The protocol of postgraduate studies
Faculty of Science – Cairo University

The presented protocol is considered as a development of the former regulations in the following aspects.

1. The identification of a number of regulatory articles including 57 articles distributed among 5 parts.
2. The introduction of new diplomas in some applied fields considered to be important for scientists.
3. Development of the list of curricula through additional new courses.
4. Avoidance of problems related to the application of the former protocol, particularly in registration, examination and award.
5. Development of the conclusive examination system for Ph. D. students to become more appropriate for the distinguished scientific level of this degree.
6. Adoption of the credit hour system (CHS) in studying programs.

Table (1). Diplomas awarded by the university, as required from the Faculty.

Department Name & Code	Specializations	Specialization Code
Physics (P)	1- Nuclear Reactors	(PNR)
	2- Radiation Physics	(PR)
	3- Solar Energy	(PSE)
	4- Material Science	(PM)
	5- Computational Physics	(PC)
Chemistry (C)	1- Analytical Chemistry	(CA)
	2- Applied Organic Chemistry	(CAO)
	3- Biochemistry	(CB)
	4- Electrochemistry	(CE)
Botany (B)	1- Applied Microbiology	(BA)
	2- Bacteriology	(BB)
Zoology (Z)	1- Enviromental Sciences	(ZE)
	2 - Invertebrates and Parasitology	(ZIP)
	3- Applied Bioscience	(ZBS)
Geology (G)	1- Ore and Mineral Exploration	(GO)
	2- Environmental Geology	(GE)
	3- Geological applications in Archaeological Site Restoration	(GGA)
	4- Geoinformatics in Earth and Environmental Sciences	(GGI)
	5- Petroleum Geology	(GP)
	6- Hydrogeology	(GH)
	7- Engineering Geology	(GEG)
Astronomy & Meteorology (A)	1- Space Physics	(ASP)
	2- Space Dynamics	(ASD)
	3- Meteorology	(AMT)
	4- Air Pollution	(AA)
Entomology (E)	1- Medical Insects	(EM)
	2- Insect Environmental Informatics	(EEI)
Geophysics (GP)	1- Applied Geophysics	(GPA)
Biophysics (BP)	1- Health Biophysics	(BPH)

Table (2). M. Sc. Degrees awarded by the university, as required from the Faculty.

Department Name & Code	Specializations	Specialization Code
Mathematics (M)	1- Pure Mathematics	(MP)
	2- Classical Applied Mathematics	(MC)
	3- Modern applied Mathematics	(MM)
	4- Statistical Mathematics	(MS)
	5- Computational Sciences.	(MCS)
Physics (P)	1- Theoretical Physics	(PT)
	2- Nuclear Physics	(PN)
	3- Solid State Physics	(PS)
	4- Experimental Physics	(PE)
Chemistry (C)	1- Inorganic Chemistry	(CI)
	2- Physical Chemistry	(CP)
	3- Analytical Chemistry	(CA)
	4- Organic Chemistry	(CO)
	5- Biochemistry	(CB)
	6- Biotechnology	(CBIO)
Botany (B)	1- Phycology	(BP)
	2- Microbiology	(BM)
	3- Plant Ecology	(BE)
	4- Plant Physiology	(BPP)
	5- Flora and Taxonomy	(BFT)
	6- Cytology and Genetics	(BCG)
Zoology (Z)	1- Molecular and integrated physiology	(ZMP)
	2- Invertebrates and Parasitology	(ZIP)
	3- Immunology	(ZI)
	4- Animal Ecology	(ZAE)
	5-Cell Biology, Histology and Genetics	(ZC)
	6- Comparative Anatomy and Embryology	(ZCA)
Geology (G)	1- Structure Geology and Tectonics	(GS)
	2- Stratigraphy and Paleontology	(GSP)
	3- Environmental Geology	(GE)
	4- Petroleum Geology	(GP)
	5- Sedimentary and Sedimentation Geology	(GSG)
	6- Mineralogy, Petrology and Ore Deposites	(GM)
	7- Engineering Geology	(GEG)
	8- Geochemistry	(GG)
	9- Hydrogeology	(GH)
Astronomy & Meteorology (A)	1- Space Physics	(AS P)
	2- Space Dynamics	(ASD)
	3- Meteorology	(AMT)
	4- Mathematical Astronomy	(AM)
	5- Astrophysics	(A AP)

