information network.
- Benefiting from the Faculty's main library, as well as the Bibliotheca Alexandrina, in addition to the digital library available at the University.
- Benefiting from the central laboratories for analysis and measurement available at the University.
- In addition, part of the financial return shall be used to update and develop laboratories, establish new specialized laboratories, and update the library with books and references.
- Benefiting from human resources, especially faculty members in the scientific departments of the faculty.

Relationship with the Program to the Labor Market

- Based on the established fact that solving water technology problems and issues is an inevitable necessity for achieving sustainable development, eliminating poverty, and improving human health and the environment, this program is expected to meet the needs of the water sector by providing water cadres and leaders capable of managing water resources and maximizing their utilization. As we present this distinguished program, we are confident, with God's help, that its implementation steps will be carried out with high levels of efficiency, so that the student will receive proper and appropriate qualification in this field, within the framework of seeking to achieve a form of compatibility between the desired academic and professional requirements, and so that Damanhour University remains a leading center and a beacon of science and knowledge, employing them positively and beneficially in the service of science, the environment, and society.
- The graduate will meet the increasing labor market demand in Egypt and the Arab countries, because most foreigners working in this specialization are currently reluctant to work in these countries, and because this specialization is not available in public or private universities in Egypt and the Arab countries.

Program Structure

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 501	Operation of Wastewater Stations	2	------	------	2
2	Geo 502	Integrated Management of Water Resources	2	-----	-----	2
3	Geo 503	Water Quality Assessment	2	-------	-------	2
4	Geo 504	Fundamentals of Geographic Information Systems (GIS) and Their Applications	2	------	-------	2
5	Geo 505	Hydrogeochemistry	2	-----	------	2
6	Geo 506	Hydrogeology of Egypt	2	------	------	2

Total Number of Credit Hours = 12

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 507	Water Treatment	2	------	------	2
2	Geo 508	Water Desalination	2	-----	-----	2
3	Geo 509	Drilling and Development of Wells	2	-------	-------	2
4	Geo 510	Quality Control in Water Analyses	2	------	-------	2
5	Geo 511	Water Quality Instrumentation	2	-----	------	2
6	Geo 512	Special Course	2	------	------	2

Total Number of Credit Hours = 12

2. Diploma in Climate Change and Coastal Protection

Objective of Offering the Program

There is clear development in all fields and knowledge that increases human welfare and prosperity on this planet. Nevertheless, some challenges and difficulties remain that limit the outcomes of this development.

Climate change is one of those phenomena that represent the greatest challenge to humanity, with its implicit problems related to the escalating pace of global warming, energy production, water scarcity, and its impact on agricultural production.

It is noticeable that these climate changes negatively affect all social and economic aspects related to human life and existence on this planet.

Within the framework of achieving Egypt Vision 2030 to disseminate and achieve sustainable development, with its economic, social, environmental, and international cooperation aspirations, including climate action as one of these goals.

Since one of the objectives of the Faculty of Science, Damanhour University, is to develop programs and establish new programs that keep pace with new changes and developments, and to graduate scientists capable of assuming responsibility and meeting the burdens and requirements of workplaces and the labor market in Egypt, one of the objectives of this program is to prepare a graduate capable of assuming responsibility and working in the field of climate change in Egypt and the Arab and African countries.

Teaching in this program shall be carried out by specialized professors from the Faculty and the University in cooperation with some competent bodies.

Expected Outcomes

1. The ability to comprehend the basic sciences in geology, geophysics, and the environment.
2. The ability to conduct practical study and extract and analyze results.
3. The ability to work in a team of different specializations.
4. Conviction of the need for continuing education as a basis for the graduate's professional advancement.
5. The ability to use modern technological methods, skills, and practical applications.

General Framework of the Program

• The language of study in the program is English.

• The faculty Bylaws for the diploma stage under the credit hour system shall apply to this program.

• To obtain the diploma, the student must successfully pass 24 credit hours distributed over two semesters. In order to achieve maximum benefit and prepare a graduate who keeps pace with changes in the field of science and technology, this program has been designed to:

- Provide opportunities to offer specialized courses in the fields of geology, environment, and geophysics.
- Provide a number of elective courses for study in order to highlight the student's talents and assist him/her in specialization.

- Provide the opportunity to update the program with recent and new developments in theoretical and applied study.
- Seek the assistance of specialists from outside the University, which will further strengthen the relationship between scientific and practical life and prepare a graduate who is familiar with applications.
- Introduce the applied graduation project.
- Give attention to languages, computer science, and their applications.
- Therefore, the graduate will be able to face the labor market in the field of environmental geology locally, regionally, and internationally.

Overview of the Study Plan of the Program

This program differs from all programs offered by the faculty, and even from those offered by faculties of science in Egypt and the Arab world, as the study plan and teaching method will depend on the credit hour system, as well as on the use of modern teaching methods, with the student being an active and essential participant in the educational process through:

1. Using modern references via the Internet.
2. Relying on the student in methods of independent research.
3. Continuous assessment of the student.
4. Changing the systems for determining the student's level.
5. Scientific and academic advising.
6. This program is distinguished by its uniqueness in forming and providing applied scientific cadres in the field of geology and the environment, a field that is not available in any Egyptian, Arab, or international universities, or in private universities in Egypt.

Faculty/University Capabilities that Contribute to the Success of the Program

- The Faculty of Science in Damanhour includes many laboratories that can be used to serve the educational process in the proposed program without conflicting with the current study system. The faculty also has several lecture halls with small seating capacities that can be used for theoretical teaching without conflicting with the theoretical study of the current programs. In addition, the faculty laboratories contain some specialized scientific equipment that will contribute significantly to practical study.
- Benefiting from Damanhour University's computer network, which is connected to the international information network.
- Benefiting from the Faculty's main library, as well as the Bibliotheca Alexandrina, in addition to the digital library available at the University.

- Practical study shall take place in the faculty laboratories.
- Benefiting from the central laboratories for analysis and measurement available at the University.
- Benefiting from human resources, especially faculty members in the scientific departments of the faculty.

Relationship with the Program to the Labor Market

- In view of the increasing need for graduates of the Faculty of Science, especially in the fields of environmental geology and geophysics, and since the current study system is unable to keep pace with changes and updates in the field of climate action, the newly introduced program will meet the needs of the labor market, as the graduate will be specialized in climate change and coastal protection.

Program Structure

First Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 513	Global Climate Change	2	------	------	2
2	Geo 514	Introduction to Oceanography	2	-----	-----	2
3	Geo 515	Coastal and Marine Geology	2	-------	-------	2
4	Geo 504	Fundamentals of Geographic Information Systems (GIS) and Their Applications	2	------	-------	2
5	Geo 516	Earthquakes and Plate Tectonics	2	-----	------	2
6	Geo 517	Climate Change Adaptation and Mitigation Management	2	------	------	2

Total Number of Credit Hours = 12

Second Semester Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Geo 518	Engineering Geology and Coastal Protection	2	------	------	2
2	Geo 519	Physical Processes of Coastal Environments	2	-----	-----	2
3	Geo 520	Climate Models and Observations	2	-------	-------	2
4	Geo 554	Principles of Remote Sensing and Its Applications	2	------	-------	2
5	Geo 521	Marine Resources and Sustainability	2	-----	------	2
6	Geo 522	Environmental Impact Assessment	2	------	------	2

Total Number of Credit Hours = 12

C. Specialized Studies Diplomas

Department of Earth Sciences

Diploma in Applied Geophysics

Diploma in Applied Geophysics

Objective of Offering the Program

The Applied Geophysics Program is an educational program that provides a distinguished level in the sciences of applied geophysics in order to produce an educational cadre capable of competing in the labor market and conducting academic and applied research in geological fields to serve society.

Applied geophysics is considered one of the most important branches of Earth sciences. It is concerned with studying and exploring the subsurface of the Earth by examining variations in its physical properties, such as differences in the strength and intensity of magnetic properties, resistivity, electrical conductivity, gravity, seismic velocity, and other terrestrial physical properties. Through this science, seismic structures and the thermal and radioactive gradient of the Earth have been explored, and its layers have been identified, namely the crust, mantle, outer core, and inner core. This science also helps monitor earthquakes and strong ground motions using ground-based seismographs. Geophysical methods have developed significantly in the field of petroleum, where they are used to identify the locations of new and previously undiscovered oil fields. They have also developed in the field of mining, where they are used to identifying the locations of deposits of buried ores and groundwater. The majority of research in the field of geophysics has been directed and conducted to support these fields, namely petroleum, mining, and groundwater.

With the advancement of the use of geophysical methods in geological exploration in Egypt and given the role they play on the global exploration map for everything hidden beneath the Earth's surface, this has become a national dimension and an obligation upon the University to supply the labor market with cadres of geologists and geophysicists specialized in applied geological studies.

Since one of the objectives of the Faculty of Science, Damanhour University, is to develop programs and establish new programs that keep pace with new changes and developments, and to target a category of scientists interested in developing themselves and fully prepared to assume responsibility and meet the burdens and requirements of workplaces and the labor market in Egypt, one of the objectives of this program is to prepare a distinguished scientific cadre capable of effort and contribution, so that he/she may have the opportunity to work in the field of applied geophysics in Egypt and the Arab and African countries.

Teaching in this program shall be carried out by specialized professors from the Faculty and the University in cooperation with some specialists from the Antiquities Authority. The practical study related to the courses of the Archaeology Diploma Program shall be conducted effectively through combining the theoretical study of the courses with practical study, which increases the scientific cadre's comprehension of archaeology sciences through visits to archaeological sites related to the subject of study and the accompanying field study.

Expected Outcomes

1. The ability to comprehend the basic sciences in the field of applied geophysics.

2. Competence in using geological, geophysical, and mathematical backgrounds, as well as computer applications, in analyzing and interpreting geophysical data.
3. The ability to conduct practical study and extract and analyze results.
4. Practical training on scientific instruments during the study of the diploma courses.
5. Conviction of the need for continuing education as a basis for professional advancement.
6. The ability to use modern technological methods, skills, and practical applications.

General Framework of the Program

The language of study in the program is English.

The faculty bylaws for the diploma stage under the credit hour system shall apply to this program.

Program Structure

The program consists of two semesters comprising 24 credit hours divided over two semesters:

First Semester: It includes the following courses: Seismic Survey Methods – Electrical and Electromagnetic Survey Methods – Magnetic Survey Methods – Gravity Survey Methods – Physical Properties of Rocks – General Geophysics.

Second Semester: It includes the following courses: Geology and Criminal Investigation – Introduction to Seismic Data Processing – Computer Programming in Geophysics – Introduction to Seismology – Interpretation of Electrical and Electromagnetic Data – Introduction to Petrophysics and Well Logging.

Overview of the Study Plan of the Program

This program differs from all programs offered by the faculty, and even from those offered by faculties of science in Egypt and the Arab world, as the study plan and teaching method will depend on the credit hour system, as well as on the use of modern teaching methods that qualify the scientific cadre for effective participation in the labor market, through:

1. Training and learning by highly competent specialists in the field of applied geophysics.
2. Relying on linking theoretical study with the accompanying practical study using the latest scientific instruments.
3. Continuous follow-up and modern methods of performance assessment for the participant in the program.
4. Providing modern learning tools, including instruments, equipment, and intensive field visits.
5. Scientific and academic advising.

This program is distinguished by its uniqueness in forming and providing applied scientific cadres in the field of applied geophysics, a field that is not available in any Egyptian, Arab, or international universities, or in private universities in Egypt. The Applied Geophysics Program is located within the Department of Geology, Faculty of Science, Damanhour University, in Beheira Governorate, which is considered the heart of the Delta and is close to recent natural gas discoveries. This helps raise the efficiency of the cadre through one-day trips to those discoveries, which facilitate practical interaction for the trainee during the study period.

The competitive position of the program graduates at the national level is evident, as a large percentage of the program graduates have been employed at Helwan Observatory and the national research institutes.

Admission Requirements for This Program

For enrollment in the Applied Geophysics Diploma, the trainee must hold a Bachelor of Science degree in Geology, general or special, or in Geophysics, general or special.

Gph 511: Exploration for minerals, petroleum, and groundwater using gravity, magnetic, radioactive, and thermal methods.

Gph 512: Exploration for minerals, petroleum, and groundwater using seismic, reflection seismic, and refraction seismic methods.

Gph 513: Exploration of minerals, petroleum, and groundwater using electrical methods and well logging.

Gph 514: Laboratory and field geophysical studies.

Faculty/University Capabilities that Contribute to the Success of the Program

The Faculty of Science in Damanhour includes many laboratories that can be used to serve the educational process in the proposed program. In addition, the faculty laboratories contain some specialized scientific equipment that will contribute significantly to practical study.

Benefiting from the expertise of specialized professors in the field of applied geophysics.

Benefiting from the Faculty’s main library, as well as the Bibliotheca Alexandrina, in addition to the digital library available at the University.

Practical study shall take place in the faculty laboratories and in specialized sites for geophysical studies spread throughout the Republic, which can be visited easily and without excessive financial costs.

Benefiting from the central laboratories for analysis and measurement available at the University.

Relationship with the Program to the Labor Market

In view of the increasing need for graduates of the Faculty of Science in the field of applied geology, and since the current study system is capable of keeping pace with changes and updates in the field

of applied geology, the newly introduced program will meet the needs of the labor market, as the program graduate will be specialized in the field of applied geophysics.

The graduate will meet the increasing labor market demand in Egypt and the Arab countries, because most foreigners working in this specialization are currently reluctant to work in these countries, and because this specialization is not available in public or private universities in Egypt and the Arab countries.

Program Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Gph 501	Seismic Methods	2	-	-	2
2	Gph 502	Electrical and Electromagnetic Methods	2	-	-	2
3	Gph 503	Magnetic Methods	2	-	-	2
4	Gph 504	Gravity Methods	2	-	-	2
5	Gph 505	Geophysical Properties of Rocks	2	-	-	2
6	Gph 506	General Geophysics	2	-	-	2
7	Gph 507	Forensic Geophysics	2	-	-	2
8	Gph 508	Introduction to Seismic Data Processing	2	-	-	2
9	Gph 509	Computer Applications in Geophysics	2	-	-	2
10	Gph 510	Introduction to Seismology	2	-	-	2
11	Gph 511	Electrical and Electromagnetic Data Processing	2	-	-	2
12	Gph 512	Petrophysics and Well Logging	2	-	-	2

Second: Master of Science

Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science grants the Master of Science degree in the following specializations:

A. Pure Mathematics.
B. Applied Mathematics.
C. Statistics and Data Science.
D. Computer Science.

A. Master of Science in Pure Mathematics

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 601	Ordinary Differential Equations	2	-	-	2
2	Math 602	Functional Analysis (I)	2	-	-	2
3	Math 603	Real Analysis	2	-	-	2
4	Math 604	Abstract Algebra (I)	2	-	-	2
5	Math 605	Numerical Methods and Algorithms	2	-	-	2
6	Math 608	Topology	2	-	-	2
7	Math 611	Complex Analysis	2	-	-	2

M.Sc. Thesis: 20 Credit Hours

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 606	Mathematical Logic and Its Applications	2	-	-	2
2	Math 607	Number Theory	2	-	-	2
3	Math 609	Measure Theory and Integration	2	-	-	2
4	Math 610	Difference Equations	2	-	-	2
5	Math 612	Differential Geometry	2	-	-	2
6	Math 613	Fractional Calculus (I)	2	-	-	2
7	Math 614	Mathematical Theory of Robotics	2	-	-	2
8	Math 615	Partial Differential Equations	2	-	-	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
9	Math 616	Numerical Optimization (I)	2	-	-	2
10	Math 617	Numerical Linear Algebra (I)	2	-	-	2
11	Math 618	Graph Theory	2	-	-	2

B. Master of Science in Applied Mathematics

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 605	Numerical Methods and Algorithms	2	-	-	2
2	Math 621	Quantum Mechanics	2	-	-	2
3	Math 623	Fluid Mechanics	2	-	-	2
4	Math 624	Theory of Elasticity	2	-	-	2
5	Math 625	Methods of Applied Mathematics	2	-	-	2
6	Math 635	Computational Methods in Applied Mathematics	2	-	-	2
7	Math 636	Statistical Mechanics	2	-	-	2

M.Sc. Thesis: 20 Credit Hours

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 626	Aerodynamics	2	-	-	2
2	Math 627	Thermoelasticity	2	-	-	2
3	Math 628	Theory of Plates and Shells	2	-	-	2
4	Math 629	Viscoelasticity	2	-	-	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
5	Math 630	Fluid Dynamics in Electromagnetic Fields	2	-	-	2
6	Math 631	Group Theory and Its Applications in Quantum Mechanics	2	-	-	2
7	Math 632	Nuclear Quantum Mechanics	2	-	-	2
8	Math 633	Micropolar Continuum Mechanics	2	-	-	2
9	Math 634	General Relativity	2	-	-	2

C. Master of Science in Statistics and Data Science

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 605	Numerical Methods and Algorithms	2	-	-	2
2	Stat 641	Multivariate Analysis	2	-	-	2
3	Stat 642	Stochastic Processes and Their Applications	2	-	-	2
4	Stat 643	Time Series Analysis	2	-	-	2
5	Stat 644	Advanced Theory of Statistics	2	-	-	2
6	Stat 649	Data Mining	2	-	-	2
7	Stat 656	Introduction to Numerical Optimization	2	-	-	2

M.Sc. Thesis: 20 Credit Hours

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Stat 646	Advanced Probability Theory	2	-	-	2
2	Stat 647	Advanced Topics in Operations Research	2	-	-	2
3	Stat 648	Information Theory	2	-	-	2
4	Stat 650	Order Statistics and Nonparametric Methods	2	-	-	2
5	Stat 651	Life Testing and Reliability	2	-	-	2
6	Stat 652	Advanced Experimental Design	2	-	-	2
7	Stat 653	Categorical and Censored Data Analysis	2	-	-	2
8	Stat 654	Stochastic Differential Equations	2	-	-	2
9	Stat 655	Reliability Analysis	2	-	-	2
10	Stat 657	Advanced Biostatistics	2	-	-	2

D. Master of Science in Computer Science

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 605	Numerical Methods and Algorithms	2	1	-	2
2	CS 662	Advanced Database Systems	2	1	-	2
3	CS 663	Advanced Software Engineering	2	1	-	2
4	CS 664	Advanced Artificial Intelligence	2	1	-	2
5	CS 605	Advanced Operating Systems	2	1	-	2
6	CS 667	Database and Network Security	2	1	-	2
7	CS 679	Quantum Computing	2	1	-	2

M.Sc. Thesis: 20 Credit Hours

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	CS 666	Biometrics	2	1	-	2
2	CS 668	Pattern Recognition	2	1	-	2
3	CS 669	Image Analysis and Computer Vision	2	1	-	2
4	CS 670	Advanced Embedded Systems	2	1	-	2
5	CS 671	Information Retrieval and Web Search	2	1	-	2
6	CS 672	Secure Software Engineering	2	1	-	2
7	CS 673	High-Performance Computing	2	1	-	2
8	CS 674	Deep Learning in Data Science	2	1	-	2
9	CS 675	Speech and Speaker Recognition	2	1	-	2
10	CS 676	Programming Language Engineering	2	1	-	2
11	CS 677	Advanced Computer Graphics and Interaction	2	1	-	2
12	CS 678	Natural Language Processing	2	1	-	2

Department of Physics

The Department of Physics grants the Master of Science degree in the following specializations:

1. Solid State Physics
2. Materials Science
3. Nanotechnology
4. Theoretical Physics
5. Nuclear Physics
6. Biophysics
7. High Energy Physics and Cosmology
8. Physics of New and Renewable Energy

1. Master of Science in Solid State Physics

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for the M.Sc. thesis.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 615	Advanced Quantum Mechanics	2	---	1	2
2	Phys 616	Mathematical Methods for Theoretical Physics	2	---	1	2
3	Phys 621	Advanced Computational Physics	2	-	1	2
4	Phys 631	Advanced Atomic and Molecular Physics	2	------	1	2
5	Phys 661	Dielectric Properties and Relaxation Theory	2	------	1	2
6	Phys 662	Semiconductors	2	------	1	2
7	Phys 663	Polymer Physics	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 664	Crystal Growth and Materials Characterization	2	---	1	2
2	Phys 665	Electron Microscopy	2	---	1	2
3	Phys 666	Properties of Thin Films	2	-	1	2
4	Phys 667	Lattice Defects	2	------	1	2
5	Phys 668	Interaction of Radiation with Matter	2	------	1	2
6	Phys 634	Condensed Matter Physics	2	------	1	2
7	Phys 635	Quantum Information Theory and Electron Optics	2	------	1	2
8	Phys 670	Theory of Precise Measurements	2	------	1	2

2. Master of Science in Materials Science

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for the M.Sc. thesis.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 615	Advanced Quantum Mechanics	2	---	1	2
2	Phys 616	Mathematical Methods for Theoretical Physics	2	---	1	2
3	Phys 652	Numerical Analysis and Computational Physics	2	-	1	2
4	Phys 669	Dielectric Properties and Relaxation Theory	2	------	1	2
5	Phys 670	Theory of Precise Measurements	2	------	1	2
6	Phys 671	Semiconductors	2	------	1	2
7	Phys 672	Nuclear Magnetism	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 659	Digital Electronics	2	---	1	2
2	Phys 660	Optoelectronics	2	-	1	2
3	Phys 664	Crystal Growth and Materials Characterization	2	---	1	2
4	Phys 665	Electron Microscopy	2	---	1	2
5	Phys 663	Polymer Physics	2	-	1	2
6	Phys 666	Properties of Thin Films	2	------	1	2
7	Phys 634	Condensed Matter Physics	2	------	1	2
8	Phys 668	Interaction of Radiation with Matter	2	------	1	2

3. Master of Science in Nanotechnology

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for the M.Sc. thesis.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 673	Basic Science of Nanotechnology	2	---	1	2
2	Phys 674	Synthesis/Fabrication of Nanomaterials	2	---	1	2
3	Phys 675	Characterization of Nanomaterials	2	-	1	2
4	Phys 665	Electron Microscopy	2	------	1	2
5	Phys 677	Vacuum Science and Thin Film Technology	2	------	1	2
6	Phys 676	Mechanical Properties of Nanomaterials	2	------	1	2
7	Phys 678	Nanoscale Physics and Surface Science	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 679	Quantum Dots	2	---	1	2
2	Phys 666	Properties of Thin Films	2	---	1	2
3	Phys 681	Measurement and Technology of Semiconductor Devices	2	-	1	2
4	Phys 682	Nanotechnology and Alternative and Renewable Energy	2	------	1	2
5	Phys 683	Selected Topics in Nanoscience and Nanotechnology	2	------	1	2
6	Phys 684	Management and Economics of Nanotechnology	2	------	1	2

4. Master of Science in Theoretical Physics

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for the M.Sc. thesis.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 615	Advanced Quantum Mechanics	2	---	1	2
2	Phys 617	Electromagnetic Theory	2	---	1	2
3	Phys 619	Advanced Thermodynamics and Statistical Mechanics	2	-	1	2
4	Phys 621	Advanced Computational Physics	2	------	1	2
5	Phys 614	Quantum Field Theory	2	------	1	2
6	Phys 616	Mathematical Methods for Theoretical Physics	2	------	1	2
7	Phys 618	Modeling of Many-Body Systems	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 625	Standard Model Physics and Beyond	2	---	1	2
2	Phys 626	Group Theory and Its Applications	2	---	1	2
3	Phys 627	Elementary Particles and String Theory	2	-	1	2
4	Phys 628	Advanced Cosmology Physics	2	------	1	2
5	Phys 629	Galaxy Dynamics, Formation, and Evolution	2	------	1	2
6	Phys 620	Theory of General Relativity	2	------	1	2
7	Phys 630	Quantum Phenomena in Gravity	2	------	1	2
8	Phys 633	Advanced Plasma Physics	2	------	1	2
9	Phys 635	Quantum Information Theory and Electron Optics	2	------	1	2
10	Phys 648	Space Plasma and Magnetospheric Physics	2	------	1	2

5. Master of Science in Nuclear Physics

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 615	Advanced Quantum Mechanics	2	---	1	2
2	Phys 617	Electromagnetic Theory	2	---	1	2
3	Phys 619	Advanced Thermodynamics and Statistical Mechanics	2	-	1	2
4	Phys 621	Advanced Computational Physics	2	------	1	2
5	Phys 624	Advanced Nuclear Physics	2	------	1	2
6	Phys 616	Mathematical Methods for Theoretical Physics	2	------	1	2
7	Phys 618	Modeling of Many-Body Systems	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 636	Radiation Dosimetry and Radiation Protection	2	---	1	2
2	Phys 637	Advanced Nuclear Accelerators	2	---	1	2
3	Phys 638	Advanced Nuclear Spectroscopy	2	-	1	2
4	Phys 639	Nuclear Detectors and Devices	2	------	1	2
5	Phys 640	Reactors and Neutrons	2	------	1	2
6	Phys 626	Group Theory and Its Applications	2	------	1	2
7	Phys 627	Elementary Particles and String Theory	2	------	1	2
8	Phys 641	Experimental Nuclear Reactions	2	------	1	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
9	Phys 642	Nuclear Scattering	2	------	1	2

6. Master of Science in Biophysics

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	B. Phys 601	Fundamentals of Radiation Biophysics and Dosimetry	2	---	1	2
2	B. Phys 602	Biological Mathematics	2	---	1	2
3	B. Phys 603	Molecular Biophysics (1)	2	-	1	2
4	B. Phys 604	Biophysics of Ionizing Radiography	2	------	1	2
5	B. Phys 605	Biophysics of Control and Communication Systems	2	------	1	2
6	B. Phys 606	Medical Radiation Protection	2	------	1	2
7	B. Phys 607	Bioelectricity	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	B. Phys 608	Advanced Statistical Thermodynamics in Biological Systems	2	----	------	2
2	B. Phys 609	Advanced Radiological and Nuclear Physics	2	2	----	2
3	B. Phys 610	Radiation Biology	2	2	----	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
4	B. Phys 611	Ionizing and Non-Ionizing Radiation Dosimetry Technology	2	2	----	2
5	B. Phys 612	Basics of Sound Waves and Lasers for Biophysics	2	-----	----	2
6	B. Phys 613	Cell and Membrane Biophysics	2	-----	----	2

7. Master of Science in High Energy Physics and Cosmology

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 615	Advanced Quantum Mechanics	2	---	1	2
2	Phys 617	Electromagnetic Theory	2	---	1	2
3	Phys 619	Advanced Thermodynamics and Statistical Mechanics	2	-	1	2
4	Phys 621	Advanced Computational Physics	2	------	1	2
5	Phys 620	Theory of General Relativity	2	------	1	2
6	Phys 616	Mathematical Methods for Theoretical Physics	2	------	1	2
7	Phys 624	Advanced Nuclear Physics	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 614	Quantum Field Theory	2	---	1	2
2	Phys 625	Standard Model Physics and Beyond	2	---	1	2
3	Phys 643	Modeling of Quantum Many-Body Systems	2	-	1	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
4	Phys 628	Advanced Cosmology Physics	2	------	1	2
5	Phys 629	Galaxy Dynamics, Formation, and Evolution	2	------	1	2
6	Phys 630	Quantum Phenomena in Gravity	2	------	1	2
7	Phys 644	Advanced Astrophysics	2	------	1	2
8	Phys 645	Photo and Particle Detectors	2	---	1	2
9	Phys 646	Electromagnetic Radiation in Astrophysics	2	-	1	2
10	Phys 647	Remote Sensing in Astrophysics	2	------	1	2

8. Master of Science in New and Renewable Energy Physics

The student studies 40 credit hours distributed as follows: 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 649	Principles of Renewable Energy	2	------	1	2
2	Phys 650	New Renewable Energy Resources	2	------	1	2
3	Phys 651	Thermoelectric Materials and Their Applications	2	------	1	2
4	Phys 652	Nanotechnology for Renewable and Alternative Energy	2	------	1	2
5	Phys 653	Materials and Devices for Photovoltaic Applications	2	------	1	2
6	Phys 654	Electrochemical Energy Storage Systems	2	------	1	2
7	Phys 655	Energy Systems Analysis	2	------	1	2
8	Phys 699	M.Sc. Thesis	------	------	-------	20

Elective Courses

The student chooses 6 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 656	Thermodynamics and Internal Combustion Engines	2	---	1	2
2	Phys 657	Energy and Sustainability	2	---	1	2
3	Phys 658	Energy Economics	2	---	1	2
4	Phys 662	Semiconductors	2	------	1	2
5	Phys 664	Crystal Growth and Materials Characterization	2	---	1	2
6	Phys 667	Lattice Defects	2	------	1	2
7	Phys 673	Basic Science of Nanotechnology	2	---	1	2

Department of Chemistry

The Department of Chemistry grants the Master of Science degree in the following specializations:

1. Inorganic Chemistry
2. Analytical Chemistry
3. Physical Chemistry
4. Organic Chemistry

1. Specialization in Inorganic Chemistry

Students study 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for M.Sc. thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 601	Advanced Applied Coordination Chemistry	2	-	2
2	Chem 602	Advanced Inorganic Chemistry	2	-	2
3	Chem 603	Computational Methods in Quantum Chemistry	2	-	2
4	Chem 604	Inorganic Polymer Chemistry and Inorganic Cyclic Compounds	2	-	2
5	Chem 605	Group Theory and Symmetry	2	-	2
6	Chem 607	Scientific Writing	2	-	2
7	Chem 622	Advanced Methods in Instrumental Analysis	2	-	2
8	Chem 699	M.Sc. Thesis Research	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 611	Inorganic Solvent Extraction	2	-	2
2	Chem 612	Sampling Techniques	2	-	2
3	Chem 613	Pharmaceutical Coordination Chemistry	2	-	2
4	Chem 614	Electrical Conductivity of Complexes	2	-	2
5	Chem 615	Modeling in Coordination Chemistry	2	-	2
6	Chem 657	Solid-State Chemistry	-	-	20

2. Specialization in Analytical Chemistry

Students study 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for M.Sc. thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 621	Advanced Analytical Chemistry	2	-	2
2	Chem 622	Advanced Methods in Instrumental Analysis	2	-	2
3	Chem 623	Quality in Chemical Analysis Laboratories	3	-	2
4	Chem 624	Chromatographic Analysis Methods	2	-	2
5	Chem 625	Statistics and Results Analysis	2	-	2
6	Chem 626	Modern Results Processing	2	-	2
7	Chem 607	Scientific Writing	2	-	2
8	Chem 699	M.Sc. Thesis Research	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 631	Modern Spectral Analyses	2	-	2
2	Chem 632	Bioorganometallic Chemistry	2	-	2
3	Chem 613	Pharmaceutical Coordination Chemistry	2	-	2
4	Chem 634	Selected Topics in Analytical Chemistry (1)	2	-	2
5	Chem 637	Different Methods of Water Treatment	2	-	2

3. Specialization in Physical Chemistry

Students study 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for M.Sc. thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 641	Advanced Studies in Chemical Kinetics and Thermodynamics	2	-	2
2	Chem 642	Advanced Electrochemistry and Its Applications	2	-	2
3	Chem 643	Spectroscopic Characterization of Solid Materials	2	-	2
4	Chem 644	Applications of Surface Phenomena and Heterogeneous Catalysis	2	-	2
5	Chem 645	Applications for Quantum Chemistry	2	-	2
6	Chem 607	Scientific Writing	2	-	2
7	Chem 622	Advanced Methods in Instrumental Analysis	2	-	2
8	Chem 699	M.Sc. Thesis Research	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 651	Selected Topics in Computational Chemistry	2	-	2
2	Chem 652	Advanced Corrosion Chemistry	2	-	2
3	Chem 637	Different Methods of Water Desalination	2	-	2
4	Chem 653	Electrochemistry and Electrical Energy Storage Techniques	2	-	2
5	Chem 654	Physical and Chemical Properties of Nanomaterials	2	-	2
6	Chem 657	Solid-State Chemistry	2	-	2

4. Specialization in Organic Chemistry

Students study 14 compulsory credit hours + 6 elective credit hours + 20 credit hours for M.Sc. thesis preparation.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 661	Advanced Heterocyclic Chemistry (1)	2	-	2
2	Chem 662	Oxidation and Reduction in Organic Synthesis	2	-	2
3	Chem 663	Advanced Natural Organic Chemistry	2	-	2
4	Chem 664	Advanced Carbohydrate Chemistry	2	-	2
5	Chem 665	Advanced Applied Spectroscopy	2	-	2
6	Chem 666	Advanced Polymer Chemistry	2	-	2
7	Chem 607	Scientific Writing	2	-	2
8	Chem 699	M.Sc. Thesis Research	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 671	Advanced Organometallic Synthesis	2	-	2
2	Chem 672	Chemistry of Nucleosides	2	-	2
3	Chem 673	Advanced Chemistry of Natural Products	2	-	2
4	Chem 674	Medicinal Chemistry	2	-	2
5	Chem 675	Organic Photochemistry	2	-	2

Department of Botany and Microbiology

The Department of Botany and Microbiology grants the Master of Science degree in the following specializations:

First: Master of Science in Botany:

A. Plant Physiology.

B. Algae.

C. Cytology and Genetics.

D. Taxonomy and Palynology.

E. Plant Ecology.

Second: Master of Science in Microbiology.

First: Master of Science in Botany

A. Specialization in Plant Physiology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 601	Instrumental Analysis of Biological Materials and Products	2	1	-	2
2	Mic 602	Advanced Experimental Design and Biostatistics	2	-	1	2
3	Bot 603	Advanced Plant Bioinformatics	2	-	1	2
4	Bot 604	Advanced Plant Water Relations	2	-	-	2
5	Bot 605	Photosynthetic Pigments	2	-	-	2
6	Bot 606	Stress Physiology	2	-	-	2
7	Bot 607	Plant Hormones and Growth Regulators	2	-	-	2
8	Bot 699	M.Sc. Thesis	-	-	-	20

B. Specialization in Algae

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 601	Instrumental Analysis of Biological Materials and Products	2	1	-	2
2	Mic 602	Advanced Experimental Design and Biostatistics	2	-	1	2
3	Bot 603	Advanced Plant Bioinformatics	2	-	1	2
4	Bot 608	Marine Algal Biodiversity	2	-	-	2
5	Bot 609	Evolutionary Relationships in Algae	2	-	-	2
6	Bot 610	Special Topics in Algae (1)	2	-	-	2
7	Bot 611	Basics of Algal Bioremediation	2	-	-	2
8	Bot 699	M.Sc. Thesis	-	-	-	20

C. Specialization in Cytology and Genetics

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 601	Instrumental Analysis of Biological Materials and Products	2	1	-	2
2	Mic 602	Advanced Experimental Design and Biostatistics	2	-	1	2
3	Bot 603	Advanced Plant Bioinformatics	2	-	1	2
4	Bot 612	Techniques in Molecular Biology	2	-	-	2
5	Bot 613	Cytology and Genetics	1	-	-	2
6	Bot 614	Advanced Epigenetics	2	-	-	2
7	Bot 615	Special Topics in Genetics (1)	2	-	-	2

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
8	Bot 699	M.Sc. Thesis	-	-	-	20

D. Specialization in Taxonomy and Palynology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 601	Instrumental Analysis of Biological Materials and Products	2	1	-	2
2	Mic 602	Advanced Experimental Design and Biostatistics	2	-	1	2
3	Bot 603	Advanced Plant Bioinformatics	2	-	1	2
4	Bot 616	Numerical Taxonomy	2	-	-	2
5	Bot 617	Special Topics in Taxonomy (1)	2	-	-	2
6	Bot 618	Documentation of Genetic Resources	2	-	-	2
7	Bot 619	Plant Fossils	2	-	-	2
8	Bot 699	M.Sc. Thesis	-	-	-	20

E. Specialization in Plant Ecology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 601	Instrumental Analysis of Biological Materials and Products	2	1	-	2
2	Mic 602	Advanced Experimental Design and Biostatistics	2	-	1	2
3	Bot 603	Advanced Plant Bioinformatics	2	-	1	2
4	Bot 620	Advanced Soil Science	2	-	-	2
5	Bot 621	Natural Resources	2	-	-	2
6	Bot 622	Special Topics in Plant Ecology (1)	2	-	-	2
7	Bot 623	Advanced Environmental Biotechnology	2	-	-	2
8	Bot 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses.

Master of Science in Botany: Plant Physiology – Algae – Cytology and Genetics – Taxonomy and Palynology – Plant Ecology

Courses

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 624	Advanced Plant Biotechnology	2	-	-	2
2	Bot 625	Advanced Plant Tissue Culture	2	-	-	2
3	Bot 626	Metabolism and Enzymology of Plant Cells	2	-	-	2
4	Bot 627	Advanced Taxonomy and Bioconservation of Plants	2	-	-	2
5	Bot 628	Environmental Awareness and Environmental Impact Assessment	2	-	-	2
6	Bot 629	Techniques of Protein Purification	2	-	-	2
7	Bot 630	Plant Techniques and Research Methodology	2	-	-	2
8	Bot 631	Physical Oceanography	2	-	-	2
9	Bot 632	Principles of Algal Nanotechnology	2	-	-	2
10	Bot 633	Advanced Flora and Phytogeography	-	-	-	-
11	Bot 634	Economic Botany	2	-	-	2
12	Bot 635	Writing Scientific Projects	2	-	-	2
13	Bot 636	Advanced Genetic Engineering and Biotechnology	2	-	-	2
14	Bot 637	Genetic Toxicology	2	-	-	2

Second: Master of Science in Microbiology

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Bot 601	Instrumental Analysis of Biological Materials and Products	2	-	1	2
2	Mic 602	Advanced Experimental Design and Biostatistics	2	-	1	2
3	Mic 603	Advanced Microbial Bioinformatics	2	-	1	2
4	Mic 604	Advanced Microbial Physiology and Microbial Enzyme Technology	2	-	-	2
5	Mic 605	Advanced Microbial Ecology	2	-	-	2
6	Mic 606	Current Topics in Microbiology	2	-	-	2
7	Mic 607	Current Topics in Molecular Virology	2	-	-	2
8	Mic 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Mic 608	Advanced Applied Microbiology	2	-	-	2
2	Mic 609	Advanced Medical Microbiology	2	-	-	2
3	Mic 610	Vaccines and Sera	2	-	-	2
4	Mic 611	Genomics and Proteomics	2	-	-	2
5	Mic 612	Writing Scientific Projects	2	-	-	2
6	Mic 613	Principles of Microbial and Environmental Risk Assessment	2	-	-	2
7	Mic 614	Current Topics in Food Microbiology	2	-	-	2
8	Mic 615	Special Topics in Molecular Biotechnology	2	-	-	2

Department of Zoology

The Department of Zoology grants the Master of Science degree in the following specializations:

1. Physiology
2. Immunology
3. Invertebrates
4. Parasitology
5. Cell Biology, Histology, and Genetics
6. Animal Ecology
7. Comparative Anatomy and Embryology
8. Entomology
9. Molecular Biology

1. Specialization in Physiology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 600	Advanced Enzymology	2	-	-	2
2	Zoo 601	Hematology	2	-	-	2
3	Zoo 602	Neurophysiology and Endocrinology	2	-	-	2
4	Zoo 603	Histology and Histochemistry	2	-	-	2
5	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses
The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 606	Organ Physiology and Environmental Toxicology	2	-	-	2
2	Zoo 607	Advanced Cardiovascular Physiology	2	-	-	2
3	Zoo 608	Reproductive Physiology	2	-	-	2
4	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
5	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2

2. Specialization in Immunology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 611	Cancer Immunology	2	-	-	2
2	Zoo 612	Cellular and Molecular Immunology	2	-	-	2
3	Zoo 601	Hematology	2	-	-	2
4	Zoo 603	Histology and Histochemistry	2	-	-	2
5	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses
The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 613	Diagnostic Immunology	2	-	-	2
2	Zoo 614	Immunotoxicology	2	-	-	2
3	Zoo 615	Biotechnology	2	1	-	2
4	Zoo 616	Immunotherapy	2	1	-	2
5	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
6	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2

3. Specialization in Invertebrates

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 617	Invertebrate Physiology	2	-	-	2
2	Zoo 618	Invertebrate Embryology and Developmental Biology	2	-	-	2
3	Zoo 619	Advanced Comparative Anatomy of Invertebrates	2	-	-	2
4	Zoo 603	Histology and Histochemistry	2	-	-	2
5	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
2	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
3	Zoo 620	Invertebrate Histology	2	-	-	2
4	Zoo 621	Animal Diversity	2	-	-	2
5	Zoo 622	Organ Physiology and Immunology	2	-	-	2

4. Specialization in Parasitology

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 623	Advanced Nematodes	2	-	-	2
2	Zoo 624	Advanced Protozoa	2	-	-	2
3	Zoo 625	Immunology of Parasitic Infection	2	-	-	2
4	Zoo 603	Histology and Histochemistry	2	-	-	2
5	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
2	Zoo 626	Medical Parasitology	2	-	-	2
3	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
4	Zoo 622	Organ Physiology and Immunology	2	-	-	2

5. Specialization in Cell Biology, Histology, and Genetics

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 627	Cell Biology and Histology	2	-	-	2
2	Zoo 628	Cellular Signaling	2	-	-	2
3	Zoo 629	Cancer Genetics	2	-	-	2
4	Zoo 622	Organ Physiology and Immunology	2	-	-	2
5	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 603	Histology and Histochemistry	2	-	-	2
2	Zoo 630	Tissue Culture and Genetic Engineering	2	-	-	2
3	Zoo 631	Cellular Pathology	2	-	-	2
4	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
5	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2

6. Specialization in Animal Ecology

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 632	Marine Ecology	2	-	-	2
2	Zoo 633	Ecophysiology	2	-	-	2
3	Zoo 634	Soil Ecology	2	-	-	2
4	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
5	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 635	Environmental Toxicology	2	-	-	2
2	Zoo 636	Population Biology	2	-	-	2
3	Zoo 622	Organ Physiology and Immunology	2	-	-	2
4	Zoo 603	Histology and Histochemistry	2	-	-	2
5	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2

7. Specialization in Comparative Anatomy and Embryology

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 637	Advanced Chordate Embryology	2	-	-	2
2	Zoo 638	Advanced Comparative Anatomy of Vertebrates	2	-	-	2
3	Zoo 639	Instruments and Apparatus for Experimental Embryology	2	-	-	2
4	Zoo 622	Organ Physiology and Immunology	2	-	-	2
5	Zoo 603	Histology and Histochemistry	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses

The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
2	Zoo 640	Physiology of Fertilization	3	-	-	3
3	Zoo 641	Control of Limb Growth and Regeneration	3	-	-	3
4	Zoo 642	Developmental Congenital Anomalies	2	-	-	2
5	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
6	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2

8. Specialization in Entomology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 643	Biological Control of Insects	2	-	-	2
2	Zoo 644	Advanced Medical Entomology	2	-	-	2
3	Zoo 645	Economic Insects	2	-	-	2
4	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2
5	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses
The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 646	Insect Pathology	2	-	-	2
2	Zoo 647	Insect Behavior	2	-	-	2
3	Zoo 648	Forensic Entomology	2	-	-	2
4	Zoo 649	Chemical Ecology of Insects	2	-	-	2
5	Zoo 650	Advanced Insect Physiology	2	-	-	2
6	Zoo 603	Histology and Histochemistry	2	-	-	2
7	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
8	Zoo 622	Organ Physiology and Immunology	2	-	-	2

9. Specialization in Molecular Biology

Compulsory Courses
(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 651	Genomics and Proteomics	2	-	-	2
2	Zoo 652	Molecular Diagnosis	2	-	-	2
3	Zoo 653	Topics in Bioinformatics and Genomics	2	-	-	2
4	Zoo 622	Organ Physiology and Immunology	2	-	-	2
5	Zoo 604	Advanced Comparative Anatomy and Embryology of Vertebrates	2	-	-	2
6	Zoo 605	Molecular Biotechnology	2	-	-	2
7	Zoo 657	Biostatistics	2	-	-	2
8	Zoo 699	M.Sc. Thesis	-	-	-	20

Elective Courses
The student chooses 6 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 654	Molecular Biology of RNA	2	-	-	2
2	Zoo 655	Stem Cell Biology	2	-	-	2
3	Zoo 656	Protein Processing	2	-	-	2
4	Zoo 603	Histology and Histochemistry	2	-	-	2
5	Zoo 609	Advanced Biology of Invertebrates and Parasites	2	-	-	2
6	Zoo 610	Advanced Topics in Ecology and Entomology	2	-	-	2

Department of Earth Sciences

The Department of Earth Sciences grants the Master of Science degree in the following specializations:

1. Applied Geology
2. Sedimentary Rocks and Fossils
3. Hard Rocks and Geochemistry
4. Geophysics

1. Applied Geology

A total of 20 credit hours: 14 compulsory credit hours and 6 elective credit hours.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Geo 601	Advanced Hydrogeochemistry	2	-	2
2	Geo 602	Advanced Sedimentary Petrology	2	-	2
3	Geo 603	Advanced Structural Geology	2	-	2
4	Geo 604	Advanced Geophysical Exploration	2	-	2
5	Geo 605	Advanced Geochemical Exploration	2	-	2
6	Geo 606	Advanced Petroleum Geology and Hydrogeology	2	-	2
7	Geo 680	Special Course	2	-	2
8	Geo 699	M.Sc. Thesis	-	-	20

Elective Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
9	Geo 607	Field Geology and Remote Sensing	2	-	2
10	Geo 608	Sedimentary Facies and Stratigraphy	2	-	2
11	Geo 609	Geology of Egypt	2	-	2
12	Geo 610	Natural Disasters and Critical Earth Phenomena	2	-	2
13	Geo 611	Environmental Geophysics	2	-	2
14	Geo 612	Seismic Exploration and Data Analysis	2	-	2

2. Sedimentary Rocks and Fossils

A total of 20 credit hours: 14 compulsory credit hours and 6 elective credit hours.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Geo 602	Advanced Sedimentary Petrology	2	-	2
2	Geo 603	Advanced Structural Geology	2	-	2
3	Geo 613	Advanced Invertebrate Paleontology: Micro- and Macro-Paleontology	2	-	2
4	Geo 614	Advanced Stratigraphy (1)	2	-	2
5	Geo 615	Geology of Egypt: Case Study	2	-	2
6	Geo 616	Quaternary Geology	2	-	2
7	Geo 680	Special Course	2	-	2
8	Geo 699	M.Sc. Thesis	-	-	20

Elective Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
8	Geo 607	Field Geology and Remote Sensing	2	-	2
9	Geo 608	Sedimentary Facies and Stratigraphy	2	-	2
10	Geo 617	Palynology	2	-	2
11	Geo 618	Applied Micropaleontology	2	-	2
12	Geo 619	Clastic Sedimentary Rocks and Petroleum	2	-	2
13	Geo 620	Carbonate Rocks and Evaporites	2	-	2

3. Hard Rocks and Geochemistry Division

A total of 20 credit hours: 14 compulsory credit hours and 6 elective credit hours.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Geo 603	Advanced Structural Geology	2	-	2
2	Geo 609	Geology of Egypt	2	-	2
3	Geo 621	Advanced Mineralogy	2	-	2
4	Geo 622	Advanced Igneous and Metamorphic Petrology	2	-	2
5	Geo 623	Advanced Igneous and Metamorphic Petrology	2	-	2
6	Geo 624	Mining Geology	2	-	2
7	Geo 680	Special Course	2	-	2
8	Geo 699	M.Sc. Thesis	-	-	20

Elective Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
9	Geo 607	Field Geology and Remote Sensing	2	-	2
10	Geo 625	Advanced Economic Geology	2	-	2
11	Geo 626	Advanced Geochemical Exploration	2	-	2
12	Geo 627	Environmental Geology and Geochemistry	2	-	2
13	Geo 628	Advanced Tectonic Geology	2	-	2
14	Geo 629	Isotope Geology	2	-	2

4. Geophysics Division

A total of 20 credit hours: 14 compulsory credit hours and 6 elective credit hours.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Gph 601	Advanced Seismology	2	-	2
2	Gph 602	Earthquake Seismology	2	-	2
3	Gph 603	Advanced Geophysical Acquisition and Interpretation Methods	2	-	2
4	Gph 604	Seismic Data Processing	2	-	2
5	Gph 605	Petrophysics and Well Logging	2	-	2
6	Gph 606	Archaeological Prospecting and Groundwater Exploration	2	-	2
7	Gph 680	Special Course	2	-	2
8	Gph 699	M.Sc. Thesis	-	-	20

Elective Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
9	Gph 607	Radiometric and Geothermal Methods	2	-	2
10	Gph 608	Seismic Properties of Geological Structures	2	-	2
11	Gph 609	Paleomagnetism	2	-	2
12	Gph 610	Advanced Marine Geophysics	2	-	2
13	Gph 612	Seismic Stratigraphy	2	-	2
14	Gph 613	Reservoir Seismics	2	-	2

Department of Biochemistry

Master of Science in Biochemistry

Master of Science in Biochemistry

Admission to the Master of Science Program in Biochemistry is granted to graduates holding a bachelor's degree in Biochemistry as a special, major, or double major specialization from the Faculty of Science at an Egyptian university or its equivalent, provided that the bachelor's degree grade is not less than Good, or that the student's cumulative grade point average at the bachelor's stage is not less than 2.5.