Entomology (E)	**1- Insect Ecology**	**(EE)**
	2- Medical and Vetrinary insects	**(EM)**
	3- Insect control	**(EC)**
	4- Insect Physiology and Cell Biology	**(EPC)**
	5- Insect structure and Growth Biology	**(ES)**
	6- Insect Biochemistry and Molecular Sciences	**(EB)**
	7- Insect Taxonomy and Classification	**(ET)**
Geophysics (GP)	**1- Geophysics**	**(GPGP)**
Biophysics (BP)	**1- Medical Biophysics**	**(BPM)**
	2- Molecular Biophysics -	**(BPMO)**
	3- Environmental Biophysics	**(BPE)**

Table (3). Ph. D. Degrees awarded by the university, as required from the Faculty.

Department Name & Code	Specializations	Specialization Code
Mathematics (M)	**1- Pure Mathematics**	**(MP)**
	2- Classical Applied Mathematics	**(MC)**
	3- Modern applied Mathematics	**(MM)**
	4- Statistical Mathematics	**(MS)**
	5- Computational Sciences.	**(MCS)**
Physics (P)	**1- Theoretical Physics**	**(PT)**
	2- Nuclear Physics	**(PN)**
	3- Solid State Physics	**(PS)**
	4- Experimental Physics	**(PE)**
Chemistry (C)	**1- Inorganic Chemistry**	**(CI)**
	2- Physical Chemistry	**(CP)**
	3- Analytical Chemistry	**(CA)**
	4- Organic Chemistry	**(CO)**
	5- Biochemistry	**(CB)**
Botany (B)	**1- Phycology**	**(BP)**
	2- Microbiology	**(BM)**
	3- Plant Ecology	**(BPE)**
	4- Plant Physiology	**(BPP)**
	5- Flora and Taxonomy	**(BFT)**
	6- Cytology and Genetics	**(BCG)**
Zoology (Z)	**1 - Molecular and Integrated Physiology**	**(ZMP)**
	2- Invertebrates and Parasitology	**(ZIP)**
	3- Immunology	**(ZI)**
	4- Animal Ecology	**(ZAE)**
	5- Cell Biology, Histology and Genetics	**(ZC)**
	6- Comparative Anatomy & Embryology	**(ZCA)**

Geology (G)	**1- Structure Geology and Tectonic**	**(GS)**
	2- Stratigraphy and Paleontology	**(GSP)**
	3- Environmental Geology	**(GE)**
	4- Petroleum Geology	**(GP)**
	5- Sedimentary and Sedimentation Geology	**(GSG)**
	6- Mineralogy, Petrology and Ore Deposites	**((GM)**
	7- Engineering Geology	**(GEG)**
	8- Geochemistry	**(GG)**
	9- Hydrogeology	**(GH)**
Astronomy & Meteorology (A)	**1- Space Sciences**	**(AS)**
	2- Meteorology	**(AMT)**
	3- Mathematical Astronomy	**(AM)**
	4- Astrophysics	**(A AP)**
Entomology (E)	**1- Insect Ecology**	**(EE)**
	2- Medical and Vetrinary insects	**(EM)**
	3- Insect control	**(EC)**
	4- Insect Physiology and Cell Biology	**(EPC)**
	5- Insect structure and Growth Biology	**(ES)**
	6- Insect Biochemistry and Molecular Sciences	**(EB)**
	7- Insect Taxonomy and Classification	**(ET)**
Geophysics (GP)	**1- Geophysics**	**(GPGP)**
Biophysics (BP)	**1- Medical Biophysics**	**(BPM)**
	2- Molecular Biophysics	**(BPMO)**
	3- Environmental Biophysics	**(BPE)**

The regulations include the following entries:

I. General rules including the articles regulating matriculation, registration, examinations and award
II. Diploma of postgraduate studies
III. Master Degree
IV. Doctor of Philosophy Degree
V. Doctor of Science Degree
VI. List of curricula
VII. Syllabi of the curricula

I. General rules

Article (1): The academic year

The academic year of postgraduate studies starts in October and lasts for 30 weeks (study and exams) in 2 semesters, interrupted by a mid-year vacation of 2 weeks, as determined by the faculty board.

Article (2): Admission calendar

a. Application forms for the admission for diplomas and masters are presented once per year, during July, to the faculty administration of postgraduate studies. Results of acceptance will be announced in September after the fulfillment of all documents and payment of fees. The first semester begins in October and the second in February.

b- For foreign students, matriculation requests are submitted to the faculty during November for the first semester and during March for the second semester as a preliminary step for the necessary procedures of registration.

Article (3): Registration terms

a. Approval of the concerned department and Faculty boards.
b. Fulfillment of all documents required by the administration of postgraduate studies.
c. Payment of the fees.
d. Administrators, assistant lecturers and scholarship holders are exempted from fees.
e. The board of the concerned department may add other conditions as necessary for the matriculation of new students, and may as well determine the number of students according to the available capacity of the department and the faculty.

Article (4): Suspended registration

According to suggestions of the concerned department board and the Committee of Postgraduate Studies and Research (CPSR), the faculty board may suspend the registration of the postgraduate student (Diploma - M. Sc. - Ph. D.) for periods not longer, in their total sum, than 24 months. This suspension is applicable only for the following not the preceding years, and must take place in the proper duration of the study, not in the registration extension periods in the following cases:

a. Military service: The student has to apply for suspension for the duration of his military service, and should submit the required documents within the first 3 months of the period.
b. Traveling abroad in an official mission or for a vacation: The student should apply for suspension before traveling or within the first month of his leave; this should be supported by the documents proving the necessity of traveling. These documents are necessary for the final decision of suspension.
c. Sickness leave: The student should apply for suspension for medical reasons, supporting his request by an endorsed certificate from the medical administration of the university, specifying his sickness. The leave should not be less than one month.
d. Delivery and maternal leave: The student should support her suspension request for delivery and maternal reasons with the birth certificate of the born child.

Other cases may be accepted by CPSR and approved by the faculty board.

Article (5): Withdrawal (revocation)

The faculty board may accept the request for revocation presented by the student after the approval of the CPSR, the board of the concerned department and the supervisors.

The faculty board may accept the request for revocation presented by supervisor.

Article (6): Residential requirements

Foreign students must submit what proves their residency in Egypt for at least two academic years.

Article (7): Attendance

The student will be deprived from attending the examination of courses, in which his attendance was less than 75%. This deprivation is based on a report of tutor of these courses and notification of the department board followed by the approval of the CPSR and the faculty board. In this case, the student will be considered to have failed this course and this will be counted out from his chances of attending exams. The student will be notified though the faculty.

Article (8): Coding system of courses

a. Courses will be encoded as follows:

The symbol code of the concerned department, as in Tables (1, 2 and 3), is followed by the symbol code referring to the specification branch.

b. Postgraduate courses are classified into:
    1. Courses for diploma students (code: 500)
    2. Courses for M. Sc. student (code: 600)
    3. Courses for Ph. D. students (code: 700)
c. The code number representing the level of the course will be placed in the hundreds digit, while that representing the number of the course, within the teaching program of the department, will be placed in ones and tens digits.
d. The department may add new courses within the limit of numbers confined to the branch, after the consent of the faculty board.

Article (9) Courses

Postgraduate courses are studied during one academic year for diploma and master. The concerned departments prepare curricula and their corresponding credit hours, as well as the departments responsible for teaching. These curricula will be approved by the CPSR, prior to the faculty board.

Article (10): Credit hours

a. Each credit hour will be accorded 50 points of the maximum score of the course
b. Each credit hour is accorded at least one hours in the written exam. The time allowed for the exam period will not be shorter than 2 hours and not exceeding 3 hours.

Article (11) Syllabi

Faculty board approves the postgraduate courses after their determination and adoption by the concerned department boards.