Compulsory Courses

(14 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 601	Nutritional Biochemistry	2	2	3
2	BCh 602	Immunology	2	-	2
3	BCh 603	Cancer at the Molecular Level	2	-	2
4	BCh 604	Enzymology and Its Applications	2	-	2
5	BCh 605	Advanced Clinical Biochemistry	2	2	3
6	BCh 606	Cell Signaling and Endocrinology	2	-	2

Total Credit Hours: Theoretical 12 – Practical 3 – Credit Hours 14

Course Code	Course Name	Credit Hours
BCh 699	M.Sc. Thesis	20

Elective Courses

(6 Credit Hours)

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 607	Biostatistics	2	-	2
2	BCh 608	Immunohistochemistry	1	2	2
3	BCh 609	Natural Products	1	2	2
4	BCh 610	Biochemical Toxicology	2	-	2
5	BCh 611	Advanced Selected Topics in Biochemistry	2	-	2
6	BCh 612	Molecular Biology and Genetic Engineering	2	-	2
7	BCh 613	Instrumental Analysis and Biomedical Screening	2	-	2

Third: Doctor of Philosophy Degree in Science

Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science grants the Doctor of Philosophy degree in science in the following specializations:

A. Pure Mathematics.
B. Applied Mathematics.
C. Statistics and Data Science.
D. Computer Science.

A. Doctor of Philosophy in Pure Mathematics

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 701	Differential Equations	2	-	-	2
2	Math 702	Abstract Algebra (II)	2	-	-	2
3	Math 703	Universal Algebra	2	-	-	2
4	Math 704	Radical Theory	2	-	-	2
5	Math 705	Numerical Linear Algebra (II)	2	-	-	2
6	Math 706	Functional Analysis (II)	2	-	-	2
7	Math 707	Fractional Calculus (II)	2	-	-	2
8	Math 708	Optimal Control	2	-	-	2
9	Math 709	Numerical Optimization (II)	2	-	-	2
10	Math 710	Applied Mathematical Logic	2	-	-	2
11	Math 711	Generalized Functions	2	-	-	2
12	Math 712	Stochastic Analysis	2	-	-	2
13	Math 713	Dynamical Systems	2	-	-	2
14	Math 714	Combinatorial Optimization	2	-	-	2
15	Math 715	Selected Topics in Pure Mathematics	2	-	-	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

B. Doctor of Philosophy in Applied Mathematics

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Math 721	Advanced Quantum Mechanics	2	-	-	2
2	Math 722	Advanced Nuclear Quantum Mechanics	2	-	-	2
3	Math 723	Advanced Applications of Group Theory in Quantum Mechanics	2	-	-	2
4	Math 724	Advanced Fluid Mechanics	2	-	-	2
5	Math 725	Non-Newtonian Fluids	2	-	-	2
6	Math 726	Advanced Aerodynamics	2	-	-	2
7	Math 727	Advanced Thermoelasticity Theory	2	-	-	2
8	Math 728	Advanced Topics in the Theory of Elasticity	2	-	-	2
9	Math 729	Advanced Methods of Applied Mathematics	2	-	-	2
10	Math 730	Advanced Statistical Mechanics	2	-	-	2
11	Math 731	Selected Topics in Applied Mathematics	2	-	-	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

C. Doctor of Philosophy in Statistics and Data Science

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Stat 741	Measure Theory and Advanced Probability	2	-	-	2
2	Stat 742	Advanced Topics in Time Series Analysis	2	-	-	2
3	Stat 743	Advanced Computations in Statistics	2	-	-	2
4	Stat 744	Linear and Non-Linear Statistical Models	2	-	-	2
5	Stat 745	Advanced Statistical Inference	2	-	-	2
6	Stat 746	Advanced Theory of Non-Parametric Statistics	2	-	-	2
7	Stat 747	Selected Topics in Operations Research	2	-	-	2
8	Stat 748	Reliability Theory	2	-	-	2
9	Stat 749	Studies in Functional Analysis	2	-	-	2
10	Stat 750	Studies in Numerical Optimization	2	-	-	2
11	Stat 751	Selected Topics in Statistics and Data Science	2	-	-	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

D. Doctor of Philosophy in Computer Science

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	CS 761	Automated Algorithmic Process Management	2	1	-	2
2	CS 762	Quantum Algorithms and Quantum Circuits	2	1	-	2
3	CS 763	Artificial Intelligence Implementation	2	1	-	2
4	CS 764	Advanced Software Design	2	1	-	2
5	CS 765	Advanced Databases: Theory and Applications	2	1	-	2
6	CS 766	Blockchain Technology	2	1	-	2
7	CS 767	Embedded Systems and Robotics	2	1	-	2
8	CS 768	Advanced Digital Signal Processing	2	1	-	2
9	CS 769	Emerging Topics in Artificial Intelligence	2	1	-	2
10	CS 770	Data Mining and Knowledge Discovery	2	1	-	2
11	CS 771	Contemporary Computer Architecture: Advanced Analysis and Design of Algorithms	2	1	-	2
12	CS 772	Selected Topics in Computer Science	2	1	-	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

Department of Physics

The Department of Physics grants the Doctor of Philosophy degree in science in the following specializations:

1. Biophysics
2. Theoretical Physics
3. Nuclear Physics
4. Solid State Physics
5. High Energy Physics and Cosmology
6. Physics of New and Renewable Energy
7. Materials Science
8. Nanotechnology

1. Doctor of Philosophy in Biophysics

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses
The student chooses 4 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	B. Phys 701	Membrane and Cell Biophysics	2	----	2
2	B. Phys 702	Radiotherapy Planning	2	---	2
3	B. Phys 703	Nervous System Biophysics	2	---	2
4	B. Phys 704	Physical Therapy Using Electromagnetic Waves	2	---	2
5	B. Phys 705	Biophysical Measurements	2	---	2
6	B. Phys 706	Bioinformatics	2	---	2
7	B. Phys 707	Biosystems Electronics	2	---	2
8	B. Phys 708	Selected Topics in Biophysics	2	---	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

2. Doctor of Philosophy in Theoretical Physics

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Phys 709	Advanced Computational Physics and Modeling	2	---	2
2	Phys 711	Mathematical Methods in Theoretical Physics (2)	2	---	2
3	Phys 708	Review Article in Selected Topics	2	---	2
4	Phys 710	Advanced Topics in Statistical Mechanics	2	---	2
5	Phys 712	Dynamical Analysis of Complex Systems	2	---	2
6	Phys 714	Leptons and Quarks Physics	2	---	2
7	Phys 715	Atomic Energy Levels for High-Resolution Lines	2	---	2
8	Phys 717	Advanced Topics in the Theory of General Relativity	2	---	2
9	Phys 716	Functional Methods in Quantum Field Theory	2	---	2
10	Phys 718	String Theory and Branes	2	---	2
11	Phys 719	Equilibrium Analysis of Complex Systems	2	---	2

Requirement Status	**Credit Hours**
Ph.D. Thesis Compulsory	48

3. Doctor of Philosophy in Nuclear Physics

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Phys 713	Computational Nuclear Physics	2	---	2
2	Phys 711	Mathematical Methods in Theoretical Physics (2)	2	---	2
3	Phys 708	Review Article in Selected Topics	2	---	2
4	Phys 714	Leptons and Quarks Physics	2	---	2
5	Phys 720	Direct Nuclear Reactions	2	---	2
6	Phys 721	Nuclear Structure Theory	2	---	2
7	Phys 722	Introduction to Heavy-Ion Collisions at High Energies	2	---	2
8	Phys 723	Gauge Theory of Elementary Particles	2	---	2
9	Phys 712	Dynamical Analysis of Complex Systems	2	---	2
10	Phys 710	Advanced Topics in Statistical Mechanics	2	---	2
11	Phys 756	Electron Spin Resonance and Nuclear Magnetic Resonance	2	---	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

4. Doctor of Philosophy in Solid State Physics

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 739	Experimental Methods in Solid State Physics	2	---	1	2
2	Phys 741	Transport Phenomena in Solids	2	---	1	2
3	Phys 715	Atomic Energy Levels for High-Resolution Lines	2	----	1	2
4	Phys 740	Advanced Electrochemical Energy Storage Systems	2	----	1	2
5	Phys 742	Superconducting Materials and Devices	2	----	1	2
6	Phys 743	Optical Properties of Semiconductors	2	----	1	2
7	Phys 744	Surface Physics	2	----	1	2
8	Phys 732	Many-Body Theory of Solids	2	---	1	2
9	Phys 733	Electrical and Magnetic Properties of Solids	2	---	1	2
10	Phys 737	Spectroscopic Analysis Methods	2	----	1	2
11	Phys 738	Materials Modeling and Simulation	2	----	1	2

Requirement Status **Credit Hours**

Ph.D. Thesis Compulsory 48

5. Doctor of Philosophy in High Energy Physics and Cosmology

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 757	Supersymmetry Theory	2	---	1	2
2	Phys 717	Advanced Topics in the Theory of General Relativity	2	---	1	2
3	Phys 708	Review Article in Selected Topics	2	---	1	2
4	Phys 710	Advanced Topics in Statistical Mechanics	2	---	1	2
5	Phys 712	Dynamical Analysis of Complex Systems	2	---	1	2
6	Phys 724	Extrasolar Planets and Astrophysical Discs	2	---	1	2
7	Phys 725	Quantum Information in Gravitational Fields	2	---	1	2
8	Phys 716	Functional Methods in Quantum Field Theory	2	---	1	2
9	Phys 726	Quantum Gravity and Field Theory	2	---	1	2
10	Phys 718	String Theory and Branes	2	---	1	2
11	Phys 730	Advanced Precision Measurements	2	---	1	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

6. Doctor of Philosophy in New and Renewable Energy Physics

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 727	Environmental Impact of Energy and Green Buildings	2	----	1	2
2	Phys 728	Energy Efficiency and Economy	2	----	1	2
3	Phys 708	Review Article in Selected Topics	2	----	1	2
4	Phys 738	Materials Modeling and Simulation	2	----	1	2
5	Phys 743	Optical Properties of Semiconductors	2	----	1	2
6	Phys 745	Material Selection and Performance	2	----	1	2
7	Phys 749	Smart Materials	2	----	1	2
8	Phys 734	Advanced Methods in Materials Structure Research	2	----	1	2
9	Phys 754	Nanotechnology Applications in Solar Cells	2	----	1	2

Requirement Status	**Credit Hours**
Ph.D. Thesis	Compulsory 48

7. Doctor of Philosophy in Materials Science

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 745	Material Selection and Performance	2	---	1	2
2	Phys 747	Materials Processing	2	---	1	2
3	Phys 746	Materials Characterization Techniques	2	---	1	2
4	Phys 742	Superconducting Materials and Devices	2	---	1	2
5	Phys 748	Principles of Physical Metallurgy	2	---	1	2
6	Phys 749	Smart Materials	2	---	1	2
7	Phys 734	Advanced Methods in Materials Structure Research	2	---	1	2
8	Phys 735	Nanomaterials Physics	2	---	1	2
9	Phys 736	Ultrafast Lasers	2	---	1	2
10	Phys 737	Spectroscopic Analysis Methods	2	---	1	2
11	Phys 738	Materials Modeling and Simulation	2	---	1	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

8. Doctor of Philosophy in Nanotechnology

The student studies 60 credit hours distributed as follows: 12 elective credit hours + 48 credit hours for the Ph.D. thesis.

Elective Courses

The student chooses 12 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Phys 751	Nanoscience and Quantum Materials	2	---	1	2
2	Phys 753	Composite Nanophysics and Technology	2	---	1	2
3	Phys 738	Materials Modeling and Simulation	2	---	1	2
4	Phys 750	Nano Applications in Defense and Security	2	---	1	2
5	Phys 752	Thin Film Science and Technology	2	---	1	2
6	Phys 754	Nanotechnology Applications in Solar Cells	2	---	1	2
7	Phys 755	Selected Topics in Nanoscience and Engineering	2	---	1	2

Requirement	**Status**	**Credit Hours**
Ph.D. Thesis	Compulsory	48

Department of Chemistry

The Department of Chemistry grants the Doctor of Philosophy degree in science in the following specializations:

A. Inorganic Chemistry

B. Analytical Chemistry

C. Physical Chemistry

D. Organic Chemistry

A. Doctor of Philosophy in Inorganic Chemistry

The student chooses 12 credit hours from the following courses + 48 credit hours for conducting the research study and preparing the Ph.D. thesis:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 701	Advanced Coordination Chemistry	2	-	2
2	Chem 702	Inorganic Biochemistry	2	-	2
3	Chem 703	Advanced Techniques for Structural Determination of Inorganic Compounds	2	-	2
4	Chem 704	Circular Dichroism Methods in Complexes	2	-	2
5	Chem 705	Solid-Phase Extraction	2	-	2
6	Chem 706	Selected Topics in Inorganic Chemistry (1)	2	-	2
7	Chem 707	Laser Applications in Inorganic Chemistry	2	-	2
8	Chem 708	Selected Topics in Inorganic Chemistry (2)	2	-	2
9	Chem 799	Ph.D. Thesis Research	-	-	48

B. Doctor of Philosophy in Analytical Chemistry

The student chooses 12 credit hours from the following courses + 48 credit hours for conducting the research study and preparing the Ph.D. thesis:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 711	Advanced Environmental Analytical Chemistry	2	-	2
2	Chem 712	Selected Topics in Analytical Chemistry (II)	2	-	2
3	Chem 713	Methods of Industrial Gas Analysis	2	-	2
4	Chem 714	Solution Equilibria	2	-	2
5	Chem 715	Techniques of Wastewater Analysis and Treatment	2	-	2
6	Chem 716	Advanced Pharmaceutical Analytical Chemistry	2	-	2
7	Chem 717	Spectroscopic Applications in Analytical Chemistry	2	-	2
8	Chem 718	Selected Topics in Analytical Chemistry	2	-	2
9	Chem 799	Ph.D. Thesis Research	-	-	48

C. Doctor of Philosophy in Physical Chemistry

The student chooses 12 credit hours from the following courses + 48 credit hours for conducting the research study and preparing the Ph.D. thesis:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 731	Ionic Conductance and Ionic Association	2	-	2
2	Chem 732	Physical and Mechanical Properties of Polymer Molecules	2	-	2
3	Chem 733	Advanced Selected Topics in Physical Chemistry	2	-	2
4	Chem 734	Environmental Applications of Catalysis	2	-	2
5	Chem 735	Nanoporous Materials	2	-	2
6	Chem 716	Advanced Pharmaceutical Analytical Chemistry	2	-	2
7	Chem 737	Laser Applications in Physical Chemistry	2	-	2
8	Chem 799	Ph.D. Thesis Research	-	-	48

D. Doctor of Philosophy in Organic Chemistry

The student chooses 12 credit hours from the following courses + 48 credit hours for conducting the research study and preparing the Ph.D. thesis:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Chem 741	Green Organic Chemistry	2	-	2
2	Chem 742	Multi-Reactant Organic Synthesis	2	-	2
3	Chem 743	Organic Reaction Design Strategy	2	-	2
4	Chem 744	Computational Chemistry Applications	2	-	2
5	Chem 745	Forensic Chemistry	2	-	2
6	Chem 746	Advanced Heterocyclic Chemistry (2)	2	-	2
7	Chem 747	Catalytic Complexes in Organic Reactions	2	-	2
8	Chem 748	Tools for Suggesting Organic Reaction Mechanisms	2	-	2
8	Chem 749	Selected Topics in Organic Chemistry	2	-	2
9	Chem 799	Ph.D. Thesis Research	-	-	48

Department of Botany and Microbiology

The Department of Botany and Microbiology grants the Doctor of Philosophy degree in science in the following specializations:

1. Doctor of Philosophy in Botany in:
    A. Plant Physiology.
    B. Algae.
    C. Cytology and Genetics.
    D. Taxonomy and Palynology.
    E. Plant Ecology.
2. Doctor of Philosophy in Microbiology.

First: Doctor of Philosophy in Botany

A. Doctor of Philosophy in Plant Physiology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Bot 701	Plant Cell Membranes	2	-	2
2	Bot 702	Nitrogen, Amino Acid, and Nucleic Acid Metabolism	2	-	2
3	Bot 703	Advanced Plant Metabolism and Biochemistry	2	-	2
4	Bot 704	Photosynthesis and Water Consumption	2	-	2
5	Bot 705	Biosynthesis of Proteins and Polysaccharides	2	-	2
6	Bot 706	Phytoremediation, Biofortification, and Nanoparticles	2	-	2
7	Bot 707	Plant Secondary Metabolites	2	-	2
8	Bot 708	Plant and Crop Stress	2	-	2
9	Bot 799	Ph.D. Thesis Research	-	-	24

B. Doctor of Philosophy in Algae

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Bot 709	Algal Management for Marine Pollution	2	-	2
2	Bot 710	Advanced Marine Microbiology	2	-	2
3	Bot 711	Advanced Algal Physiology	2	-	2
4	Bot 712	Algal Anatomy	2	-	2
5	Bot 713	Algal Biofuels	2	-	2
6	Bot 714	Algal Biodiversity	2	-	2
7	Bot 715	Algal Metabolism	2	-	2
8	Bot 716	Phytoplankton Toxins	2	-	2
9	Bot 799	Ph.D. Thesis Research	-	-	24

C. Doctor of Philosophy in Cytology and Genetics

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Bot 717	Advanced Molecular Genetics	2	-	2
2	Bot 718	Genetic Engineering Applications	2	-	2
3	Bot 719	Advanced Gene Expression	1	-	2
4	Bot 720	Molecular Genetics, Molecular Basis of Development and Differentiation	2	-	2
5	Bot 721	Specialized Topics in Genetics (2)	2	-	2
6	Bot 722	Epigenetics Applications	2	-	2
7	Bot 723	Genomics and Proteomics	2	-	2
8	Bot 724	Specialized Topics in Genetics (3)	2	-	2
9	Bot 799	Ph.D. Thesis Research	-	-	24

D. Doctor of Philosophy in Taxonomy and Palynology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Bot 725	Applications of Cladistic Models	2	-	2
2	Bot 726	Molecular Taxonomy	2	-	2
3	Bot 727	Origin of Angiosperms	2	-	2
4	Bot 728	Plant Systematic Anatomy	2	-	2
5	Bot 729	Sustainable Development and Natural Resources Management	2	-	2
6	Bot 730	Special Topics in Taxonomy (2)	2	-	2
7	Bot 731	Plant Chemotaxonomy	-	-	-
8	Bot 799	Ph.D. Thesis Research	-	-	24

E. Doctor of Philosophy in Plant Ecology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Bot 729	Sustainable Development and Natural Resources Management	2	-	2
2	Bot 731	Plant Chemotaxonomy	2	-	2
3	Bot 732	Conservation and Rehabilitation of Ecosystems	2	-	2
4	Bot 733	Safety of Using Herbal Medicine and Medicinal Plants	2	-	2
5	Bot 734	Plant Propagation Programs	2	-	2
6	Bot 735	Special Topics in Plant Ecology (2)	2	-	2
7	Bot 736	Traditional Uses of Medicinal Plants	2	-	2
8	Bot 799	Ph.D. Thesis Research	-	-	24

Second: Doctor of Philosophy in Microbiology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Mic 701	Evolution and Molecular Systematics	2	-	2
2	Mic 702	Advanced Marine Microbiology	2	-	2
3	Mic 703	Advanced Applied Immunology and Methodology	2	-	2
4	Mic 704	Biotechnology of Microbial Systems	2	-	2
5	Mic 705	Biodegradation and Bioremediation	2	-	2
6	Mic 706	Special Topics in Microbiology	2	-	2
7	Mic 707	Topics in Soil Microbiology	2	-	2
8	Mic 708	Advanced Topics in Applied Virology	2	-	2
9	Mic 709	Scientific Project Writing and Ethics of Scientific Research	2	-	2
10	Mic 799	Ph.D. Thesis Research	-	-	24

Note: The student may not register for Course No. 9 if he/she has previously studied it at the master's stage.

Department of Zoology

The Department of Zoology grants the Doctor of Philosophy degree in science in the following specializations:

1. Physiology
2. Immunology
3. Invertebrates
4. Parasitology
5. Cytology, Histology, and Genetics
6. Animal Ecology
7. Comparative Anatomy and Embryology
8. Entomology
9. Molecular Biology

1. Specialization in Physiology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 700	Renal Physiology and Acid-Base Balance	2	-	-	2
2	Zoo 701	Advanced Endocrinology	2	-	-	2
3	Zoo 702	Neuroscience and Mental Awareness in Humans	2	-	-	2
4	Zoo 703	Advanced Topics in Immunology	2	-	-	2
5	Zoo 704	Metabolism and Metabolic Physiology	2	-	-	2
6	Zoo 705	Physiology of the Musculoskeletal System	2	-	-	2
7	Zoo 750	Selected Topics in Physiology (1)	2	-	-	2
8	Zoo 751	Selected Topics in Physiology (2)	2	-	-	2
9	Zoo 799	Ph.D. Thesis Research	-	-	-	48

2. Specialization in Immunology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 706	Immunomodulators and Their Applications	2	1	-	2
2	Zoo 707	Modern Antibiotic and Antiviral Strategies	2	1	-	2
3	Zoo 708	Autoimmune Diseases	2	-	-	2
4	Zoo 709	Advanced Immunology	2	-	-	2
5	Zoo 752	Selected Topics in Immunology (1)	2	-	-	2
6	Zoo 553	Selected Topics in Immunology (2)	2	-	-	2
7	Zoo 799	Ph.D. Thesis Research	-	-	-	52

3. Specialization in Invertebrates

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Zoo 710	Evolution and Development of Invertebrates	2	-	2
2	Zoo 711	Invertebrate Pathology	2	-	2
3	Zoo 712	Biology and Ecology of Terrestrial Invertebrates	2	-	2
4	Zoo 713	Ecophysiology of Marine Invertebrates	2	-	2
5	Zoo 714	Special Topics in Invertebrates (1)	2	-	2
6	Zoo 554	Special Topics in Invertebrates (2)	2	-	2
7	Zoo 799	Ph.D. Thesis Research	-	-	48

4. Specialization in Parasitology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Zoo 715	Vector Biology	2	-	2
2	Zoo 716	Fish Parasites	2	-	2
3	Zoo 717	Host-Parasite Interactions	2	-	2
4	Zoo 718	Environmental Parasitology	2	-	2
5	Zoo 719	Molecular Ecology of Parasites	2	-	2
6	Zoo 755	Selected Topics in Parasitology (1)	2	-	2
7	Zoo 756	Selected Topics in Parasitology (2)	2	-	2
8	Zoo 799	Ph.D. Thesis Research	-	-	48

5. Specialization in Cell Biology, Histology, and Genetics

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Zoo 720	Advanced Cell Biology	2	-	2
2	Zoo 721	Advanced Histopathology	2	-	2
3	Zoo 722	Genetic Engineering and Gene Technology	2	-	2
4	Zoo 723	Oncology and Animal Cell Culture	2	-	2
5	Zoo 724	Advanced Histochemistry	2	-	2
6	Zoo 757	Selected Topics in Cell Biology, Histology, and Genetics (1)	2	-	2
7	Zoo 758	Selected Topics in Cell Biology, Histology, and Genetics (2)	2	-	2
8	Zoo 799	Ph.D. Thesis Research	-	-	48

6. Specialization in Animal Ecology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Zoo 725	Desert Ecology	3	-	3
2	Zoo 726	Ecosystem	2	-	2
3	Zoo 727	Ecological Pollution Control	2	-	2
4	Zoo 728	Community Ecology and Biodiversity	2	-	2
5	Zoo 729	Animal Behavior	2	-	2
6	Zoo 730	Environmental Risk Assessment and Climatic Changes	2	-	2
7	Zoo 759	Selected Topics in Animal Ecology	2	-	2
6	Zoo 799	Ph.D. Thesis Research	-	-	48

7. Specialization in Comparative Anatomy and Embryology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Zoo 731	Biology of Evolution and Vertebrate Origin	2	-	2
2	Zoo 732	Congenital Anomalies of Embryos	2	-	2
3	Zoo 733	Cellular Signaling and Regulation	2	-	2
4	Zoo 734	Advanced Neurodevelopment	2	-	2
5	Zoo 735	Physiological Changes in Embryos	2	-	2
6	Zoo 760	Selected Topics in Comparative Anatomy and Embryology (1)	2	-	2
7	Zoo 761	Selected Topics in Comparative Anatomy and Embryology (2)	2	-	2
6	Zoo 799	Ph.D. Thesis Research	-	-	48

8. Specialization in Entomology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Tutorials	Credit Hours
1	Zoo 736	Insect Taxonomy and Evolution	2	-	-	2
2	Zoo 737	Social Insects	2	-	-	2
3	Zoo 738	Aquatic Entomology and Pollution	2	-	-	2
4	Zoo 739	Insect Population Genetics and Evolution	2	-	-	2
5	Zoo 740	Insect Hormones and Pheromones	2	-	-	2
7	Zoo 741	Insect Microbiology	2	-	-	2
8	Zoo 742	Advanced Topics in Medical and Forensic Entomology	2	-	-	2
9	Zoo 799	Ph.D. Thesis Research	-	-	-	48

9. Specialization in Molecular Biology

The student chooses 12 credit hours from the following courses:

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Zoo 743	Molecular Mechanisms of Tumorigenesis	2	-	2
2	Zoo 744	Advanced Proteomics	2	-	2
3	Zoo 745	Advanced Molecular Therapeutics	2	-	2
4	Zoo 746	Molecular Immunology	2	-	2
5	Zoo 747	Molecular Genetics	2	-	2
6	Zoo 748	Selected Topics in Molecular Biology (1)	2	-	2
7	Zoo 749	Selected Topics in Molecular Biology (2)	2	-	2
8	Zoo 799	Ph.D. Thesis Research	-	-	48

Department of Earth Sciences

The Department of Earth Sciences grants the Doctor of Philosophy degree in science in the following specializations:

1- Applied Geology
2- Sedimentary Rocks and Paleontology
3- Hard Rocks and Geochemistry
4- Geophysics

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1. Doctor of Philosophy in Applied Geology

With 12 elective credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Geo 701	Structural Geology	2	-	2
2	Geo 780	Special Course	2	-	2
3	Geo 702	Advanced Engineering Geology	2	-	2
4	Geo 703	Advanced Petroleum Geology	2	-	2
5	Geo 704	Well Logging and Formation Evaluation	2	-	2
6	Geo 705	Advanced Mining Geology	2	-	2
7	Geo 712	Selected Topics in Applied Geology (1)	2	-	2
8	Geo 713	Selected Topics in Applied Geology (2)	2	-	2
9	Geo 799	Ph.D. Thesis Research	-	-	48

2. Doctor of Philosophy in Sedimentary Rocks and Paleontology

With 12 elective credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Geo 701	Structural Geology	2	-	2
2	Geo 780	Special Course	2	-	2
3	Geo 706	Advanced Topography	2	-	2
4	Geo 707	Advanced Stratigraphy	2	-	2
5	Geo 708	Advanced Marine Geology	2	-	2
6	Geo 709	Advanced Paleontology	2	-	2
7	Geo 717	Selected Topics in Rocks and Paleontology (1)	2	-	2
8	Geo 718	Selected Topics in Rocks and Paleontology (2)	2	-	2
9	Geo 799	Ph.D. Thesis Research	-	-	48

3. Doctor of Philosophy in Hard Rocks and Geochemistry

With 12 elective credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Geo 701	Structural Geology	2	-	2
2	Geo 780	Special Course	2	-	2
3	Geo 706	Advanced Topography	2	-	2
4	Geo 707	Advanced Stratigraphy	2	-	2
5	Geo 708	Advanced Marine Geology	2	-	2
6	Geo 709	Advanced Paleontology	2	-	2
7	Geo 714	Selected Topics in Rocks and Paleontology (1)	2	-	2
8	Geo 715	Selected Topics in Rocks and Paleontology (2)	2	-	2
9	Geo 799	Ph.D. Thesis Research	-	-	48

4. Doctor of Philosophy in Geophysics

With 12 elective credit hours.

Compulsory Courses

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	Gph 701	Advanced Potential Field Methods	2	-	2
2	Geo 780	Special Course	2	-	2
3	Gph 702	Seismic Data Processing	2	-	2
4	Gph 703	Seismic Stratigraphy	2	-	2
5	Gph 704	Seismic Reservoir	2	-	2
6	Gph 705	Computer Applications in Geophysics	2	-	2
7	Gph 706	Selected Topics in Rocks and Geochemistry (1)	2	-	2
8	Gph 707	Selected Topics in Rocks and Geochemistry (2)	2	-	2
9	Geo 799	Ph.D. Thesis Research	-	-	48

Department of Biochemistry

Doctor of Philosophy Degree in Science in Biochemistry

Doctor of Philosophy in Science in Biochemistry

To obtain the Doctor of Philosophy degree in Science in Biochemistry, the student studies 12 elective credit hours, in addition to conducting practical research and writing a scientific thesis equivalent to 48 credit hours.

No.	Course Code	Course Name	Theoretical	Practical	Credit Hours
1	BCh 701	Nanotechnology in Biochemistry	2	-	2
2	BCh 702	Stem Cells and Tissue Culture	2	-	2
3	BCh 703	Cancer Diagnosis and Treatment	2	-	2
4	BCh 704	Advanced Immunohistochemistry	2	-	2
5	BCh 705	Body Fluids and Clinical Biochemistry	2	-	2
6	BCh 706	Metabolism and Genetic Disorders	2	-	2
7	BCh 707	Cell Signaling	2	-	2
8	BCh 708	Endocrinology	2	-	2
9	BCh 709	Advanced Bioinformatics	2	-	2
10	BCh 710	Advanced Selected Topics in Biochemistry	2	-	2
11	BCh 711	Advanced Biostatistics	2	-	2

Course Code	Requirement	Status	Credit Hours
BCh 799	Ph.D. Thesis	Compulsory	48

Chapter Three

Course Content

Courses Contents

Department of Mathematics and Computer Science

Chapter Three
Course Content

Code	Course Title	Contents
Stat 541	Probabilities and Their Applications	General probability rules; conditional probability; Bayes' theorem; discrete and continuous random variables; probability mass functions and their properties, including mathematical expectation, variance, standard deviation, and moment-generating functions for discrete distributions; probability density functions and their properties, including mathematical expectation, variance, standard deviation, and moment-generating functions for continuous distributions; bivariate random variables, including covariance, correlation coefficient, variance of the sum or difference of two variables, and moment-generating functions; bivariate distributions, including marginal and conditional distributions, independence of random variables, and conditional expectation; distributions of functions of random variables; random samples, including the distribution of the sample mean, the law of large numbers, and the central limit theorem; moments and moment-generating functions; standard discrete and continuous distributions and their properties.
Stat 542	Statistical Methods	Sampling distributions; point estimation and confidence estimation; one-sample and two-sample tests; one-way and two-way ANOVA; chi-square goodness-of-fit tests; tests of independence in contingency tables. The course emphasizes the use of computers.
Stat 543	Regression Analysis	Simple and multiple linear regression and correlation; analysis of variance and covariance; assumptions of regression; variable selection; prediction; multicollinearity; model diagnostics; dummy variables; transformations; logistic and nonlinear regression. The course emphasizes the use of computer programs.
Stat 544	Simulation and Sampling Techniques	Modeling and principles of simulation; the role of random numbers; generation of pseudo-random numbers; techniques for generating random variables with known distributions; assumptions and use of simulation in experimentation; design of finite-population sample surveys; stratified, systematic, and multistage cluster sampling designs; sampling with probability proportional to size; a class project on the design and execution of an actual sample survey. The course emphasizes the use of computer programs.
Stat 545	Experimental Design and Non-	A brief history of the design of experiments; steps for planning, conducting, and analyzing an experiment; simple comparative

Code	Course Title	Contents
	Parametric Statistics	experiments; experiments with a single factor; one-way ANOVA in a completely randomized design (CRD); sample size determination.
Stat 546	Statistical Software Packages	Structure, content, and programming aspects of modern statistical packages; advanced techniques in using statistical software systems for data analysis; introduction to graphical methods in statistics; macro programming language; SPSS program.
Stat 547	Statistical Analysis	Data description and numerical measures, including measures of central tendency and variation; probabilities and probability distributions; inferential statistics, including population distribution, sample distribution, sampling distribution, central limit theorem, hypothesis testing, p-value, and confidence interval; statistical techniques, including t-test, chi-square test, and simple linear regression; simple linear regression analysis using SPSS; estimation theory.
Stat 548	Multivariate Statistical Methods	This course covers conventional statistical methods used for the analysis of multivariate data. The course content combines theoretical concepts and computer-based exercises. Topics include principal component analysis, factor analysis, canonical correlation analysis, and other related concepts.
Stat 549	Introduction to Operations Research	Basic concepts and fundamentals of management science; problems addressed by operations research; problem formulation in linear programming; graphical solution of linear programs; simplex method; Big-M technique; two-phase technique; sensitivity analysis; transportation model; network planning; critical path method and PERT.
Stat 550	Applied Time Series	Introduction; Markov chains; data transformation methods; forecasting; predicting future values; degree of forecasting accuracy; regression-based forecasting versus time-series forecasting; numerical measures for prediction accuracy, including MAD, MSE, and MAPE; time-series smoothing and decomposition methods; smoothing methods using averages; exponential smoothing methods, including simple and weighted exponential smoothing; different types of moving averages; Box–Jenkins ARIMA (p, d, q) models for time-series forecasting; identification of model characteristics and forms of autocorrelation and partial autocorrelation functions; dealing with seasonal data; fitting models to computer-generated and real data; diagnostic tests on residuals and model-selection criteria; practical exercises in data analysis and writing integrated reports using statistical software such as R.

Code	Course Title	Contents
Stat 551	Applied Stochastic Processes	This course provides students with mathematical background in stochastic processes and their applications to modern finance. The course begins with intermediate probability theory and the derivation of the Black–Scholes formula. Three solution methods for the Black–Scholes formula are then introduced: the CRR model, the heat-equation method, and quantum methods. The course also covers three applications: market microstructure, financial stability, and a quantum model of the stock market.
Stat 552	Queuing Theory	This course introduces two modeling techniques: simulation and queuing modeling. Topics include single-queue Markovian systems, semi-Markovian queuing systems, open queuing networks, closed queuing networks, pseudo-random number generation, estimation techniques for analyzing endogenously generated data, and validation of simulation designs.
CS 561	Structural Programming	Structured program development; problem solving; decision structures; repetition structures; top-down design and stepwise refinement; subprograms, including procedures and functions; structured data types, including one-dimensional arrays, two-dimensional arrays, sets, and records; files, including text files and random-access files; dynamic data structures and pointers; recursion, including recursive functions and the Towers of Hanoi.
CS 562	Data Structures	In addition to traditional representations of abstract data types (ADTs), including stacks, queues, linked lists, and trees, this course presents modern implementations of these structures using the Standard Template Library (STL), including sets, bags, maps, pairs, and iterators. It also covers hashing and hash tables, as well as numerous sorting and searching algorithms.
CS 563	Operating Systems	Types of operating systems; operating-system structures, including system components and services and virtual machines; process management; CPU scheduling, including scheduling concepts, performance criteria, and scheduling algorithms; memory organization and management for single-user and multi-user systems; secondary-storage management; disk scheduling; virtual memory.
CS 564	Object-Oriented Programming	This course introduces the concepts of object-oriented programming to students with a background in procedural programming. It begins with a review of control structures and data types, with emphasis on structured data types and array processing. It then introduces the object-oriented programming paradigm, focusing on the definition and use of classes and the fundamentals of object-oriented design. The

Code	Course Title	Contents
		course also introduces structures provided by the Standard Template Library (STL), such as vectors, lists, and sets. Other topics include an overview of programming-language principles, simple analysis of algorithms, basic searching and sorting techniques, and an introduction to software-engineering issues.
CS 564	Database Management Systems	The main objective of this course is to provide students with the background needed to design, implement, and use database management systems. Topics include the evolution of database management systems, the relational data model and relational algebra, Structured Query Language (SQL), entity-relationship modeling and design, conversion from ERM to RM, tables, normalization, and implementation of forms, reports, and menus. Upon successful completion of the course, students will be able to analyze business requirements and produce a viable database model and implementation to meet those requirements.
CS 566	Algorithms Analysis and Design	Algorithm concepts; analysis and complexity; design methods; divide and conquer; binary search; merge sort; quick sort; selection; matrix multiplication; the greedy method; dynamic programming, including shortest paths and optimal search trees; graph algorithms; backtracking; NP-hard and NP-complete problems; tries; suffix trees; orders and asymptotic analysis; recurrence relations.
CS 567	Computer Networks and Information Security	Definition, objectives, topologies, classifications, architecture, standards, and applications of computer networks; ISO-OSI model; switching techniques; flow control; error detection and correction; congestion control; routing; internetworking; public switched data networks; ISDN and B-ISDN; frame relay; ATM.
CS 568	Software Component Design	This course deals with the design and implementation of software subsystems. It introduces the concept of design patterns and applies common patterns to the development of software components. Laboratory projects provide opportunities for student teams to implement components and integrate them into complete systems. The course also introduces the use of Computer-Aided Software Engineering (CASE).
CS 569	Software Engineering	This course presents a broad perspective on software engineering, focusing on the processes and techniques fundamental to the creation of reliable software systems. It also covers agile methods and software reuse, alongside traditional plan-driven software engineering. The course is organized into major parts, including process, modeling, quality management, project management, and advanced topics.

Code	Course Title	Contents
CS 570	Computer Organization and Architecture	Design of a basic computer; processor design concepts; design of channels and controllers; interconnections; memory structures and design; memory management; cache memory systems; firmware design; reliability; testing and fault tolerance; CISC computers; RISC computers; interfacing; design of network interface cards; examples of computer architecture.
CS 571	Software Testing	This course introduces students to software testing, providing an overview of software validation and verification and testing techniques. It addresses important topics such as testing principles, test-case design, module testing, domain testing, higher-order testing, and object-oriented testing. Other topics include formal methods, reliability validation, safety assessment, and software metrics.
CS 572	Logic Design	This course introduces the concepts of the design and implementation of digital circuits. Topics include combinational and sequential circuit analysis and design, digital-circuit design optimization methods using random logic gates, multiplexers, decoders, registers, counters, and programmable logic arrays. Laboratory experiments reinforce the theoretical concepts discussed in lectures and involve the design and implementation of digital circuits. Emphasis is placed on the use of computer-aided tools in the design, simulation, and testing of digital circuits.

Courses Contents

Department of Physics

Description of the Diploma Courses		
Code	**Course Title**	**Contents**
B. Phys 501	Medical Imaging	This course is an introduction to the different medical imaging modalities including x rays, digital subtraction angiography, duel-energy x ray absorptiometry, electron microscopy, nuclear medicine, clinical ultrasound tomography, magnetic resonance imaging and gamma camera. The physical and mathematical principles involved in the formation of medical images will be presented along with discussions of the limitations to resolution and image noise. Examples of primary clinical applications for each modality will be given
B. Phys 502	Magnetic Resonance imaging	This is a basic course introduces the physical and mathematical principles of magnetic resonance imaging .Topics include atoms and protons , longitudinal relaxation forces, angular momentum and precession,nuclear magnetic resonance,radio waves tissuand magnetic fields, transverse relaxation ,spatial localization,bod s,field strength,repetition time and contrast,flip angle,MRI spectroscopy,frequency encoding,phase encoding,k-space trajectories,echo-planer imaging,basic pluse sequence annotation single slice acquisitions,2-Dmultislice acquisitions,3-d multislice acouisitions.
B. Phys 503	Radiation does measurement	Absorbed dose next to the separation between two different substances – The relationship between the energy of the effect and the exposure-saturation In ionic chambers – calculations of the efficiency of ionic assembling – ionic chambers – diuretic thermometer – chemical dosimetry – direct measurements of calorimeters – summary of standard.methods – sources of ionizing radiation – endpoints of exposure to non-radioactive radiation workers – Dose calculations due to exposure to sources of radiation outside and inside the body-Non-Ionizing Dosage Technology: ELE-EMFs Measuring Instruments- Magnetic Field – International Limits and Dosages- Biological Effects – Low Frequency Microwave Wave Measuring Instruments – Protection and Calibration Guidelines – Safety Limits – Ultraviolet Radiation- Reagents – Biological Effects on Skin and Eye – Limits of Safety and Precautions – Lasers, detectors, measuring units, supplies, organization, safety measurements, power and protective radiation cover, to meet ELF-EMF, magnetic fields, low-frequency RF), ultraviolet.

B. Phys 504	Environmental health and safety	General guidance on EHS issues at the level of facilities or projects- Emissions to the atmosphere and surrounding air quality- Areas of application and approach.
B.Phys.505	Fundamentals of radiation biophysics and dosimetry	This course deals with theory and measurement of radiation as applied to medicine and the laboratory it overs ionizing sources as used in biology, diagnostic radiology, nuclear medicine and radiation therapy optic include ICRU definition of radiation qquantities, radioactivityattenuation and scattering of photons and electrons , interaction with tissue,radiation equilibrium and practical radiation dosimeters. Quantities of the radiation, the energy transferred – Kirma – Absorption dose – Electronic equilibrium – Brah-Gray gap – Determination of the absorbed dose using the absolute ionic chamber – Effect of temperature and pressure on the measurements ionizing – exposure – Rontgen – Standard air room – Determination of the absorbed dose in the free vacuum – Determination of the absorbed dose in the phantom-caliber curve of the ionic ion deposition – Determination of the absorbed dose of energies above 3 million electron volt.
B.Phys.506	alternative biomaterials	For metals used in Al-Badayl Al-Badailyat: Al-Ma'aden, Al-Sayramik, Albolymerat, and its chemical properties and their chemical composition: Electrical properties of animal materials-Alternatives: Study of Electrical Properties in the Asymmetrical Aspects Electrostatics – Molecular – Atalaeal Relatives and Claasius and Mosai – Theory of Thabam Insulation and Molecular Weight.) General Theory of Relaxation. Tareq is different for the measurement of electrical properties, for example, the insulators, resistors, etc.) Alternative materials. Mechanical Properties of Alternative Biomaterials The basic properties of the materials used, hardness measurement, fracture, stress, talc with stress, General properties of materials used in alternative materials. Response of tissue and body after the process of replacement joints and organs, reaction of alternative material bone marrow, Study of how the surface of the separator is formed. Natural bone and alternative organ fixation cause the collapse of the papillae. Applications applied to metals as a powder, Alternative, body interactions with metals, polymers and ceramics.
B.Phys.507	Technologies for drug-carrying	Biochemistry Research- Biosafety systems- DNA– Diagnosis of genetic diseases- The technique of nanoparticles- Diagnosis and treatment of cancer by

	systems and biomolecules	biotechnology- Manufacture of insulin by biotechnology- Bioethics and national experience.
B.Phys.508	Fundamentals of therapeutic medical devices	For therapeutic devices: Hemodialysis Machine - Ventilator - Open heart –surgery - Electric shock absorberWelding methods for electronic components Use a risk-based assessment to establish a medical equipment maintenance program- Objectives of maintenance programs- Evaluate the effectiveness of the maintenance program-Electric Power: Electrical safety standards. Electrical safety tests- Electrical safety procedures-Electrical testing of electronic components-Procedures for examination of medical devices- Preventive maintenance- performance test-Medical Devices: Curve rate of holidays- Analysis of faults- Average time to holidays and average time between faults.
B.Phys. 509	Tissue chemistry and cell biology	Cell biology, sometimes cytology, is a science that studies living cells, their properties, structure, components, organisms, interactions with the surrounding environment, their life cycle, their division, and their death. Organs and the carbon molecules that produce cells. The most important molecules are DNA, RNA and proteins. Fully integrating histology, cell biology, and pathology, the 4th Edition of the award-winning Histology and Cell Biology: An Introduction to Pathology presents key concepts in an understandable, easy-to-digest manner. Authors Abraham L. Kierszenbaum, MD, PhD and Laura L. Tres MD, PhD link basic science to clinical application throughout, focusing on what you need to know for your coursework now – and how to apply that information in a clinical setting. Full-color illustrations on every page, as well as unique, student-friendly features online, help you quickly grasp the complexities of pathologic abnormalities.
B.Phys.510	Medical Statistics	Descriptive Statistics –Estimation of efficacy intervention Statistical theories used.
B.Phys.511	Ionizing radiation dosimetry technology	Quantities to show radiation – transmitted energy – kerma – absorbed dose – electronic equilibrium – Bragg-Gray gap – Determination of absorbed dose using an absolute ionic chamber – Rotten – Practical ionization chambers – Determination of the absorbed dose for high energies – Chemical dose counter – Ionizing radiation sources – Calculation of doses Radiation inside and outside the body.

B.Phys.512	بيولوجيا اشعاعية Radiation biology	Ionizing radiation – interaction of radiation with living tissues – the effect of radiation on DNA – antioxidants – international permissible limits for workers – control of the risks of radioactive contamination – risks of internal radiation exposure – control of the risks of radioactive contamination. Biological protection from the influence of ionizing radiation – Biological effects of electromagnetic waves – Components of cell and biological tissue – Protective barriers from electromagnetic waves of all kinds.
B.Phys.513	Molecular biophysics	Analysis of X-ray and Molecular Formation – X-ray diffraction – X-ray diffraction – Diffraction forms of some protein fibers – Protein form – External and internal molecular strength – Strong and weak force – Joint association – Ionic association – Resonance – Bipolar reaction – Ionizing ionizing effect on cellular components - : The effect of ionizing radiation – measurement of radiation – measurement of the dose – the results of the process of throwing large biomolecules.
B.Phys.514	vital energies	Energy transfer in the biologist, free energy change for chemical reactions, non-ionic conditions, ATP and cell transfer, mitochondria, toliad Only ATP in cell, respiration and phosphorylation, oxidation pathways, plastids, photovoltaic construction and photovoltaic flow, non-linear structures, AT. Chemical and ionic circuits, bacteriophageal staphylococcus aureus, the chemical concern of the biological structures, the organic structures of adenic acid. Al-Tinaat, Mmaia Tariqab-Cellular.
B.Phys.515	Communication and control technology	Electrical properties through tissues and cells – physical basics of vital electrical potentials – physical basics of electrical and biological potentials – stable electrical potentials – biological cell responses as a result of tissue agitation – microelectronics – their use and applications.
Phys.516	Nuclear physics	Nuclear reaction – nuclear models – nuclear fission
Phys.517	Radiology	Matter and rays – gamma transitions – alpha decay – beta decay
Phys.518	Neutron physics	Neutron reactions – nuclear fission – thermal neutrons – nuclear chain reaction – neutron propagation – critical equation .

Phys.519	Laboratory Studies 1)	Experimental study on the absorption and spectra of nuclear radiation – studies of some special effects of radiation and the characteristics of nuclear detectors and dosimeter devices.
Phys.520	radioactive reagents	Various radioactive reagents – gaseous and solid reagents and scintillation counters – nuclear emulsion detectors – neutron detectors
Phys.521	Radiological medical devices	TrueBeam, STx BBrachytherapy, PETCT, Gamma Kamera Electron Mammography- CT. magnetic resonance-X-ray sonar.
Phys.522	Laboratory studies 2)	Studying the properties of nuclear detectors Geiger – scintillation – semiconductor – plastics – sensitive films – a statistical study for data processing – estimation of the compound error – absorption of radiation alpha – beta – gamma) – handling and processing of measurement data by computer – transmission of rays collected and broadband) – Simple gamma spectrum – beta/alpha spectrum – X-rays – analysis and modeling of measurements using the computer – multi-channel use – monitoring and analysis of results – using some advanced programs – to study absorption and diffusion – inside different materials.
Phys.523	Plasma physics	lone particle motion – plasmonic fluids – introduction to plasma physics.
Phys.524	Nuclear powers and reactors	Positron reaction – nuclear fission – thermal neutrons – nuclear chain reaction – neutron mission – critical equation – interactive nuclear sequence – unstable nuclear reactors – conditions affecting the reactor activation process
Phys.525	nuclear fission	uses of nuclear fission- types of nuclear fission – What is nuclear energy - Pros and cons of nuclear energy – the products of the nuclear fission process – the dangers of nuclear fission – nuclear fission and nuclear fusion.
Phys.526	Ionizing radiation dosimetry technology	Personal dosimeter-laboratorial dosimeterFilm dosimeter-pocket dosimeter-TLD-TL theory.
Phys.527	Nuclear detectors and devices	The course consists of a special part for the different detectors – general, including gaseous and solid detectors and flash counters – nuclear emulsion detectors – neutron detectors – nuclear devices such as analog to digital converters – digital to analogue – time calibration and some special units.

Phys.528	Radiation dosimetry	Dose calculation – risks and protection from radiation – dosimetry – protection from external radiation – lasers and radio frequencies
Phys.529	Radiation protection	Composition of matter – atomic theory of matter – radiological analysis and X-rays – interaction of radiation with matter – measurement of radiation dose – radiation effect – protection technique from it.
Phys.530	reactors and neutrons	Neutron reaction – nuclear fission – thermal neutrons – nuclear chain reaction – neutron mission – critical equation.
Phys.532	Characterization of nanomaterials	This course provides a broad overview of nanotechnology, discussing the fundamental science of nanotechnology. By the end of the course, the students will have gained knowledge in the following areas: What nanotechnology is, the size and shape dependent properties at the nanometer scale, enhanced physical properties of nanomaterials, what nanoparticles are and how to synthesize them and Applications of nanotechnology in engineering, biomedical, energy, and environmental fields.
Phys.533	Nanotechnology and alternative and renewable energy	This course discusses the various top-down and bottom-up approaches to synthesizing and processing nanostructured materials. The topics include fundamentals of self-assembly, nano-imprint lithography, electron beam lithography, nanowire and nanotube synthesis, quantum dot synthesis strain patterned and colloidal), postsynthesis modification oxidation, doping, diffusion, surface interactions, and etching techniques). Topics covered will also include Langmuir-Blodgett, nanodevices based on nanoassembly, layer-by-layer self-assembly techniques, and electrochemical polymerizations. In addition, techniques to bridge length scales such as heterogeneous integration will be discussed. We will discuss new electronic, optical, thermal, mechanical, and chemical properties brought forth by very small sizes. Provides a broad overview of the global energy landscape, growing energy demand and various energy options impacted by nanotechnology innovations. Diverse sources of renewable energies that include solar, hydroelectric, wind, biomass, fuel cells will be discussed in the context of efficiency, current state of development and economic feasibility. In addition, applying nanotechnology innovations to batteries, solar

		cells, super capacitors, fuel cells and superconductors will be reviewed. Prerequisite: Permission of instructor.
Phys.534		This course is a concept-oriented introduction to the field of surface physics and nanophysics with particular emphasis on static and dynamic properties, all from the atomic/molecular viewpoint. We will focus on central unifying concepts and experimental techniques needed for understanding the properties of systems of interest. The symbiosis between experimental and theoretical approaches is emphasized. We will cover the following topics: i) geometric and electronic properties of surfaces, ii) scanning probes for microscopy, spectroscopy and manipulation of atomic size objects, iii) adsorption phenomena and dynamic processes at surfaces, iv) quantum dots and quantum wells and v) clusters, nantubes and small particles on surfaces
Phys.535	Management and economics of nanotechnology	The course will discuss various aspects of management and economics of nanotechnology. It would include: 1) Nanotechnology's role in society and particularly within a fast-changing world. 2) Nanotechnology is the next big driver of wealth creation within corporations and countries. 3) Product and Production Nanotechnologies, 4) Enhancing creativity and managing innovation in the context of nanotechnology.
Phys.536	Physics and technology of semiconductor devices	The main objective is to teach you to use and evaluate available processes for fabrication of integrated circuits and semiconductor devices and understand the equipment and the methods used in fabrication. Based on this knowledge, make detailed process descriptions for the fabrication of integrated circuits, semiconductor devices, and Microsystems and evaluate the results of the processing and understand the connection between the physical models used and the fabrication procedure used.
Phys.538	Manufacture of nanomaterials	Principles of modeling structures and processes at the nanometer scale, including meshing techniques, finite element analysis, and molecular dynamics. Simulation of Materials Science-based or Mechanics-based modeling methods employed; mechanical response of nanostructured materials; Modeling methods including electronic structure, molecular dynamics and Monte Carlo techniques are included
Phys.539	Quantitative points	Supervised organization and presentation of topics from peer-reviewed literature or student's own research, as

		well as attendance at and recording of seminars given by others.
Phys.540	Symposium	Supervised organization and presentation of topics from peer-reviewed literature or student's own research, as well as attendance at and recording of seminars given by others.
Phys.541	Lab exercises	Students will rotate through four research labs for seven weeks in each lab) to become familiar with research at JSNN and to provide training in laboratory techniques needed for dissertation research. With the advice of the advisor/committee and permission of the faculty member responsible for the lab, students will select labs based on their interests.
Phys.542	Use of computers in nanoscience	The course covers a multidisciplinary overview of computational nanoscience for both theorists and experimentalists. This course teaches the main ideas behind different simulation methods; how to decompose a problem into "simulatable" constituents; how to simulate the same thing two different ways; knowing what you are doing and why thinking is still important; the importance of talking to experimentalists; what to do with your data and how to judge its validity; why multiscale modeling is both important and nonsense.
Phys.543	Mechanical properties of nanomaterials	This course will describe the mechanical behavior that is unique to nanostructured materials – typically metallic materials. The various methods for processing nanostructured materials will be presented, emphasizing those that are suitable for mechanical property studies.
Phys.544	semiconductors	The different types of semiconductors – the phenomenon of carrier transfer and its applications in semiconductors – electrical properties of semiconductors – optical properties Various devices for semiconductors and integrated electrical circuits.
Phys.545	Photovoltaic conversion	Solar cells and sunlight – A review of the basic properties of semiconductors – Determinants of efficiency and conversion losses and their measurement – Typical technology for preparing silicon solar cells – Design of silicon solar cells.
Phys.546	thin films a	Different methods of preparing thin slices – optical properties of thin slices – different types For lamination of films – Different methods of measurements of refraction and permeability of films.