Article (12) Evaluation of passing and failing scores

a. One of the following evaluations should be applied in the appreciation estimation of the postgraduate courses as well as the general of the student:

Appreciation	Score	Points
Distinguished	**≥ 90% of the total score**	**4 points**
Very good	**≥ 80% < 90% of the total score**	**3 points**
Good	**≥ 70% < 80% of the total score**	**2 points**
Passed	**≥ 60% < 70% of the total score**	**1 point**
Failure	**< 60% of the total score.**	

b. The student will be awarded, upon request, a certificate including his evaluations in the different courses, in Arabic or English. The certificate will also include the title of each course, the appreciation, the percentage and the credit hours.
c. In the qualifying year, passing is evaluated according to the internal regulations governing the bachelor period in the faculty.

Article (13): Examination calendar

Exam of the first semester courses will be held during January, while the second semester exam takes during June, without breaching article (1).

Article (14): Re-examination

The student is offered a single chance for reexamination in the courses he failed, and in case of passing he is granted the maximum limit of "passed" (69%).

Article (15): Examination plea

The faculty board may accept pleas requested by a student from attending an exam for two times only during his study, provided that the plea is requested prior to the examination, supported by an acceptable reason to the CPSR and approved by the faculty board.

Article (16): Re-registration

a. When the registration of the student is cancelled based on any of the causes of articles 5, 29, 38, or 48 of the protocol, the faculty board may register the student after one year of the revocation, as proposed by the board of the concerned department and after the consent of the CPSR. The reregistered student will be subjected to the rules applied for freshmen (article 31). The student may be exempted from some courses of the Pre-Master year if he has already passed them during the period not exceeding 5 years and after the consent of the concerned department. Requests for re-registration must be presented at the determined calendar according to article (2) and the general registration rules article (3) as well as the special terms of registration for each degree.
b. Demonstrators assistanant lecturers bound by limited period of time for the execution of master and doctorate degrees, may re-register directly after the consent of the boards of the departments and faculty.

Article (17): Registration fees

a. Fees for postgraduate studies should be paid during October each year.
b. Administrative revocation of registration takes place if the fees are not paid during the first two months of the academic years without prior notification.

Article (18): Interdisciplinary Diplomas

Each year the faculty board forms a scientific board for each of the interdisciplinary diplomas, possessing all the liabilities of the department board in supervising all the matters of each of these diplomas. The selected members of the scientific board are; the head of the involved departments in the diploma, in addition to the tutors of the courses. The scientific board are headed by the vice dean for PSR. New interdisciplinary diplomas may be introduced according to proposals of the CPSR and the consent of the faculty board.

Article (19): Academic Guidance

The board of the department as well as the faculty will specify academic guide for the post graduated student, to follow up their study during their Pre-Master year and their Diploma study by the faculty.

Article (20): Supervising scientific theses

1. The maximum numbers of supervisors in a Master thesis is three, while in doctorate thesis the number is Four.
2. In the case of scientific channels a foreign supervisor may be added to the supervising committee.
3. The number of theses concurrently supervised by the same staff member should not exceed 10, in addition to supervising theses of demonstrators and assistants, and a maximum of 3 theses of foreign students, in accordance with the decision of the faculty board as well as the university board of postgraduate studies.
4. Requests for lease for single supervisors are denied until the supervisor presents reports about the theses under his supervision, and proposes an alternative supervisor.
5. The number of associate supervisors from outside the university should not exceed that from the university.
6. The staff member is prohibited from supervising a thesis presented a next of kin up to the fourth degree and the same applies for the jury committee.
7. The name of a deceased supervisor is retained on the thesis, if he had supervised the thesis for half the duration of supervision.
8. A deceased supervisor deserves part of the supervision reward relative to the duration of the supervision.
9. The jury committee should not be formed before the elapse of at least 6 months from the date of addition of a new supervisor provided that the remaining period of registration validity would allow for that.

Article (21): Seminars

The student should hold a Seminar one month before registration for either M.Sc. or Ph.D. and before the submission of the thesis.

Article (22): Scientific thesis

a- When accomplished, the thesis is signed by the supervisors, and the student submits 2 copies to the head of the concerned department, for the determination of a date for a general seminar held about the thesis subject according to the relevant regulations.

b- The principal supervisor should present a request to the department board for the formation of jury committee, according to article (23) of the protocol, which in turn will be submitted to the board of the faculty supported by the following:

   1- A report indicating the validity of the thesis to be submitted to the juries, including the title of the thesis in both Arabic and English, signed by all the supervisors.
   2- Four copies of the thesis, typed according to the faculty instructions, to be handled to the jury committee.

c- After the acceptance of the thesis by the jury committee, and accomplishement of necessary amendments, the student should submit four C. D. and four hard copies of the thesis approved by the head of the department, in addition to 5 summaries in both Arabic and English approved by the principal supervisor and the head of the concerned department, to the administration of PSR of the faculty.

d- According to the decision of the university board of PSR, the M. Sc. thesis should not be submitted before an elapse of one year from registration approval by the university, and not from the date of faculty approval.

e- According to the decision of the university board of PSR, the Ph. D. thesis should not be submitted before an elapse of two year from registration approval by the university.

Article (23): The jury committee

a. Based on a proposal of the concerned department, and with the approval of the CPSR, the board of the faculty forms a jury committee of three members, to examine the thesis, selected as follows:
b. For master thesis the committee is formed of the principal supervisor (s) (one vote), one professor from the Egyptian universities and one professor or associate professor from foreign universities.
c. For doctorate thesis the committee is formed of the principal supervisor(s) (one vote) and two professors or associate professors from foreign universities.
d. The validity of the committee is 6 month from the date of the university board and could be renewed only once.
e. Each member of the committee prepares a separate report about the thesis within a month from its reception. These reports are submitted to the board of the concerned department then to CPSR and forwarded to the board of the faculty, prior to its submission to the university board.
f. Each member of the committee may recommend in his report one of the following recommendations
    1. Acceptance of the thesis in its present form.
    2. Acceptance of the thesis after the accomplishment of corrections
    3. Postponing the award, for three month at most, to accomplish the required corrections.
    4. Resubmission of the thesis to the juror after accomplishing the corrections within a determined period
    5. Refusal of the thesis.
g. The thesis is then returned to the student to fulfill any deficiencies noted by the committee. The student is allowed convenient period of time to accomplish all requirements, taking into consideration the validity period of the committee and the registration period as well. Corrections should be executed under the supervision of the supervisors and approved by the head of the department.
h. Terms of inquiry of foreign jurors
    1. The jury committee is formed after inquiry of the proposed jurors, using the uniform format.
    2. The jurors are chosen according to the rules adopted by the board of the faculty:
        a. The juror should be an associate professors at least
        b. The juror should not examine more than one thesis concurrently
        c. The number of theses examined by the juror should not exceed 3 theses in one academic year.
        d. The field of specialization of the juror should be similar to that of the thesis subject under consideration.
    3. For doctorate thesis jurors should be selected from two different universities.
    4. The board of the faculty may introduce changes into the formation of the jury committee if necessary.
    5. The formation of the committee should be within two month of the acceptance of the juror.
    6. The juror acceptance should be included the name of the candidate and the title of the thesis.

II. Post graduate Diploma

Article (24): Fields of study

Cairo University awards postgraduate diploma in one of the available specializations in the faculty of science (table 1). The certificate should specify the title of the awarded diploma. New diploma may be introduced based on proposals from the departments and after the approval of the CPSR and the faculty board. New diplomas may be introduced in association with institutions from outside the university, awarding degrees in specialized fields. Concerned department are responsible for setting the regulating rules for the diploma, which are then presented to the CPSR and the board of the faculty for approval.

Article (25): Registration terms

In addition to general terms of article 3, postgraduate student in all diplomas must be B.Sc. holder graduated in one of the faculties of science in the Egyptian universities or, its equivalent from one of the higher

institutes approved by the supreme council of universities (SCU.). Students other than B. Sc. holders may be matriculated in the required specialization after passing qualifying courses to fulfill the requirements of the concerned departments. These qualifying courses are not counted in the credit hours of article (26).

Article (26): Duration of study

The duration of the study in any of the postgraduate diplomas is one academic year, during which the student will be dedicated to his tutorial, practical studies and training. The number of credit hours for the diplomas should not be less than 24 hours.

Article (27): Courses

a. The protocol determines the courses, the number of exam hours and credit hours specific for each diploma.
b. Courses will be studied during the whole academic year (no more than 16 hours per semester). By the end of each semester the students should attend examinations of the studied courses.
c. The department board may assign some B. Sc. courses to the students which are not counted among the credit hours accorded this diploma according to article (24).