Phys.547	energy uses	Converting solar heat to work using three thermodynamic cycles – direct conversion of sunlight into electricity in different ways.
Phys.548	thermal transfer	Heat conduction theory – stable and unstable heat conduction – heat conduction near moving walls – heat flow through surfaces and channels – free convection and mixed forced convection – properties of heat radiation.
Phys.549	Energy storage	Solar thermal energy – waterfalls and electricity generation – wind energy and used turbines – the importance of energy storage
Phys.550	mass transmission	Basic equations for two-component gas mixtures – applications on moist air – diffusion laws – mass transfer coefficient – level mass and thermal stratigraphic flow – integrative mass transfer equations.
Phys.551	Radiant nature	The physical basis of electromagnetic radiation – division of electromagnetic radiation and its use in the field of solar energy – interaction of radiation with matter – radiation heating technology.
Phys.552	Heating and cooling technology	A study of the different methods of solar thermal storage and the important factors that affect and are used in solar designs with some examples – methods of solar cooling for different surfaces and the selection of appropriate designs for these methods.
Phys.553	Materials science	Crystal structure of the material – Crystal symmetry – Point and line errors in the crystal structure – Mechanical properties of materials – Electrical and magnetic properties of materials.
Phys.554	properties of superconducting materials	Superconductivity-thermal properties of supertransition temperature-specific heat and thermal conductivity – energy gaps-magnetic and electromagnetic properties of superconductors- meissner effect-high energy electromagnetic properties.
Description of the Master Courses		
B. Phys601	Fundamentals of radiation biophysics and dosimetry	How to produce radioactive isotopes and radioactive pharmaceuticals, Monte Carlo's dosage calculations, emission imaging devices, gamma camera, emission photon CT, positron emission tomography, radioactive waste issues, radon, emergency and a wide range of radiation sources from a health physics perspective, Radiation risks and radiation protection guidelines, including existing international regulations.
B. Phys602	Biological mathematics	The Monte Carlo method of simulation – simulation of the results of a known model – simulation of the results of the evaluation of the decay constant and the linear

		coefficient of decay of a porous substance and its applications for the design of logic circuits – binomial distribution of Dobson and their applications in biology – models of biophysics – matching results of a linear model – Linear equations – matching the results of a nonlinear model – the Newton-Raafson method to match the practical results of a nonlinear model – regression method to match the practical results of a nonlinear model – a multi-head method to match the practical results of a nonlinear model Logic-logic method of genetic gene applications in small and large endings – ttabiqat logic gene in biological.
B. Phys603	Molecular Biophysics1	Analysis of X-ray and Molecular Formation – X-ray diffraction – X-ray diffraction – Diffraction forms of some protein fibers – Protein form – External and internal molecular strength – Strong and weak force – Joint association – Ionic association – Resonance – Bipolar reaction – Ionizing ionizing effect on cellular components -: The effect of ionizing radiation – measurement of radiation – measurement of the dose – the results of the process of throwing large biomolecules.
B. Phys604	Biophysics of ionizing radiography	Photographic receivers: Phosphorescence screen, fluoroscience – X-ray films – Digital radiography – Quality control for films and photo purification systems – Image rays: Image quality – Contrast – Diffraction of various energies – Filtration networks – Separation force and uncertainty – Engineering dimensions of film and patient and exporter Radiation therapy – High Radiation Imaging – Large-scale Radiation Imaging – Photographic Imaging Techniques – Diagnosis of Radiation Isotopes – Factors Affecting Image Quality of Radial Nuclei – Quality Control Standards Security – Diagrams: Diyographic imaging of the top – imaging Diahi axial force – Photonography of a single photon output of energy using a computer – Photographic imaging of positronate issued.
B. Phys605	Biophysics of control and communication systems	Radiation effects of radiation: Direct response to radiation doses – Radiation effects: Acute effect – Blood changes – Blood system symptoms – Digestive system symptoms – Central nervous system symptoms – Late effects: Cancer – Leukemia) – Bone cancer – Lung cancer – Biological effects: Risk and toxicity – Time period – Cataract – Risk assessment – Relative biological effects – QF Correlation coefficient – Equivalent dose – Radiation reagents – Particle counting devices – Gas filled counter - -Counter To fit the-counter Gejr- time

		measuring Chapter Alvsal- time-meter Fluorescence spectroscopy, Neuron spectroscopy, Cycloph detectors, Semiconductor detectors, Dosimeters, Pocket scale, Films, Thermodynamic thermometer, Ion flow chamber, Nitron measurement, Neuron interactions, Neutron counter with proportionometer, Long meter, For rapid neutron-meter-hars-thermometers for thermonetic and rapid neutron-shielding of external radiation exposure-general rule: methods of protection from external exposure to radiation. For electrical properties in tissues and cells, physical fundamentals of animal electrical efforts: electrophysiological jihad, responses to animal life, outcome Tissue stimulation, micro – electrodes: their applications and applications.
B. Phys606	Medical radiation protection	Safety of radiation sources – security of radiation sources – verification of radiation protection and safety and security of sources – radiation protection in occupational exposure – radiological protection in medical exposure – radiation protection in public exposure – radiation protection in exposure to naturally occurring radioactive materials – rules for the safe disposal of radioactive waste – Radiation protection in exposure to naturally occurring radioactive materials. Rules for safe disposal of radioactive wastes.
B. Phys607	Bioelectricity	This is an introductory course in electrophysiology followed by a quantitative-based approach General principles established in physics and biophysics. The basic course covers the following topics: Electrical biophysics of nerves and muscles, electrical conduction in distressed tissues, and quantitative modelsforr nerve and muscle including Hodgkin-Huxley equations, biological mapping, heart Electrical physiology, and functional electrical stimulation.
B. Phys608	Advanced statistical thermodynamics in biological systems	Binding Reactions and Biological Thermodynamics- Thermodynamic models of binding- Thermodynamic models of transcription- The unreasonable effectiveness of MWC models- The Unreasonable Effectiveness of Random-Walk Models
B. Phys609	Advanced radiological and nuclear physics	introduction to nuclear physics- pertinent nuclear properties- mode of radioactive decay and nuclear reactions- radioactive decay dynamic- quantum mechanical behaivior of nuclei- nuclear forces and interactions.
B. Phys610	Radiation biology	Radiation division ionizing and ionizing, ionizing radiation, interaction of radiation with all living systems, linear energy transmission, relative effect of ionizing

		radiation, radiation effect on DNA, radiation effect on chromosomes, cell components and living tissue, chemical resistors against radiation effects. General – Antioxidants – Radiation barriers of gamma or electrons and neutrons – Non-ionizing radiation – types – Electromagnetic radiation – Division according to the frequency – Calculation of energy – Biological effects of electromagnetic waves on living systems at each frequency and on the members of the Different types of magnetic fields – the interaction of magnetic fields on the living systems – free electrolytes – non-thermal biological effects – calculation of the coefficient of absorption of the different types – the currents of the emerging effects – the calculation of energy absorption – prevention biology of the impact of electromagnetic radiation – protective barriers of electromagnetic waves.
B. Phys611	Ionizing and non-ionizing radiation dosimetry technology	Personal Dosimeters- Laboratorial Dosimeters Pocket Dosimeter- Calorimeters-TLD-TL Theory-Film Dosimeters
B. Phys612	Basics of sound waves and lasers for biophysics	The propagation of sound waves in biological materials, examples of resulting medical devices of ultrasonic interactions with biological structures, and ultrasonic laboratory equipment. The basics of different types of laser and their medical use, the differences in their use, and the important energy-Concepts of the delivery system for the application of these lasers to tissue, clinical safety precautions, are outlined in Ansi standards for the safe use of laser in health care facilities, are discussed along with the recommended and medical accreditation guidelines.
B. Phys613	Cell and Membrane Biology	Liposomes as a model of biological membranes – properties of liposomes – stability of liposomes – stability of liposomes – interaction of liposomes with the cell and blood plasma – directing liposomes – gene therapy – gene transfer – dissolution of cell membranes by lipid solvents – separation of components of biological membranes – recombination of biological membranes and introduction of drugs into liposomes .
Phys614	Quantum Field Theory	Pair production in Electron-positron annihilation, lagrangian field theory, Hamiltonian theory, Noether's theory, Klein-Gordon field Klein-Gordon as Hrmonic oscillator, Klein-Gordon in space time, Klein-Gordon propagator causality)), Dirac field Lorentz invariance in wave equations, weyl spinors, free particle solution of

		Dirac equation, Quantization of Dirac field), Interacting fields and Feynman diagrams Perturbation theory, wick's theorem, Feynman disgrams, Feynman rules for Fermions Yukawa theory), Feynman rules for quantum electrodynamics Coulomb potential)) Ref Peskin and Schroesder An introduction To Quantum Field Theory)
Phys615	Advanced quantum mechanics	Basic concepts Stern Gerlach experiment, Keats, bra and operators, measurements, observable relations and uncertainty, change of basis, wave functions of position and momentum), quantum dynamics time evaluation and Schrödinger equation, Schrödinger image, Heisenberg image, simple harmonic oscillator, function Schrödinger waveforms, stents and integers of the Feynman path, potential transformations and scales), angular momentum theory transformation relations of angular momentum and spin, spin ½ systems and finite cycles, SO3), SU2) and binaural rotations, Eign values and the Egin state of momentum angular orbital angular momentum), symmetry in quantum mechanics symmetries, laws of conservation and decomposition, disk symmetry, parity or inversion of space) Ref Sakurai J. Modern Quantum Mechanics)
Phys616	Mathematical Methods for Theoretical Physics	MATHEMATICAL PRELIMINARIES Infinite Series, Series of Functions, Dirac Delta Functions), VECTOR ANALYSIS Coordinate Transformations, Differential Vector operators, Vector Integrations, Integral Theorems, potential theorems), TENSOR AND DIFFERENTIAL FORMS tensor analysis, Tensor in General Coordinates, Jacobians), Eignvalue problems, Ordinary 214odeling214214214i equations, STURM – LIOUVILLE THEORY, GREEN' FUNCTIONS Ref Arfken, Weber and Harris MATHEMATICAL METHODS FOR PHYSICISTS A Comprehensive Guide)
Phys617	Electromagnetic theory	Maxwell's eqution, Quasi stationary currents and currents circuits, Electromagnetic wave in vacuum, Electromagnetic wave in matter, Index of reflation and refraction, light waves, moving charge in vacuum, Covariant formulation of electrodynamics, Relativistic covariant lagrangian formalization. Ref Greiner W. Classical Electrodynamics)
Phys618	Modeling of many body systems	Using kinetic theory and statistical physics to describe the dynamics of many-body systems, Potential theory, orbit theory, Jean's modeling, gravitational encounters and secular evolution bars and spiral structure) for stellar dynamics, hydrodynamics, plasma physics) Navier-Stokes equation, vorticity, transport coefficients,

		accretion flow, turbulence, fluid instabilities, and shocks. We end with a cursory overview of plasma physics, including the Vlasov equation and the two-fluid model, Langmuir waves, Alfvén waves, Landau damping, ideal vs. resistive magneto- hydrodynamics MHD), and dynamos, Ref Harwit Astrophysical Concepts)
Phys619	Advanced Thermodynamics and statistical mechanics	Laws of thermodynamics, Eular's equations and Gibbs-Duhem relation, Phase transition and chemical reactions, Thermodynamic potentials the principles of maximum entropy, entropy and enrgy as thermodynamic potentials, the legendre transformation, the transformation of all varibles, Maxwell relations, Thermodynamic stability), Electronic systems for radiation detection and measurement, Nuclear counting statistics, experimental uncertainties, uncertainty propogation, Dead time, Laboratory measurement, uncertainty estimation, data recording, analysis, report writing, Application of radiation measurement to nuclear science and engineering, general science, biomedicine, and environmental science, Ensemble theory and microcanonical ensemble, the canonical ensemble, applications of 215odeling215 statistical, Quantum 215odeling215215215, the density operatiorsm the symmetry character of many particle wavefunctions, Ideal Bose gas, Ideal Fermi gas and applications of them, Ref Greiner W. Thermodynamics and Statistical Mechanics)
Phys620	Theory of general relativity	Geometry as physics, Space, time and gravity in Newtonian physics, Principles of special relativity, the curved spacetime of general relativity, gravity as Geometry, Geodesics, exact solutions of general relativity, Ref Hartle Gravity An Introduction to Einstein General Relativity)
Phys621	Advanced Computational Physics	linear regression, logistic regression, K-nearest neighbors classification, neural networks and support vector machines, optimization algorithms and perform model selection using cross validation, data clustering and probabilistic latent variable modeling, visualize high dimensional data by performing dimensionality reduction techniques, practical intuition about how to select an appropriate Machine Learning algorithm in order to solve a certain Data Science problem, Ref Bruce and Bruce Practical Statistics for Data Scientists)
Phys624	Advanced nuclear physics	Nuclear models and stability, Mass formula of nuclei, Structure of nuclei, Alpha decays and fission, Beta decays, Isospin, Relativistic particle, Relativistic field,

		Pion field, nuclear reactions, Nuclear decays and fundamental interactions, Fission, Fusion, Nuclear Astrophysics, Nuclear Cosmology, Ref Basdevant, Rich and Spiro Fundamentals in Nuclear Physics)
Phys626	Group theory and its applications	Introduction to discrete groups, subgroups and generators, conjugacy classes, Symmetric groups, permutation group, cycle notation, Direct product groups, semi-direct product groups, Symmetries of molecules, point groups and stereographic projection, Matrix representation of groups, reducible and irreducible representation, Great orthogonality theorem and character tables, Mulliken notation, basis, Tensor product, projection operator, observables, selection rules, molecular vibrations, Continuous groups, generators, Lorentz transformation, Orthogonal groups and Lie algebra, SO3), SU2), unitary groups, orthogonal groups, spinor representation, Lie algebra, Cartan classification, Lorentz, Poincare', and de Sitter groups, Ref Arovas Lecture Notes on Group Theory in Physics)
Phys627	Elementary particles and string theory	Quantization of scalar and Dirac Fields Klein-Gordon equation and the quantization of scalar fields, Representation theory of the Lorentz group, Dirac equations and the quantization of Dirac fields), Gauge Theory U1) gauge theory and the electromagnetic field, Non-abelian gauge theory and the Yang-Mills field), Spontaneous symmetry breaking and the Higgs mechanism Spontaneous breaking of global discrete symmetry, Spontaneous breaking of global continuous symmetry and Nambu-Goldstone bosons, Higgs mechanism), Unified electroweak theory Overview of the Weinberg-Salam model, Gauge-Higgs sector, Lepton sector, Quark sector, CKM matrix and the CP violation, Neutrino mass and mixing), Quarks and strong interactions What are hadrons, Quantum chromodynamics and quark confinement), Ref Cottingham and Greenwood An Introduction to the Standard Model of Particle Physics)
Phys628	Physics of advanced cosmology	Uniform isotropic universe model and its evolution, cosmological parameters and cosmological distances, Linear theory of the structure formation of the universe Basic equation, Evolution of fluctuations in the radiation/matter dominance period, Baryon Acoustic Vibration, Transition function) Observables of the non-uniform universe Large-scale structure of the Universe: Galactic power spectrum and correlation function, Cosmic Microwave Background Radiation: Angular

		Power Spectrum/Angular, Correlation Function Gravitational lens effect, Redshift spatial distortion and geometric distortion), Non-linear stage structure formation Spherically symmetrical model, Zel'dovich approximation, Perturbation theory, Mass function of the halo), Galactic bias, Ref MUKHANOV PHYSICAL FOUNDATIONS OF COSMOLOGY)
Phys629	Galaxy Dynamics, Formation and Evolution	Techniques how the mass distributions of galaxies are measured, Modeling the equilibrium of a gravitational system with a very large number of point sources, Structure of nearby and distant galaxies, Observational programs to study these galaxies, Observations that have been used to understand the evolution of galaxies, The role of dark matter in galaxy evolution and formationAdvanced models for stellar populations and their application to the study of galaxy evolution, Ref Galaxy Formation and Evolution by Houjun Mo, Frank van den Bosch, and Simon White)
Phys630	Quantum Phenomena in Gravity	Key aspects of General Relativity: Metric, Newtonian limit, action, equations of motion, Motivation for Quantum Gravity: Singularities of General Relativity, Bronstein cube and quantum gravity in relation to quantum theory and General Relativity, Perturbative quantization of a field: Canonical quantization of a scalar field and the relation between particles and fields, Quantization of gravity in perturbation theory, Gravitational waves and the graviton, Gauge fixing, Loop corrections and power counting, Non-renormalizability and the problem of predictivity, Overview of current approaches to quantum gravity, Ref Mendel Sachs Quantum Mechanics and Gravity)
Phys631	Advanced atomic and molecular physics	Atoms –Hydrogen-like Ion –Hellmann-Feynman Theorem –Hartree Atomic Units, Relativistic Corrections –Angular Momentum in a Nutshel-Fine-Structure, Hyperfine Hamiltonian –Angular Momentum Coupling Schemes in Multi-electron Atoms –Atoms in an External DC Magnetic Field: Zeeman Effect Spherical Tensor Operators and Wigner-Eckart Theorem-Part-II: Interaction with Light-Radiative Coupling –Transition Rates –Resonance Broadening –Electric Dipole and Quadrupole, Magnetic Dipole Absorption –Selection Rules –Spontaneous vs Stimulated Emission –Einstein Coefficients and Rate Equations Rabi Oscillations –Ramsey Interferometry-Light Shift Dynamic Stark Effect) –Resonance Fluorescence and Hanle Effect –Optical Pumping-Rotational Motion –Vibrational Motion –

		Photochemistry Nomenclature-Franck-Condon Principle –IR-Raman Spectroscopies.
Phys633	Advanced plasma physicsة	Plasma physics equation- Behavior of charged particles in magnetic and electric fields- Electromagnetic waves interaction with plasma- Fluids approach with collisions- Orbit theory. Plasma Properties, Plasmas as Fluids, Waves in Plasmas, Diffusion and Resistivity, Equilibrium and Stability, Kinetic Theory, Ref Chen Introduction to Plasma Physics and Controlled Fusion)
Phys634	Condensed matter physics	Static and Transport Properties of Solids, Electron–Electron Interaction, Dynamics of Bloch Electrons, Semiconductors, Electronics, Spintronics, Diamagnetism and Paramagnetism, Heavy Fermions, Metallic Nanoclusters, Complex Structures, Novel Materials, Elements of Group Theory, Ref Misra Physics of Condensed Matter)
Phys635	Quantum information theory and electron optics	Quantum circuits, the quantum Fourier transform and its applications, Quantum search algorithms, Quantum computers: physical realization, Quantum noise and quantum operations, Distance measures for quantum information, Quantum error-correction, Entropy and information وNonlinear optical permittivity – Optical reactance equation description no footsteps, Ref Nielsenand Chuang Quantum Computation and Quantum Information)
Phys636	Radiation dosimetry and radiation protection	Quantities to show radiation – transmitted energy – kerma – absorbed dose – electronic equilibrium – Bragg-Gray gap – Determination of absorbed dose using an absolute ionic chamber – Rotten – Practical ionization chambers – Determination of the absorbed dose for high energies – Chemical dose counter – Ionizing radiation sources – Calculation of doses Radiation inside and outside the body.
Phys637	dvanced Nuclear accelerators	Introduction to DC accelerators, Cockcroft-Walton, Van de Graaff, Tandem, Pelletron accelerators, Ion sources, high voltage generation, voltage stabilization, charging systems capacitive and inductive), Magnets, insulating gases and their characteristics, Control systems, beam handling components, Focussing systems, interlocks, Voltage / Energy calibration, beam optics, Introduction and basic principles of LINACs. Relativistic expressions. Propagation of electromagnetic waves through matter relevant to LINACs only), boundary conditions, phase velocity, group velocity, wave equation. Generation of modes in a cavity/waveguide, Application to the different types of LINACs including traveling and

		standing wave types. Transit time factor and the energy gained in a LINAC. General ideas of surface resistance, power loss, Quality factor, shunt impedance in cavities; Normal conducting LINAC structures, Superconductivity in accelerators, advantages of Superconducting cavities, breakdown mechanisms in Superconducting cavities, Superconducting accelerating cavities, Longitudinal dynamics in LINACs: Longitudinal stability, stability criteria, separatrix, synchronous oscillation with small and large amplitudes, FD, FFDD focusing, Stability criteria, phase advance and stability in LINACs; Space charge effects in high intensity beams, Cyclotrons. Synchrocyclotron. AVF principle and concept of hills and valleys in magnetic field. Different applications of cyclotrons, Equation of motion in magnetic field and concept of focusing, Weak and strong focusing, Quadrupole magnets, Principle of AG focusing, Edge focusing, Radio Frequency RF) field and particle acceleration. Longitudinal focusing and phase stability. RF bucket and longitudinal emittanceProton storage ring. Basic concept of space charge and tune shift. Fixed target collision and colliding beams. Luminosity and circular colliders, explain features in experimental data in terms of known physics, and point out features of data that may not be captured by the expected models. Particle Accelerators, M.S. Livingston and J.B. Blewett)
Phys638	Advanced Nuclear Spectroscope	Applications of Modern Optical Spectroscopy applications of modern optical spectroscopy to the study of molecular clusters. Discussions of intermolecular interactions, molecular beams, microwave and IR spectroscopy of neutral clusters and electronic, photoelectron and threshold photoelectron spectroscopy of neutral and charged clusters.), Spectroscopy Close to the Ionisation Threshold: Molecular Rydberg States and Their Applications properties and applications of an exotic type of electronically excited state called the Rydberg state. Properties of macroscopic dimensions of orbital radius, the high sensitivity to external fields, the long timescale associated with the electronic motion and the very high degeneracy and density of quantum states. Applications of Rydberg states include high-resolution spectroscopy such as ZEKE spectroscopy), to state-selective scattering of ions and Rydberg molecules to probing of surfaces, to analysis of energy and angular distributions from photodissociation events, to manipulation of molecular motion.), Nuclear Magnetic Resonance NMR)

		Spectroscopy physical background of NMR spectroscopy, anisotropic interactions in NMR, Explain NMR pulse experiments. Using NMR with solid and liquid state)
Phys639	Nuclear detectors and devices	Types and characteristics of detectors for high-energy radiation, how they work, and how they are used. Detector types include gas-filled detectors: simple ion chambers, proportional, Geiger-Muller counters, Semiconductor detectors: p-n junction, lithium drifted, high-purity gGermanium Scintillation detectors: NaITl), organic, Ref G.F. Knoll Radiation Detection and Measurement)
Phys640	Reactors and neutrons	Reactor Fundamentals / Nomenclature / Nuclear Reactions / Nuclear Stability, Neutron Sources / Binding Energy / Fission Process / Chart of Nuclides, Radioactive Decay / Cross-Sections, Compound Nucleus / Resonances / Neutron Scattering, Neutron Slowing Down / Neutron Flux / Moderators / Energy Condensation, Power Reactors I LWRs / Neutron Life Cycle), Power Reactors II CANDU / Advanced LWRs, Gas Reactors, …), Transport Equation, Criticality / Flux / Current / BC, Kinetics Approximation, Delayed Neutrons / Photoneutrons, Prompt Jump Approximation, Diffusion Equation, Non-Multiplying Systems / Multiplying Systems, Diffusion , Bare Reactors / Reflectors , Control Rods / Burnable Poisons, Energy Transport, Reactivity Feedback / Transients, Reactor Control / Xenon / Samarium, Depletion, Ref Lewis, Elmer E. Fundamentals of Nuclear Reactor Physics)
Phys641	Experimental nuclear reactions	Types of nuclear reactions – complex nuclear reactions – resonance theory of nuclear reactions – determination of nuclear parameters of nuclear reactions, Two- and three-body kinematics, Accelerator-based experimental techniques, Basic aspects of the accelerator and accessories, Radiation detector physics and its associated electronics, Theoretical 220odeling and errors, Ref Basu An Introduction to Experimental Nuclear Reactions)
Phys642	Nuclear scattering	The first and second approximations of boron – elastic scattering using spherical potential and determination of phase deviation – scattering using nuclear potential and coulomb potential – inelastic deep collision, Classical scattering theory, Quantum scattering theory, Partial wave analysis, Lippmann-Schwinger equation, Born 220odeling220220220ic, Integral form of Schordinger equation, First Born Approximation, application using the Born approximation Low-energy soft-sphere

		scattering, Yukawa scattering and Rutherford scattering), Resonance scattering, Identical particles and scattering, Inelastic electron-atom scattering, Coulmb scattering, Born series, Ref Sakurai J. Modern Quantum Mechanics)
Phys643	Modelling Quantum Many-Body Systems	Using kinetic theory and statistical physics to describe the dynamics of many-body systems, Potential theory, orbit theory, Jean's modeling, gravitational encounters and secular evolution bars and spiral structure) for stellar dynamics, hydrodynamics, plasma physics) Navier-Stokes equation, vorticity, transport coefficients, accretion flow, turbulence, fluid instabilities, and shocks. We end with a cursory overview of plasma physics, including the Vlasov equation and the two-fluid model, Langmuir waves, Alfvén waves, Landau damping, ideal vs. resistive magneto- hydrodynamics MHD), and dynamos, Ref Harwit Astrophysical Concepts)
Phys644	Advanced astrophysics	Classical mechanics Orbital mechanics, Universal gravitation, Kepler's laws, Binary stars, Extrasolar planets, Galaxy dynamics, Cosmic expansion and large scale structure), Statistical mechanics Overview of statistical mechanics, The early Universe, Particle equilibria in the early Universe, Stellar structure and compact stars), Electromagnetism Radiation from accelerating charges, Bremsstrahlung and synchrotron radiation, High energy processes in astrophysics, Electromagnetic wave propagation), Quantum mechanics The hydrogen atom, The interaction of radiation with matter, Atomic fine structure lines, Atomic hyperfine lines, Transitions involving multi-electron atoms, Molecular lines in astrophysics), Ref DURIC ADVANCED ASTROPHYSICS)
Phys645	Photon and particle detectors	Introduction to HEP detectors, Interaction of Particles with Matter, Gaseous detectors, Scintillators detectors from H.C. Schoultz-Coulon), Solid state detectors, Introduction to Synchrotron Radiation detectors, Readout Electronics, Vertex and Tracking, Calorimetry electrons and photons), Calorimetry charged hadrons and neutrons), Particle Identification, Detector systems, Ref Kleinknecht Detectors for Particle Radiation)
Phys646	Electromagnetic Radiation in Astrophysics	Demonstrate the ability to assemble electronic components, detection equipment and analysis apparatus e.g, multichannel analyzers, oscilloscopes, counter/timers) into working particle detection systems, Describe the effects of cable propagation and cable impedance on signals seen in particle detection systems,

		Explain the distinction between timing measurements and energy measurements and how they are implemented in a measurement system, Explain the features in a typical gamma-ray spectrum taken with an energy-sensitive detector NaI scintillator), Carry out complete numerical analysis of experimental data using Python and common computer libraries numpy, LMFit, matplotlib, etc.), Describe the measurement systems used in the advanced experiments: layout of apparatus, measurement concept how the measurement system leads to the intended measurement, e.g., the Compton scattering prediction of energy loss versus scattering angle, the lifetime of cosmic-ray muons)
Phys647	Remote Sensing in Astrophysics	Basic courses in Space Sciences and Technologies and in Environmental Physics, introduce the theoretical background like interaction of electromagnetic radiation with matter spectroscopy), radiative transfer and data processing. Also, the different measuring techniques will be discussed in quite some detail, this includes sensors measuring thermal emission, instruments detecting backscattered light, and active techniques based on the RADAR principle. The course content will be illustrated by a large number of examples available and in use in the different research groups in the institute of Environmental Physics, covering the atmosphere, ice and ocean, Ref BLAMONT Astrophysics from Spacelab)
Phys648	Space Plasma and Magnetospheric Physics	the single particle theory dynamical description of charged particles in electric and magnetic fields), different particle populations in the magnetosphere/ionosphere, adiabatic invariants, formation of the ring current, ionospheric current systems, and the physics of particle precipitation resulting in aurora. Furthermore, the course gives a theoretical foundation of space plasma physics with emphasis on kinetic theory based on statistical mechanics) and derivation of magnetohydrodynamics fluid description). The course also describes mechanical and electromagnetic forces and derivation of a variety of supported plasma waves Ref Khazanov Kinetic Theory of the Inner Magnetospheric Plasma).
Phys649	principles of renewable energy	An understanding of the principles of renewable energy technologies is key to assimilating the technological basis of the systems and applications. The module provides the fundamentals of renewable energy technologies and their impact on global and national energy systsystemse purpose of this module is to

		introduce the basis for assessment of the performances of solar, wind, wave and tidal, geothermal as well as hydro-electricity technologies. By the end of the module, you will have a better understanding of the various renewable technologies and will have the opportunity to visit a PV solar plant to see the real dimension of an operational plant.
Phys650	New renewable energy resources	Importance of energy-Solar energy- Nuclear Energy-Biofuels-Solar Energy-Geothermal-Hydrogen energy the green blueness)-Hydropower-Wind Energy-ammonia energy-Tidal Energy
Phys651	Thermoelectric materials and their applications	Thermoelectric Properties-Types of Thermoelectric Materials-Concept of Charge Carriers, Phonons and Scattering Mechanism-Concepts of Decoupling the Thermoelectric Parameters- Synthesis of Materials and Measurement Techniques-Thermoelectric Module and Devices-Applications
Phys652	Nanotechnology for renewable and alternative energy	This course provides a broad overview of the global energy landscape, rising energy demand, and the various energy options influenced by nanotechnology innovations. Renewable energy sources such as solar, hydroelectric, wind, biomass, and fuel cells will be discussed in terms of efficiency, current state of development, and economic feasibility. Furthermore, the application of nanotechnology innovations to batteries, solar cells, super capacitors, fuel cells, and superconductors will be discussed. Prerequisite: Instructor permission
Phys653	Materials and devices for photovoltaic applications	The course addresses the behavior of diodes under illumination, understanding of the factors which are determine the limiting efficiency of photovoltaic devices under 1 sun conditions and optical concentration, and detailed overview of the models to calculate the limiting efficiency of crystalline Si solar cells Shockley-Queisser limit, limits imposed by bulk Auger recombination, surface recombination). Also, it provides an overview of the technological steps to reduce the effect of surface and contact recombination as well as the specifics of thin-film PV materials and technologies a-Si:H, CdTe, CIGS and its alternatives, organic solar cells, perovskite solar cells). Also, it provides an overview of 3rd generation PV-devices based on multijunctions or novel concepts intermediate band solar cells, Quantum dot solar cells, hot carrier solar cells, etc…). In the last lesson, a vision on large-scale penetration of PV in the

		electricity system and what will be needed to realize this vision
Phys654	Electrochemical energy storage systems	Basic concepts, Primary and Secondary cells, Materials for batteries, supercapacitors and fuel cells, Electrochemical energy storage systems, Design, fabrication, operation and Evaluation; Safety and tolerance, Scientific and technical factors influencing electrochemical energy storage and conversion, Anode and cathode materials, Electrolyte aspects. Laboratory practical including for example analysis of charge- and discharge curves, polarization, and impedance spectroscopy.
Phys655	Electrochemical energy storage systems	the energy system and the interaction between different energy technologies and different energy sectors such as heat, power and transport. Understanding of the role of the energy system in society and in particular the role of renewable energy in the energy system as well as from a socio-economic point of view.
Phys656	Thermodynamics and internal combustion engines	Energy Conversion and General Energy Analysis Introduction, Forms of Energy Some Physical Insight to Internal Energy, Mechanical Energy, More on Nuclear Energy), Energy Transfer by Heat Mechanisms of Heat Transfer), Energy Transfer by Work Electrical Work, Mechanical Forms of Work Shaft Work, Spring Work Done on Elastic Solid Bars, Work Associated with The Stretching of a Liquid Film, Work Done to Raise or to Accelerate a Body, Nonmechanical Forms of Work), The First Law of Thermodynamics Energy Balance, Energy Change of a System, ΔE system, Mechanisms of Energy Transfer, Ein and Eout), Energy, Conversion Efficiencies, Energy and EnvironmentOzone and Smog, Acid Rain, The Greenhouse Effect: Global Warming and Climate Change) The Second Law of Thermodynamics introduction to the Second La, Thermal Energy Reservoirs, Heat Engines, Thermal Efficiency, Can We Save Qout ?, The Second Law of Thermodynamics: Kelvin–Planck Statement, Refrigerators and Heat Pumps, Coefficient of Performance, Heat Pumps), The Second Law of Thermodynamics: Clausius Statement, Equivalence of the Two Statements Perpetual-Motion Machine, Reversible and Irreversible Processes Irreversibility's, Internally and Externally Reversible Processes, The Carnot Cycle, The Reversed Carnot Cycle, The Carnot Principles, The Thermodynamic Temperature Scale, The Carnot Heat Engine, Quality of Energy, Quantity versus

		Quality in Daily Life, The Carnot Refrigerator and Heat Pump, Household Refrigerators(
Phys657	Energy and sustainability	The forms of energy and the various definitions of 'sustainable' energy, and the relevance of sustainability to the design and implementation of energy systems, the principal sources of primary energy in use today, their development over the past century, and the general patterns of world, regional and national energy consumption, the basic principles underlying the design and use of energy supply systems, and the basic principles underlying the efficient use of energy, the pollutants produced through the combustion of fossil fuels, their environmental impacts and the amelioration of these.
Phys658	Energy economics	The economics of energy resources like oil, natural gas, coal, and electricity etc. It covers various economic theories and concepts related to energy production and consumption, energy demand and supply, energy pricing, sustainability and conservation, energy policy and the development of new and renewable energy sources. The impact of their energy use, and how their energy use affects the energy sustainability, environment, and their lives now and in the future, whether they are using energy efficiently or inefficiently or unnecessarily).
Phys659	Digital Ectronics	Digital Electronics Preparation Systems – Nanoelectronics
Phys660	Optoelectronics	Radiometric and photometric units – radiation sources – lasers – radiation detectors – basics of fiber optics
Phys661	Dielectric properties and relaxation theory	Electrostatic equations for dielectric materials, polarization mechanics, methods for measurements of dielectric materials, defects and classification of dielectric materials, Crystal structure- defects of crystal structure- linear elasticity theory- non-linear elasticity and randomness theory- thermodynamic relaxation- thermoelastic relaxation
Phys662	semiconductors	Absorption coefficient of semiconductor materials with direct and indirect transmission – relationships between optical constants – photonic and electronic fluorescence for semiconducting materials – photonic conduction – nanotechnology for semiconducting materials
Phys663	polymer physics	Different theories of polymeric materials – electrical and mechanical properties of polymeric materials
Phys664	Crystal growth	Crystal growth by solutions, fusion and evaporation, Properties of X-rays, scattering and diffraction; crystal

		structures; X-ray diffraction methods, transmission electron microscopy and scanning electron microscopy.
Phys665	Electron microscope	Optical and electron microscopes – types of electron microscopes – sample preparation – special methods of examination by electron microscope – examples of examination by electron microscope
Phys666	Properties of thin film	Methods of preparing thin films – Mechanism of forming thin films – Electrical properties of thin films.
Phys667	retinal defects	Types of defects in crystals of materials – production of lattice errors in materials – Effect of crystal errors on the mechanical and physical properties of polymeric materials
Phys668	Radiation effect on materials	Properties of laser beams – interaction of the laser with the surface of the material – laser cutting – micronized welding – lasers in medicine Introduction to lasers – induced transitions – models of time equations between atomic levels – laser pumping and reverse sedation – laser amplification – types of lasers Properties of laser beams – interaction of a laser beam with the surface of the material thermal energy distribution – temperature changes – phase changes – applications of forming materials) – surface tempering – shaping of semiconductors – laser welding – micron welding – laser cutting – laser in medicine
Phys670	Accurate measurements theory	Introduction and definitions- Error types, sources, and analysis- Static and dynamic response characteristics of measurement systems- Transduction of mechanical signals into electric signals- Conditioning, acquisition, transferring, processing, and displaying of electric signals-Electric methods of measurements- Measurements of force, moment, stress, strain, and vibrations- Measurements of pressure, temperature, and flow rate – Turbulence measurements of mean and fluctuating flows with focusing on advanced modern methods.
Phys672	nuclear magnetism	Classification of magnetic materials – nuclear magnetic resonance – spin electron resonance – adiabatic magnetization
Phys673	Basic science of nanotechnology	This course provides a broad overview of nanotechnology, discussing the fundamental science of nanotechnology. By the end of the course, the students will have gained knowledge in the following areas: What nanotechnology is, the size and shape dependent properties at the nanometer scale, enhanced physical properties of nanomaterials, what nanoparticles are and

		how to synthesize them and Applications of nanotechnology in engineering, biomedical, energy, and environmental fields.
Phys674	Synthesis/manufacturing of nanomaterials	This course discusses the various top-down and bottom-up approaches to synthesizing and processing nanostructured materials. The topics include fundamentals of self-assembly, nano-imprint lithography, electron beam lithography, nanowire and nanotube synthesis, quantum dot synthesis strain patterned and colloidal), postsynthesis modification oxidation, doping, diffusion, surface interactions, and etching techniques). Topics covered will also include Langmuir-Blodgett, nanodevices based on nanoassembly, layer-by-layer self-assembly techniques, and electrochemical polymerizations. In addition, techniques to bridge length scales such as heterogeneous integration will be discussed. We will discuss new electronic, optical, thermal, mechanical, and chemical properties brought forth by the very small sizes.
Phys675	Characterization of nanomaterials	This course aims at teaching the students underlying principles of analytical techniques that are commonly used for the evaluation of bulk properties of nanomaterials. These include surface analysis technique FTIR spectroscopy; optical properties evaluation by UV-Vi's spectroscopy; crystallographic phase identification by XRD; thermal properties evaluation using TGA and DSC; microstructure investigation by Electron microscopy SEM and HRTEM); surface area analysis by BET surface area analyzer; magnetic properties by VSM and particle size- surface charge analysis by DLS and seta potential techniques. The course is planned in the form of theoretical and experimental modules for each analysis technique.
Phys677	Vacuum science and thin film technology	This course is a specialized, descriptive and exploratory course. It is designed to equip the students with the basic knowledge of vacuum systems/pumps and the use of such systems in the preparation/fabrication of alloys and semiconductor materials/thin films of various forms. The course is expected to run parallel with workshop laboratory where the students will need to carry out systematic operations and fabrication and characterization of alloy/thin films in their different forms using vacuum systems. The course will also meet the needs of students in materials science and engineering.

Phys676	Mechanical properties of nanomaterials	This course will describe the mechanical behavior that is unique to nanostructured materials – typically metallic materials. The various methods for processing nanostructured materials will be presented, emphasizing those that are suitable for mechanical property studies.
Phys678	Nanoscale physics and surface	is course beingconcept-orientedted introduction to the field of surface physics and nanophysics with particular emphasis on static and dynamic properties, all from the atomic/molecular viewpoint. We will focus on central unifying concepts and experimental techniques needed for understanding the properties of systems of interest. The symbiosis between experimental and theoretical approaches is emphasized. We will cover the following topics:i) geometric and electronic properties of surfaces, ii) scanning probes for microscopy, spectroscopy and manipulation of atomic size objects, iii) adsorption phenomena and dynamic processes at surfaces, iv) quantum dots and quantum wells and v) clusters, nantubes and small particles on surfaces.
Phys679	Quantum Dots	This course addresses the different types of Quantum Dots as semiconductor Quantum Dots, Carbon Quantum Dots, Silicon Quantum Dots, Colloidal Quantum Dots and Tetrapod Quantum Dots. Also, the course includes the Synthesis, Physics, spectroscopy, and their different Applications in medical, bioimaging and biodiagnostic, Photovoltaic Cells, electronic displays. Optoelectronic Devices.
Phys681	Measurement and technology of semiconductor devices	The main objective is to teach you to use and evaluate available processes for fabrication of integrated circuits and semiconductor devices and understand the equipment and the methods used in fabrication. Based on this knowledge, make detailed process descriptions for the fabrication of integrated circuits, semiconductor devices, and Microsystems and evaluate the results of the processing and understand the connection between the physical models used and the fabrication procedure used.
Phys682	Nanotechnology and alternative and renewable energy	Provides a broad overview of the global energy landscape, growing energy demand and various energy options impacted by nanotechnology innovations. Diverse sources of renewable energies that include solar, hydroelectric, wind, biomass, fuel cells will be discussed in the context of efficiency, current state of development and economic feasibility. In addition, applying nanotechnology innovations to batteries, solar

		cells, super capacitors, fuel cells and superconductors will be reviewed. Prerequisite: Permission of instructor.
Phys683	Selected topics in nanoscience and technology	Selected topics in nanosince and nano technology, reviewed article papers discuss topics in nanoscience.
Phys684	Management and economics of nanotechnology	The course will discuss various aspects of management and economics of nanotechnology. It would include: 1) Nanotechnology's role in society and particularly within a fast changing world. 2) Nanotechnology is the next big driver of wealth creation within corporations and countries. 3) Product and Production Nanotechnologies, 4) Enhancing creativity and managing innovation in the context of nanotechnology.
Description of the PhD Courses		
B. Phys 701	Membrane and cell biophysics	Biological cell membranes, cell protection, interconnectivity, cell differentiation, intraocular permeability, chemical electrophoresis, Biochemistry. Molecular coagulation of biological membranes: the liquid form, the mosaic, the dynamic model of biological agents,Biomembrane membrane, Monofilament membrane, Liquids, Lime-biodegradation. Aggregate and transient energy: Tyther,Both temperature terether the kinetic voltage on the permeability, the channels of penetration within the membrane. Liposomes as carriers of drugs and genes.
B. Phys 702	Radiotherapy planning	What you need to know before planning radiotherapy treatment. Underlying principles of radiotherapy planning. Radiobiological principles to be revised). Management of patients during radiotherapy. Head and Neck: General Considerations. Larynx. Hypopharynx. Nasopharynx. Oropharynx. Oral cavity. Ear. Parotid. Maxillary antrum. Orbit. Skin and lip. Thyroid. Bronchus. Oesophagus. Breast. Central nervous system. Lymphomas and spleen. Pancreas. Rectum. Anus. Prostate. Bladder. Testis. Penis. Pelvis. Cervix. Corpus. Vagina. Vulva. Sarcoma. Paediatric tumours. Systemic irradiation. Emergency irradiation.
B. Phys 703	Nervous system biophysics	Streptococcus, Streptococcus and Neurobiotic Neurons, Animal Physiology of Cellocytes, Cellulose Gland, Chemical Interaction, Electrophoresis, Memphis Neurons, electrophoresis, chemical, animal physiognomy of ionic cells, types, Tariq,Sensitivity, neuromuscularity, learning and memory, the instrument used to measure the electrophoresis of neuronal cells. Prayers outside the cells, the liturgy Intracellular, signal control, polarity, oscillation in measurements, methods of night results

B. Phys 704	Electromagnetic wave physical therapy	For the chemical significance of life, the concept of thermodynamics for the preparation of amino acids, nucleotides, cadmium and acetate to structures with a higher interest.Tannins, and nuclear and biological weapons. These include information on mobility and mechanization in the diagnosis of enzymes and the absorption of aroma. Tayaq Tnkiah and Tsuaif The twins. Biochemical and biophysical analysis of tannins, adenosine acids and applications in genetics. Liposomes and gums Microbiology of the delivery of medicine to the cell, gene therapy. Biological materials use intelligence to deal with all data in the same way as a computer.
B. Phys 705	Biophysical measurements	Methods of separation of biomolecules: chromatography separation of chromatography Amawad Alad and high-performance, chromatography separation depend on Drosophila, ionic, ionic, chromatographic, geophyte, saucer, and chromatography.Separation of the tinnitus and nucleic acid), Chapter P through diffusion and sedimentation, the basics of each of the diffraction of the cyanic rays What are the biological samples, REN. Magnetic nanometer, mass spectrometry and bipolar measurement for the measurement of electrical insulation constant, deceleration time.
B. Phys 706	Bioinformatics	Energies and statistics in the living cell: statistical thermodynamics and biology, theory of absolute reaction rates, transfer of entropy in organisms Biology, information theory, information level of biological systems, information on bacterial cells. Physical methods of obedience. Size and shape of molecules: motion Randomization and diffusion, measurement of diffusion coefficient, sedimentation, equilibrium method. Sedimentation factor, speeding pathway. Construction transactions.Dura and refractive diode, X-ray diffraction. Strong interactions b. Molecules, strong reactions, weak reactions, reaction. Bipolar diodes.
Phys707	Biosystems electronics	The transition of electrons and electrons in the natural and industrial systems, the installation of electron carriers, the movement of the tons and the tons associated with electron transfers,Hematology studies, Volatility fluctuations, polarization types, polar polarization, polarization of Maxwell Wagoner, azure relaxation, Aliay thabam isolating studies For biochemistry and biochemistry, studies on the parameters of ionization, ionization, and ionization in the tenses,Amino acids, nucleic acid, doxy ribose, liposomes, cell suspensions and tissues

Phys708	Article review in selected topics	Selected reviwed articles in different topics discuss a certain subject in physics
Phys709	Advanced computational physics and modeling	linear regression, logistic regression, K-nearest neighbors classification, neural networks and support vector machines, optimization algorithms and perform model selection using cross validation, data clustering and probabilistic latent variable modeling, visualize high dimensional data by performing dimensionality reduction techniques, practical intuition about how to select an appropriate Machine Learning algorithm in order to solve a certain Data Science problem Ref Bruce and Bruce Practical Statistics for Data Scientists)
Phys710	Advanced Topics in Statistical Mechanic	Ensemble theory and microcanonical ensemble, the canonical ensemble, applications of 231odeling231 statistical, Quantum 231odeling231231231, the density operatiorsm the symmetry character of many particle wavefunctions, Ideal Bose gas, Ideal Fermi gas and applications of themRef Greiner W. Thermodynamics and Statistical Mechanics)
Phys711	Mathematical Methods in Theoretical Physics 2	Special functions and applications, Fourior series and applications, Group theory, Topology Ref Arfken, Weber and Harris MATHEMATICAL METHODS FOR PHYSICISTS A Comprehensive Guide)
Phys712	Dynamical Analysis of Complex Systems	Using kinetic theory and statistical physics to describe the dynamics of many-body systems, Potential theory, orbit theory, Jeans modeling, gravitational encounters and secular evolution bars and spiral structure) for stellar dynamics, hydrodynamics, plasma physics) Navier-Stokes equation, vorticity, transport coefficients, accretion flow, turbulence, fluid instabilities, and shocks. We end with a cursory overview of plasma physics, including the Vlasov equation and the two-fluid model, Langmuir waves, Alfvén waves, Landau damping, ideal vs. resistive magneto-hydrodynamics MHD), and dynamos Ref Harwit Astrophysical Concepts)
Phys713	Computational Nuclear Physics	The Nuclear Shell Model- Shell-Model Algorithms –The Oxford-Buenos Aires Shell Model-OXBASH) Code- The DUSM Code- The Lanczos Algorithm- Results in the Os, Op and sd Shells-The FDUO Shell-Model Code- Beyond the sd-Shell- The Background to FDSM – The Hamiltonian –Matrix Elements for Transition Operators-The Fitting Procedure-An FDUO –Technical Note-The Skyrme-Hartree-Fock Model of the Nuclear Ground State by P.-G. Reinhard-Skyrme-Hartree-Fock Theory with Schematic Pairing-The Skyrme Energy Functional-The Coulomb Energy- Pairing-The Center-of-Mass Correction-Representation of Wave

		Functions and Fields-The Radial –Storage of Densities and Potentials- Shell Ordering- Storage of Wave Functions- Iterative Solution of the Hartree-Fock Equations- The Gradient Iteration- The Damped Gradient Iteration- The Inverse Gradient Step-Efficient Inversion with Five-Point Precision. Pairing Iteration- The Form Factor and Related Observables –Composing the Nuclear Charge Density- Radii and Surface Thickness- Handling Form Factors on a Grid-Instructions and Suggestions- Structure of the Code- Examples for Input Data- Technical Notes-The Cranked Nilsson Model- Present Version of the Macroscopic-Microscopic Approach-The Single-Particle Potential-Total Nuclear.
Phys714	Leptons and quarks physics	Quantization of scalar and Dirac Fields Klein-Gordon equation and the quantization of scalar fields, Representation theory of the Lorentz group, Dirac equations and the quantization of Dirac fields), Gauge Theory U1) gauge theory and the electromagnetic field, Non-abelian gauge theory and the Yang-Mills field), Spontaneous symmetry breaking and the Higgs mechanism Spontaneous breaking of global discrete symmetry, Spontaneous breaking of global continuous symmetry and Nambu-Goldstone bosons, Higgs mechanism), Unified electroweak theory Overview of the Weinberg-Salam model, Gauge-Higgs sector, Lepton sector, Quark sector, CKM matrix and the CP violation, Neutrino mass and mixing), Quarks and strong interactions What are hadrons, Quantum chromodynamics and quark confinement) Ref Cottingham and Greenwood An Introduction to the Standard Model of Particle Physics)
Phys715	Atomic energy levels for high-resolution lines	Repetition of quantum mechanical foundations: stationary states; expectation values; electronic states and wave functions, One-electron atoms: energy levels and wave functions; spin-orbit interaction; relativistic and QED-related effects; electronic transitions; electric dipole approximation; quantum numbers and selection rules; angular momenta and coupling schemes; radiation of higher order; radiation-less transitions, Helium: approximations for the Schrödinger equation; Coulomb- and exchange integrals; ground state and excited states; wave functions and their symmetry; spectra, Many-electron atoms: theoretical approximation schemes; LS-coupling; fine structures; jj-coupling; configuration mixing; spectra, Molecular symmetry and motion: Symmetry and

		symmetry operations; point groups; group theory; representations; analysis of molecular motions, Molecular quantum mechanics and beyond: H2+-molecule, H2-molecule, bonding, LCAO-MO-approximation; symmetry adapted molecular orbitals; electronic states and electron correlations; rotations and vibrations including symmetry analysis; potential curves; transitions between different states, Molecular spectra: Rotational- and vibrational resolved spectroscopy; electron spectra ; Franck- Condon principle; interaction with electromagnetic radiation; semi-empirical calculation methods, Computer-assisted calculations and simulations, such as extended Hückel and ab initio. Ref Demtröder An Introduction to Atomic-, Molecularand Quantum-Physics)
Phys716	Functional Methods in Quantum Field Theory	Pair production in Electron-positron annihilation, lagrangian field theory, Hamiltonian theory, Noether's theory, Klein-Gordon field Klein-Gordon as Hrmonic oscillator, Klein-Gordon in space time, Klein-Gordon propagator causality)), Dirac field Lorentz invariance in wave equations, weyl spinors, free particle solution of Dirac equation, Quantization of Dirac field), Interacting fields and Feynman diagrams Perturbation theory, wick's theorem, Feynman disgrams, Feynman rules for Fermions Yukawa theory), Feynman rules for quantum electrodynamics Coulomb potential)) Ref Peskin and Schroesder An introduction To Quantum Field Theory)
Phys717	Advanced topics in theory of General Relativity	Geometry as physics, Space, time and gravity in Newtonian physics, Principles of special relativity, the curved spacetime of general relativity, gravity as Geometry, Geodesics, exact solutions of general relativity.Ref Hartle Gravity An Introduction to Einstein General Relativity)
Phys718	String Theory and Branes	Quantization of scalar and Dirac Fields Klein-Gordon equation and the quantization of scalar fields, Representation theory of the Lorentz group, Dirac equations and the quantization of Dirac fields), Gauge Theory U1) gauge theory and the electromagnetic field, Non-abelian gauge theory and the Yang-Mills field), Spontaneous symmetry breaking and the Higgs mechanism Spontaneous breaking of global discrete symmetry, Spontaneous breaking of global continuous symmetry and Nambu-Goldstone bosons, Higgs mechanism), Unified electroweak theory Overview of the