The student will attend courses of the curriculum under code 500 and may also attend some courses under code 600 of the master studies.

Article (28): Equalization of the courses

According to the suggestions made by concerned department, the faculty board may consider equivalent courses that have been studied by the postgraduate student in the faculty or any SCZU-approved institute during the five years prior to his registration.

Article (29): Registration revocation

Revocation of registration takes place in the following cases:

a. If the student was not awarded the diploma within 3 years from the date of registration, including the accepted pleas.
b. If the student had not paid the accorded fees in compliance with the regulations.
c. If the students apply for withdrawal according to article (5).

III. Master Degree

Article (30): Fields of study

Cairo University awards the master degree of science, based on proposals from the faculty board, through the study in the departments indicated in table (2). The certificate should include the name of the department (the specialization) and the title of the thesis.

Article (31): Registration terms

In addition to the terms of article (3), student registering for Master degree must be:

a. B.Sc. holder with score “good” at least from any of the faculty of science in the Egyptian universities or, its equivalent from any institute approved by the SCU.
b. According to recommendations of the concerned department, the faculty board may accept the registration of M. Sc. student, with a total B. Sc. score less than good, if the student has passed one of the postgraduate diplomas with a score “very good” at least in one of the faculties of science approved by the SCU.
c. According to recommendations of the concerned department, the faculty board may accept foreign students awarded the B.Sc. degree from any faculty or institute approved by SCU, with a general passed and score “good” in the specialization courses.
d. The student should be dedicated to his study for two days per week at least for two academic years.

e. M. Sc. Student awarded BSc. in other than the required specialization may be registered after attending the exam of qualifying courses proposed by the concerned departments. The courses are not counted in the credit hours of article (35).

Article (32): Duration of study

a. M. Sc. degree may be awarded after a minimum of one calendar year from the date of registration (consent of the university board).
b. The maximum limit to obtain M.Sc. is 5 calendar years from registration date, taking into consideration the periods of suspended registration. Registration may be extended for a maximum of one calendar year, according to a request of the principal supervisor and the approval of the concerned department, the CPSR and the faculty board.
c. The registration of master thesis should be within 5 years after passing the exams of the Pre-Master year. The student should successfully pass the exams of all courses including TOEFL(450) before the registration for master degree.

Article (33): Courses

The concerned department board specifies the courses before the beginning of the academic year, from the curriculum under the code 600, according to the attached tables. These courses must be adopted by the vice dean of PSR and the faculty board.

Article (34): Supervision

a. Based on a proposal of the concerned department board and the approval of the CPSR, the faculty board appoints a principal supervisor from the professors or associate professors in the faculty. One of the lecturers, if approved by the faculty board or, one equivalent specialist from outside the faculty may take part in the supervision. In all cases the number of supervisors should not exceed three.
b. If one of the supervisors should travel abroad, the faculty board may keep the supervising committee unchanged or, add another member, remove the absent supervisor from the committee, or both. The decision should be according to the suggestion of the concerned department board and the approval of the CPSR, in addition to a report presented by the supervisor prior to his leave and supported by the opinion of the principal supervisor, without breaching article (20).
c. The faculty board may change the supervising committee either by removing or adding a supervisor or both, according to the proposal of the principal supervisor and the approval of the concerned department board and PCSR, without breaching article (20).
d. The principal supervisor should provide the concerned department board with an annual report at the end of each academic year about the progress made by the student. The principal supervisor may recommend either the continuation or revocation of the registration.

Article (35): Study requirements

a. The total number of credit hours for the award of master degree is 36.
b. The concerned department should determine the courses required for the specialization branch from courses adopted by the faculty board and the vice dean for PSR. The total number of hours should not be less than 18 credit hours from code 600 (not more than13 hours per semester).
c. The student should perform a research in a specific subject determined by the supervisor and approved from the concerned department board, the CPSR and the faculty board. The submitted thesis is accorded 18 credit hours.