		Weinberg-Salam model, Gauge-Higgs sector, Lepton sector, Quark sector, CKM matrix and the CP violation, Neutrino mass and mixing), Quarks and strong interactions What are hadrons, Quantum chromodynamics and quark confinement) Ref Cottingham and Greenwood An Introduction to the Standard Model of Particle Physics)
Phys719	Equilibrium Analysis of Complex Systems	Using kinetic theory and statistical physics to describe the dynamics of many-body systems, Potential theory, orbit theory, Jeans modeling, gravitational encounters and secular evolution bars and spiral structure) for stellar dynamics, hydrodynamics, plasma physics) Navier-Stokes equation, vorticity, transport coefficients, accretion flow, turbulence, fluid instabilities, and shocks. We end with a cursory overview of plasma physics, including the Vlasov equation and the two-fluid model, Langmuir waves, Alfvén waves, Landau damping, ideal vs. resistive magneto-hydrodynamics MHD), and dynamos Ref Harwit Astrophysical Concepts)
Phys720	Direct nuclear reactions	Introduction: Direct and Compound Nuclear Reactions-The Plane-Wave Theory-Scattering Theory and General Results-The Phenomenological Optical Potential-Distorted-Wave Born Approximation-Operator Formalism-Calculation of the DWBA Amplitude-Coupled Equations and the Effective Interaction-Microscopic Theory of Inelastic Nucleon Scattering from Nuclei-Core Polarization-Effective Interactions and the Free Nucleon–Nucleon Force-Further Developments in the Theory of Inelastic Scattering-Scattering from Deformed Rotational Nuclei-Calculation of Specific Components of the Optical Potential-Two-Nucleon Transfer Reactions-Finite-Range Interaction in Transfer Reactions-Higher-Order Processes in Particle Transfer Reactions-Heavy-Ion Reactions-Polarizability of Nuclear Wave Functions in Heavy-Ion Reactions.
Phys721	Nuclear structure theory	Fermions and bosons – The particle physicist's picture of nature – Conservation laws and symmetries: parity – Problems – Leptons and the electromagnetic and weak interactions – The electromagnetic interaction – The weak interaction – Mean life and half-life – Leptons –The instability of the heavy leptons: muon decay – Parity violation in muon decay - Nucleons and the strong interaction – Properties of the proton and the neutron – The quark model of nucleons The nucleon±nucleon

		interaction: the phenomenological description – Mesons and the nucleon±nucleon interaction – The weak interaction: ÿ-decay – More quarks –The Standard Model of particle physics –Nuclear sizes and nuclear masses – Electron scattering by the nuclear charge distribution – Muon interactions – The distribution of nuclear matter in nuclei – The masses and binding energies of nuclei in their ground states – The semi-empirical mass formula – The þ-stability valley – The masses of the þ-stable nuclei - Nuclear binding and the nucleon-nucleon potential.
Phys722	Introduction to the collision of heavy ions at high energies	Kinematic Variables - Nucleon–Nucleon Collisions - Hard Processes in Nucleon–Nucleon Collisions - Particle Production in a Strong Field - Particle Production in Two-Dimensional Quantum Electrodynamics- Classical String Model- Dual Parton Model - Quarks, Gluons, and Quark–Gluon Plasma- Lattice Gauge Theory- Results from Lattice Gauge Theory- Nucleus–Nucleus Collisions- High-Energy Heavy-Ion Collisions and Quark-Gluon Plasma – Signatures for the Quark–Gluon Plasma I – V)
Phys723	Standard model for elementary particles	The Photon –Mesons –Antiparticles – Neutrinos – Strange Particles – The Eightfold Way –The Quark Model – The November Revolution and Its Aftermath – Intermediate Vector Bosons –The Standard Model –Elementary Particle Dynamics – The Four Forces – Quantum Electrodynamics QED) – Quantum Chromodynamics QCD) – Weak Interactions –Neutral –Charged – Leptons – Quarks – Weak and Electromagnetic Couplings of W and Z -Decays and Conservation Laws – Unification Schemes – Relativistic Kinematics – Lorentz Transformations – Four-vectors – Energy and Momentum –Collisions – Classical Collisions – Relativistic Collisions –Symmetries –Symmetries, Groups, and Conservation Laws – Angular Momentum – Addition of Angular Momenta – Spin ½ – Flavor Symmetries – Discrete Symmetries – Parity – Charge Conjugation – Neutral Kaons – CP Violation –Time Reversal and the TCP Theorem –Bound States – The Schrödinger Equation – Hydrogen – Fine Structure – The Lamb Shift – Hyperfine Splitting – Positronium – Quarkonium –Charmonium – Bottomonium – Light Quark Mesons – Baryons – Baryon Wave Functions – Magnetic Moments – Masses –The Feynman Calculus – Decays and Scattering –Decay Rates – Cross Sections – The Golden Rule – Golden Rule for Decays – Two-particle Decays – Golden Rule for Scattering –Two-body Scattering in the CM Frame –Feynman Rules for a Toy Theory – Quantum Electrodynamics – The Dirac Equation –Solutions to the Dirac Equation –Bilinear Covariants – The Photon – The Feynman Rules for QED-

		Casimir's Trick –Cross Sections and Lifetimes – Renormalization –Electrodynamics and Chromodynamics of Quarks – Hadron Production in e+e− Collisions – Elastic Electron–Proton Scattering – Feynman Rules For Chromodynamics –Color Factors Quark and Antiquark – Quark and Quark – Pair Annihilation in QCD – Asymptotic Freedom 298
Phys724	Extrasolar Planets and Astrophysical Discs	Techniques how the mass distributions of galaxies are measured, Modeling the equilibrium of a gravitational system with a very large number of point sources, Structure of nearby and distant galaxies, Observational programs to study these galaxies, Observations that have been used to understand the evolution of galaxies, The role of dark matter in galaxy evolution and formationAdvanced models for stellar populations and their application to the study of galaxy evolution Ref Galaxy Formation and Evolution by Houjun Mo, Frank van den Bosch, and Simon White)
Phys725	Quantum information in gravitational field	Key aspects of General Relativity: Metric, Newtonian limit, action, equations of motion, Motivation for Quantum Gravity: Singularities of General Relativity, Bronstein cube and quantum gravity in relation to quantum theory and General Relativity, Perturbative quantization of a field: Canonical quantization of a scalar field and the relation between particles and fields, Quantization of gravity in perturbation theory, Gravitational waves and the graviton, Gauge fixing, Loop corrections and power counting, Non-renormalizability and the problem of predictivity, Overview of current approaches to quantum gravity Ref Mendel Sachs Quantum Mechanics and Gravity)
Phys727	Environmental impact of energy and green buildings	Introduction, Embodied energy, Operational energy in Building and Life cycle energy. Ecological foot print, Bio-capacity and calculation of planet equivalent. Role of Material: Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission,Sustainability issues for concrete, Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability, Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding crushing of cement aggregate etc. and reduction. Operational energy in building role of materials and thermal conductivity, Clay Bricks, Types kilns, Comparative energy performance emission performance and financial performance, Indoor air quality, Paints, adhesive and

		sealants for use in building, volatile organic content VOC) emission issues and indoor air quality for sustainability and health hazard, Operational energy reduction and net zero building, Optimization for design of building for energy efficiency and example of optimization through use of Evolutionary genetic algorithm, Radiation budget, urban heat island; Surface water balane, Effects of trees and microclimatic modification through greenin, Use of Building Integrated Photo Voltaic BIPV) and other renewable energy in buildings, basic concepts and efficience, Energy codes ECBC requirement, Concepts of OTTV etc, Green Performance rating, requirements of LED, GRIHA etc.
Phys728	Energy efficiency and economy	This course explores the theoretical and empirical perspectives on individual and industrial demand for energy, energy supply, energy markets, and public policies affecting energy markets. It discusses aspects of the oil, natural gas, electricity, and nuclear power sectors and examines energy tax, price regulation, deregulation, energy efficiency and policies for controlling emission
Phys729	Atomic energy levels for high-resolution lines	Repetition of quantum mechanical foundations: stationary states; expectation values; electronic states and wave functions, One-electron atoms: energy levels and wave functions; spin-orbit interaction; relativistic and QED-related effects; electronic transitions; electric dipole approximation; quantum numbers and selection rules; angular momenta and coupling schemes; radiation of higher order; radiation-less transitions, Helium: approximations for the Schrödinger equation; Coulomb- and exchange integrals; ground state and excited states; wave functions and their symmetry; spectra, Many-electron atoms: theoretical approximation schemes; LS-coupling; fine structures; jj-coupling; configuration mixing; spectra, Molecular symmetry and motion: Symmetry and symmetry operations; point groups; group theory; representations; analysis of molecular motions, Molecular quantum mechanics and beyond: H2+-molecule, H2-molecule, bonding, LCAO-MO-approximation; symmetry adapted molecular orbitals; electronic states and electron correlations; rotations and vibrations including symmetry analysis; potential curves; transitions between different states, Molecular spectra: Rotational- and vibrational resolved spectroscopy; electron spectra ; Franck- Condon principle; interaction with electromagnetic radiation; semi-empirical calculation methods, Computer-assisted calculations and simulations, such as extended Hückel and

		ab initio.Ref Demtröder An Introduction to Atomic-, Molecularand Quantum-Physics)
Phys730	Advanced Precision Measurements	Introduction and definitions- Error types, sources, and analysis- Static and dynamic response characteristics of measurement systems- Transduction of mechanical signals into electric signals- Conditioning, acquisition, transferring, processing, and displaying of electric signals-Electric methods of measurements- Measurements of force, moment, stress, strain, and vibrations- Measurements of pressure, temperature, and flow rate – Turbulence measurements of mean and fluctuating flows with focusing on advanced modern methods.
Phys731	Extrasolar Planets and Astrophysical Discs	Techniques how the mass distributions of galaxies are measured, Modeling the equilibrium of a gravitational system with a very large number of point sources, Structure of nearby and distant galaxies, Observational programs to study these galaxies, Observations that have been used to understand the evolution of galaxies, The role of dark matter in galaxy evolution and formationAdvanced models for stellar populations and their application to the study of galaxy evolution Ref Galaxy Formation and Evolution by Houjun Mo, Frank van den Bosch, and Simon White)
Phys732	Multibodies theory of solids	the interacting system- the basic problem , the jellium solid – hartree theory-the sommerfeld model-hartree-fock- exchange and correlation holes- correlation effects and the 238odeli-fermi model-bibliography-green's functions of the single-particle schrodinger equation green's functions of the schrodinger equation- green's functions and perturbation theory- time-dependent green's functions green's function diagrams- green's functions or wave functions? Bibliography –prof 'us-quantization of waves second quantization) waves and particles- the linear chain of atoms – the general quantization of a wave system – quantization of the electromagnetic field- elementary excitations and "particles"- perturbations and the elementary excitations – representations of quantum-mechanics- schrodinger representation. 238odeling238238 representation.interaction representation – occupation number representation interaction between waves and particles- field operators
Phys733	Electrical and magnetic properties of solids	The electrical conduction processes and magnetism in a whole range of solids: ionic solids, metals, semiconductors, fast-ion conductors and superconductors. The experimental discussion is enriched by related

		theories like the free electron theory and the band theory of solids. A large spectrum of topics is presented in this book: Hall effect, magnetoresistance, physics of semiconductors, functioning of semiconductor devices, fast-ion conduction, classical and modern aspects of superconductivity. The book explains the magnetic properties of solids and theoretical and experimental aspects of the various manifestations of magnetism, dia-, para-, ferro-, antiferro- and ferri-magnetism. The consideration of magnetic symmetry, magnetic structures and their experimental determination completes the spectrum of the book. Theories, techniques and applications of NMR and ESR complete the analytical spectrum presented.
Phys734	Advanced methods in materials composition research	Processing Techniques of Advanced Materials- Influence of Composition and Structure of Pt-Based-Electrocatalysts on Their Durability in Different Conditions-of Stress-Test-Preparation of Pt/C Catalysts – Preparation of PtCu/C Catalysts –Characterization of the Catalysts Structure – Electrochemical Measurements- Degree of Degradation of Pt/C Electrocatalysts – The Effect of the Spatial Distribution of Pt NPs-on the Degree of Degradation of Pt/C-Electrocatalysts – The Effect of the Structure of Bimetallic-Nanoparticles on the Stability of Catalysts-with Stress Testing - - Investigation of the Effect of Different Organic Additives on Morphology and Electrocatalytic Activity of Platinum Nanomaterials Towards Oxygen Reduction Reactions - Preparation of Electrode – Electrodeposition of Platinum – Characterization of Pt/C – Platinum Electrodeposition on Carbon- Activity of Platinum Nanomaterials Towards Oxygen Reduction Reactions – X-ray Spectroscopy Study of the Atomic and Electronic Structure-of Polyacrylonitrile-Based Nanocomposites at Different Stages of Formation-Platinum Electrodeposition on Carbon- Activity of Platinum Nanomaterials Towards-Oxygen Reduction-Morphology and Structure of Carbon Nanoparticles Generated-from Graphite Nitrate Co-intercalation Compound. Effect of Sonication Regime – Formation of Surface Micro and Nanostructures When Exposedto Laser UV and VUV Radiation of Nanosecond Duration .
Phys735	Nanomaterial Physics	Introduction to nanomaterials and nanostructures – Top-down and bottom-up approaches – Overview on physical chemistry of solid surfaces – Introduction – Surface energy – Electrostatic stabilization and steric stabilization – Electrosteric stabilization – References – Classification and characterization of nanomaterials – Dimensional

		classification of nanomaterials – Layered materials – Nanocomposites – Porous materials – Core–shell nanomaterials - Hybrid nanomaterials – Advances in characterization techniques - - Zero-dimensional nanostructures – Introduction to zero-dimensional nanostructures – Fundamentals of homogeneous nucleation – Fundamentals for heterogeneous nucleation – Synthesis of NPs – Vapor-phase methods – Liquid-phase methods – Kinetically confined nanoparticles - One-dimensional nanomaterials – Introduction to one-dimensional nanostructures – Spontaneous growth – Evaporation condensation growth – Dissolution–condensation growth – Vapor–liquid–solid growth VLS) – Solution–liquid–solid growth SLS) – Templates based synthesis 4-9 4.3.1 Electrochemical deposition 4-9 4.3.2 Electrophoretic deposition – Electrospinning 4-13 References – Two-dimensional nanostructures – Introduction to thin films – Fundamentals of film growth – Physical vapor deposition PVD) – Chemical vapor deposition CVD) – Atomic layer deposition ALD) – Self-assembly – Sol–gel thin films – Electrochemical deposition - Concerns and challenges in nanomaterials
Phys736	Ultrafast lasers	Laser action – Oscillators and amplifiers – Amplifiers – Oscillators – Laser light and laser beams – Laser light – Pulsed lasers and time-bandwidth products – The transform limit –Repetition rates and pulse trains – Polarisation – Gaussian beams –Ideal beam parameters – Deviations from ideality – Origins of dispersion – Dispersion, ultrafast pulses, and chirp – Envelopes and carriers –Propagation through a dispersive medium- -The role of the spectral phase – The form of the spectral phase – Group delay dispersion – Predicting broadening from dispersion – Dispersion of optical elements – Pulse compression—compensating for dispersion – Non-linear optics – Non-linear material response – Self-focussing and self-phase modulation – Non-linear frequency mixing – Birefringent phase matching –Optical parametric amplification –Generating ultrashort pulses – Laser systems – Oscillators – Modelocking – Amplifiers –Chirped pulse amplification – Regenerative amplification – Pulse compression –Compressor geometries – Alternative strategies for compression –Optical parametric amplifiers – Characterising ultrashort pulses – Temporal 240odeling240240240ic240s240 –Measuring the central frequency – Electronic measurement- Measuring the intensity profile: autocorrelation –Measuring the spectral phase: FROG – One complication: measuring UV pulses –

		Ultrafast Lasers and Optics for Experimentalists- Spatial 241odeling241241241ic241s241 – Beam waist – Divergence –Energy 241odeling241241241ic241s241 – Energy and power 6- Peak power, fluence, and intensity – Practical ultrafast optics Optical elements General considerations – Optical substrates ptical coatings – Optical 241odeling –Mirrors – Metallic mirrors –Dielectric mirrors – Chirped mirrors – Beamsplitters – Standard beamsplitters -optics – Polarisers – Waveplates – Focussing optics – Mirrors - - Gratings and prisms – Gratings –Prisms –Windows and filters
Phys737	Spectral analysis methods	Introduction to the techniques and theories of spectral analysis of time series. In a discursive style, and with minimal dependence on mathematics, the book presents the geometric structure of spectral analysis. This approach makes possible useful, intuitive interpretations of important time series parameters and provides a unified framework for an otherwise scattered collection of seemingly isolated results. The books strength lies in its applicability to the needs of readers from many disciplines with varying backgrounds in mathematics. It provides a solid foundation in spectral analysis for fields that inclbook'statistics, signal process engineering, economics, geophysics, physics, and geology. Appendices provide details and proof for those who are advanced in math. Theories are followed by examples and applications over a wide range of topics such as meteorology, seismology, and telecommunications. Topics covered include Hilbert spaces; univariate models for spectral analysis; multivariate spectral models; sampling, aliasing, and discrete-time models; real-time filtering; digital filters; linear filters; distribution theory; sampling properties of spectral estimates; and linear prediction.
Phys738	Materials modeling and simulation	Using software program to model the physical systems of materials Using software program to simulate materials used in kinetic, thermal and electrical applications Using software program to design materials and employing them in various applications
Phys739	Experimental methods in solid-state physics	Diffusion Pump, Turbo Molecular Pump, Gauges for Measuring High Vacuum. Preparation of Materials: Crystal Growth, Amorphous Materials, Nano Materials, Polymers by Different Techniques. Device Fabrication: Oxidation Diffusion, Ion Implantation, Metallization, Lithography and Etching, Bipolar and MOS Device Fabrication.

		Characterization Techniques: Impedance, TEP, AFM, TEM, SIMS, Micro Raman, Luminescence, Ellipsometry.
Phys740	Advanced electrochemical energy storage systems	Basic concepts, Primary and Secondary cells, Materials for batteries, supercapacitors and fuel cells, Electrochemical energy storage systems, Design, fabrication, operation and Evaluation; Safety and tolerance, Scientific and technical factors influencing electrochemical energy storage and conversion, Anode and cathode materials, Electrolyte aspects. Laboratory practical including for example analysis of charge- and discharge curves, polarization, and impedance spectroscopy
Phys741	Transport phenomena in solids	Introduction – The Boltzmann Equation- electrical conductivity- thermal conductivity-thermoelectric phenomena- thermoelectric measurements-phonon drag effect- electron and phonon scattering
Phys742	Superconducting materials and devices	Basic properties of Superconductors; Zero resistance, Perfect Diamagnetism, Meissner effect, London's theory, Penetration depth, Concept of coherence length and origin of surface energy, Type I and Type II superconductors, Intermediate and mixed states, Critical currents and critical fields. Outlines of B-C-S theory, concept of energy gap. Tunneling in superconductors: Giaever tunneling and Josephson tunneling, Josephson junction in magnetic field; Fabrication of tunnel junction, Photolithography. Flux Flow, Flux pinning, Pinning force, Magneto-thermal Instabilities in Type II superconductors, Flux Jumps, Stabilization Criterion: cytostatic, dynamic and enthalphicstabilization, Manufacture of long length superconducting multifilmentarywires. Designand fabrication of superconducting magnets, Persistent switches, superconducting magnetenergization; Basic concepts of superconducting energy storage SMES).Superconducting Quantum Interference Devices SQUIDS): DC and RFSQUIDs,SQUID's Fabrication, Applications of SQUIDs. Superconductive Switches and Infrared detectors.
Phys743	Optical properties of semiconductors	Introduction to optical materials and characteristic of optical physics in solid states- classical propagation- Optical absorption in semiconductor- Excitons- luminescence in semiconductors Optical behaviors of dopants and defects in semiconductor's- Quantum confinement effect in nanostructures- Free electrons and Plasmonic effect- luminescence centers of some metallic dopants in semiconductors- Phonon absorption- Nonlinear

		optical properties- optical properties of new emerging semiconductors
Phys744	surface physics	Surface structure, stability and reactivity. Surface crystallography. Reconstructions and relaxation. Surface electronic structure. Experimental methods for surface electronic structure. Adsorption of atoms and molecules. Different types of bonding. Kinematics and dynamics of surface processes. Reactions on surfaces. Heterogeneous catalysis. Epitaxial growth. Layer-by-layer growth and island formation. Properties of interfaces. Segregation. Research presentations are also given. Instruments and their construction: x-ray photoelectron spectroscopy XPS), low energy electron diffraction LEED) and scanning tunneling microscopy STM).
Phys745	Material selection and performance	Introduction to Materials Selection and Design, Materials Property Charts, and Material and Process Selection Basics, Case studies.
Phys746	Material characterization techniques	Optical Microscopy: Optical microscope – Basic principles and components, Different examination modes. Electron Microscopy: Interaction of electrons with solids, scanning electron microscopy Transmission electron microscopy and specimen preparation techniques, Scanning transmission electron microscopy, Energy dispersive spectroscopy, Wavelength dispersive spectroscopy. Diffraction Methods: Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Electron diffraction. Surface Analysis: Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy. Spectroscopy: Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy. Thermal Analysis: Thermo gravimetric analysis, Differential thermal analysis, Differential Scanning calorimetry, Thermo mechanical analysis and dilatometry.
Phys747	Material characterization techniques	This course emphasis is on the basic principles and strategies for processing metallic, ceramic, electronic, and polymer materials. Processing topics will include refining of materials as well as methods to impart specific properties and shapes to a material
Phys748	Principles of physical mineralogy	Physical metallurgy principles with a focus on understanding structure-property relationships in metals and alloys. Topics include structure, dislocations, mechanical behavior, grain boundaries, annealing, recrystallization, grain growth, diffusion, phase diagrams,

		transformations, strengthening mechanisms, fatigue, creep and fracture. Emphasis on the basic structure-property-processing relationships in metals and how they differ from other material classes.
Phys749	Smart materials	Overview of smart materials- High band width, low strain smart materials – Smart Actuators-Smart composite-Advances in smart structures, materials
Phys750	Nano applications in defense and security	Military applications of Nanotechnology – Artificial intelligence materials – Propulsion –Vehicles – Propellants and Explosives – Camouflage distributed sensors – Amour protection – Conventional weapons – Soldier systems – Implanted systems, Body manipulation – Autonomous systems – Mini-/Micro robots – Bio-technical hybrids – Small satellites and Space launchers – Nuclear weapons – Chemical weapons – Biological weapons – Chemical/Biological protection.
Phys751	Nanoscience and Quantum Materials	The course provides a conceptual and practical framework dealing with physics and description of a set of prototype nanosystems, from nanotubes and 244odeling structures to nanocrystals, quantum wells, wires and dots
Phys752	Thin Film Science and Technology	This course aims to provide physics and design aspects related to thin film technologies. It also provides better understanding of the different techniques used in producing and characterization of thin films. Thin films case studies will be presented throughout the course work.
Phys753	Composite Nano Physics and Technology	1.Ceramic/Metal Nanocomposite Systems. Preparation technologies: mechanical alloying, sol-gel synthesis, melt spraying. Structures: particles, thin films, wires, porous systems. Applications: electrical, magnetic, and optical. 2. Nanocomposites based on polymer matrix: polymer / polymer, ceramic / polymer, metal / polymer, carbon nanotube / ppolymer. Preparationtechnologies: solid mixture, solutions mixing, in-situ polymerization, polymer coatings, other coatings. Applications: mechanical, electrical, optical. 3. Naturalnanocomposites: Nanocomposites synthesized biologically; Nanocomposites synthesized by mimicking natural processes; Packaging proteins. 4. Nanocomposite materials modeling: current issues. Multiscale modeling. Multi-physics modeling
Phys754	Nanotechnology applications in solar cells	The aim of this course is to use Nanomaterials that are involved in the design and manufacturing of solar cells to improve device efficiency and lowelower production costs.

		Case studies will be presented throughout the course work.
Phys755	Selected topics in nanoscience and engineering	Selected coverage of topics specializing in different fields in nanoengineering and nanoscience.
Phys756	Electron spin and magnetic resonance	In this course, the fundamentals of MRI are presented and discussed in detail. Technical aspects, especially those related to the homogeneity of image illumination and contrast are emphasized. These include among others the generation and detection of homogeneous RF fields. One of the related technological challenges is the design of RF coils that can generate a homogeneous magnetic field within the object to be imaged.
Phys757	Supersymmetry theory	Standard Model: Brief reminder and Problems, Anomalies, Aspects of Effective Field Theory, Aspects of Grand Unified Theories, Neutrinos and Dark Matter, Aspects of Supersymmetry Ref Quantum Field Theory and the Standard Model de Matthew D. Schwartz)

Courses Contents

Department of chemistry

Code	Course Title	Contents
Chem 501	Inorganic Industrial Chemistry	The paper imparts basic knowledge of chemistry of inorganic materials such as silicates, non-silicates, ceramics, cement. Silicate Industries a) Glass: Glassy state and its properties, Classification silicate and non-silicate glasses). Manufacture and processing glass. Composition and properties of the following: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass and photosensitive glass. b) Ceramics: Ceramic, their types and manufacture. High technology ceramics and their applications, super conducting and semi conducting oxides, fullerenes carbon nanotubes and carbon fiber, clays and feldspar. c) Cement: Classification of cement, ingredients and their role. Manufacture of cement and the setting process, quick setting cements.
Chem 502	Food industries	Food additives: A general study of food flavours, colours and preservatives, artificial sweeteners. Sugar industry; source of sugars, cane and beet, sugar manufacture from cane and beet, energy consumption in sugar industry, wastewater from sugar factories.
Chem 503	Environmental pollutions	Air Pollution: Pollutants and their sources, pollution by SO2, CO2, CO, Nox, H2S and

		other foul-smelling gases. Methods ofestimation of CO, Nox, Sox and their control procedures. Greenhouse effect and global warming, Ozone depletion by oxides ofnitrogen, chlorofluorocarbons and halogens, Removal of sulphur from coal. Particulate matter and its types. Water pollution and Water Quality Standards: Pollutants and their sources, Effluent treatment plants primary, secondary and tertiarytreatment). Industrial effluent from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agrochemicals, fertilizer. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification reverse osmosis, electro dialysis, ion exchange). Water quality parameters for wastewater, industrial water anddomestic water.
Chem 504	Petroleum and Petrochemical Industry	Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional distillation principle and process), Cracking thermal and catalytic cracking), Reforming petroleum and non-petroleum fuels LPG, CNG, LNG, biogas, ffuelderived from biomass), fuel from waste, synthetic

		fuels gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and Xylene.
Chem 505	Polymer industries	Introduction and history of polymeric materials: History of polymeric materials, Different schemes of classification of polymers, Polymer nomenclature, classification of polymerization processes. Kinetics of Polymerization Mechanism of step growth polymerization, kinetics of step growth, radical chain growth, ionic chain, Mechanism and kinetics of copolymerization, polymerization techniques. Determination of molecular weight of polymers Mn, Mw, etc.) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Unit 4 Properties of Polymers Physical, thermal, Flow & Mechanical Properties) Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene copolymers, polyvinyl chloride) and related polyrelatedcetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins Bakelite, Novolac), polyurethanes,

		silicone polymers, polydienes, Polycarbonates, Conducting Polymers: polyacetylene, polyaniline, polyp-phenylene sulphide, polypyrrole, polythiophene
Chem 506	Unit Chemical processes	The course provides basic information about unit operation and unit processes. The course covers the concept of various unit processers like halogenation, alkylation, oxidation, hydrogenation, nitration, sulfonation, esterification, hydrolysis and hydration. Synthesis is based on carbon monoxide and hydrogen. Types of reactors, mass and heart balance.
Chem 507	Process Safety and transportation of fluids	The first part of the course emphasise on the knowledge of loss prevention, personal safety, industrial safety, hazard analysis and various elements of process safety management The second part of the course aims to cover basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.
Chem 508	Instrumental analysis 1	The course is divided into four units. The first unit highlight on IR and NMR spectroscopy. The knowledge of IR and NMR spectroscopy helps to indentify unknown compounds. It covers principle, theory and application of spectroscopy. Second unit comprises introduction, principle and

		application of mass spectroscopy. Third unit covers instrumentation of HPLC and HPTLC and explain various applications of it. The fourth unit covers introduction and instrumentation of TGA, DTA, DSC, XRD and SEM. It also covers various applications of all instruments.
Chem 509	Processing oils and fats to utility products	The first part of the course covers principles, kinetics, thermodynamics and optimum conditions for hydrogenation. Manufacture and utilization of products obtained from edible oil blends. Manufacture and uses of peanut butter the second part of the course covers the manufacturing technology of soap and detergent. The course provides basics information about various oils and additives used for manufacture of soap and detergents.
Chem 510	Instrumental analysis 2	Modern Instrumental analysis in chemical analyzes. Spectroscopy and electroanalysis
Chem 511	Introductory Forensic Chemistry	This course emphasizes the history, philosophy, and major theories of chemistry as they apply to current forensic analytical techniques." This liberal arts class entails learning, thinking about, and applying major laws, concepts, and theories of chemistry to issues confronting the practicing crime scene analyst,

		forensic scientist, and law enforcement.
Chem 512	Chemical analysis 1	General tests of carbohydrates. Specific reactions of selected sugars-Osazones, sucrose, pentoses. General reactions of amino acids and proteins. Qualitative tests of lipids and steroids. Estimation of total sugars by anthrone method. Estimation of maltose by 3,5 dinitrosalicylic acid
Chem 513	Practical Forensic Chemistry	Instruction and laboratory practice of analytical procedures used for analysis of arson, explosives and trace evidence. Laboratory work includes sample preparation and use of microscopes, FTIR, and GC/MS as well as analysis and interpretation of data. Use of conformity to standard protocols, calibration, and discriminant function analysis.
Chem 514	Practice in Forensic science	Introduction to chemical and physical analyses used by a modern crime laboratory in the evaluation of physical evidence encountered in criminal acts. Areas of concentration will include drug analysis, toxicology, forensic serology, explosives analysis, arson examination, firearms and tool marks, latent prints and trace evidence. Emphasis will be placed on the value of such examinations as presented by the expert witness in a criminal trial.
Chem 515	Chemical analysis 2	Estimation of amino acids by formal titration. Estimation of

		tyrosine by Millons-reaction. Estimation of amino acid by Ninhydrin method. Estimation of proteins by Lowry methods. Estimation of proteins by Biuret methods. Estimation of cholesterol by Libermann-Burchard method.
Chem 520	Chromatographic separation techniques	Study the methods for separation of organic compounds by chromatographic techniques: Thin layer chromatography TLC), Column chromatography, Liquid chromatography, Gas chromatography, High performance liquid chromatography HPLC).
Chem 521	Petroleum refining and petroleum additives chemistry	Chemistry of crude oil and petroleum products, Refining process, Fractional distillation, Catalytic reforming, Alkylation, Isomerisation, Cracking and hydrotreating processes, Lubricating oil production, Additives technology.
Chem 522	Chemistry of petrochemical industries	Petrochemicals, Raw materials, Basic building block processes, Petrochemical process technology, Ethylene and co-products, Ethylene derivatives, Propylene derivatives, Butadiene and butanes, Toluene and xylenes production, Steam reforming and related processes.
Chem 523	Chemistry of paints and inks industries	Paint systems, Surface preparation, Basic paint formation, Paint component functions, Types of paints, Application of paints, Types of resins and binders, Pigments

		and their toxicity, Colour systems and colour measurement. Definition and scope of inks, Types of inks, Conventional printing inks, Duplicating and latentimage inks, Pigments and dyestuffs, Radiation curable inks, Specialty inks and applications, High-speed inks.
Chem 524	Chemistry of polymer and fibers industries	Principles, Polymer synthesis, Measurements of molecular weight and size, Analysis of polymers, Structure and properties, Polymer processing. The chemistry of natural and synthetic fibers, Pretreatments of textiles and finishing methods, Auxiliaries and their uses, The relation between fiber structures and their properties
Chem 525	Chemistry of detergents industry	Detergency process, Effect of surfactant on dirt removal, Builders, Soaps and soap products, Synthetic surfactants, Anionic surfactants, non-ionic surfactants ethoxylation reaction, Cationic surfactants, Household detergent products based on synthetic surfactants, Fabric washing products, Fabric softening products, dishwashing liquids.
Chem 526	Industrial application of polymer	Methods of polymerization, Polymer morphology Additives Copoly-merization Relation between, Structure and Application Technology of use of polymers Moulding of polymers Reaction of Polymeric material spinning of

		fibrous materials Elastomers Composite.
Chem 527	Environmental pollution and water treatment	Environmental management system, Material safety data sheet, Environmental studies of a new plant, Industrial waste, Hazardous waste, Chemical labeling system. This course is related to water analysis and treatment to improve the quality of water to make it appropriate for a specific end-use. The end use may be drinking, industrial water supply, irrigation, river flow maintenance, water recreation or many other uses, including being safely returned to the environment. The different standard and advanced methods for analysis and treatment of drinking water and domestic and industrial wastewater treatment will be studied. The terms quality assurance and quality control of water are also discussed.
Chem 528	Application of organometallic chemistry	Study the synthesis, reactions and application of organo-lithium compounds, organo-magnesium, organo-boron, organo-silicon, organo-tin and organo–cadmium compounds. This course intends to introduce the students to understand some advanced aspects related to organometallic compounds, their scope, conventions, reviews and journals, modern synthetic methods such as electrochemical and

		miscellaneous methods, structure and bonding in organometallic compounds, thermochemistry of organometallic compounds, organometallic compounds as sources of carbanions, reactions of organic groups bonded to metals, as well as special emphasis on the catalytic applications of organometallic compounds in different pathways.
Chem 529	Applied spectroscopy	Fundamentals, instrumentations and applications of atomic spectroscopy: Flame, Arc and spark atomic emission spectroscopy, inductively coupled plasma, inductively coupled plasma-mass spectrometry, atomic absorption spectroscopy and light amplification by stimulated electromagnetic radiation spectroscopy.
Chem 530	Analysis results and quality codes	This course gives a clear account of the underlying principles of statistical methods, validation and application to any form of chemical analysis. Also, stability testing as a requirement for the regulatory approval during product marketing, and is a vital component of the overall quality control program can be simply discussed
Chem 531	Laboratory safety and security	This course gives a clear account of the general laboratory safety rules,

		Chemical safety in the lab and lab security.
Chem 601	Advansed Applied Coordination Chemistry	Coordination compounds in medicinal chemistry, Coordination compounds as catalysts, Coordination chemistry in microelectronics.
Chem 602	Advanced Inorganic Chemistry	Symmetry: Elements and operations, Point group, Matrices, applications to molecular vibrations, Applications to chemical bonding, Ligand field theory. Nuclear magnetic resonance spectroscopy: Elementary aspects, Principles and Applications, Nuclear magnetic resonance spectra of paramagnetic transition metal ion complexes. Electron paramagnetic resonance spectroscopy: Electron paramagnetic resonance spectra of transition metal ion complexes.
Chem 603	Computational Methods in Quantum Chemistry	The molecular Hamiltonian, Born-Oppenheimer approximation, The linear combination of atomic orbits molecular orbital – variation, treatments of molecules, Hückel molecular orbitals method and its limitations, The development of some simple zero differential overlap – self consistent field methods, The Molecular orbit mechanics method
Chem 604	Inorganic Polymer Chemistry and Inorganic Cyclic Compounds	Inorganic polymers, Coordination polymers, Metal polymers, Chemistry of non-

		metals, Inorganic cyclic compounds.
Chem 605	group theory and	Symmetry elements, point groups of different complexes. Other associations in solid state. topics of ESR studies.
Chem 607	Scientific Writing	Definition of scientific writing, Origin of scientific writing, Preparing and publishing research papers, Review articles and theses, Preparation of oral presentations and posters, Ethics, Rights and permissions, Jargon, Abbreviations, Common errors in style and in spelling.
Chem 611	Inorganic solvent extraction	Inorganic solvent extraction, sampling of solid, liquid and gases. chromatoghraphic methods, electroanalytical separation
Chem 612	Sampling teqhniqes	Obtaining samples from different industries and environmentsm condition governies the sampling process, distribution coefficients studies for separation from different phases
Cehm 613	Pharmaceutical coordination chemistry	Elements in human bodies. Interaction between different types of drugs
Chem 614	Methods for measuring the electrical	Potentiometric studies, cyclic voltammetry, electrophoresis and their applications. studies

	conductivity of AC and DC compounds	of electric conductivity of solid compleses in direct and alternative current
Chem 615	Modeling in coordination chemistry	Computer programs modeling of coordination componds using hyper chemistry programs and chemdraw ooffice.
Chem 621	Advanced Analytical Chemistry``	Fundamentals, Instrumentations and Applications of Molecular Spectroscopy: Ultraviolet, Visible, Infrared and raman spectroscopy, Fluorescence and phosphorescence, Mass spectrometry, Nuclear magnetic resonance. X-Ray method and Electron spin resonance spectroscopy, Absorption methods and LASER spectroscopy Fundamentals, Instrumentations and Applications of Atomic SSpectroscopy:Flame Arc and spark Atatomicmission spspectroscopy, Inductivelyoupled plasma, Indinductivelyupled plasma-mass spectrometry, Atomic Absorption Spectroscopy and LASER spectroscopy.
hem 22)	Advanced instrumental analytical methods 2h)	Molecular Photoluminescence Spectroscopy, Spectroscopy Based on Scattering, Ultraviolet-Visible and Infrared Spectrophotometry, Atomic Absorption Spectroscopy, Potentiometric Methods of Analysis, Voltammetric Methods of Analysis, Coulometric Methods of Analysis, Gas

		Chromatography, High-Performance Liquid Chromatography, Flow Injection Analysis, Optimizing the Experimental Procedure, Verifying the Method, Quality Assurance.
Chem 623	Quality in chemical analysis laboratories	Definition of quality system in labs, biological hazards, Physical Hazards, Chemical Hazards and Safety hazards.
Chem 624	Methods of chromatographic analysis	Fundamentals, Instrumentations and Applications of Chromatographic Techniques: Planar chromatography, Liquid chromatography and High-performance liquid chromatography, Gas chromatography, Supercritical fluid chromatography, Ion chromatography, Gas chromatography-Mass spectrometry, Electrophoresis: Introduction, Types and applications.
Chem 625	Statistics and results analysis	Definition of evaluating Analytical Data and Calibrations, standardization and Blank corrections.
Chem 626	Recent processing results	Explaining results by computer applications such as Excel, Mat lab and SPSS
Chem 631	Spectral analysis	Fundamentals, instrumentations and applications of molecular spectroscopy: Ultraviolet, Visible, Infrared and Raman spectroscopy, Fluorescence and phosphorescence, nuclear spectroscopy, Nuclear magnetic resonance, X-Ray method, Electron spin

		resonance spectroscopy, Absorption methods and Laser spectroscopy.
Chem 632	Bioorganometallic Chemistry Lec. 2 hrs	Metalloproteins, Metal atoms in enzymatic catalysis, Binding of metal ions and complexes to biomolecule-active centers, Electron transfer proteins, Substrate binding and activation by non-redox mechanisms, Atom and group transfer chemistry. Models of metalloproteins, Studying and discussion of different examples from current inorganic literature primary journals and review journals).
Chem 634	Selected Topics in Analytical Chemistry	Offered as needed to present material not normally available in regular departmental course offerings.
Chem 637	Different methods in water desalination 2h)	Classification of desalination technologies, energy sources to supply desalination process, renewable energy sources, Multi-Effect Distillation MED), Multi-Stages Flash MSF), Vapor Compression VC), Reverse Osmosis RO), Forward Osmosis, Nanofiltration NF), Electrodialysis ED), Capacitive Deionization CDI), Hydration HY), Membrane Distillation MD), Ion-Exchange Resin IXR), Solar Still Distillation SSD), Humidification–Dehumidification HDH).
Chem 641)	Advanced chemical kinetic and thermodynamic studies 2h)	Pseudo-first order reactions, autocatalytic reaction, kinetic of adsorption process, kinetic of photocatlysis, kinetics of reversible reactions. Heat capacity, heat capacity of solid

		elements, heat capacity of reactions, Lewis law, Debye law, entropy and probability. Thermal equilibrium and colorimetric method. Thermodynamic state of equation. Partial molal quantities: special forms of the partial molal quantities. Determination of partial molal quantities.
Chem 642)	Advanced Electrochemistry and its application 2h)	Introduction to electrochemistry: electrode kinetics, dynamic electrochemistry, the Butler-Volmer and Tafel equations. Overpotentials. Kinetically and mass transport controlled electrochemical processes. Mass transport by migration, convection and diffusion. Potentiostatic and galvanostatic methods including chronoamperometry, coulometry, cyclic voltammetry, chronopotentiometry, and an impedance spectroscopy. Polarography and pulse voltammetry: polarography, normal pulse voltammetry, differential pulse voltammetry, square wave voltammetry. Controlled-current techniques. Bulk electrolysis methods. Electrochemical techniques coupled with in situ techniques providing structural information. Surface confined electrochemical processes.

		Electropolymerization. Homogeneous and heterogeneous electrocatalysis.
Chem 643)	Spectroscopic characterization of solid materials	Principles and instrumentation of advanced equipment such as thermal analyzer DMA, TMA, DSC, TGA etc.), Rheometer, Microscopes SEM, TEM, ESCA, image analyzer and AFM), Dilatometry, Flammability tests Cone calorimeter, burning test apparatus etc.), IR Spectroscopy, Thermal conductivity apparatus etc. Accelerated exposure test Humidity chamber, UV chamber etc.), Interpretation of instrumental data.
Chem 644	Applications of surface phenomena and heterogeneous catalysis	Oriented adsorption of surfactants at interface, micelle formation, surfactants shapes in colloidal solution, heterogeneous degradation of organic pollutants, dynamic and static adsorption, drug delivery by solid adsorbents, organic synthesis based on heterogeneous catalysis.
Chem 646)	Advanced photochemistry	Essential parts of modern theoretical and experimental photochemistry. Fundamental photochemical and photophysical processes in molecules and semiconductors. Advanced description of photochemical transformations relevant to energy conversion schemes, including photocatalysis and photosynthesis. Applications of photoinduced processes in

		medicine and industry, atmospheric photochemistry and its environmental aspects.
Chem 651)	Selected topics in computational chemistry 2h)	Calculating the ground-state energy of many types of molecules; determining the ground-state electron geometry of a molecule; modeling the 3D) potential energy surface for many types of molecules; Predicting the reaction mechanisms of different types of reactions; Modeling the transition states of complicated reaction mechanisms to better understand how the reaction works.
Chem 652)	Advanced corrosion chemistry 2h)	Basics of corrosion: Thermodynamics and electrochemical aspects of corrosion; EMF and galvanic series; Pourbaix diagram; Evans diagram; Corrosion mechanism – kinetics of activation polarization, kinetics of passivation polarization, mixed potential theory, diffusion, limiting current tendency; Corrosivity and passivity. Forms of Metallic Corrosion: Uniform, pitting, crevice, intergranular, stress corrosion, corrosion fatigue, hydrogen cracking, dealloying, high-temperature, Corrosion prevention through design, coatings, inhibitors, cathodic and anodic protection. Corrosion Testing and Monitoring. Quantitative measurement of corrosion

		rate – weight loss, electrochemical techniques such as potentiodynamic polarization, cyclic voltammetry and impedance techniques
hem 53)	Electrochemistry and stored energy technique 2h)	Fundamental aspects related to energy storage and conversion with focus on batteries, fuel cells and photoelectrochemical cells. Batteries: Types of the main current batteries Leclanché, lead-acid batteries, zinc-air, ZEBRA system, nickel-cadmium, nickel-metal hydrides, lithium batteries, etc.) and advanced lithium-air and lithium-sulfur); energy conversion mechanism in batteries; focus on materials; critical operating parameters; main types of reactions to the electrodes; effects of the discharge current; self-discharge; Fuel cells. Types in-depth study of SOFCs and PEMFCs), structure and possible configurations; mechanisms underlying the transformation processes in a fuel cell; state-of-the-art and emerging materials; anionic and proton conductivity; criteria for choosing the electrolyte; energy balances; efficiency. Technical challenges and perspectives. Photoelectrochemical cells: The photovoltaic effect. Functional materials for solar cells: p-n junction and

		multijunction photovoltaic systems. Systems based on crystalline and amorphous silicon; thin film cells CuInSe2, CdTe). Equivalent electrical circuit, open circuit voltage and short circuit current; voltage-current and voltage-power curves. Dye-sensitized solar cells: advantages, production problems, sensitization. Liquid, gel and solid electrolytes.
hem 54)	Physical and chemical properties of nanomaterials 2h)	Fabrication of nanomaterials, X-Ray Diffraction from Nanostructured Materials, High Resolution Electron Microscopy of Surfaces and Interfaces, Nanoelectronics, porosity of nanoparticles, thermal stability of nanoparticles, Unike chemical properties of nanmaoetrials, adhesion on the nanoscale, Nanometric Solid Deformation of Soft Materials in Capillary Phenomena, electrostatic self-assembly of nanoparticles.
hem 57)	Chemistry of solid materials 2h)	Structure of crystalline materials, chemical bonding, electronic band structure, optical materials, dielectric materials, magnetic materials, superconductivity, amorphous and disordered materials, zeolite materials, MOFs and MILs materials.
Chem 661	Advanced heterocyclic chemistry	Synthesis and reactions of some six membered ring and fused heterocycles.

Chem 662	Oxidation and reduction in organic chemistry	Oxidation – reduction in organic synthesis. Metal hydride reduction, dissolved metal reduction and catalytic reduction.
Chem 663	Advanced carbohydrates chemistry	New development in chemistry of oligo and polysaccharides. Factors affecting sweetness of sugars. Theoretical evaluation of sugar sweetens. Conformational analysis.
Chem 664	Advanced polymers chemistry	Synthesis of modern polymers, studying of polymer chain length and co-polymer sequence distribution, polymer chain models and configurationally study.
Chem 665	Advanced applied spectroscopy	Advanced studying of IR, UV, $_1$H-NMR, ^{13}C-NMR, 2D-NMR, ^{15}N-NMR and mass spectra.
Chem 666	Scientific writing and publishing	Definition and bases of scientific writing. Scientific writingof Thesis, reviews, articles, …….)).Definition and types of palagrism in scientific publishing. Ranking, impact factor and citation index.
Chem 671	Advanced organo-metailc synthesis	Synthesis and reactions of organo-metallic compounds of Li, Mg, B, Al. applications of organo-metallic compounds.
Chem 672	Chemistry of nucleosides.	Classification of nucleosides. Synthesis and reactions of N-nucleosides examples Synthesis and reactions of C-nucleosides examples. Examples of nucleosides biological activities.
Chem 673	Advanced chemistry of natural products.	Chemistry of carotenoids α, β, γ-carotenes, vitamin A), steroids cholesrol, vitamin D, steroid hormones). Steroidal

		glycosides and steroidal alkaloids.
Chem 674	Chemothrapy.	Sulphpamides, antimalarial, arsenic drugs. Antibiotics Penicillins, Cephalosporin, Ctreptomycin, Chloramphenicol and poly acetylene antibiotics.
Chem 675	Organic photo chemistry.	Energies of photochemical conversions, radiation and molecular orbitals, theoretical organic photochemistry. Mechanistic organic photochemistry, photochemical reactions, photo addition, photo substitution and photo fragmentation reactions, isomerization and rearrangements, chemo-luminescent organic chemistry.
Chem 701	Advanced Coordination Chemistry	Reactivity of coordination ligands, Hydrolysis of coordinated esters e.g. amino acid esters), Hydrolysis of coordinated imino group Schiff bases), Hydrolysis of coordinated amides e.g. peptides, polypeptides and proteins), Hydrolysis of nitriles, redox reactions. Multinuclear metal complexes, Synthetic strategies for di-, tri-, tetra- and polynuclear metal complexes
Chem 702	inorganic BioChemistry	Role of drugs and drugs compleses in Human, studies of stability of drug ccompleses inhuman body.
Chem 703	Advanced Techniques for Structural Determination of Inorganic Compounds	Proton magnetic resonance spectra of paramagnetic inorganic compounds, Magnetochmical methods, Electro-spray mass spectra and related techniques, X-ray

		crystal analysis and molecular structure, thermal analysis
Chem 704	circular dichroism	Principle of circular dichroism, interaction of circular dichroism, molar of circular dichroism, molar elliptcity.
Chem 705	Cloud point extraction	Techniques of cloud point extraction of inorganic/ organic chemistry using benign extants), nonionic ssurfactant, application in bio system
Chem 706	Selected Topics in Organic Chemistry 1	Different selected topics in organic chemistry
Chem 707	Laser applications in inorganic chemistry	Ultra-short, pulsed lasers have proven to be effective in tracking transient changes in atoms and molecules. Think about it this way. Each chemical element boasts of varying spectral fingerprints, which form the basis for spectroscopy.
Chem 708	Selected Topics in Organic Chemistry 2	Different selected topics in organic chemistry
Chem 711	Advanced environmental analytaical chemistry	Air analysis, lake aanalysis, waterananalysis, eaa analysis
Chem 712	Selected Topics in Analytical Chemistry II	Offered as needed to present material not normally available in regular departmental course offerings.

Chem 713	Methods of analysis of industrial gaseous	Advanced methods for separation of different industries, advanced separation methods		
Chem 714	solution equilibrium	Equliprium in different phases homogenous and non-homogenous system). Mass balance, charge bbalance andproton condition for detrming different spspeiecious, tudy of differnent specious at differentmedmedium. Chemm 715	techniques of wastewater analysis and treatment	Waste water component and iitsananalysis, ethods of separation of wastewatwater, fferentt wastsoursources, atmentnt of wastewastewaterces
Chem 716	Advanced pharmaceutical analytic chemistry	The principles and procedures for the determination of various pharmaceutical bulk drugs and their formulations belonging to different categories are discussed in detail. The applications of the important reagents like MBTH, FC, PDAB etc. in the determination of the pharmaceuticals are also discussed.		
Chem 717	Spectral applications in analytical chemistry	Spectral analysis or spectrum analysis is analysis in terms of a spectrum of frequencies or related quantities such as energies, eigenvalues, etc. In specific areas it may refer to: Spectroscopy in chemistry and physics, a method of analyzing the properties of matter from their electromagnetic interactions.		
Chem 718	Selected Topics in Analytical Chemistry	Different selected topics in organic chemistry		

hem 31)	Electrolytic conductance and ionic association 2h)	Introduction to electrolytic conductance, Debye-Hückel theory “ionic atmosphere theory”, physical significance of γ± and D. H. theory, potential energy of an ion φ, relaxation time of ionic atmosphere, ion association and solvent effects, ion size parameter, Faous-Onsagar limiting conductance treatment, the electrophoretic effect
hem 32)	Physical and mechanical properties of polymer molecules 2h)	Biopolymers, synthetic polymers, thermal expansion, transition temperature, cohesive properties and expansion, intrinsic viscosity, electrical properties, elastic parameters, rubber elasticity, sonic absorption, crystallinity nucleation and growth, thermal degradation, deformation properties, environmental decay of polymers, optical properties, transport properties, breakdown of polymers.
hem 33)	Advanced selected topics in physical chemistry 2h)	Linearization of the rate equations, relaxation times in single, two and multistep systems, what is a small perturbation solution of the relaxation equations? Experimental techniques and application, the rate equations, the term “relaxation kinetics” is associated with the study of very rapid reactions, classification of relaxation times, the relaxation time is related to the specific rates of

		the involved reactions, measuring the relaxation times, special techniques for studying of the fast reactions.
hem 34)	Environmental applications of catalysis 2h)	Homogeneous and heterogeneous catalysis, different methods of environmental treatment, advanced oxidation process, adsorption, photocatalysis, sonocatalysis, photosonocatalysis, Fenton oxidation process, modification of catalysts, energy band gab of catalysts.
hem 35)	Nano porous materials	Nano solid particles, stability of solid materials, porosity of solid materials, types of pores, origin of pores, determination of solid porosity, surface area and porosity, metal organic frame works, hydrogen gas storage, raising porosity of solid materials nanoparticles, surface functionalization of nanoparticles environmental applications of porous materials, industrial applications of porous materials.
Chem 737	aser applications n inorganic hemistry	There are two broad areas within computational chemistry devoted to the structure of molecules and their reactivity: molecular mechanics and electronic structure theory. They perform the same basic types of calculations: Computing the energy of a particular molecular structure.
Chem 741	reen organic hemistry.	Introduction to the concepts and principles of Green

		Chemistry. Selected real world applications of Green Chemistry. Prevention of pollution at source through new and sustainable synthetic methods, real world case studies including the clothing industry, enzymes as biocatalysts, renewable feedstocks as well as recycling, and pure water. Elimination of solvents in the organic Laboratory. Organic Reactions under Aqueous Conditions. Organic Reactions in Greener Non-Aqueous Media. Using More Environmentally Friendly Organic Reagents. Green Organic Reactions under Microwave Heating.
Chem 742	Multi-reactants organic synthesis.	Introduction to the types and ideality of chemical reactions. Definition and history of multi-components reactions. Comparison of multi-component reactions with multi-step reactions. Types of multi-component reaction for examples Passerini reaction, Ugi reaction, Beginilli reaction,…….etc…….. . Mechanisms of different multicomponent reactions and their applications.
Chem 743	Organic reactions design strategy..	The basis for retrosynthetic analysis and terminologies, transform based strategies, Substrate/precursor-based strategies. Functional group-based strategy and mechanism-based strategy. Consideration of symmetry elements in

		synthetic planning and synthesis of symmetrical molecules and concoctive species. Stereochemical strategies to create new chiral center/s in an organic molecule. Concepts of synthetic equivalents and its application in total synthesis. Fragmentation reactions and molecular rearrangements and its application in organic synthesis. Selective protection and deprotection of various functional groups and its application in total synthesis. Important name reactions and their applications in organic synthesis. Total synthesis of few natural products.
Chem 744	Computational chemistry applications.	Definition of computational chemistry, concept of the energy surface, Molecular mechanics; commonly Available force field MM2, MM3, MM4. Introduction to quantum mechanics for organic chemistry in computational chemistry Huckel Molecular Orbital theory, Ab initio calculation, Computed spectral properties and structure, Identification. Semiempirical calculation for identification of organic reaction mechanisms. Density Functional calculation, Computational Approaches to understanding Enzymes, Quantitative structure-activity relationships, Software, and hardware

Chem 745	Forensic Chemistry.	Chemical analysis of trace amou of materials including: Explosive Drugs, Toxicants, Fibers, Textiles Paints, Cements, Inks, Building materials,….etc….by chromatography TLC, GC, GC/M Visible UV and Fluorescence spectrophotometry, Infrared spectroscopy, Mass spectroscop and Various separation/extracti techniques such as solid phase extraction and liquid/liquid extractions.
Chem 746	Advanced heterocyclic chemistry	Nomenclature, Synthesis, and reactions of different types of fused-ring heterocyclic compounds, Special topics in heterocyclic transformations including: Tautomerism, Agricultural chemical applications, Organometallic reactivity, And automated synthesis
Chem 747	Catalytic complexes in organic reactions	Synthetic reactions of alkyltransition metal complexes and their chemical properties. Oxidative addition and reductive elimination. Bonding of olefin complexes and carbonyl complexes. Insertion of olefin and of carbonyl ligands into a metal-alkyl bond, β-hydrogen elimination and decarboxylation.
Chem 748	Tools for suggesting organic reaction mechanisms	Spectroscopic observation of reaction intermediates. Determination of the stereochemistry of products, for example in nucleophilic substitution reactions. Measurement of the effect of

		isotopic substitution on the reaction rate.
Chem 749	Selected Topics in Organic Chemistry	Different selected topics in organic chemistry

Courses Contents

Department of Botany

and Microbiology

Code	Course Title	Contents
Mic501	Microbial Quality Control and risk assessment	The course is responsible for multiple tasks, including 1Environmental monitoring sampling, bioburden counts, microbial identifications, and tracking and trending of data), 2- Investigating out of specifications, deviations, and contamination events, and 3- Implementing and validating QC methods and testing based on release specifications. Testing the sum of all controllable factors that ultimately influence positively or negatively the quality of the finished product e.g. selection of raw materials, processing methods…etc. Cleaning and disinfection methods in microbiology. Types of soil, detergents, chemical disinfectants, heat treatment, dry cleaning, cleaning-in-place CIP), mechanical aids for cleaning. Definition of quality and quality control. Classification of quality attributes, responsibilities and organization of quality control department and its relation with other departments of industry.
Mic502	Introduction in Fermentation Technology	History of fermentation and introduction to fermentation processes. Microbial cultures and media formulation. Process designing and reactor selection. Fermentation types in industry. Downstream processing and bioprocess economics. Improvement of industrial strains. Practical: Anatomy of fermentor. Cleaning and pre-sterilization of bioreactors. Aseptic techniques in inoculation of fermenters. Aseptic sampling from fermenters. Techniques to determine microbial contaminations. Trouble shooting and diagnostics.
Mic503	Microbial Enzymes	General properties of enzymes, Nomenclature and classification of enzymes, enzyme units, enzyme purification, Co-factors –definition and function with special reference to the representative substances Enzyme kinetics – Themodynamics of enzyme kinetics, Michalelis – Menten equation. Effect of temperature and pH on enzyme activity. Study the different types of microbial enzymes used in

		biotechnology, production of enzymes, methods used for the preparation of immobilized enzymes, kinetics of immobilized enzymes, application of enzymatic analysis in medicine and application of enzymes in industry. Practical Quantitative estimation of some important enzymes. Determination of Km and Vmax of enzymes. Determination of pH optima of enzymes.
Mic504	Industrial Biotechnology	Basic concepts in industrial biotechnology. Methods and tools of industrial biotechnology and its modern applications. Gene transfer technology and its role in improving some industries. Gene therapy and its role in industry. Biopolymers and their industrial uses. Strategies for microorganisms cultivation with particular emphasis on different fermentation techniques; applied and fundamental concepts in fermentation technologies; Enzyme modifications and how to produce high-capacity enzymes. Studying biotechnological aids that contributed to improving food quality, quantity and processing. Methods of developing and improving medicines, vaccines, treatments, and others that improve human and animal health.
Mic505	Methods in Microbial Molecular Biology	Introduction and fundamentals of molecular microbiology. Study molecular genetics processes in some microorganisms, the use of genetic engineering in microbiology. Principal techniques of recombinant-DNA –technology. Molecular cloning techniques and their importance Study polymerase chain reaction and derivatives qPCR, RT-PCR, cloning), DNA sequencing amplicon sequencing, whole genome sequencing, metagenomics) and modern techniques such as transcriptomics, proteomics and genomics studies and their significance. Sanger sequencing, sequence data analysis. Study current molecular methods used in environmental microbiology. Practical: Isolation of chromosomal and plasmid DNA, gel electrophoresis, polymerase chain reaction PCR), DNA sequencing, restriction enzyme analysis, gene transfer, genome analysis, gene cloning, DNA finger printing, protein finger printing.
Mic506	Principles of Environmental Microbiology	Diversity of microbial communities in their natural habitats and at their interactions with the Environment under variable and often extreme conditions. Introduction of microbial ecology environmental biotechnology, the microorganisms present in the community, the structure of the community,

		the phenotypic of the community, the reactions that the community members perform, the interrelationships among the members of the community predation, parasitism, Commensalism) and between it and their environment, extremophiles, Microbial ecology of drinking water systems, marine water
Mic507	Diagnostic Microbiology	This course focuses on : Basic rules and requirements of microbiology lab, the identification and isolation of microorganisms for the diagnosis of infectious diseases, the characteristics of pathogens, their modes of transmission, mechanisms of infection and growth, Some microbiological tests techniques and principles such as Cerebro spinal fluid CSF) Culture & Sensitivity, Blood Culture & Sensitivity, Urine Culture & Sensitivity, Nasal swab Culture & Sensitivity, Throat swab Culture & Sensitivity, Sputum Culture & Sensitivity, Eye conjunctival) swab Culture & Sensitivity, Ear swab Culture & Sensitivity, Pus wound) swab Culture & Sensitivity, Stool Culture & Sensitivity, Vaginal swab Culture & Sensitivity, HIV, Hepatitis A,B,C), Toxoplasma. Practical: methods of identification of pathogens biochemical tests and PCR), performing of different microbiological tests in microbiology laboratory. Methods for isolating pathogenic bacteria and determining significant properties and immunological features.
Mic508	Advanced Analytical Chemistry	Fundamentals, Instrumentations and Applications of Molecular Spectroscopy: Ultraviolet, Visible, Infrared and raman spectroscopy, Fluorescence and phosphorescence, Mass spectrometry, Nuclear magnetic resonance. X-Ray method and Electron spin resonance spectroscopy, Absorption methods and LASER spectroscopy Fundamentals, Instrumentations and Applications of Atomic Spectroscopy: Flame, Arc and spark Atomic emission spectroscopy, Inductively coupled plasma, Inductively coupled plasma-mass spectrometry, Atomic Absorption Spectroscopy and LASER spectroscopy.
Mic509	Assessment of Water Quality	Introduction of water quality challenges and impacts, the effect of pollution of water on human health and aquatic animals, different sources of pollution, Water Quality Standards, parameters used in monitoring of Water quality standards, chemical, physical and biological contaminants in water Turbidity, color, microorganisms growth, chlorine percentage, pH, taste, and odour). General laboratory measurements and instrumental analysis based on optical,

		electrical and chromatography methods. Toxicity and BOD tests. Pathogenic microorganisms and microbial examination of water. Environmental sampling and quality assurance. Water quality., methods for treatment of water. Practical: instruments used in determination of water quality and treatment, water sample analysis pH, turbidity, conductivity, detection of some elements and minerals, culturing of microorganisms in different water samples from different areas. Toxicity and BOD tests.
Mic511	Advanced Bioinformatics	This course provides introduction and characteristics of biological data, analysis of genomic data and the different approaches to mapping and aligning genome sequence data, clustering, evaluation and phylogeny, Phylogenetic tree construction methods and programs, Protein structure and its secondary, tertiary structure prediction, proteomics.
Mic512	Toxicology and pollutants	Introduction of environmental toxicology; Types and sources of toxicants, Toxins of biological origin, Waste products, Ecological impacts of toxic chemicals, Factors affecting xenobiotic action, Assessment and monitoring of toxic substances, Soil and water pollution, Environmental metals and metalloids, Synthetic and natural organic and inorganic toxicants, Mode of action of toxicants, Mechanisms of toxicity of organic compounds, Pesticides and related materials, Basic toxicological principles, Ecological risk assessment, Mutagenic Pollutants.
Mic513	Environmental Biotechnology	Introduction of Environmental Biotechnology, Applications of Environmental Biotechnology bioleaching, biomining), Environmental engineering, metabolic engineering, rDNA technology and omics to study the role of microbes and plants in tackling environmental issues, Advances in waste water and industrial effluents treatment, Sludge processing and disposal, Enzyme application, Environmental detection and monitoring, Biosensors, Different Areas of Environmental Biotechnology, Recovery and recycling of materials and products, Environmental protection and pollution prevention, Microbial Enhanced Oil Recovery MEOR), Bio-electrochemical systems, Microbial electro-remediation, Biofuels for microbial and process engineering, Creative management of chromium phytotoxicity, Enhanced Biological Phosphorous Removal EBPR), Environmental Biotechnology and The Future. Risk assessment and environmental management systems.

Mic508	Advanced Analytical Chemistry	Fundamentals, Instrumentations and Applications of Molecular Spectroscopy: Ultraviolet, Visible, Infrared and raman spectroscopy, Fluorescence and phosphorescence, Mass spectrometry, Nuclear magnetic resonance. X-Ray method and Electron spin resonance spectroscopy, Absorption methods and LASER spectroscopy Fundamentals, Instrumentations and Applications of Atomic Spectroscopy: Flame, Arc and spark Atomic emission spectroscopy, Inductively coupled plasma, Inductively coupled plasma-mass spectrometry, Atomic Absorption Spectroscopy and LASER spectroscopy.
Mic514	Biodegradation of pollutants	Introduction and a critical view on the bioavailability of the substrates, Organic pollutants: types and properties, Environmental importance of natural microorganisms, responses of microorganisms to changing Environmental conditions, factors that affect biodegradation, Types of bioprocess for organic pollutant remediation, the role of microorganisms in the degradation of organic pollutants, Advantage of microorganisms for organic pollutant bioremediation, Mechanism of biodegradation of pollutants, Approaches to increasing biodegradation in contaminated environments, Factors affecting the biodegradation of pollutants, Microbial degradation of pollutants at high salt concentrate ions, Degradation of some aromatic compounds, Microbial degrading consortia for the remediation of Pesticide. Microbial degradation of selected organic pollutants.
Mic515	Phytoremediation	Background about Phytoremediation as an economical and sustainable technology for environmental cleanup, Definition of Phytoremediation, Detoxificationmechanism, Phytoremediation, Phytostabilization, Phytoextraction, Phytovolatilization, Phytofiltration,phytodegradation, phytostimulation Advantages and limitations of phytoremediation, Improving plant performance, Genetic Engineering, Using microbes to improve plant performance, Increasing bioavailability of heavy metal, Study of different plant species known to utilize different phyto-mechanisms during phytoremediation of diverse. Phytoremediation of heavy metals, organic hydrocarbon, and inorganic and organic gaseous pollutants, molecular and genetic basis of metal hyper-accumulation by plants.
Mic516	Remediation of wastes	Principles of secondary, biological treatment processes; includes sewage sand filters, trickling filters, activated sludge

		plants, lagoons, ponds, rotating biological contactors, aerobic and anaerobic digesters and biological nutrient removal. Mechanism of waste remediation process. Pollutants.
Mic517	Introduction to Cleaning in Place Technology	Cleaning and Sterilization-In-Place as systems designed for automatic cleaning and disinfecting, automated or manual systems of cleaning demanded by biotechnology and pharmaceutical industries.
Mic519	Environmental Law	Development and need for Environmental law; introduction to a legal system; public and private rights in the Environment; regulation of pesticides and toxic substances; Environmental legislation and rulemaking; Environmental impact statements; professional as expert witnesses.
Mic521	Advanced Microbiology and Biotechnology	General characteristics of various groups of prokaryotes: bacteria including, Rickettsiae, Chlamydiae, Spirochaetes and Actinomycetes, Cyanobacteria and Mycoplasmas. Eubacteria: cell structure, nutrition, cultivation, growth, reproduction, endospore formation, classification of bacteria and Archaea according to the Bergey's Manual of Systematic Bacteriology. Environmental factors affecting growth of microorganisms, Control of microbial growth by physical and chemical methods. Algal and Cyanobacterial diversity and distribution; Characteristics: cell structure, pigmentation, thallus organization, nutrition, reproduction. General characteristic of fungi, Major taxonomic groups of fungi; Identification and Cultivation.
Mic522	Medical Microbiology	This course provides learning opportunities in the basic principles of medical microbiology and infectious disease. It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora. The biology of bacterial, viral, fungal, and parasitic pathogens and the diseases they cause are covered. The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body. Studying the pathogenic microbes and the role of microbes in human illness. This includes the study of microbial pathogenesis and epidemiology and is related to the study of disease pathology and immunology. Studying microorganisms that are related to the production of antibiotics, enzymes, vitamins, vaccines, and other pharmaceutical products. Pharmaceutical microbiology also studies the causes of pharmaceutical contamination and spoil.

		Practical: The course provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
Mic523	Virology, Immunology and serology	Virus systematics. Electron microscopy of in Vitro preparations. Serological methods of virus diagnosis. Serological tests. Immunoenzymatic Assays. Immunity to bacteria and fungi avoidance of immune system), Tumor immunology mechanisms of immunity, Tumor immunology avoidance of immune system, Viral immunology mechanisms of immunity, system) Vaccination new approach in vaccines production and uses, Immunological techniques ELISA), Round up discussion on the topics of the course, Immunological techniques PCR). Vaccination introduction, traditional production of vaccines, Vaccination new approach in vaccines production and uses and Immunological techniques ELISA).
Mic524	Microbiological analysis and Instruments	Sterilization, Disinfection and Antisepsis. Growth and death measurements. Microbiological analysis of special environments. Antimicrobial analysis. Immunological analysis. Diagnosis of some pathogenic microorganisms. It also includes different microbial identification and characterization methods. Besides, growth, reproduction and maintenance of microbial cultures will be presented. Qualitative and quantitative analysis of environmental samples using UV visible spectrophotometry technique. Single and double beam spectrophotometers. Calibration curve and standard addition methods. Chromatographic separation and detection of organic pollutants in environmental samples using different Chromatographic techniques. Paper Chromatography PC). Thin layer

		Chromatography TLC). Electrophoresis. Ion-exchange Chromatography. Gas Chromatography GC). High-Performance Liquid Chromatography HPLC). Testing the sum of all radiation types affecting plants and animals. Methods for detecting radioactivity. Practical: Demonstrating the structure, use and way of work of different lab tools and devices. Aseptic procedures, isolation steps, characterization and maintenance of microbial cultures. Microscopic examination with different types of dyes and population measurement will also be tested.
Mic525	Toxicology	An introduction to the general principles of toxicology. Salient topics include: dose-response relationships, toxicokinetics, target toxicity, mechanisms of toxic action, general principles of toxicity testing, and mechanisms of action of antidotes.
Zoo 549	Techniques of clinical chemistry	This course is intended to present theories of more complex testing in the clinical chemistry laboratory to include the physiological basis for the test, specimen type, tests principles, expected values, sources of error, limitations of the test, and human diseasescorrelation.The course also introduces analytical and clinical evaluation of Laboratory medical tests.
Zoo 550	Diagnostic Immunology and serology	This coure is intended to introduce fundamental and important aspects of the various immunological and serological methods used in laboratory diagnosis of disease, with insight into the basic mechanisms and reactions involved in such methods. It is also intended to give a background to the particular tests used for various human diseases and their normal and abnormal status.
Zoo 551	Genetics and Immune Disorders	This course is intended to understand the cellular and molecular interactions in the inductions, expression, and regulation of cellular and humoral immune responses. Also, this course will present the genetic basis of immune responsiveness. Reviews the genetic mechanisms responsible for the generation of diversity in the genes for immunoglobulins, the T cell receptor molecules, the major histocompatibility molecules, and other key molecules of the immunoglobulin superfamily. Discusses mechanisms and statistical evaluation of immunogenetic associations with susceptibility or resistance to disease.
Zoo 552	Immunohematologic disorders	This course involves the study of the theory and practice of a wide variety of procedures used in the following: donor

		selection, component preparation, use, and techniques used to detect antigen/antibody reactions that may adversely affect a patient receiving a transfusion. The topics to be covered include Blood bank, donor screening, preparation of components, antigens/antibodies of the ABO, Rh and other blood group systems, pre-transfusion testing procedures, hemolytic disease of the newborn, neonatal and obstetrical transfusion practice, autoimmune hemolytic anemias and adverse effects of transfusion. It also covers the diagnosis and management of blood cell disorders, anatomy and physiology of hematopoiesis, routine specialized hematology tests, analysis, classification, and monitoring of blood cell abnormalities.
Zoo 553	Viral Immunology disease	This course is intended to understand how the immune system works to prevent and remove viral infections. It also covers the Basic knowledge and skills needed to work in a molecular diagnostic laboratory for virus detection. The topics to be covered include Introduction to Viruses, Viral Pathogenesis, Methods of Immune Evasion, T Cell Exhaustion, Passive Immunotherapy, Adjuvants and Immune Activation, Viral Invasion, Viral Replication, and Immune Responses to Viruses.
Zoo 554	Cancer Immunology	This course involves the study of the necessary background and scientific tools to understand the role of the immune system in oncogenesis. It also intended to provide the basic information necessary regarding tumor markers and how they are used to detect, diagnose, and provide a prognosis of various cancers, as well as to provide an increased understanding of the many emerging diagnostic biomarkers.
Bot 601	Instruments and analysis of products and biological material	Methods of isolation and identification of the biological compounds proteins, lipids, polysaccharides, Nucleic acids, Secondary metabolites others), Analysis of biocompounds using recent techniques NMR, HPLC, Electron microscopy, PCR,...etc), Qualitative and quantitative analysis: Sources of error in experimental results, results, Precision, Accuracy, Standard deviation, Determinate and indeterminate errors, Introduction to chromatography, Principles of chromatography, Gas chromatography, Theory, And equipment, Different detectors and columns used in GC and their application and modes of operation, Liquid chromatography, Detectors, Normal phase versus reversed phase chromatography, Ion exchange, Gel permeation and supercritical fluid chromatography, Spectrophotometry,

		fluorometry, colorimetry, polarimetry, nephelometry, turbidimetry), The absorption laws of spectrophotometry, Demonstration of spectrophotometric equipment, Methods used in single-beam and double-beam spectrophotometry, Electrophoresis. Theory of electrophoresis, methods of electrophoresis, PAGE, IF, CE. Centrifugation of biomolecules. Infrared absorption Requirements for infrared absorption).
Bot 602	Experimental Design and statistical analysis of data	Topics include analysis of observational studies and randomized clinical trials for testing hypotheses Analysis of variance, T-tests, Regression and nonparametric methods) and issues in sampling and design of experiments, Techniques in the analysis of survival and longitudinal data, Approaches to handling missing data and meta-analysis. Frequency distribution, Standard errors and confidence limits, Significance tests, Correlation measurements, Regression analysis, Cluster analysis and principal component analysis, Probability and its application in biological research, Introduction to basic computer programs used in biology, systematic and evolution research
Bot 603	Advanced Plants Biotechnology	Basic Concepts and Techniques in Molecular Biology. Molecular Cell Biology. Protein-Structure, folding, and Engineering. Gene Expression in Prokaryotes. Molecular Basis of Plant Growth and Development. Production of transgenic plants Unit. Recombinant DNA technology: Gene cloning, Vectors, Role of Agrobacterium, Gene cloning techniques – Gene gun, Electroporation, Microinjection, Liposome mediated gene transfer, Ultra sonication and Pollen Mediated gene transfer. Techniques for plant transformation, Agrobacterium. Molecular Basis of Pathogenicity, Molecular aspects of plant-pathogen interaction.
Bot 604	Advanced Plant Tissue Culture	Focuses on role of plant tissue culture in in various aspects including sustainable agriculture, plant breeding, horticulture and forestry. This covers the latest technology, broadly applied for crop improvement, clonal propagation, Somatic hybridization Embryo rescue, Germplasm conservation, genetic conservation, or for the preservation of endangered species. Micropropagation for multiplication of disease-free and genetically uniform plantlets. The role of plant tissue culture in pharmaceuticals and secondary metabolites production. Studies and innovations in biotechnology. Covers commercialization and current perspectives in the field of plant tissue culture techniques.

Bot 605	Metabolism and enzymology of plant cell	This course will explore the history of the evolution of enzymes, the Proteinaceous nature of enzymes, Structure of enzymes. Studying the chemical nature of enzymes, specificity of enzymes, sources of enzymes, naming and enzyme classification, and mechanism of enzyme action. Assaying of enzymes by studying the nature and origin of diversity in enzymes, measures of enzyme activity, enzyme and Specific activity units, and related terminology. Also studying the factors affecting the enzyme activity, and limits of enzymatic analysis. Additionally, this course will explore the scope of enzyme assay and the development of new analytical methods. Applications of microbial enzymes in the food industry as amylases, glucoamylases, proteases, lactase β-galactosidase), lipases, phospholipases, esterases, lipoxygenases, cellulases, xylanases, pectinases, glucose, oxidase, laccase, catalase, Peroxidase, Acetolactate Decarboxylase, Asparaginase and debittering enzymes-naringinase.
Bot 606	Advanced taxonomy and bio conservation of plants	This course is an additional material to the undergraduate course of flowering plant taxonomy. This course focus on the Egyptian and African taxonomic families: Classification, evolutionary history, botanical nomenclature, and taxonomic evidences at various levels, the Plant classification taxonomic theories and comparative taxonomic integrative and conventional taxonomic keys. The reconstruction of the basal and terminal clades and origins of the most dominant angiosperm and gymnosperm theory will be covered. The conservation of the plant species and the bio strategies for the environmental conservational methods will be studied.
Bot 607	Environmental awareness and environmental impact evaluation	Contents and Organization of EIA, Environment Impact Identification and Assessment Factor Screening, EIA stages, The effectiveness of EIA, The future of EIA and sustainability, Ecological Evaluation and EIA, EIA Training, Objectives, Ideas and Methods of EIA, Environmental Policies, Framework for Laws and Regulations, Compilation Basis, National Laws and Regulations, Ministry and Commission Regulations, Overview of Natural Environment, Environmental Impact Assessment and Environmental Protection Measures, Environmental Risk Analysis and Mitigation Measures, Demolition and Resettlement, Public Participation and Information Disclosure, Environmental Management Plan.

Bot 608	Techniques of protein purification	This course will explore the mechanistic basis of protein isolation, solubilities of proteins, chromatographic separations, electrophoresis and ultracentrifugation
Bot 609	Advanced lant water relation	This course will explore the membrane structure, membranes of plant cells, obtaining membranes for transport studies, driving forces for movement, methods of studying transport through membranes, properties of plant membranes, water and osmosis. Study the ion transport across the plasma membrane and tonoplast as active transport, proton pumps and the transport of ions other than protons. Studying ion uptake by plant roots. Studying transport from root to shoot.
Bot 610	Plant techniques and methodology	This course will explore the study of different and modern methods of physiological measurements inside plants
Bot 611	Pigments of photosynthesis	This course will explore types and distribution of chlorophyll pigments, biosynthesis of chlorophyll, dark synthesis of chlorophyll, biosynthesis of other chlorophylls. Studying the biosynthesis of carotenoid pigments and its function in photosynthesis. Studying phycobiliproteins and its localization, light effects on the synthesis of phycobiliproteins, chemistry and biosynthesis of phycobilins.
Bot 612	Physiology of stress	This course will explore types and distribution of chlorophyll pigments, biosynthesis of chlorophyll, dark synthesis of chlorophyll, biosynthesis of other chlorophylls. Studying the biosynthesis of carotenoid pigments and its function in photosynthesis. Studying phycobiliproteins and its localization, light effects on the synthesis of phycobiliproteins, chemistry and biosynthesis of phycobilins.
Bot 613	Plant hormones and growth regulators	This course will explore that auxine stimulate shoot elongation, gibberellins regulate stem elongation, cytokinins stimulate cell division, abscisic acid controls the water balance of the plant, ethylene makes fruit ripen, phytochromes function as light sensors, signal transduction chains known from animal metabolism could be models for signal transduction in plants as G-proteins act as molecular switches, Ca^{2+} acts as a messenger in signal transduction, the phosphoinositol pathway controls the opening of Ca^{2+} channels, Calmodulin mediates the messenger function of Ca^{2+} ions and phosphorylated proteins form elements of signal transduction.

Bot 614	Evolution relationships in algae	Basic Concepts of algal evolution relationships. Molecular approaches for algal studying. Protein-Structure, The nature and origins of green algae and land plants, algae as a linkage between Prokaryotes and eukaryotes. Molecular Basis of algal Growth and evolution. Modifications of algae along different era. Green lineage relationships: Morphology, ultrastructure and molecules, Phylogeny of the green lineage, Two main lineages: Chlorophyta and Streptophyta, Early diverging Chlorophyta: the prasinophytes, The core Chlorophyta: ecological and morphological diversification, Radiation of the algal division in within each other,
Bot 615	Physical oceanography	This course is an overview of physical oceanography, the field which strives to understand oceanic motions over a variety of time and space scales. We will seek a better understanding of these motions using both theoretical concepts and examination of actual oceanographic data from a wide variety of instruments. Wherever possible we will explain aspects of the observations using the theoretical concepts. By the end of the course, you will understand oceanic distributions of temperatures and salinities, the importance of rotation and stratification for oceanic motions, the forces that drive oceanic motions, the types of waves 290odeling290 in the ocean, and the reasons that the ocean is important for Earth's climate. Specific topics covered include the physical properties of the ocean and water masses; the circulation of the atmosphere; wind- and buoyancy driven ocean circulation; tides; surface and internal waves; oceanic mesoscale eddies; and mixing. To underline some specific knowledge and skills you will obtain in this course, you will learn to evaluate statements such as "the tsunami traveled at jetliner speeds" seen in the popular press. You will examine oceanic temperatures using the same archived datasets that practicing physical oceanographers use. You will learn how to use Matlab to manipulate scientific data, and you will practice your teamwork and public speaking skills.
Bot 616	Principles of algal nanotechnology	Scientific revolutions –Time and length scale in structures – Definition of a nanosystem –Dimensionality and size dependent phenomena – Surface to volume ratio –Fraction of surface atoms – Surface energy and surface stress- surface defects-Properties at nanoscale optical, mechanical, electronic and magnetic) Classification based on dimensionality-Quantum Dots,Wells and Wires, prepration of

		quantum nanostructures, size effects, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states, exitons, single electron tunneling. Basics of Ferromagnetism, Effect of Bulk Nanostructuring of Magnetic Properties, Dynamics of Nanomagnets, Nanopore Containment of Magnetic Particles, Nanocarbon Ferromagnets, Giant and Colossal Magnetoresistance, Ferrofluids.
Bot 617	basics of algal bioremediation	Definition of bioremediation, point and nonpoint sources for water pollution, methods for bioremediation, basics of bioremediation, nanoparticles production and water perification, algal methods for water treatment, microalgae immobilization methods, genetically engineering and bioremediation.
Bot 618	Marine algae biodiversity	A course on the diversity, ecology, cell biology and evolutionary origins of multicellular algae, illustrated through fresh water and marine algae in general and marine algae in details Apply the taxonomic ranks and conventions to the hierarchical classification of algae. Interpret a phylogeny tree to map where ancestral characters evolved, and provide biological explanation for nodes and internodes. Specify the processes and character changes that take place in the life cycle and reproductive phases of algae. Explain the importance of algae life cycle to ecosystem interactions such as diseases, anti-algal drugs, or species conservation. Given a diagram, label and explain the cellular structures and functions, and predict the impact of environmental factors to their form e.g. habitat, ecology). Diagram the correct number of chromosomes and mating type alleles at each life cycle stage. Analyze and record key features of microscopic structures by using a microscope and making biological sketches. Locate, observe, and identify algae, specimens in the field.
Bot 619	Special Topics 1)	This course helps students who are relatively new to writing scientific research articles with the writing process Designed to cover basic steps in the research process including selecting the general topic of interest and clearly defining the main and specific objectives, Setting a plan of action, Both for desk work and practical measures, Including Listing of key words and a literature search of similar studies to get an overview of the topic, Making source cards and writing a statement of purpose about the focused topic, Setting

		brainstorm questions about the focused topic grouped under similar headings and finding possible sources methods that can answer them, Refocus thesis statement and writing the body of the project from notes, Citing necessary information and writing introduction, conclusion and title
Bot 620	Writing scientific project	The student selects a special topic for discussion. Gain focused academic experience under the supervision of a Faculty member. The experience is expected to provide academic learning opportunities. A diversity of types of academic work is acceptable, including a literature review, community and/or program development, collection and analysis of laboratory data, directed study, etc. The objective of paper presentations is to demonstrate the utilization of discussed techniques in diverse topics. In particular, the presentation should include 1) significance of the study discuss major hypothesis being tested); 2) experimental design and methods which assays they used and how that is related class's discussions and lectures); 3) results discuss their validity, reliability, replicability); 4) conclusions drawn from the study not just the authors' but yours as well). Students should not simply give a blow-by-blow account of each experiment and the authors' conclusions
Bot 621	Techniques in Molecular Biology	Introduction for the evolutionary history of different markers employed in identification and characterization throughout the planta kingdom. Some insights into protein synthesis and the effect of environment on regulation on gene expression. Studying categories of markers; Morphological, Biochemical and Molecular markers. Biochemical markers involving protein and isozymes isolation, quantitative protein estimation, qualitative estimation of protein and isozymes by electrophoresis. Some insights into different matrix used in electrophoresis. Immunoblotting analysis; Western, Northern, and southern blotting. Protein sequencing. Fingerprinting techniques of DNA/RNA molecular markers involving PCR based non-PCR- based techniques; Molecular Tools for Analysis of Genome Principles and applications of RAPD, ISSR, SSR, FISH, AFLP, RFLP, LSU, SSU, ITS, ETS, RT-PCR, SNP, FLP-FRT and hybridization techniques). Principle and applications of DNA sequencing- Automated DNA sequencing – Next Generation Sequencing. Molecular Biology Techniques Isolation and amplification of nucleic acid – Plasmid isolation, chromosomal DNA isolation, Quality and quantity checking of DNA by AGE, UV Spectrometry and Real Time PCR,

		Polymerase Chain Reaction PCR)-Principles, Types, and applications. Gene cloning techniques – Physical and chemical methods – Lipofection – Electroporation – Gene Bombardment. Construction of cDNA and genomic DNA library – Screening of libraries.
Bot 622	Advanced Genetic Engineering and Biotechnology	Discussion of molecular cloning: gene manipulation and cloning vectors. Properties and applications of DNA modifying enzymes – restriction endonucleases & types Type I to type IV); host-controlled restriction modification system, isoschizomers. Modifying enzymes- methyltransferses, polymerases, kinases, phosphatases, nucleases, reverse transcriptase, terminal transferase and ligases. Gene transfer methods: Transformation, Tnansfection, Electroporation, Biolistic method. Cloning vectors- properties of cloning vectors. Types of cloning vectors – plasmids, lambda-based vectors, and derivatives insertion vectors, replacement vectors, Cosmides, phasmids SV40, shuttle vectors & phagemids); plant transformation vectors- Ti, Ri plasmids. High-cloning capacity vectors- single stranded DNA vectors M13), YACs, BACs, PACs, construction of expression vectors Recombinant DNA techniques, Agrobacterium mediated transformation colony hybridization, plaque hybridization. Hosts used in genetic engineering, prokaryotic hosts- Escherichia coli, Bacillus subtilis and Eukaryotic hosts –Yeast. Recombinant DNA technology. DNA molecular analyzing including restriction nucleases, DNA fragments separation, and determination of DNA nucleotide sequences. Nucleic acid hybridization in situ at in cells and chromosome and its role in diagnosis of genetic diseases. DNA cloning and cDNA library and using hybridization .Discussion of molecular principles in genetics and functional genomics with focus on cancer and stem cell biology. Technologies for high throughput analysis of gene expression – Approaches to genome-wide single cell analyses – Functional genomics and growth-based screens genetic concepts and genome-wide approaches using shRNA and CRISPR/Cas9 strategies) – Chemical genomics. Molecular genetics in cancer and stem cell research – Approaches using the CRISPR/Cas9 technology- Molecular genetics of cell cycle control and its implications to cancer e. g. oncogenes and tumor suppressors) – The role of the ubiquitin proteasome system and the SUMO conjugation machinery in cancer and the challenges drugging these pathways – Molecular genetics approaches to chromosome biology and implications for

		cancer and stem cell biology e. g. telomere and telomerase in tumorigenesis and pre-mature aging) – Histone modifications and epigenetic regulations.
Bot 623	Cytology and Genetics	Introduce cytogenetic manipulation of the chromosome complements including i. Chromosome structure and packaging of DNA. Ii. Nucleosome organization, DNA Structure A, B and Z forms) iii. Organization of centromere and telomere. Iv. Karyotype analysis and the banding patterns. V. Special types of chromosomes- Polytene, Lampbrush, B-chromosome and sex chromosomes. Vi. Molecular basis of chromosome pairing. Structural and Numerical alterations in chromosomes: i. The origin, meiosis and breeding behavior of duplication, deficiency, inversion, translocation heterozygotes, haploids, aneuploids and autopolyploid. Ii. The allopolyploids and evolution of major crop plants. Mutation: i. Spontaneous and induced mutations. Ii. Physical and chemical mutagens. Iii. Molecular basis of gene mutations. Iv. Transposable mobile) elements and mutation induced by transposons. V. Site directed mutagenesis. DNA damage and repair mechanism. i. DNA damage and repair mechanism. Ii. Initiation of cancer at cellular level. Proto-oncogenes and oncogenes. Cytogenetics of aneuploids and structural heterozygotes: i. Effect of aneuploids on plant phenotypes. Ii. The use of monosomics and trisomics in chromosome mapping of diploid and 294odeling294294 species. Iii. The breeding behavior and genetics of structural heterozygotes. Iv. The complex translocation heterozygotes. V. Robertsonian translocation. Vi. B-A translocation. Genetics of prokaryotic and eukaryotic organelles: i. Phage and Bacterial Genetics —mapping of the bacteriophage genome, genetic recombination in phage, transformation, transduction, and conjugation in bacteria ii. Genetics of mitochondria and chloroplast, cytoplasmic male sterility. Iii. Gene fine structure. Cis-trans test, introns and their significance, RNA splicing. Iv. Regulation of gene expression in prokaryotes and eukaryotes.
Bot 624	Genetic toxicology	Understanding genetic damage by environmental contamination genotoxicity leading to genetic damage, including gene mutations and chromosome aberrations, and molecular modes of action for DNA repairing/alterations. Studying some phenomena related to genotoxicity like apoptosis. Studying cytogenetic tests; and molecular analysis and biotechnological techniques for genotoxicity detection at both at the chromosomal and DNA level; chromosomal

		rearrangements can be detected by FISH; DNA fragmentation can be estimated using the TUNEL test and the single cell gel electrophoresis Comet assay).
Bot 625	Advanced Epigenetics	Theoretical understanding of complex epigenetic phenomena. Understand the definition of epigenetics and recognize various epigenetic phenomena. Outline the major epigenetic mechanisms The basis of transcription process Epigenetic mechanisms- DNA methylation and demethylation- histones and nucleosomes- histone modifications- Polycomb complex and Trithorax complex Epigenetic mechanisms– ncRNA, Higher order chromatin structure). Genomic imprinting in mammals; Dosage compensation. Know current techniques developed to study epigenetics and epigenomes. Appreciate the role of epigenetic regulation in normal development and in diseases; Epigenetic control in gametogenesis and development. Computational analysis of transcriptome and Epigenome. : Epigenetic control of the mitotic cell cycle. Epigenetic heterogeneity.
Bot 626	Special Topics 1)	The student selects a special topic for discussion. Lectures of a topic are followed by paper presentations by students. The objective of paper presentations is to demonstrate the utilization of discussed techniques in diverse topics. In particular, the presentation should include 1) significance of the study discuss major hypothesis being tested); 2) experimental design and methods which assays they used and how that is related class's discussions and lectures); 3) results discuss their validity, reliability, replicability); 4) conclusions drawn from the study not just the authors' but yours as well). Students should not simply give a blow-by-blow account of each experiment and the authors' conclusions.
Bot 627	Numerical Taxonomy	The goal of this course is to introduce students to the basic concepts and history of numerical taxonomy. The rise of computers paralleled the emergence of numerical taxonomy tools, possibilities to compare a large number of phenotypic features for a large number of Taxa. Evaluate the resulting datasets numerically. The degree of similarity between any two taxa displayed using matrices in data analysis, and the resulting dendrogram providing a snapshot of the behavioral qualities shared by a certain taxonomic group. Angiosperms including Salix, Chenopodium, Crotalaria, and Cucurbita) will be studied as an effective use of developed categorization systems by numerical analysis. The course includes hands-on

		labs where students may put what they've learned about Pcord, Delta, and Puap into practice.
Bot 628	Plant fossils	The course introduces students to the evolution, biology, and morphology of land plants and algae through the study of their fossil records. The primary objective is to teach students how to use microscopic techniques and statistical modeling to examine pollen/spores and algal remains in order to recreate the palaeo-environment and palaeo-climate. Students in this course will learn how to use plant fossils such as stomata frequency and leaves margin in palaeo-climate reconstructions as well as how to deduce the evolutionary histories of a variety of plants and algae from the fossil record determining atmospheric carbon dioxide level, temperature, precipitation. What factors, like as sedimentary transit and post-depositional processes, influence the preservation of plant fossils.
Bot 629	Economic Botany	The course is focusing on the importance and nature of plant products, industrial plants and plant products. Shed the light on the drug plants and drugs, food plants, food adjuncts, fibers and fiber plants, forest products: wood and cork, forest resources, tanning and dye materials, rubber and other latex products, gums and resins, essential oils, fatty oils and waxes, sugars, starches, and cellulose products, medicinal plants, fumitories and masticatories, spices and other flavoring materials.
Bot 630	Special topic 1)	The purpose of this class is to increase students' levels of knowledge and awareness by exposing them to the most recent published works in plant taxonomy that can be found in the articles of the most prominent journals, such as Taxon, Systematic Botany, and Phylogeny. In addition to assessing and supporting student abilities in data collection and literature review scanning in Plant taxonomy and associated disciplines, the course also correlates the results and analytical techniques to the local plant taxonomical group

Bot 631	Documentation of genetic resources	This course aims to improve the usage of common procedures for typical gene-bank operations, including how to create a manual for such operations. Gain a practical grasp of how genetic resources are used and how gene banks and breeders interact. Give pupils the fundamental information they need to manage databases and documents. Students will learn about morphological and molecular methods for characterizing and evaluating plant genetic resources, and they will gain more knowledge of domestic and international policy frameworks that govern genetic resource trade and access.
Bot 632	Advanced Bioinformatics	These topics provide an introduction to the most common computational approaches in the field of molecular biology. The many methods of mapping and aligning genome sequence data, as well as their implications, are extensively covered in this course. Furthermore, methods for detecting and analyzing alterations in the genome include programming and scripting. Outlining the fundamental ideas and methods needed to analyses, display, and interpret datasets including thousands upon thousands of genes, genomic variations, or microbiological species. Differential gene expression, discovering and understanding genomic variations, and meta-genomics will all be addressed in this presentation. Research design and critical analysis of big sequencing data in the context of bioinformatics will be discussed. The main practical goals of this course include analysis of Next-generation Sequencing, RNA-sequence Analysis, Meta-genomics Analysis, and De-novo Sequencing instruments.
Bot 633	Advanced Soil Sciences	Moisture regime with respect to spatial variability Of soil hydraulic properties, risk reduction of extreme hydrological events with sustainable land use and soil management, Extreme Soil Moisture Regime As An Increasing Environmental Problem In The Carpathian Basin, quantifying abiotic stress: the use of response functions, effect of Pinus nigra plantation on the soils of dolomite Grassland, agroecological investigation on a salt affected landscape in the Danube valley, nitrate-n in the soil profiles of long-term field experiments, characterization of the nutrient buffer capacity of K, Ca, Mg in Two Hungarian soils, soil organic matter management to soil and water quality, soil and plant interrelations on MN2+ requirement of sunflower, tobacco

		At early stage of growth, moisture and substance regimes as frames of the n transport in Soils, indicator microbes of chlorsulfuron addition detected by a Simplified plate counting method, soil microbiological consequences of the stress effect of soil Acidification in a long-term experiment, biological n-fixation under different n-fertilizer input on soya yield, Soil microbial biomass-c as a possible indicator Of soil pollution, toxicity of some field applied heavy metal salts to the rhizobia And fungal microsymbionts of alfalfa and red clover, GIS-Based Stochastic Approach For Mapping Soil Vulnerability, integration of remote sensing and GIS techniques in land Degradation mapping, new approach in salinity/sodicity mapping in Hungary, multifunctional soil management for sustainable development in Hungary.
Bot 634	Natural Resources	Natural resources, Classification Of Natural Resources, innovation and development, Natural resource intensive industries and structural change, Linkage dynamics, diversification and natural resources, Innovation in natural resources: new opportunities and new challenges, Natural resources and sustainable development, Towards innovation based natural resource intensive development: some policy issues, The origins of the sustainability problem, Ethics, economics and the environment, Concepts of sustainability, Welfare economics and the environment, Pollution control: targets, instruments, Pollution policy with imperfect information, Economy-wide 298odeling, International environmental problems, Cost–benefit analysis, Valuing the environment, Irreversibility, risk and uncertainty, Natural resource exploitation, The efficient and optimal use of natural resources, The theory of optimal resource extraction: non-renewable resources, Stock pollution problems, Forest resources, Accounting for the environment.
Bot 635	Advanced Flora and Phytogeography	Biodiversity of Vegetation and Flora in Africa, Afromontane Forest Diversity and the Role of Grassland-Forest Transition in Tree Species Distribution, The Role of Climate and Topography in Shaping the Diversity of Plant Communities, Diversity and Conservation through Cultivation of Hypoxis in Africa, Diversity and Structure of an Arid Woodland, Diversification of African Rainforest, Phylogenomic Study of Monechma Reveals Two Divergent Plant Lineages of Ecological Importance in the African Savanna and Succulent

		Biomes, Diversity of Tree Species in Gap Regeneration under Tropical Moist Semi-Deciduous Forest, Spatial and Temporal Trends of Burnt Area “Implications for Natural Vegetation and Protected Area Management”.
Bot 636	Special Topics in Plant Ecology 1)	Studying newest topics of the research fields that keep pace with scientific development in all plant ecology fields.
Bot 637	Advanced Environmental Biotechnology	Decomposition of Organic Carbon Compounds in Natural and Manmade Ecosystems, Biotechnology for Conversion of Organic Wastes, Industrial Wastewater Sources and Treatment Strategies, Biotechnological Procedures for Environmental Protection, Environmental Biotechnology for Bioconversion of Agricultural and Forestry Wastes into Nutritive Biomass, Biodegradation of Hazardous Contaminants, Production-integrated Environmental Protection, Applications of Soil Remediation and Disposal, Bioremediation by the Heap Technique, Bioreactors, In-situ Remediation, Bioremediation Technologies, Environmental Monitoring, Sanitary Landfills: Long-term Stability and Environmental Implications, Role of Biotechnology for Protection of Endangered Medicinal Plants, Bioremediation: Its Strategies, Scope and Perspective in Relation to Contaminated Soil, Water and Associated Environments, Modern Approach for Contamination Free Environment.
Mic601	Instruments and analysis of products and biological material	Methods of isolation and identification of the biological compounds proteins, lipids, polysaccharides, Nucleic acids, Secondary metabolites others), Analysis of biocompounds using recent techniques NMR, HPLC, Electron microscopy, PCR,...etc), Qualitative and quantitative analysis: Sources of error in experimental results, results, Precision, Accuracy, Standard deviation, Determinate and indeterminate errors, Introduction to chromatography, Principles of chromatography, Gas chromatography, Theory, And equipment, Different detectors and columns used in GC and their application and modes of operation, Liquid chromatography, Detectors, Normal phase versus reversed phase chromatography, Ion exchange, Gel permeation and supercritical fluid chromatography, Spectrophotometry, fluorometry, colorimetry, polarimetry, nephelometry, turbidimetry), The absorption laws of spectrophotometry, Demonstration of spectrophotometric equipment, Methods used in single-beam and double-beam spectrophotometry,

		Electrophoresis. Theory of electrophoresis, methods of electrophoresis, PAGE, IF, CE. Centrifugation of biomolecules. Infrared absorption Requirements for infrared absorption).
Mic602	Experimental Design and statistical analysis of data	Topics include analysis of observational studies and randomized clinical trials for testing hypotheses Analysis of variance, T-tests, Regression and nonparametric methods) and issues in sampling and design of experiments, Techniques in the analysis of survival and longitudinal data, Approaches to handling missing data and meta-analysis. Frequency distribution, Standard errors and confidence limits, Significance tests, Correlation measurements, Regression analysis, Cluster analysis and principal component analysis, Probability and its application in biological research, Introduction to basic computer programs used in biology, systematic and evolution research.
Mic603	Genomics and Proteomics	Molecular analysis of plant growth and development. Molecular techniques and their application to understanding control of gene expression in plants, recent studies in the field of molecular biology .Genomics classification, Structure and organization of prokaryotic genomes. Transcriptional regulators of bacterial genes. Transposable genetic elements in bacterial genomes. Evolution of bacterial operons and operonisation. Islands and segments of pathogenicity and resistance. Structure and organization of eukaryotic genomes. Repetitive and transposable elements and their effect on genome. Telomeric and subtelomeric regions in chromosomes. CpG methylation and gene silencing. Yeast-two-hybrid system. cDNA microarrays. Evolution and structure of mitochondrial genomes. Genome sequencing: whole shotgun genome sequencing. Sequencing technology: Sanger capillary sequencing, Roche 454 pyrosequencing), Illumina/Solexa, SOLiD System. Pros and cons of sequencing techniques. MaxamGilbert sequencing. ORF and promoter predictions. Intron and exon predictions. Gene annotation. Major genome databases. Proteomics classification. 1D-SDS-PAGE and 2D-SDS PAGE. Detection and quantitation of proteins in gels. Pros and cons of various staining methods. Basics of mass spectrometry. Malditof and ESI, and their application in proteomics. Tandem MS/MS spectrometry. Peptide sequencing by tandem mass spectrometry. Affinity purification of protein.