Article (36): Equalization of the courses

According to suggestions made by the concerned department and the approval of the CPSR, courses of the same level and specialization as master postgraduate studies that had already been studied either in the faculty or in any of the higher institutes equalized and approved by the SCU, will be considered by the faculty

board. The student should have successfully passed these courses within the last 5 years prior to his registration for M. Sc.

Article (37): Terms of degree award

Based of the recommendation of the department board and the CPSR, the faculty board awards the degree of master if the student fulfills the following terms:

a. An elapse of at least one calendar year from the date of registration (consent of university board).
b. The student should successfully pass the exams of all courses including the German language, before the registration for master degree. Prior to submitting the thesis the student should also pass TOEFL.
c. The jury committee must approve the thesis and recommend the award of the degree, according to article (23).

Article (38): Revocation of registration

The board of the faculty may cancel the registration of the student in the following cases:

a. Failure of the student in any of the courses more than two times. The student may present two pleas at most during the whole period of registration in the Pre-Master year. In exceptional conditions a third and final plea may be accepted after the consent of the board of the department and the faculty, as well as the university CPSR, if the student has failed in only one or two courses.
b. If the student has discontinued his study, or has proved to be not diligent in his research, and according to the approval of the concerned department board, and the CPSR, based on two reports by the supervisors.
c. If the jury committee rejects the thesis and recommends that the student should not be awarded the degree.
d. If the degree was not awarded within the time period stated in article (32), taking into consideration the cases in which the registration was suspended.
e. A request submitted by the student for the revocation of his registration of master degree and the agree of the supervisors.
f. If the student has not paid the fees in compliance with the relevant regulations. This is not applicable for demonstrators of the faculty.

IV. Doctorate degree

Article (39): Fields of study

Cairo university awards the degree of doctor of philosophy in science, through one of scientific departments of faculty of science (table 3), according to the suggestion of the faculty board. The certificate should include the name of the department (and the specialization), as well as the title of the thesis.

Article (40): registration terms

a. In addition to the general terms of article (3), the student must be:
b. M. Sc. degree holder in the same specialization, awarded from one of the faculties of science in the Egyptian universities or, any equivalent degree awarded from a scientific institute approved by the SCU.
c. The student submits a request to the dean for registration after the acceptance of a professor or an associate professor to supervise the thesis. The request is presented to the board of the concerned department for the adoption of supervision and the determination of the research field. After the fulfillment of all the required documents, the file is presented to the CPSR, and then forwarded to the faculty board.

Article (41): Duration of study

a. Ph. D. degree may be awarded after a minimum of two calendar year from the date of registration (consent of the university board).

b. The maximum limit to obtain Ph.D. is 5 calendar years from registration date, taking into consideration the periods of suspended registration. Registration may be extended for a maximum of one calendar year, according to a request of the principal supervisor and the approval of the concerned department, the CPSR and the faculty board.

Article (42): Study courses

Based on a request from the principal supervisor the department board may determine the specialization courses for the student, selected from the curriculum-code 700 - in compliance with the rules of the concerned departments and a maximum of 16 credit hours. The supervisor can be able to request any topic from other programs (not more than four credit hours).

Article (43): Supervision

In addition to clauses of article (34-b, c &d):

The supervision of a doctorate thesis may be collaborative between the members of supervision committee belonging to Cairo university and another supervisor belonging to a foreign university recognized by the SCU, without breaching article (20).

Article (44): Plan of doctorate study

a. Specialization courses relevant to the subject of the thesis as mentioned in article (42)
b. The student should pass an exam in English language, the content and level of which previously adopted by the faculty board. The student may be exempted from this exam if he submits the necessary documents proving that he has successfully passed the exam during the 4 years preceding the registration date.
c. The number of credit hours for the courses should be 16 credit hours. The number of credit hours confined for the thesis should be 44 credit hours, and the total number of credit hours should be 60 credit hours.
d. The principal supervisor determine the field of research that will be adopted by the department board and the vice dean for PSR. The student will submit a thesis containing the result of the research that should represent a new contribution in the branch of specialization, taking into consideration the time periods stated in article (41).
e. Based from a request from the principal supervisor, the department board may approve changes in the field of research, for one time only during the doctorate study. This may or may not be accompanied by changes in supervising committee. The changes are adopted by the CPSR and the faculty board. These changes should not breach the clauses concerning the time period stated in article (41).
f. The student should attend training course about computer uses in compliance with the rules determined by the faculty.