Mic 604	Microbial enzymes technology	Enzymes as proteins, Enzyme biosynthesis and secretion in microorganisms, Enzyme catalysis, Kinetics, Enzyme modification, Use of enzymes in reverse, Biphasic systems, Enzyme engineering, Biotechnological enzyme processes, Biosensors, Artificial and synthetic enzymes, Bioinformatics and protein technology.
Mic 605	Advanced microbial ecology	Methods of study and isolation of soil microorganisms, molecular methods for studying microbial ecology, Advanced molecular techniques in microbial ecology, molecular methods to study microbial succession in soil Interspecies interactions in microbial communities, Isotopes and biomarkers in microbial ecology, Microbial Diversity and Evaluation Methods, Metagenomics and metabolomics analysis. behavioral strategies of surface-colonizing bacteria, Ecology and diversity of extremophiles, Ecology and diversity of marine microorganisms, Geomicrobiology.
Mic 606	Current topics in microbiology	Designed to meet needs of graduate students with topics of related interest in Microbiology. Current research topics within different aspects of basic and applied Microbiology and related fields will be focused upon and discussed, topics may be changed in different semesters.
Mic 607	Principles assessment of microbial and Environmental risk	Hazard Identification and Hazard Characterization, What does Virulence and/or Pathogenicity Mean, Mechanisms that May Lead to the Development of New Pathogens or Pathogens, Methodological Approaches can be Used to Identify and Quantify Microorganisms, explore microbes of public health significance from environmental exposures and microbiological aspects of the environment as related to human health. The role the environment in the transmission of infectious diseases, the specific microbes that cause environmentally transmitted disease of public health importance, their prevention and control by technological and other measures and how the health risks posed these microbes are assessed will be explored. We will consider the microbes and their diseases transmitted by wastes, water, air, food and vectors, the ways that these disease agents enter, survive and spread through the environment to result in human exposures, how their risks are assessed and measured and how these risks are prevented and controlled through engineered/technical, policy and regulatory approaches. Biosafety in Microbiological and Biomedical

		Laboratories and risk assessment laboratory-acquired infection, risk assessment, hazard group.
Mic 608	Current topics in molecular virology	This course will explore basic and advanced features of viruses, the virus-like particles VLPs) and their major applications are discussed. Viruses as vectors in genetic engineering; Uses of recombinant viruses in gene therapy, vaccinology and immunotherapy. VLPs) in prophylactic, therapeutic vaccines, also as vehicles in drug and gene delivery and more recently as tools in nanobiotechnology. The implications of large-scale production of viruses and VLPs are discussed. Importance of viruses in in plant disease and human medicine and the use of viruses in biotechnology and cell biology. Mechanisms of virus evolution. Techniques used in molecular virology. Issues in virology at the stage of current cutting-edge research in molecular virology are studied through research articles.
Mic 609	Advanced industrial microbiology	Application of microorganisms in production of cells, primary and secondary metabolites. Introduction to fermentation technology, regulation of microbial metabolism, recombinant DNA technology, method of fermentation, setting up an industrial process, Methods for production of industrial enzymes and selected applications of enzyme technology; for the pharmaceutical, chemical industries and for environmental remediation are presented. Production of pharmaceuticals: Antibiotics, steroids, production of organic acids, vaccines, production of amino acids, production of enzymes, production of fuels. Microbiological production of food and beverages.
Mic 610	Applied Environmental Microbiology	Introduction to legislation, waste characteristics, major degradative metabolic pathways. The course highlights the actions and interactions of micro-organisms in different environments; consequences and applications of microbial colonization processes, economics and treatment technology. Also emphasis is given to the importance of microorganisms in such applied areas as public health, plant disease, pollution and pollution abatement, biological control of pests, bio-deterioration, and ecology. Application of microbial activities in bioremediation of soil and water. Biological aspects of environmental nanotechnology. Waste to bioenergy. Microbial fuel cells for remediation and energy production. Microbiology of man-made environments.

Mic 611	Advanced medical microbiology	A medical view of microorganisms, their morphology and physiology. Pathogenic microorganisms, including etiology and pathology are examined in detail as applicable to the hospital environment. Medically important microbial pathogens are discussed in terms of the clinical, Therapeutic and epidemiological aspects of diseases caused by them, Molecular mechanisms of pathogenesis and their identification in the clinical laboratory.
Mic 612	Vaccines and Sera	Introduction to immunology and vaccinology , Difference between Vaccines and sera ,Types of Immunizing agents Vaccines and immunoglobulin), How vaccines work, RNA Vaccines, Hybrid Vaccines, Durability of Immune Responses , The Creation of Vaccines, Vaccine Safety.
Mic 613	Writing Scientific Project	Designed to cover basic steps in the research process including selecting the general topic of interest and clearly defining the main and specific objectives Setting a plan of action, Both for desk work and practical measures, Including Listing of key words and a literature search of similar studies to get an overview of the topic, Making source cards and writing a statement of purpose about the focused topic, Setting brainstorm questions about the focused topic grouped under similar headings and finding possible sources methods that can answer them, Refocus thesis statement and writing the body of the project from notes, Citing necessary information and writing introduction, conclusion and title page.
Bot 701	Plant Cell membranes	This course will explore the composition of cell membranes lipids and proteins), structure of cell membranes as interaction of lipids and proteins, molecular architecture of membranes and biosynthesis and assembly of cell membranes), properties of specific cell membranes as plasmalemma, plastid membranes, Golgi membrane, nuclear membrane and endoplasmic reticulum and vacuolar membrane)
Bot 702	Nitrogen, amino acid and nucleic acid metabolism	This course will explore the cycling of nitrogen in nature, assimilation of nitrate, assimilation of ammonia, absorption of soil ammonium. Studying the amino acids as its classification, the chemical and physical properties of amino acids and amino acids catabolism and anabolism. Studying nucleotide structure, the structure of deoxy ribo nucleic acid DNA), the structure and classes of ribonucleic acids RNA) and purine and pyrimidine metabolism.

Bot 703	Advanced plant metabolism and biochemistry	This course will explore the adenosine triphosphate formation and utilization, the standard free energy of hydrolysis of ATP, types of phosphorylation, biological functions of energy-rich compounds and the mechanism of oxidative phosphorylation. Studying the lipids as a general classification of lipids, saturated fatty acids chemical characteristics, unsaturated fatty acids chemical characteristics, functions of lipids, fatty acids oxidation, energetics of fatty acid oxidation and fatty acid and fat biosynthesis
Bot 704	Photosynthesis and water consumption	This course will explore the entry of CO_2 into the leaf is accompanied by an escape of water vapour from the leaves, stomata regulate the gas exchange of a leaf, the diffusive flux of CO_2 into plant cell, C_4 plants perform CO_2 assimilation with less water consumption and crassulacean acid metabolism makes it possible for plants to survive even during very severe water shortage.
Bot 705	Proteins and polysaccharides biosynthesis	This course will explore that large quantities of carbohydrate can be stored as starch in the cell, sucrose synthesis takes place in the cytosol, utilization of trios phosphate formed during photosynthesis is strictly regulated, in some plants assimilates from the leaves are exported as sugar alcohols or oligosaccharides of the raffinose family, fructans are deposited as storage substances in the vacuole and cellulose is synthesized by enzymes located in the plasma membrane.
Bot 706	Phytoremediation, Biofortification and nanoparticles	This course will explore the effect of metals on physiological processes, the defense reactions of plants, the food- Quality, sufficiency, safety, and human health risks. Studying the medicinal plants as its response to metal presence. Studying the classification of metallophytes and plant strategies for metal uptake as hyperaccumulating plants. Studying the phytoremediation classification and principles, and phytoattenuation. Studying biofortification a phytofortification. Studying nanoparticles and plants as biosynthesis of metal nanoparticles.
Bot 707	Plant secondary metabolites	This course will explore the examine some of the broader aspects of secondary metabolites. The focus will be the biosynthesis, physiology, and ecological roles of four major classes of secondary metabolites: natural products, terpenes, glycosides, phenylpropanoids. Studying secondary metabolites are active against insects and disease. Jasmonates are linked to ubiquitin-related protein

		degradation. Alkaloids are a large family of chemically unrelated molecules.
Bot 708	Plant and crop stress	This course will explore the germination of seeds and propagules under salt stress, mineral nutrient acquisition and response by plants grown in saline environments, nutrient uptake by plants under stress conditions, photosynthesis under stress and protein synthesis by plants under stressful conditions.
Bot 709	algal management for marine pollution	This course will provide students with in-depth knowledge of the environmental field and skills to perform environmental management according to modern development trends. Specifically, the course will provide students with knowledge of measures to prevent and control marine pollution and related legal requirements in the control and monitoring of marine environment through measures for prevent and control of marine pollution Monitoring compliance with legal requirements in marine pollution control. Work at the individual level and team collaboration to communicate, discuss among individuals in groups to study and report, study the different algal mechanisms for water pollution management.
Bot 710	Advanced algal physiology	To acquire an appropriate functional background of algal cells, tissues& systems. To integrate algal physiological data & mechanisms with the ongoing basic sciences: anatomy, histology & biochemistry and clinical applications To follow the rapidly changing and inflating details about molecular biology & genetics. To explore in detail the functions of the autonomic, the neuromuscular , the respiratory and other algal vital processes systems as well as their integration to achieve homeostasis. To develop the basic scientific research skills as well as effective communication and team work attitudes
Bot 711	Marine microbiology	Marine Microbial Ecology: This course covers recent developments in the field of marine microbial ecology and will give an overview on structure and function of microbial communities in the oceans including discussions on novel methods, results and hypotheses. Among the topics covered are: Photoheterotrophic bacteria, marine bacteria and the carbon cycle, UV radiation effects on microbes and microbial processes, uptake and regeneration of inorganic nutrients by marine heterotrophic bacteria, bacterivory: interactions

		between bacteria and their grazers, symbiosis and mixotrophy among pelagic microorganisms, marine viruses and their ecological impact, the Global Ocean Survey of Marine Metagenomics, single cell activity in marine bacterioplankton.
Bot 712	algal anatomy	Basic differences between algae and higher plants in anatomical structures. Special algal anatomical structures, methods for study algal anatomy evolution of algal anatomy, different algal thallis types. Explanation of algal differentiation leakage.
Bot 713	Algae biofuels	Basics of algae based biofuels, methods of algae large scale production, optimization of algal biofuel production algae gene manipulation for biofuel production, characterization of algal biofuels, biofuels from macro algae, biofuel production byproducts, evolution of biofuel production methods, basics of hybrid fuel production
Bot 714	Algal biodiversity	Study of different algal habitate, terrestrial algae biodiversity, light wave length type and algal distribution The taxonomic introduction to the major algal groups macrophytic and microscopic) with an emphasis on the marine seaweeds. Basic taxonomic difference will be covered, along with an introduction to macrophyte ecology, human uses and symbioses. Laboratory sessions will focus on morphology and reproduction. You will learn to identify the major algal groups based upon recognition characteristics and create your own herbarium collection and slides. A major focus of this course will be the field identification of a set list of Nova Scotian seaweeds.
Bot 715	Algal metabolism	Basic algal metabolic process, differences between algal and higher plant metabolic processes, genetic control of algal metabolic processes, algal photosynthesis, dark fermentation lagal metabolism, algal secondary metabolites optimization- extraction- applications). Algal primary metabolites
Bot 716	Phytoplankton toxins	Phytoplankton diversity- definition- classification). Techniques of toxins production timing and metabolism). Algal bloom cases and explanation. Phytoplankton's remote sensing, hazardous of phytoplankton toxins. Biological management of algal toxins and blooms
Bot 717	Advanced Molecular Genetics	Introduction to modern and principles concepts of molecular genetics approaches of molecular principles in genetics and functional genomics with focus on cancer and stem cell biology. Technologies for high throughput analysis of gene expression – Approaches to genome-wide single cell

		analyses. Functional genomics and growth-based screens genetic concepts and genome-wide approaches using shRNA and CRISPR/Cas9 strategies). Using the CRISPR/Cas9 technology- Molecular genetics of cell cycle control and its implications to cancer e. g. oncogenes and tumor suppressors) – The role of the ubiquitin proteasome system and the SUMO conjugation machinery in cancer and the challenges- Molecular genetics approaches to chromosome biology and implications for cancer and stem cell biology e. g. telomere and telomerase in tumorigenesis and pre-mature aging) – Histone modifications and epigenetic regulations.
Bot 718	Genetic Engineering Applications	PCR: Concept, methodology, types and applications iii. Expression: Heterologous expression, Expression of recombinant proteins using bacterial, animal and plant vectors; Construction of genomic and cDNA libraries. Generalized cloning strategies. Strategies for construction of genomic libraries. Positional cloning chromosome walking & chromosome jumping). Construction of subtractive and normalized cDNA libraries & its advantages, in vitro mutagenesis and deletion techniques. PCR primer design-gene specific primers, nested primers, degenerate primers, optimization of PCR components and thermal conditions, types of PCR – inverse PCR, nested PCR, RACE-PCR. Selection and screening of recombinant clones. Genetic selection-insertional inactivation and alpha complementation. Principle of hybridization- northern, southern & western blotting, dot-blot & colony hybridization, colony PCR 3.3 Labeling of nucleic acids- end labeling [3'-& 5'-], random priming & nick translation using radioactive & non-radioactive probes. Immunological screening. Isolation of individual genes by complementation assay & contig assembly. DNA sequencing methods- Maxam-Gilbert and Sanger's method, automated sequencing, multiplex sequencing. Next Generation Sequencing- principle & its applications. Analysis of recombinant clones. Mapping of restriction sites, S1 mapping. Site directed mutagenesis mis-incorporation of mismatched oligo & mis-repair of mutant oligonucleotides, PCR-based method). Screening of cloned genes hybrid arrest and hybrid released translation). Gene silencing technology, antisense, siRNA, microRNA. Transgenic, gene knock-in & knock-out technologies in bacterial and eukaryotic organisms; RNAi: Antisense construct, Micro RNA and their applications Cell Culture: Plant cell culture:

		Micropropagation, callus culture, haploid production, somatic embryogenesis, somatic hybridization and cybridization, somaclonal variation. Applications of genetic engineering in agriculture GMO and conservation); medicine Manufacturing of drugs, Human albumin, Human growth hormones, Monoclonal antibodies, Antihemophilic factors, Vaccines and Gene therapy); In Research by creating genetically modified bacteria in the process; In industry: the top eight applications are: Protein Engineering , Metabolic Engineering, Pharmaceutical Industry, Biodegradable Plastic Industry, Oil Industry, Bio-Hydrometallurgy, Bio-Mineralisation and Fuel Industry. Recognizing benefits and Challenges of Genetic Engineering and Regulation. Biosafety: Laboratory methodologies, Handling of GMOs, Testing, Evaluation, Toxicity, Allergenic & Animal ethical issues, Disposal methodologies, Natural guidelines, role of IBSC, RCGM and GEAC.
Bot 719	Advanced Gene expression	DNA replication, RNA synthesis and processing. Genetic code, Protein synthesis and processing. Post- translational modification of proteins: Signal cleavage, di-sulfide bond formation, Glycosylation, folding of nascent protein, role of chaperons. Regulation of gene expression: Regulation in prokaryotes: Lac operon: structure and regulation, tryptophan operon: attenuation control. Regulation at the level of DNA structure: Super coiling, DNA methylation, role of nucleosome structure of eukaryotic DNA in gene expression. Regulation at the level of Transcription – Transcription factors, Regulation at the level of RNA processing, RNA export and RNA stability. Regulation at the level of Translation: e.g. Regulation of Ferretin and Transferrin mRNA. Role of upstream AUG codons, translational introns, protein splicing and inteins. DNA Binding Protein Motifs: Zinc finger, Leucine Zipper, Helix-Turn-Helix and other motifs. Molecular Biology Techniques Isolation and amplification of nucleic acid– Plasmid isolation, chromosomal DNA isolation, Quality and quantity checking of DNA by AGE, UV Spectrometry and Real Time PCR, Polymerase Chain Reaction PCR)-Principles, Types and applications. Gene cloning techniques – Physical and chemical methods – Lipofection – Electroporation – Gene Bombardment. Construction of cDNA and genomic DNA library – Screening of libraries. Blotting Techniques Southern, Northern and Western blot),

		Hybridization –plaque, colony hybridization Molecular Tools for Analysis of Genome Principles and applications of RFLP, RAPD, AFLP and DNA fingerprinting. Principle and applications of DNA sequencing- Automated DNA sequencing – Next Generation Sequencing.
Bot 720	Molecular genetics, Molecular basis of development and differentiation	Mendelian principles: Dominance, segregation, independent assortment. Alleles: multiple alleles, Lethal alleles, pseudo-allele. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, linkage and crossing over, sex linkage, sex limited, and sex influenced characters, Linkage and construction of genetic maps, Evolution of gene concept Benzer's work). Extra chromosomal inheritance. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation. Molecular basis development and differentiation: Drosophila: Primary axis formation during oogenesis. Generating dorsal – ventral pattern in embryo. Segmentation and the anterior– posterior body plan, segmentation genes, homeotic selector genes. Morphogenesis and organogenesis in plants: Embryogenesis, Organization of shoot and root apical meristem; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum. Meristem and stem cells. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structural organization and function of intracellular organelles. Organization of genes and chromosomes: Interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Apoptosis, Cancer cells and stem cells.
Bot 721	Specialized Topics 2	The student selects a special topic for discussion. Lectures of a topic are followed by paper presentations by students. The objective of paper presentations is to demonstrate the utilization of discussed techniques in diverse topics. In particular, the presentation should include 1) significance of the study discuss major hypothesis being tested); 2)

		experimental design and methods which assays they used and how that is related class's discussions and lectures); 3) results discuss their validity, reliability, replicability); 4) conclusions drawn from the study not just the authors' but yours as well). Students should not simply give a blow-by-blow account of each experiment and the authors' conclusions.
Bot 722	Epigenetics Applications	Introduction to Epigenetics. DNA memories involves; DNA methylation: an epigenetic mark of cellular memory, Rules governing the mechanism of epigenetic reprogramming memory. Epigenetic and stem cells pluripotent stem cells); DNA methylation dynamics in human induced pluripotent stem cells. Epigenetic memory in induced pluripotent stem cells, Deciphering the heterogeneity in DNA methylation patterns during stem cell differentiation and reprogramming. Barcoding for life- DNA barcoding: From barcodes to genomes: extending the concept of DNA barcoding; The epigenetic basis of individuality, Barcoding Nuclei to Illuminate Single-Cell Epigenetics; Epigenetics, as a DNA signature that affects gene expression and enables rapid reaction of an organism to environmental changes during the process of biological invasions. DNA methylation is an epigenetic mechanism common in plants and animals for gene expression regulation. DNA barcoding impacts biodiversity, pest and disease control, food production and safety, resource management, conservation, quick identification of species and taxonomy. Epigenetic and cancer involves DNA Methylation and chromatin remodeling, The Blueprint of Cancer Epigenetics, Cancer and DNA Methylation, Epigenetic reprogramming in cancer. Epigenetic applications in personalizing medicine and gene therapy, Precision medicine and 310odeling310310310ic310s310 biomarkers. Personalized Cancer Medicine.
Bot 723	Genomics and Proteomics	Genomics and its types: Structural Genomics, Functional Genomics. Genome sequencing: Raw genome sequence data, EST, Polymorphisms, SNPs, Types of physical maps. Genomic databases. Genome of E. coli, Arabidopsis thaliana. Sequence alignment and database searches: DNA sequence analysis, Homology sequence analysis using BLAST, FASTA, pairwise alignment, ORF Plotting, Gene Finding, Translation. Multiple sequence alignment using CLUSTAL W. v. Phylogenetic Analysis: Phylogenetics data analysis, Tree building methods, Rooted tree, un-rooted tree, Distance method. Introduction

		to proteomics: Protein digestion techniques, Mass Spectrometers for protein and peptide analysis. Protein identification by peptide mass fingerprints, peptide sequence analysis by tandem mass spectrometry. Protein sequence analysis using software: Protein expression profiling, , protein complexes. Mapping protein modifications. Protein secondary structure analysis, Molecular visualization of protein 3D structure. Basics of Molecular modeling and Drug designing.
Bot 724	Specialized Topics 3	The student selects a special topic for discussion. Lectures of a topic are followed by paper presentations by students. The objective of paper presentations is to demonstrate the utilization of discussed techniques in diverse topics. In particular, the presentation should include 1) significance of the study discuss major hypothesis being tested); 2) experimental design and methods which assays they used and how that is related class's discussions and lectures); 3) results discuss their validity, reliability, replicability); 4) conclusions drawn from the study not just the authors' but yours as well). Students should not simply give a blow-by-blow account of each experiment and the authors' conclusions.
Bot 725	Advanced Flora and Phytogeography	Biodiversity of Vegetation and Flora in Africa, Afromontane Forest Diversity and the Role of Grassland-Forest Transition in Tree Species Distribution, The Role of Climate and Topography in Shaping the Diversity of Plant Communities, Diversity and Conservation through Cultivation of Hypoxis in Africa, Diversity and Structure of an Arid Woodland, Diversification of African Rainforest, Phylogenetic Study of Monechma Reveals Two Divergent Plant Lineages of Ecological Importance in the African Savanna and Succulent Biomes, Diversity of Tree Species in Gap Regeneration under Tropical Moist Semi Deciduous Forest, Spatial and Temporal Trends of Burnt Area "Implications for Natural Vegetation and Protected Area Management"

Bot 726	Sustainable development and natural resources management	Natural Resource Management and Development, Concepts, Theories and Principles of Natural Resource Management, Integrated Natural Resource Management, Community-Based Natural Resource Management, Gender and Natural Resource 10 of 11 Management, Natural Resource Management in the Context of Climate Change, Natural Resource Project Planning and Management, Policy and Governance in Natural Resource Management, Research in Natural Resource Management, Adaptive Natural Resources Management, Application of Models, Remote Sensing and GIS in Natural Resource Management, Climate Change Mitigation and Adaptation, Natural Resources Management and Poverty Alleviation, Sustainable Natural Resource Management, a Global Challenge of This Century, Roles of Diverse Stakeholders in Natural Resources Management, Sustainable Development Projects, Sustainable Management Of Waste.
Bot 727	Molecular Taxonomy	This class will concentrate on the classification of the two main groupings of angiosperms, known as dicots and monocots, using the most recent findings in the field of molecular phylogenetics, such as the molecular sequences of DNA and RNA. Examine the exhaustive topographic and concatenated datasets in order to evaluate the reconstructed classification systems and examine the validity of employing genetic data rather than morphological characteristics as the determinant of categorization. Look into the Amborellaceae and the nymphaeaceous families as starting point.
Bot 728	Plant Systematic Anatomy	This topic tries to give an overview of significant advancements in structural plant systematics. Examine the data in light of the macro-morphological characteristics as a reliable classification from a variety of sources. Analyze the evolutionary relationships of the biological relationships 312odeling312 anatomical features. Comparative morphology of the stem, leaf, and flower should be studied along with the anatomy of the node as a key component of taxonomy. Stomatal kinds are categorized based on how their mature subsidiary cells are arranged and how they develop. Anomocytic, anisocytic, and paracytic stomata are examples of mature stomata. At the same time that the leaf blade is growing, the petiole is also developing. We'll look at the fast extension that follows cell division all along the

		petiolar meristem. We'll talk about the anatomical features of various vegetative and reproductive organs.
Bot 729	Origin of Angiosperm	In order to provide a believable account for the beginning and early evolution of angiosperms, this course integrates knowledge of both living and fossil plants. The idea that angiosperms began in the Early Cretaceous is the main topic of this course. Examine the pre-Cretaceous angiosperms, which included carpels, the fundamental building blocks of the gynecium, which evolved from megas-porophylls and carried ovules and seeds along their edges through longitudinal folding. Investigating the evidence for pre-Cretaceous angiosperms, the alleged mega-sporophyll, and the history of angiosperms, which only dates back to the Cretaceous, and comparing it to the results of molecular clocks? Investigate the lines of evidence that point to the Triassic as the origin of angiosperms. Determine whether there is a difference between angiosperms and gymnosperms. This course will examine the Triassic fossils as a transitional group between angiosperms and gymnosperms.
Bot 730	Special topic 2)	Selected plant families from Africa and the Mediterranean are the subject of this lesson. Analyze the most recent technologies for characterization and classification of the chosen taxonomic categories. This course provides interactive instruction on how to use online taxonomical databases and herbarium data that are published in plant sciences journals platforms and provided in the universal plant sciences institutions worldwide as ATOL, TROPICOS and IPNI.
Bot 731	Conservation and Rehabilitation of Ecosystems	Ecosystem Preservation And Conservation Strategies, Viability Of Threatened Species, Biodiversity And Habitat Fragmentation, Protecting Biological Diversity, Conservation Tools, Ecosystem Conservation Ethics, Restoration And Rehabilitation Actions, Environmental Issues, Deforestation, Desertification, Reforestation, Monitoring The Restoration And Rehabilitation, Study Cases, Restoration Ecology, Rehabilitation Ecology, Interfaces Of Conservation And Restoration, Addresses Causes Of Degradation, Rehabilitation Necessity, Approaches, Principles And Tools For Conservation And Rehabilitation, Broader Conditions Needed For Successful Ecosystem Conservation And

		Rehabilitation, Novel Ecosystems And Adapting To Rapid Global Change, Climate-Smart Agriculture And Enhancing Socio-Ecological Resilience, Green Infrastructure And Nature-Based Solutions, Ecological Restoration As An Integral Component Of Production Landscapes, Evidence Of Success And Benefits Of Ecological Restoration, Incentives and enablers to mainstream ecological restoration And Rehabilitation.
Bot 732	Plants Chemotaxonomy	Chemotaxonomy As Classification Tool for Plant, Biodiversity and Chemotaxonomy, Chemotaxonomic Classification, Applications of Phytochemical Markers in Classification, Significance of Chemotaxonomy, Glycosides, Glucosinolates, Cyanogenic glycoside, Alkaloid and Phenols in chemotaxonomy, Applications Of Chemotaxonomy, Techniques Of Chemotaxonomy, Chemotaxonomy: An Approach for Conservation And Exploration of Industrially Potential Medicinal Plants
Bot 733	Safety of Using Herbal Medicine and Medicinal Plants	Toxicity and Safety of Medicinal Plants, Safety Concerns of Herbal Remedies, Dosage of the Active Compounds, Integration of Tradition with Modern Technology, WHO Guidelines on safety monitoring of herbal medicines in pharmacovigilance systems, Challenges in monitoring the safety of herbal medicines, Safety monitoring of herbal medicines, Safety monitoring of medicinal products, Current Status and Major Challenges to the Safety and Efficacy Presented by Herbal Medicine, Self-Medication and Drug-Herb Interaction, Conventional Extraction Techniques for Bioactive Compounds from Herbs, Novel Extraction Techniques for Bioactive Compounds from Herbs, Purification and Isolation Techniques for Enrichment of Bioactive Phytochemicals from Herbs, Medicinal Properties of Herbs: Past, Present, and Future, Synergy in Whole Plant Medicine, Biotic and Abiotic Safety Concerns for Herbs, Adverse Human Health Effects and Regulation of Metal Contaminants in Terrestrial Plant-Derived Food and Phytopharmaceuticals, Drug safety and efficacy, Tradition and safety of herbal medicines, Carcinogenic effects of traditional herbal medicines, Kinetic interactions of herbal medicines with conventional medicines, Liver toxicity associated with herbal medicines.

Bot 734	Plant Propagation Programs	Tissue culture as a sustainable alternative for plant propagation, Advances in micropropagation of Plants, Meristem culture for the future of sustainable plant propagation, Micrografting for complete field-ready disease-free planting material, Biology of Plant Propagation, The Propagation Environment, Advanced Techniques of Propagation by Seed, Advanced Techniques of Propagation by Seed, Techniques for Micropropagation, Plant Growth Regulators, Developmental Biology, Somatic Embryogenesis, Innovation in Propagation of Fruit, Vegetable and Ornamental Plants, In Vitro Propagation and Acclimatization of Trees, Improved Propagation and Growing Techniques for Nursery Production Plants, Propagation from Basal Epicormic Meristems Remediates an Aging-Related Disorder in Clones, Propagation Techniques for Some of the Rare Plants, Future Perspectives In Propagation Techniques.
Bot 735	Sustainable Development and Natural Resources Management	Natural Resource Management and Development, Concepts, Theories and Principles of Natural Resource Management, Integrated Natural Resource Management, Community-Based Natural Resource Management, Gender and Natural Resource Management, Natural Resource Management in the Context of Climate Change, Natural Resource Project Planning and Management, Policy and Governance in Natural Resource Management, Research in Natural Resource Management, Adaptive Natural Resources Management, Application of Models, Remote Sensing and GIS in Natural Resource Management, Climate Change Mitigation and Adaptation, Natural Resources Management and Poverty Alleviation, Sustainable Natural Resource Management, a Global Challenge of This Century, Roles of Diverse Stakeholders in Natural Resources Management, Sustainable Development Projects, Sustainable Management Of Waste.
Bot 736	Special Topics in Plant Ecology2)	Studying newest and the more specific topics of the research fields that keep pace with scientific development in all plant ecology fields
Bot 737	Traditional Uses of Medicinal Plants	Medicinal plant diversity, The Place of Medicinal Plants in Treatment, Traditional Medicinal Plants, use and promotion of traditional Medicinal plants, Chemical and pharmacological studies of marketed traditional drugs, Research into medicinal plants, A comparative study of the traditional remedy and Medicinal remedy, Ethnobotany and conservation of medicinal plants, Traditional Medicinal Uses

		of some plants, Pharmacological Activities and Clinical Trials of some plants, Quantitative ethnobotany and preparation of herbal, Ailments and diseases treated and herbal preparation Therapies, Future research and perspectives.
Bot 738	Bioinformatics	Basics for Bioinformatics, Biological Foundations of Bioinformatics, Basic Statistics for Bioinformatics, Topics in Computational Genomics, Statistical Methods in Bioinformatics, Algorithms in Computational Biology, Multivariate Statistical Methods in Bioinformatics Research, Association Analysis for Biological Diseases: Methods and Examples, Data Mining and Knowledge Discovery Methods with Case Examples, Applied Bioinformatics Tools, Biological Databases, Sequence Comparisons and Sequence-Based Database Searches, The Decoding of Eukaryotic Genomes, Protein Structures and Structure-Based Rational Drug Design, Systems Biology: The Functional Analysis of Genomes, Comparative Genome Analyses, Bioinformatics for Vaccinology.
Mic701	Evolution and Molecular Systematics	Basic principles of molecular biology and recombinant DNA technology, genotypic tools classification, molecular phylogenetic and application of computers to comparative molecular analysis. Also covers the basic methods of phylogenetic analysis and their application in fields such as systematics, comparative biology, and molecular evolution. Lectures will emphasize the logical basis and computational details of various tree-building algorithms and associated methods of hypothesis testing, as well as novel applications of phylogenetic analysis in various fields of biology. Computer based labs will give students the opportunity to implement these methods using a variety of phylogenetic software.
Mic 702	Marine Microbiology	A survey of methods and concepts of marine microbiology. Focus on the technical aspects, sample collection, microbial ecology of marine environment, enrichment culture methods of enumeration and identification. This course will explore knowledge of the immune system components and how they normally respond to infection. Knowledge and incorporate principles to evaluate how aberrations in immunoregulation underlie autoimmunity, immunodeficiency, allergy and cancer. How immune aberrations can be measured in the laboratory and potentially corrected by directed therapeutics. Analyses and interpret experimental data on research in immunology. Study the interrelationship between infectious agents and their hosts by study microorganisms

		such as viruses, bacteria, fungi, and parasites that are important in medicine and can cause diseases in humans. Study of disease pathology and immunology and encompasses microbial pathogenesis and epidemiology. The current literature to assimilate views on the latest findings, and communicate them in written and oral formats.
Mic703	Advanced Applied Immunology and Methodology	This course will explore knowledge of the immune system components and how they normally respond to infection. Knowledge and incorporate principles to evaluate how aberrations in immunoregulation underlie autoimmunity, immunodeficiency, allergy and cancer. How immune aberrations can be measured in the laboratory and potentially corrected by directed therapeutics. Analyses and interpret experimental data on research in immunology. Study the interrelationship between infectious agents and their hosts by study microorganisms such as viruses, bacteria, fungi, and parasites that are important in medicine and can cause diseases in humans. Study of disease pathology and immunology and encompasses microbial pathogenesis and epidemiology. The current literature to assimilate views on the latest findings, and communicate them in written and oral formats.
Mic704	Biotechnology of Microbial Systems	This course is an introduction to the field of biotechnology. Topics include recombinant DNA, production of biological molecules, bioprocessing, and current events. The topics covered will include the biofuels, feeds and foods, industrial enzymes, therapeutic proteins and others. Fermentation technology, Yeast fermentation applications
Mic705	Biodegradation and Bioremediation	Environmental contaminants and contaminated site characteristics; relevant microbial ecology biochemistry and physiology; design and operation of engineered bioremediation systems including reactor and in situ approaches; monitoring methods for evaluating the success bioremediation projects
Mic706	Advanced Bioinformatics	This course covers computational techniques for mining the large amount of information produced by recent advances in biology, such as genome sequencing and 317odeling317317 technologies. Main topics of the course include: Major online databases. DNA and protein sequence alignment, sequence motifs/patterns, phylogenetic trees, protein structures: prediction, alignment, classification, microarray data analysis: normalization, clustering and biological networks. Practical

		use of databases. DNA, RNA, proteins in bioinformatics. Amino acid classification. Similarity, homology, local and global sequence alignment. Scoring matrices PAM, BLOSUM). Pairwise alignment. Dot sequence alignment. BLAST. Types of BLAST. How to use BLAST. FASTA. ClustalW. BOXSHADE.
Mic707	Writing scientific project	Designed to cover basic steps in the research process including selecting the general topic of interest and clearly defining the main and specific objectives Setting a plan of action, Both for desk work and practical measures, Including Listing of key words and a literature search of similar studies to get an overview of the topic, Making source cards and writing a statement of purpose about the focused topic, Setting brainstorm questions about the focused topic grouped under similar headings and finding possible sources methods that can answer them, Refocus thesis statement and writing the body of the project from notes, Citing necessary information and writing introduction, conclusion and title page.
Mic708	Advanced Topics in Applied Virology	This course will explore new virus vaccine technology and chemotherapy; the status of vaccination against viral diseases; and the epidemiology and diagnosis of viral diseases. Study applications of Plant Virus-Derived Vectors in agricultural and medical biotechnology. Study noninfectious, synthetized peptides used as safe virus vaccines. Demonstrates the impact of virus diseases on the environment, economy, and the health of man, animals, and plants. Study how viruses can be used in the biotechnology industry and gene based therapeutic approaches to treat disease. Focus on the technology used in the modern diagnostic virology laboratory and recent advances in pathogen detection and disease epidemiology. Study viruses from a public health perspective including preventing transmission and control of disease oubreaks, including vaccination and pharmacological intervention strategies.
Mic709	Pharmaceutical Microbiology	Fermentation of suitable substrate for the production of drugs, dietary supplements, and industrial solvents, as well as the development of the various vaccines that have been critical to the advancement of global health, are examples of useful areas. Pharmaceutical microbiology also provides knowledge and understanding of the importance of the presence of a wide range of microorganisms and toxins microbial by-products such as endotoxins and pyrogens) in

		pharmaceutical raw materials, intermediates, finished products, and pharmaceutical manufacturing environments, as well as microbiological control

Courses Contents

Department of Zoology

أ. First: Diplomas

ب. Applied Studies Diplomas

ت. A. Diploma in Immunology and Parasitology

Code	Course title	Course description
Zoo 549	Techniques of clinical chemistry	This course is intended to present theories of more complex testing in the clinical chemistry laboratory to include the physiological basis for the test, specimen type, tests principles, expected values, sources of error, limitations of the test, and human diseases correlation. The course also introduces analytical and clinical evaluation of Laboratory medical tests.
Zoo 550	Diagnostic Immunology and serology	This course is intended to introduce fundamental and important aspects of the various immunological and serological methods used in laboratory diagnosis of disease, with insight into the basic mechanisms and reactions involved in such methods. It is also intended to give a background to the particular tests used for various human diseases and their normal and abnormal status.
Zoo 551	Genetics and Immune Disorders	This course is intended to understand the cellular and molecular interactions in the inductions, expression, and regulation of cellular and humoral immune responses. Also, this course will present the genetic basis of immune responsiveness. Reviews the genetic mechanisms responsible for the generation of diversity in the genes for immunoglobulins, the T cell receptor molecules, the major histocompatibility molecules, and other key molecules of the immunoglobulin superfamily. Discusses mechanisms and statistical evaluation of immunogenetic associations with susceptibility or resistance to disease.

Zoo 552	Immunohematologic disorders	This course involves the study of the theory and practice of a wide variety of procedures used in the following: donor selection, component preparation, use, and techniques used to detect antigen/antibody reactions that may adversely affect a patient receiving a transfusion. The topics to be covered include Blood bank, donor screening, preparation of components, antigens/antibodies of the ABO, Rh and other blood group systems, pre-transfusion testing procedures, hemolytic disease of the newborn, neonatal and obstetrical transfusion practice, autoimmune hemolytic anemias and adverse effects of transfusion. It also covers the diagnosis and management of blood cell disorders, anatomy and physiology of hematopoiesis, routine specialized hematology tests, analysis, classification, and monitoring of blood cell abnormalities.
Zoo 553	Viral Immunology disease	This course is intended to understand how the immune system works to prevent and remove viral infections. It also covers the Basic knowledge and skills needed to work in a molecular diagnostic laboratory for virus detection. The topics to be covered include Introduction to Viruses, Viral Pathogenesis, Methods of Immune Evasion, T Cell Exhaustion, Passive Immunotherapy, Adjuvants and Immune Activation, Viral Invasion, Viral Replication, and Immune Responses to Viruses.
Zoo 554	Cancer Immunology	This course involves the study of the necessary background and scientific tools to understand the role of the immune system in oncogenesis. It also intended to provide the basic information necessary regarding tumor markers and how they are used to detect, diagnose, and provide a prognosis of various cancers, as well as to provide an increased understanding of the many emerging diagnostic biomarkers.
Zoo 555	Advanced parasitology	The course includes the identification of the parasitic organisms of different species with systematic position, morphological features and life cycle with an emphasis on mode of transmission, diagnosis and preventation.
Zoo 556	Platyhelminthes biology	This course is designed for classification and identification of different species of 321odeling321321321ic321s with special reference on their morphology, life cycle, digestive, excretory, nervous and reproductive systems.
Zoo 557	Nematodes biology	This course is designed for classification and identification of different species of nematodes with special reference on

		their morphology, life cycle, digestive, excretory, nervous and reproductive systems.
Zoo 558	Biology of parasitic protozoa	This course is designed for classification and identification of different species of parasitic protozoans with special reference on their morphology, life cycle, nutrition, excretion, respiration and reproduction.
Zoo 559	Resistance to parasitic infections and epidemics	The course presents different methods for control and prevention of infection with different species of parasites.
Zoo 560	Laboratory techniques in parasitology	The labs associated with this course are designed to identify the different types of parasites and to learn different types of techniques for diagnosis of parasites, especially in human.

B. Diploma in Embryology and ICSI Techniques "Special Fee-Based Program"

Code	Course title	Contents
Zoo 521	Early embryonic development of mammals	Anatomy of gonads, Fertilization, Formation of zygote, Implantation of blastocyst, gastrulation and organogenesis. Embryonic membranes; structure and functions.
Zoo 522	Techniques of external fertilization	Oocyte retrieval- Frozen techniques of gametes- Media for preservation of gametes-Techniques of sperm injection in oocyte- Incubation of zygote-Embryo transfer
Zoo 523	Congenital anomalies	Types and causes of anomalies- Prevention of anomalies-Pattern of congenital abnormalities.
Zoo 524	Techniques of fertilization	Factors affecting fertilization- Mechanism of fertilization-Abnormal fertilization- Ectopic pregnancy.
Zoo 525	Lab training 1	Model for oocyte retrieval- Hormonal stimulation-Experimental model for fertilization- Models for congenital anomalies.
Zoo526	Reproductive physiology	Male and female hormones- Causes of infertility- Physiology of fertilization and gestation. Study of pituitary-gonadal axis.
Zoo527	Diseases of Reproductive system	Ovarian and testicular diseases –Hormonal disorders-Uterine disorders- Gonadal ducts diseases.
Zoo528	Chronic diseases and fertilization	Study of chronic diseases; Diabetes-Thyroid disorders-Tumors-Liver cirrhosis – Complications of chronic on fertilization.

Zoo529	Fertility analysis	Semen analysis- Pre-diagnostic test-Hormonal analysis- Sperm parameters.
Zoo530	Lab training 2	Identification of media for gametes preservation- Microscope of ICSI-Incubators-Follow up of fertilization in lab- Cryopreservation of gametes and blastocyst.

C. Diploma in Biological Forensic Evidence "Special Fee-Based Program"

Code	Course title	Contents
Zoo531	Applied Forensic Entomology	Concept of entomology in a forensic approach and applying their biology to add different assumptions helping the legal investigations, determining the postmortem interval in a crime scene with the help of the insect succession throughout the decomposition of the corpse. Focusing on applying those skills in different industries and in the private and/or public sector, offering students practical experience using scientific information, methodology, technology, and legal procedures inherent to the field of forensic entomology; emphasis on collecting, preserving, and identifying information as evidence and expert witness testimony in courts of law.
Zoo532	Forensic Molecular biology	This course involves introduction to Human Genome, Human Nuclear Genome; Genes and Related Sequences, Intergenic Noncoding Sequences, Interspersed Repeats, Tandem Repeats. Human DNA Polymorphisms. Collection and preservation of biological evidence blood, hair, bone). DNA Extraction; Cell and Tissue Disruption; Lysis of Membranes and Organelles; Removal of Proteins and Cytoplasmic Contaminants; Contamination; Storage of DNA Solutions. Methods of DNA Extraction. DNA Quantitation; Slot Blot Assay, Fluorescent Interchelating Dye Assay, Quantitative PCR Assay; Real-Time Quantitative PCR; TaqMan method. DNA Amplification by Polymerase Chain Reaction; Basic Principles of Polymerase Chain Reaction; Essential PCR Components; Thermostable DNA Polymerases; PCR Primers. DNA

		Electrophoresis; Slab Gel Electrophoresis, Capillary Electrophoresis. Detection Methods; Direct Detection of DNA in Gels; Detection of DNA Probes in Hybridization-Based Assay; Biotinylation of DNA with Colorimetric Reporting System, Detection Methods for PCR-Based Assays. Forensic DNA Profiling; Restriction Fragment Length Polymorphism RFLP); Amplified Fragment Length Polymorphism AFLP), Single Nucleotide Polymorphism Profiling, Mitochondrial DNA Profiling.
Zoo533	Cyto Genetics	This course aims to understand basic genetic principles, forensic DNA analysis, genome mapping, and the application of statistics and quality assurance of forensic genetic analyses.
Zoo534	Biological fluid	This course aims to understand the body fluids including the composition and analyses of blood and other body fluids. It includes the formation of body fluids, blood cells, blood plasma and/or serum analysis, hormonal and enzyme assays in serum, hepatic and renal functions. Cerebrospinal Fluid, urine, Seminal Fluid, Synovial Fluids, Serous Fluids Pleural, Pericardial, and Peritoneal), Amniotic Fluids – Fetal Distress and Fetal Maturity, Sweat, Fecal and other miscellaneous body fluid.
Zoo535	Forensic toxins	These courses involve toxicological study in connection with preliminary) legal investigations. These studies are carried out to clarify whether individuals have been intoxicated with certain substances and whether this can explain e.g. death or effects on driving or behavior also study the study drugs, and their implications in a forensic
Zoo536	Carrion Ecology	Carrion Ecology includes a range of organisms including bacterial, fungal, invertebrate, and vertebrate communities. Intra & interspecific interactions related to population biology, community ecology, & processes that manifest into habitats and ecosystems will be addressed. A multidisciplinary view of organisms will provide the basis for understanding decomposition.
Zoo537	Stored Products Insects	The concept of stored products; the products environment; factors that affect the stored products environment and their role. Damage and food loss in the post-harvest system; types and causes of loss; the role of causal agents. Loss assessment methods. Origin and survey of stored product pests; biology of major stored product insect pests; Modern trends in pest control in the post-harvest system. Review of storage systems of the tropics.

	Introduction in Forensic chemistry	To provide candidate with basic information about veterinary medicine and skills required for identification of dead body, cause of death and criminal evaluation. To prepare our candidates to acquire basic knowledge, competencies, skills related to detection of different drug in body tissue and fluids using different techniques
Zoo538	Forensic Bioinformatics	This course aims to provide students with principal techniques, and major applications of forensic bioinformatics in the field of forensic science includes; DNA-Chip based microarrays and thin film based transistors, DNA microarray sequencing, sequencing analysis and bioinformatics, DNA-based genotyping methods, DNA profiling and profile statistics, Sequence unmasking, computer review and storing DNA evidence.
Zoo 562	Crime scene and physical evidence	Explore the world of forensic science and crime scene investigation. Understand the nature and importance of physical evidence in solving crimes, and how to collect and process that evidence. Learn skills and techniques used by crime scene investigators to diagram and photograph crime scenes, dust and lift fingerprints and perform gunshot residue tests. Explore careers in law enforcement and administration of justice. Note: Some field trips may take place outside of regular school hours. Participation in field trips is optional Public Services classes are designed to give students both the theory and hands-on experience in the skills and knowledge required in these fields. Classroom instruction may include real depictions of graphic or violent content. Some topics in the Administration of Justice and Crime Scene Investigation classes may be sensitive to high school students. Lastly, some programs require the submission of personal information, such as DOB and social security numbers, with state agencies and/or clinical internship partners due to licensing and security clearance requirements
	Forensic Science Internship	Handwriting and document examination, Handwriting, Copiers indentation, Security marks, Typewriters, Printers, Embossing, Palm prints, Foot print, Marks and impressions, Audio, video and computer analysis, Accident investigation, Scene investigation, Forensic archaeology.

D. Diploma in Hematology “Special Fee-Based Program”

Code	Course title	Contents

Zoo 539	Hematological immunology	General Immunology, Immunoglobulin antigen-antibody reactions, HLA complex Immunohematology; red cell antigens and blood group systems- Leucocytes and platelet antigens and antibodies, Complemented activation by blood group antibodies.
Zoo 540	Physiology of circulatory system, blood, and lymph	An Overview of Blood Vessels, lymph and Circulation, Homeostatic Regulation of the Vascular System, Blood; Production of the Formed Elements, Erythrocytes, Leukocytes and Platelets, Hemostasis, Blood Typing.
Zoo 541	Parasitic Blood diseases	Parasitic diseases that can be blood borne include malaria, leishmaniasis, trypanosomiasis, filariasis and toxoplasmosis.
Zoo 542	Basic laboratory techniques	Collection of blood &processing – Anticoagulants, Buffers and solutions – Units of measurements – Instrumentation and Analytical procedures – Complete blood picture – Platelet function tests. ELISA. Compatibility test. – Screening tests on recipients and donors. Tests for hemolytic transfusion
Zoo 543	Hematological molecular biology	The molecular biology of chronic lymphocytic leukemia. Molecular basis of acute lymphoblastic leukemia. Molecular diagnostics and risk assessment in myeloid malignancies. Molecular therapeutics in hematology: gene therapy.
Zoo 544	Fetal and Neonatal Hematology	Hematopoiesis During Embryonic Development and Fetal Circulation, Hematologic reference values in fetus and pediatrics. Fetal and infant clinical findings associated with hemolytic disease of the fetus and newborn HDFN). The prevention strategies for HDFN.
	Clinical biochemistry	Enzymes, metabolism of amino acids, myoglobin and hemoglobin, porphyrins and bile pigments, hormones and their mechanisms of action, free radicals and antioxidants will be covered.
Zoo 545	Laboratory hematology	Types of anemia, Diagnostic tests for anemias. The morphological classification of anemia – specific tests for hemolytic anemia – Diagnostic approach to bleeding disorders. Laboratory findings in inherited & acquired coagulation disorders.
	Computer science	Fundamental knowledge of computer hardware and operating systems; components of an operating system. Positional number systems, Numerical data types and arithmetic expressions, modern operating systems structure. The principles of computational thinking.
Zoo 546	Hematological cell biology	Haemopoietic stem cells, Composition and function of erythrocytes. Production and fate of erythrocytes,

		Neutrophils, Eosinophilis, Basophilis, Monocyte, Lymphocyte and plasma cells, Megakaryopoiesis.
Zoo 547	Experimental blood diseases	Experimental animals- Hematologic differences from human – Transplantation of leukemias & tumors – Types of leukemias in animals and differences from human – Use of experimental malignancy for screening of new methods of treatment.
Zoo 548	Benign and Malignant Blood diseases	Platelet disorders; Thrombocytopenia, Bleeding and coagulation disorders, Thrombosis. Classification of leukemia; Acute myeloid leukemia, Acute lymphoid leukemia, Chronic myeloproliferative disorders.

1. Professional Diplomas A. Diploma in Insect Control

Code	Course title	Contents
Zoo500	Biological control of Insects	Theory and practices relating to the role and use of natural enemies in arthropod and plant population regulation; review and analysis of projects in biological control; biology and behavior of entomophagous arthropods. Lab experience includes field trips to private industry labs, collecting samples and analyzing problems.
Bot 500	Plant pathology	This course provides a broad-based integrated study of different diseases affect cultivated and wild plants. It interested in identifying both biotic and abiotic pathogens, understanding of mechanism of infection and monitoring all the symptoms associated the disease. The course delves into the study of how the pathogens attack the hosts, and how they defend. The course provides a wide knowledge' study of disease cycle involved the hosts and the pathogens. Finally, it offers different ways to eradicate or reduce the amount of pathogen present in an area, a plant, or plant parts. This course will include laboratory sessions covering the study of various plant diseases, including isolation of the pathogens, microscopic examination of infected plant parts, identifying the pathogens and suggesting specific methods for controlling the disease
Zoo501	Agriculture parasitic pests	This course will study Insect pests affecting stored grain – Insect pests affecting horticultural crops – Insect pests that affect vegetable crops – plant parasitic nematodes
Zoo502	Medical and forensic entomology	Ecology, transmission, and control of diseases carried by insects, ticks, and mites; interactions of vectors, animal hosts, and humans. Biting and stinging arthropods and forensic entomology, including evidence collection and

		species succession. Labs and field trips emphasize the identification and field assessment of medically important arthropods.
Zoo503	Advanced insect physiology	Recent advances in certain fields of insect physiology, Physiological processes of insects; metabolism, nutrition, neuroendocrinology, nerve action, cell structure, respiration, circulation, excretion, and flight; functional integration and regulatory processes of organism.
Zoo504	Insect Ecology	Provides basic ecological background with an applied interpretation, emphasizing influences of insect populations and communities on ecosystem processes that influence landscape structure, function and change.
Zoo505	Integrated Pest Management	An introduction to Integrated Pest Management IPM): Concepts, principles, development, and application of IPM. IPM constitutes a series of pest control tactics and strategies toward more sustainable agriculture, natural resources, and urban and rural health and well-being.
Zoo506	Stored products pest control	This course provides fundamental knowledge required to prevent and manage pest infestations using practical non-chemical and chemical methods. Participants will learn about pests associated with grain, methods and devices used in sampling, the overall value of sampling grain, preventive and responsive management techniques and proper use of grain protectant and fumigation.
Zoo507	Toxicology and Insect pesticides	Fundamentals of insect pesticides, provide an overview on insecticide classification, formulation, mode of action, resistance, metabolism, environmental fate, and regulatory legislation; application and handling; labeling; safety; pest control methods, including Integrated Pest Management IPM); and calculations and calibration.
Zoo508	Bioinformatics	This course provides students with both a theoretical background and a working knowledge of the techniques employed in bioinformatics. Biological sequence DNA, RNA, protein) analysis and its applications; bioinformatics databases, sequence and structure alignment, protein structure prediction, protein folding, protein-protein interaction.
Zoo509	Arthropods vectors	This course will study arthropods that can transmit bacteria, viruses and parasitic infections and the mode of transmission either by mechanical and biological methods

		with reference to the life cycle of these pathogens inside these arthropods.

Code	Course title	Contents
Zoo510	Biology of marine invertebrate animals	This course deals with taxonomy and life cycles of selective groups of marine invertebrate groups, their roles in aquatic ecosystems and basic interrelations of marine invertebrate animals with the physical, chemical and biological factors of environment.
Zoo511	Aquaculture of economic fishes and crustaceans in Egypt	This course deals with culture techniques of economic fish and shrimps tilapia, mullets, carps, cat fish, sea bass, sea bream, shrimps), planning of aquaculture projects, design, construction and management of fish farms, site selection, water requirement and quality, aquaculture systems, fish and shrimps nutrition, pond fertilization, fish and shrimps reproduction, hatchery operation, seed production, larval rearing and environmental impacts of aquaculture including fish and shrimps stress and diseases.
Zoo512	Fish biology	This course deals with study of fish taxonomy and morphometrics, basic anatomy, fish feeding habits, food digestion, absorption and metabolism, nutrient requirements, feeding regimes, supplemental feeding in semi-intensive systems, age determination, fish growth in length and weight, fish mortality and survival, migrating of fish populations, modes of reproduction and recruitments.
Zoo513	Fish and aquatic invertebrates physiology	This course deals with metabolism, nutrition, respiration, osmoregulation, excretion, endocrine organs and reproduction of fish and aquatic invertebrates.
Zoo514	Marine fisheries management	This course deals with study of fisheries resources, food relationships among aquatic animals populations, marine food chains, growth modes of aquatic animals populations, fishing methods, fishing gear selectivity, use of time and space in fish movements, population dynamics, stock assessment, management of marine fisheries.
Zoo515	Fish and aquatic invertebrates diseases	This course deals with factors affecting fish and aquatic invertebrates health, integrated health management, major fish and aquatic invertebrates diseases and disease treatment.
Zoo516	Fish production and propagation	This course deals with modes of reproduction of farmed animals, brood stock selection and management, control of reproduction, induced reproduction, gametes preservation,

		egg fertilization and hatching, sex reversal, larval rearing, live food production and larval nutrition.
Zoo517	Natural marine products	This course deals with the study of drugs and other organic products with medical importance, such as proteins, carbohydrates, lipids and their derivatives fatty acids, steroids and trepenoids), carotenoids, chitosan, nitrogenous compounds and other natural products that can be extracted from fish and marine invertebrate animals.
Zoo518	Marine environment pollution	This course presents overview of classification of pollutants inorganic, organic and microbiological pollutants) and their effects on aquatic marine ecosystem.
Zoo519	Marine resources	This course deals with global fish and invertebrates production, living marine resources, products from the sea, conservation of marine resources, nonliving resources from the ocean floor and water distribution, origin, and exploitation of minerals), energy production from the ocean, environmental and political problems of ocean exploitation.
Zoo520	Aquatic ecology	This course presents overview of historical development of different schools of thought in ecology. This course deals with trophic levels, food chains, food webs, efficiencies, biodiversity, stability, natural and human impacts on aquatic communities, adaptations of animals to aquatic life, mechanisms controlling the distribution of aquatic animals, carbon flow in aquatic ecosystem, ecological concepts as applied to pelagic and benthic aquatic organisms and their environment.

Second: Master of Science Degree Courses of the Master of Science Degree:

Code	Course title	Contents
Zoo 600	Advanced Enzymology	This course will study classification and properties of enzyme, structural organization of enzymes. Isolation and Purification of enzymes. Enzyme Specificity. Kinetics of Enzymatic Reactions, Molecular Mechanisms of Enzymatic Reactions. The mechanisms of enzyme catalysis, and enzymatic regulation, enzyme inhibition and multi-substrate enzyme systems. Active site studies and the description of specific well-characterized enzymes.
Zoo 601	Hematology	The course enables the student to understand the physiology and anatomy of blood components and function, general cell morphology with an emphasis on hematopoiesis and bone marrow evaluation. Hematological

		disease. Hemostasis, thrombosis and disease of the coagulation system. The course introduces both manual and automated testing in the hematology laboratory the basic concepts of hematology with principles of blood testing. This course covers the diagnosis and management of blood cell disorders, anatomy and physiology of hematopoiesis, routine specialized hematology tests, analysis, classification, and monitoring of blood cell abnormalities.
Zoo 602	Neurophysiology and endocrinology	This course provides an introduction to neuroendocrinology principles, concepts and mechanisms useful for understanding the nervous system and brain function and its aberrations in pathologies conditions. The relationship of the nervous system to the endocrine system is explored in the context of signaling within a multicellular organism. Also, the pathological conditions and diagnostic procedures associated with endocrine imbalance are investigated. This course also covers the endocrine glands and mechanism action of hormones. The neuroendocrine role in bone remodeling. Pineal gland physiology. Photoperiod, pineal and seasonal breading. Pineal and extra-pineal melatonin biosynthesis
Zoo 603	Histology and Histochemistry	This course will explore cells and tissues through the use of various histological preparation techniques and histochemical methods emphasizing on the relationship between structure and function and the development of pathological conditions.
Zoo 604	Advanced Comparative Anatomy and embryology of Vertebrates	A study of vertebrate anatomy based on recent representatives of the living vertebrate classes. Emphasis is on anatomy and anatomical evidence for current concepts of evolutionary relationships of vertebrates
Zoo 605	Molecular biotechnology	Scientific principles and techniques used in molecular biotecl Manipulation of DNA, DNA cloning, expression of recombina proteins, and modification of genomes. Molecular mechanisr gene regulation in prokaryotic and eukaryotic organisms. Tec based on DNA renaturation Southern blot, northern blot, PCI microarrays).

Zoo 606	Organ physiology and environmental toxins	The course enables the student to understand the effects and pathological states caused by toxins in specific organs of the body. For each organ, also provide the main mechanisms involved in the toxicity, the main toxicants responsible for the damage and the currently used biomarkers which are able to specify the kind of damage and the place where is being produced. The basic principles of toxicology are covered through discussion of the responses of biological systems to drugs and chemicals.
Zoo 607	Advanced Cardiovascular physiology	The course includes the Anatomy, physiology and pathophysiology of the cardiovascular system. Focuses on cardiac and vascular structural anatomy and relationships, electrical innervation, embryology and hemodynamics of the heart and vascular system. Includes pathophysiology, etiology, pathology, signs, symptoms, risk factors, and treatment of cardiovascular diseases.
Zoo 608	Reproductive physiology	This course discussed the role of hormones in regulating reproduction in mammals, with an emphasis in humans. Also include sexual differentiation of the brain, spermatogenesis and oogenesis, pregnancy, parturition, and lactation, and fertility and sexually transmitted diseases. Background in anatomy and physiology is recommended.
Zoo 609	Advanced biology of invertebrates and parasites	The course includes the identification of the invertebrates and parasitic organisms with an emphasis on systematic position, morphological features and life cycle of different species.
Zoo 610	Advanced topics in ecology and insect	This course will explore ecosystem; Structure and Function. The interaction of animals with their physical, chemical, and biological environments. Principles of population ecology. Introduction to quantitative methods in ecology. Environmental pollution and its causes. Nature of behavior and its relation to the nervous system. Reflexes. Orientation, learning, social and sexual behaviors. Parental care. Also current research issue taken from literature in special topics in entomology.
Zoo 611	Cancer immunology	This course involves the study of the necessary background and scientific tools to understand the role of the immune system in oncogenesis. It also intended to provide the basic information necessary regarding tumor markers and how they are used to detect, diagnose, and provide a prognosis of various cancers, as well as to provide an increased

		understanding of the many emerging diagnostic biomarkers.
Zoo 612	Cellular and Molecular Immunology	This course covers the basic concepts underlying the mechanisms of innate and adaptive immunity, as well as key experimental methods currently used in the field. The course will include clinical correlates in such areas as infectious diseases, autoimmune diseases, cancer, and transplantation. It is also intended to give a background to the particular tests used for various human diseases and their normal and abnormal status.
Zoo 613	Diagnostic Immunology	This course is intended to provide up-to-date knowledge of basic and technical immunology and serology as well as hands-on practical laboratory applications of some common immunological and serological techniques. Students learn to use immunological assays, such as enzyme immunoassays and fluorescent antibody assays, for the diagnosis of infectious diseases and immunological disorders.
Zoo 614	Immunotoxicology	This course is intended to familiarize students with the consequences of immunotoxicity, mechanisms of immunotoxicity, and testing for immunotoxicity. It also studies how environmental contaminants, drugs, and natural biotoxins affect the immune system of man; cellular and molecular mechanisms of action by immunotoxic agents.
Zoo 615	Biotechnology	This course is intended to give students a comprehensive introduction to the scientific concepts and laboratory research techniques currently used in the field of biotechnology. Students attain knowledge about the field of biotechnology and a deeper understanding of the biological concepts used. In addition, students develop the laboratory, critical thinking, and communication skills currently used in the biotechnology industry.
Zoo 616	Immunotherapy	This course aims to evaluate modern immunotherapy and the future perspective of immune modulation. It also focuses on the two axes of immunotherapy – enhancement of immune activity as is often used to treat cancer, and inhibition of immune activation as is done in the treatment of inflammatory disease. The course will introduce different diseases with the potential for immunotherapy. This includes different common types of cancer and inflammatory disease, but also rare immunodeficiencies,

		with well-described genetic origins. The mechanisms of action of the immunotherapies will be discussed in detail including antibody-based therapies, T-cell-directed therapy, and small molecule inhibitors of specific signaling pathways.
Zoo 617	Invertebrates physiology	This course covers topics related to invertebrate animals in marine, freshwater and terrestrial ecosystems with emphasis on basic principles of physiological processes. This course provides a comprehensive overview of the physiology of the invertebrate systems as digestive, respiratory, circulatory, excretory, nervous, reproductive systems and their physiological functions. In addition to general principles, some unique physiological adaptations will also be considered.
Zoo 618	Invertebrates embryology and developmental biology	This course will study the reproduction types Asexual and sexual), the morphology of gametes, gametogenesis, mechanism of development fertilization, cleavage, blastulation, gastrulation and organogenesis) in invertebrate animals, such as sponges, coelenterates, 334odeling334334334ic334s, nematodes and Echinoderms with emphasis on the evolutionary changes in development in these invertebrates.
Zoo 619	Advanced comparative anatomy of invertebrates	The course includes the comparative studies on anatomical and structural aspects of the different body systems and organs in different invertebrates. Also, this course presents an introduction to the functional significance and evolutionary importance of the various changes.
Zoo 620	Invertebrates histology	The course enables the student to understand the general invertebrate tissues characteristics, microscopic structure and function of major tissues with studying principles of tissue processing, fixation, and common stains.
Zoo 621	Animal diversity	This course provides an introduction to animal diversity and the phylogenetic relationships between the animal phyla in the kingdoms 334odeling and animalia from primitive to advanced groups. This course covers the distribution of the different invertebrate phyla in the terrestrial, freshwater and marine environments, the taxonomic characters, classification, life habitats free living, ectoparasitic, endoparasitic) and adaptation of various invertebrate phyla like Sarcomastigophora, Apicomlexa, Ciliophora, Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda,

		Mollusca and Echinodermata with an emphasis on Egyptian examples.
Zoo 622	Physiology and immunology	This course enables the student to gain an advanced knowledge of anatomy and physiology of pulmonary, cardiovascular, renal, gastrointestinal, neurological, immunologic and endocrine systems, and their homeostatic mechanisms and system interaction. Analyzes complex interrelationships and interdependence of organ systems in disease and wellness throughout the lifespan.
Zoo 623	Advanced nematodes	This course is designed for study the classification, morphological characters, life cycle of different species of nematodes with special reference on mode of transmission, diagnosis, treatment and control.
Zoo 624	Advanced protozoa	This course is designed for study the classification, morphological characters, physiology and life cycle of free living and parasitic protozoan animals like zooflagellates intestinal flagellates and haemoflagellates), Sarcodina, Apicomplexa, and Ciliophora with special reference on factors which influence their distribution, mode of transmission, diagnosis, treatment and control.
Zoo 625	Immunology of parasitic infection	This course illustrates the host immunological mechanisms operative in the control of parasitic infection.
Zoo 626	Medical parasitology	This course presents fundamental and important aspects of some medically important parasites including protozoans and 335odeling335335 causing human disease with an emphasis on geographical distribution, morphology, life cycle, pathogenicity, diagnosis and control. Special attention is given to methods used in collection and examination of specimens for diagnosis.
Zoo 627	Cell Biology and Histology	This course aims to integrate the knowledge of functional histology and cell biology by providing students with knowledge about the organization and function of cells and human tissues with particular attention to the connection between morphology, function, and pathogenesis.
Zoo 628	Cellular signals	The course will focus on significant signal transduction mechanisms and the role of aberrant signaling pathways in human diseases such as inflammatory disorders and cancer.
Zoo 629	Cancer genetic	This course will focus on the fundamentals of cancer genetics and genomics, control of cell proliferation,

		invasion and metastasis, mechanism of action of cancer drugs, and the development of resistance.
Zoo 630	Tissue Culture and Genetic Engineering	This course presents an overview of approaches being used in Genetic engineering and tissue culture for therapeutic and scientific purposes.
Zoo 631	Cellular Pathology	This course describes mechanisms behind cellular adaptations, cell deaths, and carcinogenesis progression. Also to identify methods used to differentiate between different pathological cases.
Zoo 632	Marine environment	Ecological concepts as applied to pelagic and benthic marine organisms and their Environment. Marine habitats and harmful algae and tides. Ocean dumping of waste materials from industries. Land runoff, Dredging industrial activities, ocean acidification. Sea water level rising. Ozone depleting substances. Water pollution from ships. Noise pollution from ships. Oil spills. Plastic pollution.
Zoo 633	Eco physiology	This course will cover advanced principles of Environmental physiology. The emphasis of the course will be to examine the responses of non-adapted animals to changes in the Environment and compare these responses to animals adapted to those Environments. Adaptations that some animals have developed to allow them to remain in homeostasis despite the Environmental extremes. The underlying physical constraints on evolution will be discussed in the context of these adaptations. Typical stressors may include salinity, water limitation, hypoxia, altitude, depth, temperature extremes, or exercise. Physiological systems include gas exchange, circulation, osmoregulation, metabolism, communication, locomotion and thermoregulation, and the endocrine and neural control of these systems Behavioral components for surviving and/or adapting to Environmental extremes. This course will almost exclusively deal with vertebrate adaptations. Dynamic global vegetation models, chemical composition. Physiology ecology of the forest. Eco physiological factors affecting growth and sporulation and survival population
Zoo 634	Soil Ecology	The course gives basic knowledge on the relationships between soil physics, chemistry and biology. The various groups of soil organisms including micro-organisms and soil fauna and their interactions in soil are described. The importance of soil organisms in nutrient transformations is

		emphasized, as are the effects of Environmental changes on soil biology, and on the other hand, the impacts of soil biological functions on the Environmental quality. Geological guides, characteristics for mineral resource, application to water resources evaluation and soil moisture determination: watershed parameters, physiographic measurements, surface water, Soil as a living community, soil composition. Methods of extraction of soil microorganisms. Impact of soil on fertility. Soil pollution, sources methods of control.
Zoo 635	Soil Ecotoxicology	The effects of chemical toxicants and other contaminants on ecosystems with emphasis on organisms other than human. Topics include fundamental concepts in ecotoxicology, in situ biological monitoring, biomarkers in population studies, major classes of pollutants and their fate in ecosystems, effects of contaminants on individual organisms, and effects of contaminants on population and communities. Methods of extraction of soil organisms, the impact of soil and on soil fertility, soil pollution: source and effect, and methods of control. Types of soil, Techniques of laboratory extraction of animals other than micro-organism Observational techniques to show changes taking place over a period of time in soil which indicates the spatial distribution of micro-organisms. The contact slide technique.
Zoo 636	Population Biology	The biological species concept as population as well as examples in the environment. Genetic information and interbreed. What the advantage and limitations of biological species. Ecological niche. Phylogenetic species .Key ways as morphological, ecological and phylogentic species. Topics include population regulation, population dynamics, population viability analysis and population monitoring.
Zoo 637	Advanced chordate embryology	The course provides a broad overview of the fundamental processes and concepts in embryonic development including the acquisition of multicellularity, organization of the early embryo, morphogenesis of tissues, major organ systems, fetal membranes, growth, and differentiation.
Zoo 638	Advanced comparative anatomy of vertebrates	This course explores the anatomy and function of vertebrates with an emphasis on vertebrate evolution. Lectures cover topics such as the origin, anatomy, physiology, paleontology, and evolution of various vertebrate groups, with a focus on organ systems such as

		the nervous, circulatory, and respiratory systems), life history, locomotion, behavior, and conservation.
Zoo 639	Instruments and apparatus for experimental embryology	The course is linked with the study of major equipment in assisted reproductive technologies, their advantages and disadvantages.
Zoo 640	Physiology of fertilization	This course includes the role of hormones on gametogenesis, ovulation and fertilization.
Zoo 641	Control of limb growth and regeneration	The course is associated to the investigation of the embryonic development of limbs in vertebrates and the role of genes in growth and regeneration.
Zoo 642	Developing Congential anomalies	This course studies the prevalence, prenatal features, associated abnormalities, investigations, perinatal management, prognosis and risk of recurrence for both common and rare fetal abnormalities
Zoo 643	Biological control of Insects	Theory and practices relating to the role and use of natural enemies in arthropod and plant population regulation; review and analysis of projects in biological control; biology and behavior of entomophagous arthropods. Lab experience includes field trips to private industry labs, collecting samples and analyzing problems.
Zoo 644	Advanced medical entomology	Advanced emphasizing the roles of insects and other arthropods in the direct causation of disease in humans and animals, and as vectors in the transmission of disease organisms. The epidemiology and replication cycles of vector-borne pathogens with major medical and veterinary importance will be examined.
Zoo 645	Economic Insects	This course covers where the destructive and beneficial insects live, what they eat, how reproduce, and are distributed in different habitats. The students should be able to recognize the different life cycle stages with their economic values.
Zoo 646	Insect pathology	The general principles of pathology as they apply to insects; include non-infectious and infectious diseases caused by viruses, bacteria, fungi, protozoa, and nematodes. Studies the epizootiology of naturally occurring insect disease and the use of insect pathogens as microbial control agents.
Zoo 647	Insect behavior	The course provides a theoretical and empirical overview of insect behavior, ranging from the physiology underlying behavior to the evolution of behavioral diversity. The focus will be on recent and current research on insect behavior,

		the diversity of approaches for studying it, and how this knowledge can be applied to solve human challenges.
Zoo 648	Forensic entomology	Explores the science, methodology and technology employed to gather, preserve and present information about insects and other arthropods in such a manner that this information can be used in courts of law as evidence and testimony to help resolve issues of a criminal or civil nature.
Zoo 649	Chemical ecology of insects	Introduce the field of chemical ecology and emphasize the role of chemistry in the biological context by application to insects. The course differentiates between the main concepts of Chemistry, Ecology, and Entomology to understand the origin, function, significance, and human uses of insect's natural products. To achieve this aim, examples of chemical communication in some social insects such as bees, ants, and termites are studied.
Zoo 650	Advanced insect physiology	Recent advances in certain fields of insect physiology, Physiological processes of insects; metabolism, nutrition, neuroendocrinology, nerve action, cell structure, respiration, circulation, excretion, and flight; functional integration and regulatory processes of organism.
Zoo 651	Genomics and proteomics	Organization and structure of genomes; Genome size; Sequence complexity; Introns and exons; Chromosomes-isolation, chromosome micro dissection and its applications. Gene identification and expression; Traditional routes of gene identification; Detecting open-reading frames; Identifying the function of a new gene. Determining gene function by sequence comparison and through conserved protein structure. Introduction to Proteomics – the proteome, mining proteomes, bridging, genomics and proteomics data; Analysis of proteomes – SDS-PAGE, 2D gel electrophoresis, detecting proteins; Mass spectrometry. Genome analysis; Micro arrays – types of micro arrays, designing a microarray experiment, applications of microarray technology; Chip array; Shotgun method.
Zoo 652	Molecular diagnosis	An overview of the principles of clinical molecular diagnostics, the use of molecular techniques to diagnose diseases, the laboratory techniques used to detect: microorganisms, inherited disease, DNA polymorphisms, neoplastic processes, DNA based tissue typing.

Zoo 653	Topics in bioinformatics and genomics	An introduction to genomics and bioinformatics. Topics include next-generation sequencing, biological databases, sequence alignment, similarity searches, genome browsers, molecular evolution, human disease genetics and proteomics.
Zoo 654	Molecular biology of RNA	Introduction to molecular biology of RNA; catalytic RNA, RNA binding proteins, pre-mRNA splicing by spliceosomes, regulated alternative splicing, pre-mRNA splicing defects in development and disease, co-transcriptional of pre-mRNA processing, nucleocytoplasmic traffic of messenger RNA, messenger mRNA localization, translation of mRNA, stability and degradation of mRNA, RNA editing, short non-coding RNAs and gene silencing, the biogenesis and nucleocytoplasmic traffic of non-coding RNA, RNA-guided genome editing.
Zoo 655	Stem cells biology	Cell cycle regulation of pluripotent stem cells. Epigenetic regulation of adult stem cells. Hematopoietic stem cell aging and oxidative Stress. Genetic manipulations of pluripotent stem cells. Stem cells in the development, regeneration and repair. Progenitor cells in embryonic and adult Lungs. Liver and pancreas: Mechanisms of development and size control.
Zoo 656	Protein processing	Protein Degradation, Major Types of post transitional modifications, Expanding structural and functional repertoires of proteins via post transitional modifications. Classification of post transitional modifications. Intrinsic disorder and post transitional modifications, post transitional modifications and diseases. Recombinant DNA technology and protein replacement therapy.

Zoo 657	Bio statistics	This course explores the meaning of statistics. It introduces students to some basic terms like variable, continuous variable, discrete or discontinuous variables population, sample, histogram, frequency, classes, class interval and frequency distribution; a distribution in statistical terms: mode, median, mean; measuring the spread of a distribution: range, semi- interquartile range, mean deviation, variance, standard deviation; samples and populations: probability and the normal distribution curve, distribution of t, calculating the limits of a mean; and comparing the means of two samples: null hypothesis, alternate hypothesis, differences between standard deviations, limits for standard deviation and variance. The course also examines a comparison of three or more samples: simple analysis of variance; correlation of two variables: scatter diagram, correlation coefficient, regression lines, mean centre; and chi-square test: the 2x2 contingency table. Learners are taken through planning experiments: layout of experiments, controls, precision of measurements, number of replicates, randomization, Latin squares, and interaction.

Third: Doctor of Philosophy Degree in Science

1. Doctor of Philosophy in Physiology:

Code	Course title	Contents
Zoo 700	Renal physiology and acid base balance	This course is intended to give students a comprehensive introduction to normal physiology and development of kidney and urinary tract, normal and abnormal function of kidney, renal blood flow and its regulation and recognize the importance of renal function in acid base balance and homeostasis through regulation of water and electrolyte balance. Body fluids. Renal clearance, renal plasma flow and glomerular filtration rate. Reabsorption and secretion. NaCl regulation, K+ regulation. Renal regulation of urea, phosphate, calcium and magnesium. Concentration and dilution of urine. Renal hormones.
Zoo 701	Advanced endocrinology	This course provides an overview of human endocrinology as it relates to human health and disease. The various hormone systems are considered from physiological, biochemical and molecular perspectives. The topics to be covered include the mechanism of action of peptide hormones, steroids and thyroid hormones, second messenger systems, autocrine effects of growth factors, endocrine functions of the hypothalamus, posterior and anterior pituitary hormones, adrenal

		glucocorticoids and mineralocorticoids, the renin-angiotensin system, thyroid hormones, insulin, glucagon and glucose homeostasis, hormones regulating calcium balance, and male and female reproductive physiology.
Zoo 702	Neuroscience and mental awareness in humans	The course enables the student to understand the neuro-physiological and control of human 342odeling in health and disease. The course shall emphasize the role of disorders of neuro-physiological and neuro-endocrine disorders in the genesis of psychological symptoms. Also provide correlations between specific psycho-physiologic syndromes and abnormal neuro-physiologic. Neuro-muscular physiology and synaptic transmission. The sensory system. The motor system. Neuro-physiological mechanisms of perception. Learning and memory. Emotion. Neuro-physiology of sexual 342odeling and aggression. Localisation of cerebral function. Arousal, sleep, and EEG. Dreams and dreaming.
Zoo 703	Advanced topics in Immunology	This course is intended to provide up-to-date knowledge in the nature of immunity, antigen recognition and presentation, lymphocyte interactions, cytokines, cell signaling and activation, immunoglobulin and diversity, lymphoid system, primary and secondary organs, immunological memory, immunological tolerance, regulation of immune response, major histocompatility and CD markers, inflammation and natural responses, immunity to viruses, bacteria and fungi, immunity to protozoa and worms, integration to immune system with other regulatory systems.
Zoo 704	Metabolism and metabolic physiology	This course provides an overview of the metabolic processes in prokaryotes and eukaryotes, and how metabolism is affected by membranes, enzymes, substrates and other metabolites. The topics to be covered include basic concepts in membrane transport, signal transduction, and molecular physiology. Physiological states and how they affect metabolic pathways. Roles of various tissues and to metabolic pathways in disease states, including adipocyte biology, beta-cell biology, epigenetics, inflammation, and aging related diseases. Transformation of energy. Metabolism of carbohydrates. Vital importance of plasma glucose homeostasis. Glucose transport across cell membrane. Metabolism of fats, proteins and nucleic acids. Energy-transforming mechanisms Oxidation-reduction and cytochromes. Energy reversibility, duplication and activation. Energy storage. Metabolic rate and body size

Zoo 705	Physiology of musculoskeletal system	This course is designed for study the body bones, types of muscles, cartilage, tendons, ligaments ,joint anatomy and structure .also provide overview about importance of calcium metabolism and diseases in musculoskeletal system. Topics covered include basic components of skeletal muscles, molecular mechanism of contraction, force-tension relationship, muscle innervations and muscle fatigue.

دكتوراه الفلسفة في علم المناعة:

Code	Course title	Contents
Zoo 706	Immunomodulators and their applications	This course is intended to give students a comprehensive introduction to immunomodulator agents used in immune-mediated inflammatory diseases. These agents include interleukin IL) receptor antagonists, tumor necrosis factor TNF)-blocking agents, T-cell activation inhibitors, a Janus kinase inhibitor, and an integrin receptor antagonist. These agents interfere with inflammatory pathways through slightly different mechanisms and are indicated in rheumatoid arthritis, psoriatic arthritis, psoriasis, ankylosing spondylitis, ulcerative colitis, Crohn's disease, and neonatal-onset multisystem inflammatory disease. It also covers the three main categories of immunomodulants; immunostimulant, immunosuppressant, and immunoadjuvant.
Zoo 707	Modern antibiotic and antiviral strategies	This course is intended to provide students with fundamental and important aspects of the common types of pathogens which infect humans, the different classes of antibiotics, their spectrum of activity, and their modes of action.
Zoo 708	Autoimmune Diseases	This course provides an overview of the current understanding of the pathogenesis of autoimmune diseases and presents evidence-based approaches to the diagnosis, treatment, and follow-up of autoimmune diseases. The topics to be covered include The Immunology of Inflammatory Disease, Anti-Cytokine Therapies, Targeting Immune Cells, Migration, and Signaling Pathways.
Zoo 709	Advanced Immunology	This course is intended to provide the students with an enhanced understanding of immunological concepts and techniques applicable to research in immunology and related fields. It also familiarizes students with the current immunological concepts, paradigms, and techniques that are applicable not only to research in immunology but are also increasingly necessary for an enhanced understanding of all biological disciplines.

1- Doctor of Philosophy in Invertebrates:

Code	Course title	Contents
Zoo 710	Evolution and development of invertebrates	This course is an introduction to various invertebrate animals with an emphasis on their evolutionary relationships between different invertebrate phyla including similarities and differences between them.
Zoo 711	Invertebrates pathology	This course includes the study of different agents of invertebrate diseases, such as parasitic, bacterial, fungal, and viral diseases by using different macroscopic and microscopic examinations to differentiate between each disease. It also illustrates the mode of transmission, diagnostic methods and control measures of these diseases.
Zoo 712	Biology and ecology of terrestrial invertebrates	This course covers the diagnostic features, systematics, biology, ecology, distribution and evolution of terrestrial invertebrates, such as Annelids, Arthropods arachnids, isopods and insects) and gastropods with special reference to their affinity and inter-relationships
Zoo 713	Ecophysiology of marine invertebrates	This course covers the diagnostic features, the basis of classification, physiology, ecology and distribution of marine invertebrates, such as Porifera, Cnidaria, Annelida, Crustacea, Mollusca and Echinodermata with special reference to their affinity and inter-relationships and their adaptations to life in extreme environments.
Zoo 714	Special topics in invertebrates	This course includes different topics on invertebrate animals like anatomy, biology, histology, physiology, embryology, behavior, and ecology. Also, this course presents different species of invertebrates that can be used in traditional medicine as antioxidant, anti-inflammatory, anticancer, antimicrobial and antiviral, and illustrates the bioactive components in these invertebrate animals.

4. Doctor of Philosophy in Parasitology:

Code	Course title	Contents
Zoo 715	Vectors biology	This course will study arthropod vectors that can transmit parasitic infections and diseases and the mode of transmission with reference to the life cycle of these parasites inside their vectors.
Zoo 716	Fish parasites	This course focuses on the parasites that found in fish and provides identification of systematic position, morphological features and life cycle of these parasites with an emphasis on mode of transmission, diagnosis and preventation.
Zoo 717	Host-parasite interactions	The course is designed to look at major parasitic diseases of humans and domesticated animals and the principal factors which affect levels of parasite infection in humans and animals. An understanding of parasite biology and their

		interactions with host populations will lay the foundation for exploring approaches to management and control of parasitic diseases.
Zoo 718	Environmental parasitology	This course deals with the study of different water-and soil-borne parasite infections, their consequence in cases of immunological deficiencies in humans, 345odeling345345345ic organisms and their biology, the role of water, food and soil in spreading human parasitic infections, biology of protozoans, cestodes and nematodes transmitted through food products, arthropods and their role as vectors, Tick-borne diseases, monitoring and prevention of environmental contamination with pathogens of parasites origin.
Zoo 719	Molecular ecology of parasites	This course aims to study the interaction between three elements: host genes, parasites and the environment in which parasitic infections develop. It deals with parasites identification, the host population genetic structure and transmission patterns of parasitic infection. Emphasis will be placed on infection, pathogen survival, pathogen virulence factors, genetic selection, 345odeli-modulation of host defense mechanisms and development of drug resistance.

5. Doctor of Philosophy in Cell Biology, Histology, and Genetics:

Code	Course title	Contents
Zoo 720	Advanced Cell Biology	This course will address advanced concepts of cell biology, focusing on imaging techniques, stem cell biology, protein transport, and electron microscopy.
Zoo 721	Advanced Histopathology	This course presents an overview of topics related to pathological processes that underlie various human diseases and special staining procedures used in diagnosis.
Zoo 722	Genetic engineering and gene technology	This course dives into the research, technologies, and applications of genetic engineering with emphasized on gene therapy and its applications.
Zoo 723	Oncology and Animal Cell culture	This course is intended to introduce the student to the principles and practical considerations of cell culture, and their applications in cancer drug discovery.
Zoo 724	Advanced Histochemistry	This course provides an overview of advanced theory and practice of histochemistry staining techniques of histological samples. And their application in diagnosis.

6. Doctor of Philosophy in Animal Ecology:

Code	Course title	Contents
Zoo 725	Desert Ecology	General description of desert classification and distribution of the world's major deserts. Weather and climate of the desert environment. Morphological, behavioral, and physiological adaptation of animals to the desert environment
Zoo 726	Ecosystem	Animal ecology and geography of the environment, hydrology watersheds and sedimentation landscape ecology as well as plant ecology and the physical parameters of the soil.
Zoo 727	Ecological Pollution Control	Types of environmental pollution causes, effects, and remedies. Exploring and potential current tools for removal and hazardous materials from the environment. The sustainability and ecosystem services. Air pollution, water, soil, and land. Concerned about the problems that affect biodiversity and ecosystems and human health worldwide by contaminating soil and water. Diffusion and premixed flames, Laminar and turbulent flames, Flame stability, Low-pressure flames, Spontaneous ignition and cool flames, Flammability limits, Factors affecting burning velocity, The structure of the reaction zone, Two-stage combustion, Three-way catalytic converter, Formation of oxides of nitrogen and sulfur, The carbon black process.
Zoo 728	Communities environment and biodiversity	This course deals with the study of air pollution and its impact on animal biodiversity, indoor air issues like asbestos. Air quality, emissions and greenhouse gases. Climatic changes and chemicals. Greener living.
Zoo 729	Animal behavior	Types of animal 346odeling, characteristics of innate or stereotyped behavior, Types of innate behavior. Irritability is an excessive response to stimuli. Communication in animals: Visual, olfactory, auditory and tactile. Ecological Aspects of 346odeling: Habitat selection, food selection and optimal foraging theory, anti-predator defense mechanisms, aggression, territoriality and dispersal.
Zoo 730	Environment risk assessment and climatic changes	Study number of specific environment issues can impede human health and wellness and include chemical pollution, air pollution climatic changes. Disease –causing microdes. Poor infrastructure and poor water quality.

7. Doctor of Philosophy in Comparative Anatomy and Embryology:

Code	Course title	Contents

Zoo 731	Biology of Evolution and vertebrate origin	The fundamentals of the course include the systematic and geological context of vertebrate evolution, explains key changes in vertebrate diversity, adaptational morphology, radiation/extinction cycles, historical biodiversity, climate change impacts, and modern species conservation.
Zoo 732	Congenital anomalies of embryos	The course provides a broad overview of the description, timing, causes, diagnosis and treatment of congenital abnormalities.
Zoo 733	Cellular signals regulation	The course explores the signaling mechanisms that exist in human cells. These mechanisms are the source of many new drug targets and understanding their biology is critical for the development of new therapeutics and an advanced understanding of current treatment options.
Zoo 734	Advanced science in growth of nerves	The course is related to the study of the development, structure of nervous system, mechanism of action from molecules and cells to functional networks.
Zoo 735	Physiological changes in embryos	The course studies the structural functional relationships between the gametes and reproductive organs and describe the interaction between the developing fetus, placental membranes, maternal tissues and the environment the physiology of pregnancy and several developmental disorders that arise due to biomedical miss-regulation or environmental agents.

1. Doctor of Philosophy in Entomology:

Code	Course title	Contents
Zoo 736	Insect taxonomy and evolution	Analytical survey of the classification and evolution of the orders and principal families of insects, with practical experience in the identification of insects at these taxonomic levels.
Zoo 737	Social Insect	Examine in depth the astounding diversity of social behaviors exhibited by insects, ranging from transient parental care to the complex super societies of ants, bees, and termites. Exploring the evolutionary causes and consequences of insect sociality, current trends in social insect research, and other special topics.
Zoo 738	Aquatic entomology and pollution	Effects of pollutants on biology. Ecology and community structure of aquatic insects. Life-cycle, trophic guilds, community structure in lotic/lentic habitats. Organic

		pollution/eutrophication, heavy metal pollution, runoff/siltation, acidification, thermal pollution. Changes in aquatic insect community structure according to original literature sources for each class of pollutant. Biological monitoring networks.
Zoo 739	Insect Population Genetics and Evolution	Employing the principles of insect population genetics and phylogenetics to answer questions about organismal diversity, population dynamics, community assembly, and macroecology. Having a foundation in molecular evolution and genomics allows for broad topical applications, including the study of infectious diseases, the conservation of endangered species, insect responses to global environmental change, and the evolutionary origins of biological diversity.
Zoo 740	Insect hormones and pheromones	The metamorphosis hormones: The activation brain) hormone – The molting hormone and its analogs, Methodologies of using insect hormones, Effects of hormones on some physiological processes. Pheromones as a means of communication in the animal world; Classification of insect pheromones Secretion and reception of pheromones in insects: Major factors affecting secretion of pheromones –Role of pheromones in insect control.
Zoo 741	Insect Microbiology	The diverse associations exist between insects and microorganisms. These associations include mutualistic relationships, commensalism, vector biology, and insect-pathogen interactions. Insects from a wide range of orders as well as a diverse array of microbes will serve as theoretical models for the students to learn about developmental biology, physiology, behavior, and ecology involved in interactions between insects and microbes.
Zoo 742	Advanced topics in medical and forensic entomology	The goals of this course are to review contemporary topics and current issues in medical and forensic entomology. Students will present recent literature from the fields of medical and/or veterinary entomology that include aspects of disease transmission, epidemiology, and challenges for vector control. In addition to presenting recent topics in forensically importance insects. Students are also expected to engage in in-class discussions of the material.

9. Doctor of Philosophy in Molecular Biology:

Code	Course title	Contents
Zoo 743	Molecular mechanisms of tumorigenesis	Cell death. Cell proliferation and migration. Oncogenes and tumor suppressor genes. Apoptosis. Tumorigenesis, invasion and metastasis. Telomerase and Cancer. Tumor-related signaling pathways. Tumor diagnosis and therapy.
Zoo 744	Advances proteomics	Bioinformatic analysis of proteomics data. Quantitative proteomics for identifying biomarkers. Clinical proteomics of enervated neurons. Automated peptide mapping and protein topographical annotation of proteomics data. SASD: The Synthetic Alternative Splicing Database for Identifying Novel Isoform from Proteomics. The Proteomics of Lung Injury in Childhood. Urinary Proteomics and Metabolomics Studies to Monitor Bladder Health and Urological Diseases.
Zoo 745	Advanced molecular therapeutics	Simple protein replacement therapy. Recombinant protein production. Recombinant vaccines. Reproductive cloning. Stem cell therapy. Gene augmentation therapy. Gene silencing technologies; Antisense therapy, Triple helix triplex) technology, Ribozymes. Small interfering RNAs siRNAs).
Zoo 746	Molecular Immunology	Innate Immunity and Inflammation; pathogen and danger-associated molecular patterns and their receptors. Myeloid cells of innate immunity. Mechanisms of phagocytosis. Inflammation lymphoid cells of innate immunity. Mechanisms of antigen receptor diversity. Antigen-Presenting Cells and the Major Histocompatibility Complex. T Cell Immunity: T cell receptors and their effector functions. Immunological Hypersensitivities: Allergy and autoimmunity. Cancer immunology; monoclonal antibodies in cancer immunotherapy. Monoclonal antibodies in cancer immunotherapy. Immune cell therapies.
Zoo 747	Molecular genetics	Nucleic Acid Structure and Gene Expression. Fundamentals of Cells and Chromosomes. Cell-Cell Interactions and Immune System Biology. Aspects of Early Mammalian Development, Cell Differentiation, and Stem Cells. Understanding Genomes; Core DNA Technologies:

		Amplifying DNA, Nucleic Acid Hybridization, and DNA Sequencing. Analyzing the Structure and Expression of Genes and Genomes. Genetic Manipulation of Mammalian Cells. Gene Regulation and the Epigenome. Comparative Genomics and Genome Evolution. Chromosomal Abnormalities and Structural Variants.

Courses Contents

Department of Earth Science

code	Course Title	Contents
Geo 501	Operation of wastewater stations	This course on Design criteria for wastewater pumping systems include the capacity to deal with variable flow rates and types, floatable objects, large solids and abrasive materials. The outcome of design should be a suitable pumping system comprising efficient equipment, cost-effective installation, smooth operation and minimum downtime with normal maintenance. The hands-on design problems that you solve in this seminar/workshop under instructor guidance enhance your understanding of design procedures.
Geo 502	Integrated management of water resources	Using the concept of integrated water resources management in rivers and lakes, Risk management and risk analysis for ecosystems in arid and semi-arid regions. Hydrodynamic models of ground and surface water flow. The impact of climate change on water resources in arid and semi-arid regions. The role of international cooperation, transfer of expertise and integration of research in water resource management.
Geo 504	Principles of Geographic Information System and Its Applications	Meaning, Definitions, History Types and Components of GIS, Cartographics Basic for GIS, Types of Geodatabases., Building of GIS Project, GIS Data Capturing and Editing, Geoprocessing and Spatial Data Analysis, Applications of GIS in climate change.
Geo 503	Water Quality assessment	Introduction – Water quality standards – Sampling methods – Basic and accurate chemical components of water – Quality measurement methods – Natural concentrations of dissolved elements in water in different environments – Sources of pollution – Evidence of pollution – Pollution of surface water and underground reservoirs – Methods of treating polluted reservoirs, health impact of polluted water – case studies.
Geo 505	Hydrogeochemistry	Chemical composition of natural groundwater; inorganic parameters in natural water, chemical reactions and processes in groundwater systems; water-rock interaction processes, chemical evolution of groundwater; equilibrium and disequilibrium; dissolution and precipitation of minerals; Sampling methods for hydrogeochemical studies, chemical analysis methods, calculation and presentation of hydrochemical data as a

		basis for interpretation, Data processing and representation.
Geo 506	Hydrogeology of Egypt	Introduction, water resources in Egypt, surface water systems, Nile Valley and Delta region, Western Desert region, Eastern Desertt region, Suez Canal and Sinai region, groundwater aquifers in Egypt, prevailing hydrogeological problems, Plans for the uses and management of water resources in Egypt, Floods and natural hazards in Egypt and methods of protection from them.
Geo 507	Water treatment	Water problems – sources of drinking water – methods of producing and treating drinking water – means of exploiting groundwater – Water distribution networks – Wastewater treatment – Treatment of underground reservoirs – Hydrogeological determinants for water protection – reuse of treated water – applications and case studies
Geo 508	Water desalination	Introduction to water resources & Desalination processes, Thermal Technologies: Single and Multi-Stage Flash MSF) Technology, Process calculations and MSF performance parameters, Single and Multi-Effect Distillation MED) Technology, Process calculations and MED performance parameters, Membrane Technologies: Osmosis and Reverse Osmosis RO),RO system performance parameters, Energy Recovery and pretreatment, Electro dialysis,Solar –Desalination Systems, Process calculations of Solar –Desalination Systems, Nuclear-Desalination Systems, Introduction to Future Technologies H-DH, MD, FO, CDI, NF), Introduction to desalination problems scaling, fouling, corrosion), and their mitigation, Final project presentations.
Geo 509	Drilling and development of wells	Introduction – types and uses of wells – drilling methods – drilling fluids – well design – oil casing – pumps, their types and capacities – well development – drilling problems – applications.
Geo 510	Quality control in water analyses.	This course on water quality assessment is an attempt to equip students with theoretical background and practical skills to participate in water quality-ensuring practices and prepare a student in acquiring skills in the art of water monitoring and quantitative analysis of critical

		water quality parameters. It also brings in those aspects of chemistry which are important for water quality management and pollution control
Geo 511	Water Quality Instrumentation أ	In this course, complete analyzer systems are discussed while special attention is given to applied sampling systems next to the main types and principles of currently applied Process Analyzers ranging from Physical Properties, Chromatography, Water type analysis to the promising future of Spectroscopic type of analysis while advantages and disadvantages are clarified with the aim to enhance the understanding the operational ranges and limitations of each type of analysis system.
Geo 513	Global Climate Change	Introduction, What is Climate Change?, Energy Balance and Climate, Greenhouse Effect, Greenhouse Gases, Structure of the Atmosphere , Review of Greenhouse Effect, Ocean and Biosphere , The Carbon Cycle: Ocean and Biosphere ,The Carbon Cycle: Mineral Weathering , Climates of the Past, The Pleistocene Ice Ages, Climate Models ,Future Climate Change, How Will Climate Change Affect Our Lives
Geo 514	Introduction to Oceanography	Introduction, Marine Geology, Plate Tectonics, Plate Tectonics and the Sea Floor, Marine Provinces, Ocean Chemistry, Water and seawater, Surface Ocean, Deep Ocean, Waves and water dynamics, Tides, Marine Life and the Marine Environment, Biological Productivity and Energy, Biological Productivity and Energy Transfer, Marine pollution, The Oceans and Climate Change, Marine Life Animals of the Benthic Environment
Geo 515	Coastal and Marine geology	Sedimentology and sedimentary processes. Different types of sediments in the ocean basins and on their margins. Sediment processes – cohesive and non-cohesive sediments. Bed forms. Deltas. Estuaries. Tidal Flats. Continental Shelves. Coastal Processes. Deep sea sedimentation. Techniques for observing the ocean basins. Broad introduction to different techniques then focusses on acoustic techniques. Seismic reflection. Multi beam bathymetry, and Sidescan sonar. Plate Tectonics and large-scale earth processes. Historical development of plate tectonics. Mid Ocean Ridges, Subduction Zones, Plate Tectonic Cycle, Driving mechanisms. Sea Level changes

Geo 516	Earthquakes and Plate Tectonics	Basics of Revolution – Plates and Plate Boundaries, Plates in Velocity Space and Triple Junctions, Rotations on a Sphere, Plate Tectonics on the Globe, Earthquakes and Plates, Finite Rotations, Magnetism and Isochrons, Driving Mechanisms, Absolute Motion
Geo 517	Climate change Adaptation and Mitigation management)	climate change, it causes and impacts concepts such as adaptation and mitigation, causes and risks) and implications for food security, agriculture, aquaculture and natural resource management, Risk assessment concepts: hazards and risks, Risk assessment and risk management, Primary and secondary risk control mechanisms, Application to human and environmental risk assessment
Geo 518	Engineering Geology & Coastal Protection	The processes are ongoing at the shoreline and construction within the coastal zone. This includes the management and mitigation of shoreline erosion; improvement of navigation channels and harbors; protection against flooding brought on by storms, tides, and even tsunamis; improvement of coastal recreation; and management of pollution in nearby marine environments. Coastal engineering approaches to erosion or hazard mitigation have traditionally been “hard” through the installation of structures or hard approaches. In this course, we will explore these hard approaches and their advantages and disadvantages, explore erosion trends induced by these structures and how they disrupt sediment transport along coastlines, and discover alternative soft approaches to mitigation
Geo 519	Physical Processes of Coastal Environments	A general introduction to the discipline of coastal geomorphology, a review of coastal environments and related problems, and a more detailed consideration of beach-dune systems. Specifically identifying and understanding the complex relationships between the suite of physical processes actively shaping the coast. Emphasis is put on critical analyses of the process-landform models e.g. sediment transfers; system equilibria) operating on different time scales seconds to 355odeling355), Types of coasts and coastal sediments coastal morphology Changes in sea level Waves: Wave Types Coastal wave currents Profile beach, coastal morphodynamics, Coastal erosion and protection

Geo 520	Climate Models and Observations	climate Models and Their Characteristics, Techniques for Assessing Model Performance, Simulation of Recent and Longer-Term Records in Global Models, Importance of Simulating Climate Variability, Climate Sensitivity and Climate Feedback, Types and Sensitivity of Climate Models, Uncertainty and Climate Modeling, Low-Carbon Energy Technologies, Innovation and Carbon Dioxide Management.		
Geo 554	Principles of Remote sensing and Its Applications	Definition of Remote Sensing, Remote Sensing's History, Electromagnetic Radiation and its Interaction with Earth, Satellite Systems, Remote Sensing Imaging Systems, Remote Sensing Data Types Image Processing, Basics of Processing of Digital Image, Satellite images cropping – Satellite images radiometric corrections –preprocessing process, Visual image interpretation, Image classification methods, Image enhancement, Classification and Visualization, Applications of remote sensing techniques in climate change		
Geo555	Subsurface Geology	Subsurface structural mmaps, wireline lolog crosssecsections, ppreparationnd uses ofof ofhicknessps, qualiqualitative interpretation loglogging diagradiagramsadioactivity logging, g gegeolologiccation ofdrillingtime time patpatimemetergic applicatiapplicationtem oftem testtest, cridataitericriteriasurface faultingsis of sedimentary basins		
Geo 556	Engineering Geology	Introduction, engineering pproperties of sosoil androcrocks, soilechanics, site inveinvestigation andvilengineering, rock masses, engineering problems related to dams and land-landsliding 521	Marine resources	advanced scientif

			and Sustainability	ict technologies for sustainably utilizing o

				ceans and their resources and energy while

				preserving the environment, balance the pre

				servation of the ocean environment and deve

				l o p n e n t a n d u t i l i z a t i o n o f i t s r e s o u r c e s a n

				d e n e r g y , a n d f o c u s o n e n g i n e e r i n g t e c h n o l o

				gies for improving the safety and productiv

				ity of narine production activities, compon

				ent analysis, exploration, development and

				utilization of narine mineral and energy re

				sources, improvement of environmental perfo

				rnance, safety and economy of narine facili

				ties, safety of environmentally sound nari

				engine systens, marine operations and sh

				ips, naintenance and safe usage of coastar

				eas, acoustic instrumentation of narine cre

				atures, resource volume, biology and living

				environment, and purification of hydrosphe

				ric environment
Geo 522	Environmental Impact Assessment	Introduction to Environment Management & EIA, The methodology of environmental impact assessment EIA) as a vital tool for sound environmental decision-making. It introduces the concepts, methods, issues and various stages of the EIA process. The various stages of the EIA process, such as screening, scoping, EIA document preparation, public involvement, review and assessment, monitoring and auditing, appeal rights and decision-making are examined		
Geo 535	Shallow Subsurface imaging	techniques of geophysical investigation of shallow subsurface as they apply to solving groundwater, environmental, archaeological, and engineering problems. Emphasizes methods, survey design, and interpretation with focus on case studies. Laboratory consists of both field training and computer exercises using geographic information systems for analysis of spatial data. Subsurface structural mmaps, wireline lolog crosssecsections, ppreparationnd uses ofof ofhicknessps, qualiqualitative interpretation logging diagradiagrams, rradioactivity logging geol, gegeologiccation ofdrillingtimtime patimerametergic applicatiapplication ofteoftem testta, cridata, critecriteriasurface faultinglysis of sedimentary basins		
Geo 601	Advanced Hydrogeochemistry	hydrogeochemistry interfaces with other natural sciences, the need for and benefits of interdisciplinary research; physicochemical characteristics and components present in the groundwater, occurrence of		

		components forms in groundwater, most of all dissolved speciations, methods for quantitative evaluation of speciations in the waters; factors, processes and reactions that affect the supply and removal of material to/from groundwater, in particular: the role of the substances supplied to the environment, with atmospheric depositions, the influence of processes occurring in the vegetation cover and soil, the processes of dissolution and transformation of minerals in the weathering zone, the most important chemical reactions associated with the transfer of protons and electrons, the role of organic matter present in the aquifer and groundwater, the role of the mixing of groundwater of different composition, the effect of evaporation on the composition of the groundwater; the impact of human activity on groundwater chemistry, including the impact of major origin of danger and pollution of groundwater quality; the basic principles of geochemical modeling of groundwater, the principles of hydrogeochemical methods, including designation and preparation of test points, water sampling techniques, sample handling procedure, rules of the program of field and laboratory quality assurance/quality control QA/QC); principles of evaluation of groundwater quality
Geo 602	Advanced Sedimentary rocks	This course explores sedimentary rocks as archives of information about Earth's surface processes and geological history. We will explore how sediments and sedimentary rocks can be used to reconstruct surface processes, ancient sedimentary environments, and the evolution of sedimentary basins. The course will have a particular focus on describing and interpreting clastic sedimentary deposits from a modern process-based and sediment-routing systems perspective
Geo 603	Advanced structural geology	The course examines the deformation of the earth´s lithosphere. The course aims to elucidate advanced theoretical aspects of rock deformation. Besides the quantitative aspects of stress and strain analyses, the broad spectrum of deformation complexities in contractional, extensional and strike-slip regimes at various scales are discussed. The course provides an in-depth understanding of the rheological properties of the lithosphere, including brittle and plastic deformation

		processes at the micro scale. A focus is also given to the deformation behavior of ice
Geo 604	Advanced geophysical Exploration	This course deals with refraction seismic, reflection seismic, gravity and magnetic methods applied to exploration for hydrocarbons, and their uses in engineering and hydrogeology studies. Ground-penetrating radar GPR) and electromagnetic useconductivity meters and their uses in archaeology
Geo 605	Advanced geochemical Exploration	This course deals with sampling techniques, geochemical exploration, geochemistry of selected groups of elements such as RREE, PPGE HFSE oror heavymetmetals, gegeochemistryf ordepodeposits metmetallic nontallic), geochemical data processing and geochemical mapping, data interpretation and modelling, isotopes geochemistry Rb-Sr, Sm-Nd, Nd, Ndd Th-Pb systems), datingdating calcucalculationrcises andlems, ore resource estimation
Geo 606	Advanced petroleum and hydrogeology	This course deals with hydrogeology, aquifer ttypes, aquifer paparameters, undergroundwatwater, mmovementelationship of watewater ququality geologiccondiconditions, watwaterlity, undergroundater water explexploration seismicd eland electricalds, hydrochemistry, applications of isotopes in hydrogeology. While petroleum geology deals with composition of hydrocarbon, origin, diagenesis and maturation of organic matter, source rocks, reservoir rocks, migration, petroleum trap definition, components, trap types, basin modeling
Geo 680	Field geology and Remote sensing	This course introduces field and elementary surveying techniques, systematic of hand specimen collection, study of llandforms structure, lithology, sesedimentary rocksfiefield relationsigneous rockrocks fieldlations, metamorphic rocks field relations, preparation of field reports, geological mapping on small and large scales, typestypes ofles, construction of geologic maps and cross-sections. Definition of Remote Sensing, remote sensing's history, electromagnetic radiation and its interaction with earth, satellite systems, remote sensing imaging systems, remote sensing data types, Image enhancement, applications of remote sensing, remote sensing and GIS in geological mapping and mineral exploration
Geo 608	Sedimentary facies and stratigraphy	Transport and deposition of sediments. Sedimentary textures and structures. Depositional environments and

		facies. Stratigraphy and stratigraphical principles. Practicals consist of the microscopy of sedimentary rocks, interpretation of sedimentary structures, description and interpretation of sedimentary facies in cores, interpretation of graphic sedimentary logs	
Geo 609	Geology of Egypt	Structural and tectonic framework oof EEgypt ArabianNubian shield, geotectonic models, babasement complexin in Egyptgeology of the Eastern Desert, geology of the Western Desert, Geology of Sinai, geolgeology ofoflected areasin in Einyptern Desert- D- Dellta Sea-- Gu Gulffz- - andandNatural disasters and critical Earth phenomena	The main objective of this course is t

			o i n t r o d u c e s t u d e n t s t o t h e u n d e r s t a n d i n g o

			f N a t u r a l D i s a s t e r s a s v i o l e n t d e s t r u c t i v e

			phenonena triggered by the interaction of l

			ong-term geological processes and to eva lua

			te the resulting hazards and risks to human

			life. Special emphasis will be given to ge

			ological hazards natural phenomena or process

			especially becoming a disaster), and ri

			sks magnitude and vulnerability to potentia

			l d e a t h , i n j u r y , o r l o s s o f p r o p e r t y d u e t o

			a g i v e n g e o h a z a r d) . C u r r e n t e n v i r o n m e n t a l

			issues such as threat to the world's human

			population and biodiversity and the cyclic

			recurrence of some of these disasters will

			l be discussed
Geo 611	Environmental geophysics	This course introduces geophysical methods in environmental site assessment, emphasis on sites relevant to toxic waste disposals, contamination, detection and mapping of cavities, near-surface pipes, and hidden harmful objects, geophysical precursors for monitoring earthquakes and volcanic eruptions	
Geo 612	Seismic exploration and data analysis	This course will focus on the seismic expression of structural and stratigraphic geologic features. Course development leads to skills necessary to interpret and generate petroleum prospects using 3D seismic data and well control	
Geo 617	Numerical Linear Algebra I)	The LU decomposition, Cholesky decomposition, the QR decomposition, and the SVD; Iterative methods for solving systems of linear equations using Jacobi method, Gauss-Seidel method, the SOR method, and Conjugate Gradient methods; the linear least-squares problem.	
Geo 627	Graph Theory	Fundamental Concepts of Graphs and Sub-graphs, Directed Graphs, Trees and Distance, Matching and Factors, Connectivity and Paths, Coloring of Graphs, Independent Sets and Cliques, Planar Graphs, Network Flow Problems.	
Geo 602	Advanced Sedimentary Petrology	Basic concepts, classifications and methodology, clastic and non-clastic sediment, identification of hand-specimen and systematic petrographic study oof various sesedimentary rocks textural and mineralogical evolution of the sedimentary rocks reflecting depositional and burial processes	

Geo 607	Field geology and remote sensing	Relationship to other geological disciplines equipment's and tools planning for field project, mapping projection methods, compass uses, methods and errors clinometer strike and dip measurements, Plane tabling description and theory advantages, disadvantages theodolites equipment and theory advantages and disadvantages GPS description and Uses resolution, controls, exercises on field and surveying tools, and application on geological maps, Radiometric and geometric corrections, digital image analyses, image classifications, earth science applications, environmental applications, survey applications, hydrological applications
Geo 603	Structural Geology	Primary structures of sedimentary and volcanic rocks, bedding planes, joints, folds aand faults rereading ofstrstructural mapsstereographic projprojection oofructural elements Types of scales, construction of geologic maps and cross-sections
Geo 616	Quaternary Geology	Introduction, the quaternary system, historical development of definition and subdivision, terminology, and nomenclature today, sedimentological and petrological characteristics, importance for archaeological sciences, worldwide quaternary climatic) events, the quaternary of Egypt and case studies
Geo 616	Quaternary Geology	Introduction, the quaternary system, historical development of definition and subdivision, terminology, and nomenclature today, sedimentological and petrological characteristics, importance for archaeological sciences, worldwide quaternary climatic) events, the quaternary of Egypt and case studies.
Geo 615	Geology of Egypt	Tectonic framework of Egypt, basement complex in Egypt, geology of selected areas in Egypt Western Desert-Delta-- RedSea- - Gulff Suez- - andnai), geological eras Distribution of Egypt).
Geo 617	Palynology	Introduction, palynological techniques, pollen grains and spores, dino fflagellates, acritarchs chitinogoa, corodonts, microscopic identification of the different palynological texa for age dating and paleoenvironments

Geo 608	Facies Analysis and Depositional Environments	Analysis of sedimentary facies and environments of deposition. The processes, characteristics, and relationships among depositional systems; depositional basin analysis. Principles of sedimentation and modeling. Mechanical, chemogenic and biogenic sedimentation, and diagenetic processes discussed in detail. Emphasis on the study of the recent environments of sediment deposition. The products of sedimentary processes will be related to their analogs in the stratigraphic record
Geo 614	Advanced Stratigraphy	Principles of stratigraphy, including biostratigraphy, magnetostratigraphic, seismic stratigraphy, isotope stratigraphy, subsurface analysis, evolution of sedimentary basins and continental margins. Correlation methods, use of facies models, facies delineation, impact of tectonics and changes in relative sea level on sedimentary record, transgressions and regressions, concept and construction of stratigraphic framework and sequence stratigraphy. Biostratigraphic units: The Biozones, The species as a unit, Stratigraphical record and global rhythm, Trace fossils. Chrono-stratigraphy, seismic stratigraphy, magmeto-stratigraphy, interpreting the stratigraphical records. Interpreting biostratigraphic records and correlations
Geo 613	Invertebrate micropaleontology and micropaleontology	- Macropaleontology: Fossils and fossilization names and classification, phylum Porifera sponges), phylum 395odeling395 Coelenterate), phylum 395odeling moss animals), phylum brachiopod Lampshells), phylum 395odeling, class bivalvia Pelecypoda), class gastropod, class Cephalopoda, class echinoiderma, class crinoidea, phylum arthropoda, phylum hemicordate. - Micropaleontology: Collecting and processing microfossils, classification of microfossils, application of microfossils, the general characters of the foraminifera, variation in the structures of the foraminiferal test, classification of order foraminifera, foraminifera through time

Geo 620	Carbonate Rocks and Evaporite	Carbonate rocks: are a class of sedimentary rocks composed primarily of carbonate minerals, and it concerned with the studying the different classification of carbonate rocks. The two major types are limestone, which is composed of calcite or aragonite different crystal forms of $CaCO_3$), and dolomite rock also known as dolostone), which is composed of mineral dolomite Ca $MgCO_3)_2$). Evaporites: a water-soluble sedimentary mineral deposit that results from concentration and crystallization by evaporation from an aqueous solution. There are two types of 396odeling396 deposits: marine, which can also be described as ocean deposits, and non-marine, which are found in standing bodies of water such as lakes. Evaporites are considered sedimentary rocks and are formed by chemical sediments.it describe 396odeling396396 formation and its marine and non-marine environments
Geo 619	Clastic sedimentary rocks and petroleum:	are composed of fragments, or clasts, of pre-existing minerals and rock. A clast is a fragment of geological detritus, chunks, and smaller grains of rock broken off other rocks by physical weathering. Studying the different types of clastic rocks, composition, classification, and diagenesis process. Explore Sedimentary basins and their hydrocarbon potentialities, basin modeling and geo history, evolving play concepts and analogues and Explores the aspects of sedimentary rocks and sequences that control their potential as sources or reservoirs of hydrocarbons, coal or other resources
Geo 618	Applied Micropaleontolog	application of microfossils, the general characters of the foraminifera, variation in the structures of the foraminiferal test, classification of order foraminifera, foraminifera through time. Including nano fossils and its applications
Geo 603	Advanced structural geology	The course examines the deformation of the earth´s lithosphere. The course aims to elucidate advanced theoretical aspects of rock deformation. Besides the quantitative aspects of stress and strain analyses, the broad spectrum of deformation complexities in contractional, extensional and strike-slip regimes at various scales are discussed. The course provides an in-

		depth understanding of the rheological properties of the lithosphere, including brittle and plastic deformation processes at the micro scale. A focus is also given to the deformation behavior of ice.
Geo 609	Geology of Egypt	Structural and tectonic framework of Egypt, Arabian-Nubian shield, geotectonic models, basement complex in Egypt, geology of the Eastern Desert, geology of the Western Desert, Geology of Sinai, geology of selected areas in Egypt Western Desert- Delta- Red Sea- Gulf of Suez- and Sinai), geological eras Distribution of Egypt), ore deposits in Egypt
Geo 621	Advanced mineralogy	Chemical and Physical Fundamentals: atoms; ions; periodic table; bonding crystallization; crystal imperfections defects, zoning, twinning); crystal precipitation; mineral classification schemes; physical properties of minerals appearance, crystal shape, strength, density, magnetism, reaction with acid); polarized light; refractive index; uniaxial and biaxial indicatrices; interference figures. Rock-forming minerals: Igneous minerals silicates); phase relations; Sedimentary minerals; Metamorphic minerals; textures, reactions; phase equilibria and thermodynamics; Economic minerals. Symmetry, Crystallography, and Atomic Structure: symmetry; stereo diagrams; forms and crystal morphology; unit cells and lattices in two dimensions and three dimensions; Bravais lattices; unit cell symmetry and crystal symmetry; crystal structures; crystal habit and crystal faces; X-ray diffraction; ionic radii; coordination number; Pauling's rules; silicate structures; substitutions; structures of nonsilicates
Geo 622	Advanced Igneous and metamorphic petrology	An introduction to a basic understanding of the formative processes of igneous and metamorphic rocks through quantitative applications of simple physical and chemical principles. The course encourages a deeper comprehension of the subject by explaining the petrologic principles rather than simply presenting the student with petrologic facts and terminology. Assuming knowledge of only introductory college-level courses in physics, chemistry, and calculus, it lucidly outlines mathematical derivations fully and at an elementary level, and is ideal for intermediate and advanced courses in igneous and metamorphic petrology. They also

		introduce several widely used thermodynamic software programs for calculating igneous and metamorphic phase equilibria and image analysis software. Contains valuable new material on the structure of the Earth's mantle and core, the properties and behavior of magmas, recent results from satellite imaging, and more
Geo 623	Advanced geochemistry	Introduction; What is geochemistry? The zonal structure and chemical composition of the earth. Major and minor discontinuities. Internal part of the earth; Structure, geochemistry and evolution of the crust, mantle and core, Mantle geochemical reservoirs, mantle plume reservoirs. External part of the earth; Structure, geochemistry and evolution of the atmosphere, Geochemistry of the hydrosphere and biosphere. Primary differentiation of elements Major elements; Trace elements, Geochemical classification of elements, Applied geochemistry; in the field of agriculture, public health, marine, petroleum production, geochronology, environment, geologic mapping and mineral exploration. Analytical techniques in geochemistry; Concepts and instrumentation of: AAS, ICP-AES, XRF, XRD and microprobe. Practical with AAS and XRF
Geo 624	Mining Geology	Introduction, advanced knowledge of selected ore deposit types, mining process, mining methods, exploration technology, surveying, and computer applications for mining operations and mineral explorations. Surface mining quarrying, open cast, open pit), underground mines cut-and-fill method, shrinkage stopping method, block caving, sublevel open stopping, sublevel caving, room-and-pillar method, long wall mining), stages in the life of a mine, ore resource estimation, environmental and social impacts of mining
Geo 607	Field geology and Remote sensing	This course introduces field and elementary surveying techniques, systematic of hand specimen collection, study of land forms, structure, lithology, sedimentary rocks field relations, igneous rocks field relations, metamorphic rocks field relations, preparation of field reports, geological mapping on small and large scales, types of scales, construction of geologic maps and cross-sections. Definition of Remote Sensing, remote sensing's history, electromagnetic radiation and its interaction with earth, satellite systems, remote sensing imaging systems, remote sensing data types, Image enhancement,

		applications of remote sensing, remote sensing and GIS in geological mapping and mineral exploration.
Geo 625	Advanced Economic geology	Introduction, developing skills in analyzing and classifying ore and hydrothermal alteration samples using transmitted and reflected light microscope. Ore deposits, preparation of polished samples, mineral identification, ore mineral textures, paragenesis and paragenetic sequences, ore mineral assemblages, genetic models of ore deposits, industrial materials, ornamental stones, nonmetallic deposits in Egypt: phosphorites, coal, black shales, limestones, glass sand, basement rocks, among others, economic prospects, ore resource estimation
Geo 626	Advanced Geochemical Exploration	Introduction to the fundamental concepts and processes relating to geochemistry of surface environment with applications exploration geochemistry. It provides an introduction to the design, interpretation of results from geochemical surveys and their use in fields ranging from environmental management to mineral exploration. , sampling techniques, geochemical exploration, geochemistry of selected groups of elements, geochemistry of ore deposits metallic or non-metallic), geochemical data processing and geochemical mapping, data interpretation and modelling, isotopes geochemistry, dating calculation, exercises and problems, ore resource estimation
Geo 627	Environmental geology and geochemistry	Introduction; Hazardous Earth Processes Volcanism; Earthquakes; Landslides and Related Phenomena; Subsidence; River Flooding); Soil Resources; geochemistry of soil solids; agricultural contaminants and Treatment; Water Supply and Use; Solid Waste Management; Heavy metals in ground and surface waters, both natural and non-natural distributions; Hazardous Chemical Waste Management; Radioactive Waste Management; Aquatic Microbial Biochemistry, ecological factors, pollutant toxicity; Organic molecules in nature; Organic contaminants in ground water: sources, sinks, remediation techniques; Drinking water and Sewage Water Treatment; The Earth's Atmosphere; The global carbon cycle; atmospheric carbon dioxide and other greenhouse gases; Global Climate: Past, Present and Future; Global Warming; Ozone; Acid Rain; Urban Air

		Pollution; Land Use; Environmental Law; Energy, technology and resources.
Geo 628	Advanced tectonic geology	Introduction; principles of plate tectonics; the development of tectonic theory; seafloor spreading; continental rifting; oceanic crust recycling centers; subduction zones and arc complexes; the rising mantle leachate; arc complexes; sweeping the oceans; suspect and exotic terranes; closing the ocean basin and welding continents; collision zones; slip-sliding away; the character of continental transforms; effect of plate tectonics on the history of life; early forms of tectonism; Pangea, Gondwana land and the supercontinent hypothesis; driving forces
Geo 629	Isotope geology	Introduction to nucleosynthesis, Distribution of elements in the Solar System, Fundamentals of radioactive decay and growth, Geochronometry; Mass spectrometry: Techniques and Applications, K-Ar and Ar-Ar methods of dating and their applications, Rb-Sr and Sm-Nd methods of dating and their applications, Re-Os and Lu-Hf methods of dating and their applications, U-Th-Pb geochronology, Isotope Geology of Pb, Processing and presentation of raw isotope geochemical data, Application of Sr, Nd, Pb and Hf isotopes in petrogenetic studies, Fission Track method of dating; U-disequilibrium methods of dating, Cosmogenic radionuclides and their applications, Extinct radionuclides and cosmo-chronology.
Gph 601	Advanced seismicity	Seismic methods in relation to the other geophysical methods, role of seismic methods in hydrocarbon , water & mining explorations, seismic methods refraction and reflection), theoretical background Basic elasticity theory , elementary wave propagation theory , types of seismic waves and noises , seismic velocities , seismic refraction method, seismic refraction along horizontal and dipping layers, refraction data acquisition refraction data corrections, seismic velocities , seismic reflection method seismic reflection along horizontal and dipping layers , reflection data acquisition , reflection data corrections , seismic stratigraphy and seismo – tectonics).
Gph 602	Earthquake seismology	Seismicity and its causes in the context of plate tectonics, determination of earthquake location, size and focal parameters, seismogram interpretation, seismometry,

		hazard potential, use of earthquakes in determining earth structure
Gph 603	Advanced acquisition and interpretation of geophysics methods	The overall objective of the course is to study Introduction, Basic concepts, Earth's Gravity field, Gravity anomalies, acquisition of Gravity data gravity Instruments, Gravity surveys, corrections of gravity Data elevation correction, terrain correction, drift), interpretation of gravity data qualitative and quantitative interpretations). Rock magnetism, Geomagnetic field, magnetic anomalies, acquisition of magnetic data magnetic surveying instruments, ground magnetic surveys, aeromagnetic and marine surveys, corrections of magnetic data normal correction, diurnal correction, elevation and terrain corrections, interpretation of magnetic data qualitative interpretation, quantitative interpretation, ambiguity of magnetic interpretation. Electrical properties of rocks and minerals and their determinations, fundamentals of direct current flow, relationship between point and line pole potential distribution, by Electrical and Electromagnetic methods, EM systems for ground survey frequency domain 119 system, dip angle measurements, time domain), airborne EM survey, EM field procedure and interpretation procedure, field examples.
Gph 604	Seismic data processing	Digitize analogue signal graphical method choosing different sampling intervals, plotting the digitized record and examining the aliasing phenomenon), convolving the two signals wavelets), plot and examine the results, autocorrelation and cross-correlation functions for a given data set, plot and examine the results, digital filtering after designing a low, high and band pass 111 filters and to examine the effects of truncation, computation of the amplitude, phase and power spectra of a given time series, application of Wiener inverse filtering to seismic data, comment on wavelet extraction problems
Gph 605	Petrophysics and well logging	Definition of a well – log, importance of well – logs, logging techniques and measurements, classification of log measurements, problems specific to well log measurements, logging equipment's surface and downhole), log presentation, origin of SP curve. Static SP, pseudo – SP, factors influencing in the shapes and amplitude of SP peaks, Geology and the SP log.

		Applications, resistivity logs, classification of resistivity logs. Geological factors which influence resistivity. Environmental corrections of resistivity logs, applications, natural gamma ray log GR origin of natural radioactivity in rocks, minerals and rock containing radioactive elements factors affecting the gamma ray responses. Applications natural gamma ray spectrometry NGS), definition, tools descriptions, computation of the U, Th and K content Applications, neutron logs N), principles, neutron logs environmental effects, geological factors affecting the hydrogen index applications, formation density log FDC), applications, sonic logs BHC) Principles. Factors influencing the measurements, environmental corrections and other factors, applications, thermal decay time TDT), principles, tools, factors influencing the measurements. Environmental effects. Geological factors affecting on measurements, applications. Well log interpretation, qualitative and quantitative interpretation of well logs porosity determination, permeability determination Saturation determination. Lithology identification.
Gph 606	Archaeological prospecting and groundwater	The nature of matter, Soils and Chemical Prospection, Site Evaluation Strategies, Electrical Methods of Survey, Magnetic and Electromagnetic Methods of Survey, Treatment, Display and Interpretation of Field Data
Gph 607	Spectrometry method and geothermal	This method is studied to investigate the distribution of the three radio elements, K%, eU, and e Th, as well as the total count radiation. These data are subjected to many processes including the statistical treatment where the environmental effect as dose rate is calculated, which is one of our main targets in this course and help to remapping of different rock units and determining of radiogenic heat
Gph 608	Seismic properties of structure geology	The overall objective of the course is to understand the seismic expression of structures in petroleum basins, and correctly apply structural models and techniques to seismic interpretation
Gph 609	Paleomagnetism	Fundamental principles of rock magnetism, paleo-magnetism, and geomagnetism and its applications to geology and geophysics, the origin and behavior of the geomagnetic field, physical and chemical basis of paleomagnetism; physics of magnetism as it applies to rocks and minerals, origin of remnant magnetization;

		mineralogy of magnetic minerals; paleomagnetic measurement techniques, magneto-stratigraphy; geodynamics, environmental magnetism; and bio-geomagnetism. The course is suitable for undergraduate juniors and seniors and graduate students in physics, geophysics, geochemistry, mineralogy-petrology, and quaternary studies who want a basic understanding of paleomagnetism and its potential applications to the Earth Sciences
Gph 610	Advanced marine geophysics	Ocean and Seas Classification, growth and decline of ocean basins, turbidity currents, submarine sedimentation and stratigraphy, physiography and divisions of the sea floor, continental shelves, slopes, aprons and abyssal planes, occurrence of mineral deposits and hydrocarbon in offshore), seismic Surveys : Marine energy sources, Finger, Boomer, Sparker, exploder, air gun, vapor cook etc. hydrophones active section and streamer towing gear, shooting methods near offshore and offshore exploration techniques, recording of signals by digital system, analysis of seismic data their processing and interpretations, refraction survey with Son buoy's and interpretation, radio Positioning System : Short range and long range Doppler Sonar, satellite navigation, GPS and GIS
Gph 612	Seismic stratigraphy	Overview of seismic data acquisition and processing methods, seismic wavelets, static and dynamic corrections, and seismic velocities; seismic reflection data interpretation; seismic reflection responses; seismic mapping; seismic stratigraphy and seismic lithology, consent required.
Gph 613	Seismic reservoir	Elastic wave propagation and Petro-acoustic relations, principle geophysical methods for characterizing oil and gas reservoirs, mapping of elastic properties from post-stack and pre-stack seismic data,, integration of well information with seismic data in order to extract petrophysical properties, flow of reservoir characterization from a geophysical point of view; Amplitude Versus Offset – Amplitude Versus Angle) importance of anomalies according to different contexts, in relation to the petrophysical data), post-stack and pre-stack seismic inversion, 4D/monitoring seismic, and analysis of seismic attributes qualitative and quantitative approaches).

Geo 701	Structural geology	Primary structures of sedimentary rocks bedding planes, ripple marks, graded bedding, cross bedding, unconformities), secondary structures of igneous and metamorphic rocks joints, folds, faults), reading of structural maps, stereographic projection of structural elements, extensional tectonics and applications, compressional tectonics and applications, wrench tectonics and applications, inversion tectonics and applications
Geo 702	Advanced engineering geology	Advanced engineering geology focused on engineering practice. Interpretation of in-situ testing and laboratory test data the topics covered include, but are not limited to, design and analysis of site investigation, advanced core logging, slope stability analysis, rock fall assessment, introduction to numerical modeling, liquefaction and seismic hazard assessment for engineering design
Geo 703	Advanced petroleum geology	This course introduces evolution of petroleum, composition of hydrocarbon, origin, diagenesis and maturation of organic matter, source rocks, reservoir rocks, migration, petroleum trap definition, components, trap types, traps mechanism, commercial accumulations and critical risk, basin modeling, exploration techniques, sedimentary basins and their hydrocarbon potentialities, main hydrocarbon provinces in Egypt
Geo 704	Well Logging and Formation Evaluation	This course deals with Well logging and Formation evaluation – Temperature tool- Electric tools- Porosity tools –Lithology tools – Caliper tool-SP and Gamma Ray tools- Petrophysical parameters volume of shale- porosity- permeability- water and hydrocarbon saturations) Mud logging – Core analysis – Risk analyses – reserve calculation.
Geo 705	Advanced mining geology	During the course, students work with various aspects in the value chain of mining projects and advanced exploration projects, from 404odeling mineral resources from geological data before mining, to the process of converting mineral resources to mineral reserves by applying modifying factors, to the mining geological methods used for further characterization and evaluation of deposits in connection with mining
Geo 701	Structural Geology	Primary structures of sedimentary rocks bedding planes, ripple marks, graded bedding, cross bedding,

		unconformities), secondary structures of igneous and metamorphic rocks joints, folds, faults), reading of structural maps, stereographic projection of structural elements, extensional tectonics and applications, compressional tectonics and applications, wrench tectonics and applications, inversion tectonics and applications
Geo 706	Advanced Topography	Relationship to other geological disciplines equipment and tools planning for field project, mapping projection methods, compass uses, methods and errors clinometer strik and dip measurements, Plane tabling description and theory advantages, disadvantages theodolites equipment and theory advantages and disadvantages, GPS description and Uses resolution, controls, exercises on field and surveying tools, and application on geological maps
Geo 707	Advanced Stratigraphy	Biostratigraphic units: The Biozones, the species as a unit, Stratigraphical record and global rhythm, Trace fossils. Chrono-stratigraphy, seismic stratigraphy, magmeto-stratigraphy, interpreting the stratigraphical records. Interpreting biostratigraphic records and correlations
Geo 708	Advanced Marine Geology	Marine environment, physical chemistry of sea water, intertidal environment, estuaries, the seabottom productivity, plant-growth and the pelagic habitats. Study of the biota and lithofacies characters of the different rocks in different environments. Study of different biota events undermicroscope
Geo 709	Advanced Paleontology	Fossils and fossilization names and classification, phylum Porifera sponges), phylum 405odeling405 Coelenterate), phylum 405odeling moss animals), phylum brachiopoda Lampshells), phylummollusca, class bivalvia Pelecypoda), class gastropda, class cephalopda, class echinoidea, classcrinoidea, phylum arthropda, phylum hemicordata. Ostracoda general characteristics and taxonomy), nannofossils general characteristics and taxonomy), principles of paynology: a) Pollen and spores. B) Dinoflagellates. Morphology of theostracod carapase, morphology of the calcareous nannoplanktons,

		morphology of the pollen and spores, morphology of the dinoflagellates
Geo 701	Structural Geology	Primary structures of sedimentary rocks bedding planes, ripple marks, graded bedding, cross bedding, unconformities), secondary structures of igneous and metamorphic rocks joints, folds, faults), reading of structural maps, stereographic projection of structural elements, extensional tectonics and applications, compressional tectonics and applications, wrench tectonics and applications, inversion tectonics and applications
Geo 702	Advanced engineering geology	Advanced engineering geology focused on engineering practice. Interpretation of in-situ testing and laboratory test data the topics covered include, but are not limited to, design and analysis of site investigation, advanced core logging, slope stability analysis, rock fall assessment, introduction to numerical modeling, liquefaction and seismic hazard assessment for engineering design
Geo 705	Advanced mining geology	During the course, students work with various aspects in the value chain of mining projects and advanced exploration projects, from 406odeling mineral resources from geological data before mining, to the process of converting mineral resources to mineral reserves by applying modifying factors, to the mining geological methods used for further characterization and evaluation of deposits in connection with mining
Geo 710	Advanced isotope geology	Introduction to nucleosynthesis, Distribution of elements in the Solar System, Fundamentals of radioactive decay and growth, Geochronometry; Mass spectrometry: Techniques and Applications, K-Ar and Ar-Ar methods of dating and their applications, Rb-Sr and Sm-Nd methods of dating and their applications, Re-Os and Lu-Hf methods of dating and their applications, U-Th-Pb geochronology, Isotope Geology of Pb, Processing and presentation of raw isotope geochemical data, Application of Sr, Nd, Pb and Hf isotopes in petrogenetic studies, Fission Track method of dating; U-disequilibrium methods of dating, Cosmogenic radionuclides and their applications, Extinct radionuclides and cosmo-chronology
Geo 711	Advanced Oraganic geochemistry	An introduction to organic chemistry, focusing primarily on the basic principles to understand the structure and reactivity of organic molecules. Emphasis is on

		substitution and elimination reactions and chemistry of the carbonyl group. The course also provides an introduction to the chemistry of aromatic compounds with the importance of geochemical processes and biogeochemical cycles in the functioning of the Earth system. Students will learn about the history of geochemistry, discover geochemical research methods, interpret geochemical data, and apply simple geochemical models. The module is designed with a focus on Earth's carbon cycle – past, present, and future. Students will also learn how research in geochemistry can be applied to trace, predict, and mitigate future environmental change. Describe the importance of biogeochemical cycles in the oceans and the Earth system Conduct simple geochemical 407odeling. Explain the use of geochemistry in the projection and mitigation of environmental change .Synthesise and evaluate cutting-edge geochemical research
Gph 701	Advanced Potential Field Methods	The course is designed to provide participants with a better overall understanding of when, where and how to use potential field data to the best advantage when exploring both large and small-scale geologic features associated with hydrocarbon systems. The course focuses on methods for interpreting potential field data collected over various types of sedimentary basins e.g., rifts, passive margins and foreland basins), and examines the gravity and magnetic anomalies that are produced from typical geologic structures and lithologies in these basins. Both qualitative and quantitative methods of analysis are presented. The course includes workshop exercises that provide an opportunity for "hands-on" experience of working with data
Gph 702	Seismic data processing	Digitize analogue signal graphical method choosing different sampling intervals, plotting the digitized record and examining the aliasing phenomenon), convolving the two signals wavelets), plot and examine the results, autocorrelation and cross-correlation functions for a given data set, plot and examine the results, digital filtering after designing a low, high and band pass filters and to examine the effects of truncation, computation of the amplitude, phase and power spectra of a given time series, application of Wiener inverse filtering to seismic data, comment on wavelet extraction problems

Gph 703	Seismic Stratigraphy	This course is designed to provide a basic understanding of sequence stratigraphy. Covers the use of seismic reflection data to study lithology, geometry, and depositional history of sedimentary bodies; factors affecting resolution and velocity; and new techniques for identifying lithologies. Integrates current concepts on interaction of tectonics, sea level and sediment supply to generate predictive models for architecture of sedimentary basin fill
Gph 704	Seismic Reservoir	Relations between reservoir parameters and seismic parameters. Requirements for acquisition of time lapse seismic data. Processing of time lapse seismic data. Repeatability and matching. What can change in addition to reservoir changes? Relation between repeated well logs and repeated seismic data. Coupling to fluid flow simulation. Differencing techniques. Use of seabed seismic data for reservoir monitoring. Techniques for time shift estimation and determination of changes in pay thickness. Monitoring of fluid movements. Methods for discrimination between pressure and fluid saturation effects. How to estimate compaction changes in a reservoir. Field examples
Gph 705	Computer Application in Geophysics	Logical Expressions, Loops, Formatted-Unformatted Data Input / Output, Modules, Array Processing, Complex data type, File types and Open, Close statements, Numerical calculations, Precision, Iterations, Basic Applications in Geophysics

Courses Contents

Department of Biochemistry

Code	Course Title	Contents
Bch 501	Biomolecules	Chemical Structure, properties, reactions and function of carbohydrate, amino acids, peptides, proteins, fatty acids & lipids, nucleic acids. Practical periods: Direct application on the theoretical course.
BCh 502	Enzymology	Enzyme classification and nomenclature. Enzyme properties. Mechanism of enzyme action. Kinetics of enzyme catalyzed reactions and the self-regulation of biological processes. Mechanism of inhibition and allosterism and their theories. Reversible and irreversible covalent modification of enzymes. Mechanism of certain enzymes. Ribozymes and Abzymes. Vitamins as coenzymes): structure, occurance, defeciemcy and mechanism of interaction with enzymes. Practical periods: Direct application on the theoretical course.
BCh 503	Hormones	Mediators of hormonal action, classification of hormones. General mechanism of hormonal action. Pituitary and hypothalamic hormones. Pineal gland hormone. Thyroid hormones. Hormones that regulate calcium metabolism. Hormones of the adrenal cortex. Hormones of the adrenal medulla. Hormones of the gonads. Pancreatic Hormones Non-endocrine hormones).
BCh 504	Cancer biology	Cellular and molecular basis of cancer. Genes implicated in tumor development and their mechanisms of action in normal cell growth and differentiation. Cell cycle and its regulation, modulation of cell death, apoptosis. Omics-based platforms of cancer diagnosis.
BCh 505	Histology & Immunohistoch-emistry	Cell Structure and the microscopic anatomy of tissues. Fixation technique of tissues. Different staining of cells as hematoxylene and Eosin, Trichrome) & Using of different antibodies in determination of immunological paramaters. Practical periods: Direct application on the theoretical course.
BCh 506	Metabolism & Genetic Disorders	Study some errors that is occurred during metabolism of food & their relationship with some genetic diseases. The role of genetic mutation in induction of many diseases. Study of some diseases produced from defects in metabolism of some amino acids.
BCh 507	Hematology & parasitology	Studying the basis of hematology types of blood cells, blood and bone marrow films). Classification of parasites of medical importance. Identification of fecal, urinary, sputum & blood parasites. Investigation of amoebic liver abscess. Diagnosis of toxoplasmosis, hydatide disease. Examination of muscle tissue for trichenella larvae. Detection of Drucunclus medinesis.

		Practical periods: Direct application on the theoretical course.
BCh 508	Nanotechnology & Its Bioapplications	Basis of nanotechnology and its applications in biochemistry & in different industrial techniques.
BCh 509	Quality Control	Control the instrument in standard. The design and operation of a quality control program in a clinical laboratory. The action necessary to provide adequate confidence that test results satisfy given requirements and standards. Such areas as statistics, patients preparation, specimen integrity, external proficiency control, internal quality control, analytical goals and laboratory management, and control the hazardous compounds.
BCh 510	Clinical Biochemistry	Samples for biochemical investigation and general quality control assurance. Pre-clinical affecting results. Complete routine analysis. Complete blood picture. Renal functions. Disorders of carbohydrate metabolism. Acid-base balance respiratory aspects and renal aspects). Diagnostic tests for gastrointestinal and liver diseases. Lipids and lipoproteins disorders. Mascocardiac diseases and their measurements. Practical periods: Direct application on the theoretical course.
BCh 511	Forensic biochemistry& Toxicology	Biochemical action of toxicants and assessment of cellular damage by biochemical measurements. Basis concepts in toxicology, history and branches, dose –response curves, statistically defined expression in toxicology, classification of toxicants and their mode of action, mutagens, and carcinogen, phytotoxins, zootoxin and environmental toxicants. Uhlenhuth test and Forensic DNA analysis.
BCh 512	Basis of Immunology	An introduction to modern immnunological theory and practice covering the biology and chemistry of the immune response, including the chemistry, synthesis and biological properties of antibodies structure of antigens and the chemistry of antibody-antigen interactions. Receptor interleukins and associated mediators of immune cell function. Antigen processing and presentation, the major histocompitability complex, autoimmune diseases, hypersensitivity reactions. Immunochemical techniques general principle, production of monoclonal and polyclonal antibodies, immunoelectrophoresis, radioimmunoassay “RIA”, flouroimmunoassay “FIA”, enzyme immunoassay “ELISA”)

BCh 513	Microbiology & Biotechnology	Isolation of chromosome & plasmid DNA. Gel electrophoresis. PCR, DNA-sequencing, restriction enzymes, gene transfer. Genome analysis & gene cloning. DNA finger-print. Production & pharmaceutical of antibiotics. Study techniques used in production of genetically modified organisms included animal, plant or microbes. Preparation of bacterial growth media for studying microorganisms. Preparation of cultures for aerobic & non-aerobic organisms.
BCh 514	Instrumental & analytical methods	Spectrophotometrical analysis, Fluorometry, Thermal analysis, Electrophoresis. Chromatography methods and its applications. Introduction of electrochemistry. Electro-analytical techniques. Potentiometric analysis. Practical periods: Direct application on the theoretical course.
BCh 515	Essay	Selected different topics in biochemistry. Human and animals treatment ethical protocols. Publication Ethical Standards Guidelines and Procedures). Plagiarism art. Basis of scientific writing.
BCh 521	Molecular biology	Central dogma in molecular biology and its verification. Conservative, semi conservative and dispersive mode of DNA replication, Uni and bidirectional DNA replication, discontinuous synthesis of DNA, DNA primers, DNA polymerase I, II & III, DNA ligase, AP endonuclease, Topoisomerases and telomerase. Structure and functions of prokaryotic and eukaryotic RNA polymerase. Biosynthesis of prokaryotic and Eukaryotic m-RNA, r-RNA, and t-RNA. Post transcriptional modifications of RNA- capping, adenylation and splicing. Role of hn RNA, sn RNA and sn RNP in processing of RNA. Inhibitors of Transcription. DNA binding motifs. Composition of Prokaryotic and eukaryotic ribosomes. Polysomes and organelles ribosomes. Protein synthesis-Amino acid activation, protein chain initiation, elongation, and termination. Mechanism of protein synthesis in relation to gene action. Inhibitors of protein synthesis. Post translation modification of proteins. Synthesis of secretary and membrane proteins-signal sequence hypothesis. Mi and Si RNA mediated translation control. DNA repair and recombination. Gene expression models.
BCh 522	Biological Fluids	study of urine, blood, lymph, semin with studying their biological functions and body fluid analysis. chemical and microscopic examination of urine, cerebrospinal fluid, and other body fluids.

BCh 523	Practical Biochemistry 1	Extraction of nucleic acids DNA and RNA): basis and techniques. cDNA biosynthesis. Different techniques of Polymerase chain reaction PCR). Purity and concentration assessment of the isolated nucleic acid techniques.
BCh 524	Practical Biochemistry 2	Protein and nucleic acid gel electrophoresis. Gel documentation by different programs and with instruments.
BCh 530	General aspects of infection control	Definition of infection, Different types of nosocomial infections urinary tract, respiratory, surgical wound and surgical site infections, vascular catheter, septicemia, factors controlling nosocomial infections microbial agents, patients susceptibility, environmental factors). Transmission factors endogenous & exogenous). General Infection control program's surveillance rules.
BCh 531	Sterilization techniques	Definition and requirements. Sterilization types Steam, heat, Chemical). The scientific principles of the synthesis and the usage of normal detergents as soaps) in the body and hand hygiene. The synthesis and the usage of alcohol-based hand sanitizers and the mechanism of its action. Differentiation between standard, airborne, droplet, and contact precautions. Barrier precautions and equipment's sterilization. Practical course: Direct application of the theoretical course.
BCh 532	Immunity and Vaccinations المناعة و التطعيمات	General concepts of human immunology. Principles of Vaccinations. Types of vaccinations. Relation between human immunity and prevention of some communicable diseases.
BCh 533	Microbiology and Infection	General Elements of Microbiology. Role of microbiology in infectious diseases. Virology, bacteriology, mycology, and parasitology. Different microbiological samples. Antibiogram: New Concepts for Interpretation and Utilization.
BCh 534	Disease transmission Chain	Definition of infectious diseases and how do diseases spread. Describe and explain basic biology, including structure, function, genetics, and pathogenesis. Basis of different types of hostparasite relationships, e.g. the importance and evolution of normal flora, viral latency and quasispecies evolution. Principles of active and passive immunization. Examples of chain infections.
BCh 535	Antibiotic Resistance	Emergence and Development of Antibiotic Resistance. Mechanisms of Antibiotic Resistance. Staphylococcal Resistance. Resistance of Gram-Positive & Gram-negative Germs bacteria. Virus and fungal resistance.

BCh 536	Healthcare associated infection	Healthcare associated infection definition. Recognizing how infection presents itself and signs of infection. Common health care–associated infections affecting patients including intravascular catheter related infections, respiratory tract and gastro-infections) with identifying the potential sources of infection. Discussing the standard methods for its preventing and treatment. The standard "Saving Lives–care bundles" to prevent infection and promote good practice. Differences between the Exposure Control Plan and the Post-Exposure Control Plan.
BCh 537	Microbial Metabolomics	Metabolomics definition & importance, the metabolome and metabolic reactions. Applications of metabolomics. Designing a metabolomics study. Overview of complete analysis workflow. Data processing, analysis and interpretation.
BCh 538	Quality of infection Control	Standard precautions list. The proper bag technique & the difference between critical and noncritical equipments. Steps for cleaning a urinary catheter using the boiling and micro-wave methods. Differences between regulated medical waste and home-generated medical waste.
BCh 539	Safety accreditation & Improvement techniques	Improving the quality of processes and maintaining acceptable levels of performance are critical factors in the success of any organization including people management and their performance skills via active learning and hands-on activities, the best accreditation system for the organization. Acquire a solid foundation of the different improvement and evaluation methodologies through mini-project models following FOCUS-PDCA, Six Sigma, or Lean methodologies.
BCh 540	Topics in epidemiology	Selected topics in epidemiology with different examples.
BCh 550	Perfect nutrition principles	Principles of human nutrition. Physiological and psychological factors of food intake and utilization, dietary improvements of groups and individuals. Study of nutrients and of their ingestion, digestion, absorption, transport, storage and excretion. The Dietary Guidelines, Food Exchange System, Recommended Dietary Allowances and other standards as a foundation for food selection. Practical periods: Direct application on the theoretical course.
BCh 551	Nutritional biomolecules metabolism	The energetics of metabolism; the structure and metabolism of proteins, carbohydrates, and lipids; and the integration of metabolic systems. The chemistry of nitrogenous bases on the cellular level.

		Practical periods: Direct application on the theoretical course.
BCh 552	Nutrition in life span & Malnutrition	Nutritional requirements and challenges change throughout the human lifecycle and how alteration in nutritional requirements impact on human health. Investigating the influence of nutrition prior to and during conception. Nutritional requirements during infancy, childhood, adultness, pregnancy, lactation, and in elder people. Nutritional interventions designed to improve human health and well-being at specific age associated time points.
BCh 553	Food fermentation and Probiotics	Food fermentation principles. Functional foods and nutraceuticals, functional fermented foods, bioactive proteins and bioactive peptides, genetically modified foods. D and z-value calculation of common food pathogens, production of antimicrobial substances-bacteriocin, antifungal substances. Gut bacterial flora and how bacteria, associated to man, interact with the host, administration of specific probiotic bacteria could prevent and counteract disease and how probiotic food could be designed. Practical periods: Direct application on the theoretical course.
BCh 554	Nutritional Supplements & Functional Food	Dietary supplements and natural antioxidants as vitamins and minerals and their role in protection of human health against disease as cancer, rheumatoid arthritis and depression. Supplements as alternative or complementary medicine. The use of supplements to enhance physical appearance or improve cognitive functioning. The prophylactic and medicinal properties of many natural foods.
BCh 555	Analysis & Quality of Food	Introduction to analysis methods. Moisture and ash estimation. Total carbohydrate, lipid and protein determination. Nitrogenous non-proteinic compounds estimation. Dairy products analysis. Practical periods: Direct application on the theoretical course.
BCh 556	Genetic Metabolic Disorders	Study some errors occurred during metabolism of food & their relationship with some genetic diseases. The role of genetic mutation in induction of many diseases. Study of some diseases produced from defects in metabolism. .
BCh 557	Nutritional Natural Product Extraction	Sources of crude drug. Various methods of extraction and isolation of phytopharmaceuticals: infusion, decoction, maceration, percolation, hot continuous extraction, successive solvent extraction, supercritical fluid extraction, steam distillation, counter-current extraction, ultrasound sonication). Phytochemical screening: alkaloids, saponins, flavonoids,

		polyphenols, tannins, cynogenetic glycosides and amino acids in plant extract. Practical periods: Direct application on the theoretical course.
BCh 558	Therapeutic Nutrition	Care of individuals with pathologies caused by or causing nutritional impairments or disorders. The relation between diet and the management of some chronic diseases as hypertension, diabetes, osteoporosis, hepatic disorders, renal disorders, and cardiovascular diseases.
BCh 601	Nutritional Biochemistry	An overview of nutrition, food choice, obesity and diet planning diets, diet and health, functional foods, antioxidants, food drugs interactions, genetically modified food. Practical periods: Direct application on the theoretical course.
BCh 602	Immunology	Mechanisms of immune recognition by the innate and acquired immune system and how failures of these responses can lead to disease. The course will demonstrate how failures of the immune system can lead to conditions such as allergies, hypersensitivity reactions, and autoimmunity, and how bacterial and viral pathogens can evade the immune system in order to cause disease.
BCh 603	Cancer at molecular Biology	Eukaryotic cell division cycle, molecular mechanisms regulating the passage of cells through restriction points ,the roles of cyclins, cyclin-dependent kinases, phosphatases and inhibitors of cyclin-dependent kinases, cell cycle. Apoptosis, autophagy and oncogenesis. Biochemical basis of protein structure, mechanisms involved in folding and unfolding of proteins, misfolding in disease. The importance of how nucleotide metabolism has led to the development of different chemotherapeutic approaches to the treatment of cancer.
BCh 604	Enzymology & Its Applications	Enzymes-binding interactions directed to non- reacting parts of substrate molecules to catalyze the chemical transformations of the reacting parts of substrates. Subject include: Transition state theory, Enzyme mechanism and kinetics, Enzyme regulation and medical and pharmaceutical application of enzymes. Practical periods: Direct application on the theoretical course.
BCh 605	Advanced Clinical Biochemistry	The outline of the biochemical mechanisms for controlling different pathways under different physiological and nutritional conditions and the importance of diseases arising from defects in these pathways. Particular emphasis will be placed upon the etiology, symptoms and treatment of diseases such as Type I and II diabetes mellitus; atherosclerosis and other lipid disorders and inborn errors of carbohydrate and

		amino metabolism. Liver and kidney disorders. Practical periods: Direct application on the theoretical course.
BCh 606	Cell Signaling & Endocrinology	Discussion on general mechanisms for activation of protein kinases in cascades. Subjects include: the roles of membrane rafts and caveolae in signaling pathways, including the activities of A Kinase. Endocrine systems and regulation of metabolism, reproduction, growth and developement. Hypothalamo/pituitary axis and its integration with the adrenal, thyroid, Parathyroid, ovary, testis. The control of salt balance, pancreatic control of carbohydrate metabolism, and the control of growth.
BCh 607	Biostatistics	Application of the law of statistics in biochemistry researches. Subjects include: experimental design, describing and summarizing the data, estimation and hypothesis tests, the analysis of variance, analysis of regression and correlation and the analysis of categorical data.
BCh 608	Immunohistochemistry	Cell Structure and the microscopic anatomy of tissues. Fixation technique of tissues. Different staining of cells as hematoxylene and Eosin, Trichrome) & Using of different antibodies in determination of immunological paramaters. Practical periods: Direct application on the theoretical course.
BCh 609	Natural Products	Chemistry, classification and biological function of: alkaloids, terpenoids and carotenoids. Bacterial toxins and mycotoxins. Anthocyanins and its applications in biochemistry. Practical periods: Direct application on the theoretical course.
BCh 610	Biochemical Toxicology	The biochemical basis of toxicity. Basis concepts in toxicology, history and branches, dose –response curves, statistically defined expression in toxicology, classification of toxicants and their mode of action, mutagens, and carcinogen, phytotoxins, zootoxin and environmental toxicants.
BCh 611	Advanced Selected Topics in Biochemistry	Selected topics in different branches in biochemistry.
BCh 612	Molecular Biology & Genetic Engineering	Experimental methods in developmental biology. Mutational dissection and recombinant DNA methodology in genetic analysis. Mechanisms involved in the development of spatial patterns, and cellular fate restrictions in embryogenesis. Cell proliferation and differentiation, analysis, metamorphosis, and communication between cells.

BCh 613	Instrumental analysis & Biomedical Screening	The basic and modern techniques in the field of practical biochemistry. Subjects include: basic and modern techniques for the isolation, purification and characterization of biological molecules. Different instrumental and scanning techniques.
BCh 701	Nanotechnology in Biochemistry	Introduction in basis of nanotechnology. Applications of nanotechnology in different diseases such as cancer diagnosis and treatment.
BCh 702	Stem Cells & Tissue Culture	Introduction in different types tissue culture techniques, media and dyes. Stem cell types, separation, differentiation, and its applications in different diseases.
BCh 703	Cancer Diagnosis & Treatment	Different techniques of cancer diagnosis invasive, noninvasive). Omics-based techniques genomics, epigenomics, proteomics, metabolmics). Usage of mi-RNA in cancer diagnosis and treatment.
BCh 704	Immunohistochemistry Advanced	Clinical aspects of different tissues histology. Fixation technique of tissues. Different staining of cells as hematoxylene and Eosin, Trichrome) & Using of different antibodies in determination of immunological parameters.
BCh 705	Body Fluids & Clinical Biochemistry	Hematolgy. Seminal fluid analysis. Sputum analysis. Cerebrospinal fluid analysis. Calculi analysis. Homeostasis mechanisms of the endocrine organs and their pathophysiology. Tumor markers. Amniotic fluid and examples of inborn errors of metabolism and their measurments. Autoimmune diseases investigations.
BCh 706	Metabolism & genetic disorders	Description of the mechanism of metabolic regulation. Subject include: Regulation of Carbohydrate, Lipid and protein. Hormonal action of metabolic control. Regulation of metabolism in starvation and obesity.
BCh 707	Cell Signaling	The membrane in signaling, general signaling mechanisms, signaling in the nervous system, electrophysiology and bioelectric potentials. Signaling in the nervous system-channels. G-protein signaling, G-protein coupled receptors signaling, nitric oxide, sensory transduction in prokaryotes and eukaryotic microbes. Cytokine receptors and tyrosinekinas, chemoreception in eukaryotes, chemoreception in prokaryotes. Sensory transduction. Developmental signaling, development in Drosophila eye, JAK/STAT signaling, retinoic and steroid hormones, growth factors, apoptosis for signaling,

		vesicle targeting, ptotein signaling in exocytes and endocytes, abnormal signaling in cancer.
BCh 708	Endocrinology	Hormones and Growth factors. The endocrine system and mechanism of hormone and growth factor action with emphasis on receptors and signal transduction.
BCh 709	Bioinformatics	Introduction in a core number of biological databases and bioinformatics tools, and utilizing these data to answer biological questions. Computational applications in nucleic acid and protein sequences, analysis of mass protein fragments.
BCh 710	Advanced Selected Topics in Biochemistry	Selected topics in different branches in biochemistry.
BCh 711	Advanced Biostatics	Application of the law of statistics in biochemistry researches. Subjects include: experimental design, describing and summarizing the data, estimation and hypothesis tests, the analysis of variance, analysis of regression and correlation and the analysis of categorical data. Usage of different statistical programs.