Article (45): Equalization of courses

The faculty board may consider courses already studied, either in the faculty or in any of the higher institutes approved by the SCU, in the level of Ph. D., according to suggestions made by the concerned department. The student should have successfully passed these courses within the last 5 calendar years prior to the registration.

Article (46): Special rules of courses for the Ph. D. degree:

a. All courses should be elective
b. The department may omit or add new courses to cope with the continuous scientific progress.
c. The department board should notify the postgraduate administration with the selected courses and their syllabi. These will be enclosed in the registration file of the student.

d. The student must successfully pass all courses before submitting his thesis.
e. Exams for Ph. D. courses will be held twice per academic year and the departments should notify the postgraduate administration with the names of students and the courses in which they will attend their exams at least two months before the examination to organize the exam schedule in an appropriate.
f. The student may omit and add two courses to his scientific progress after the approval of the concerned department and Faculty boards.
g. The number of credit hours not more than 8 credit hours per semesters.
h. It is permitted to the student to inter first semester exam only after two months from his Ph.D. registration.

Article (47): Terms of degree award

Based on the recommendation of the concerned department and the CPSR, the faculty board recommends the award of the Ph. D. degree if the student fulfills the following conditions:

a. An elapse of at least two calendar year from the date of registration (consent of university board).
b. The jury committee must approve the thesis and recommend the award of the degree.

Article (48): Revocation of registration

The board of the faculty may cancel the registration of the student in the following cases:

a. If the student has discontinued his study, or has proved to be not diligent in his research, and according to the approval of the concerned department board, and the CPSR, based on a report by the supervisors.
b. If the student fails the exam, paragraph (d), article (46) within the time period stated in article (41) paragraph (b).
c. If the jury committee rejects the thesis.
d. If the degree was not awarded within the time period stated in article (41), paragraph (b).
e. A request submitted by the student for the revocation of his registration of Ph. D degree with the agree of the supervisors.
f. If the student has not paid the fees in compliance with the relevant protocol.

V. The degree of Doctorate of Science (D. Sc.)

Article (49): For the award of D. Sc. the candidate should fulfill the following terms:

1. Candidate must be awarded the Ph. D. from at least 5 years.
2. Candidate should have published novel papers not previously submitted for the award of either the Ph. D or the M. Sc. degrees.
3. Candidate should indicate the general trend of his researches and point out his contributions in the scientific field. In addition he should mention the joint researches and the theses he has supervised.
4. Moreover, the candidate should provide a list of his original scientific and constructive activities that are not published and show his contribution to science

Article (50):

The faculty board investigates the validity of the publications of the candidate to be submitted to the jury committee. The latter is appointed by the faculty board and the jurors will be elected from professors from the Egyptian universities or their equivalent from other recognized foreign universities or institutes.

Article (51):

Members of the jury committee prepare reports, singly, on the originality of the student-submitted publications in his field of specialization and on the validity of his scientific production to recommend the award of the degree. The D.Sc. should be awarded unanimously from the committee.

Article (52):

The D.Sc. certificate should mention the specialization of the candidate.

Article (53):

The faculty board may consider the following condition for D.Sc. degree:

a. Unpublished papers or papers published during the year preceding the date of submission will be omitted.
b. The English title of publications should specify their scientific contents.
c. An English report highlighting the leading role of the candidate in his researches.
d. A citation index should be included to support the position of the candidate.
e. An English report on the role of the candidate in supervising theses.

Article (54): Complimentary Studies

a. departments may require complimentary courses in the required specialized from code 300 or 400.
b. If the student register himself in a different specialize that his Pre-Master study, the concerned department may require complimentary courses from code 600.
c. The complimentary courses should not exceed 4. for more than 4 courses, the student should finish one complimentary year to pass those courses, as required for the registration to either Pre-Master year or the thesis.

Article (55): Continuous study Programs

a. According to a proposal of the department board, the faculty board may hold seminars or sessions, on the level of PSR, aiming at updating the scientific standards and encouraging sustained learning of scientists and specialists awarded recognized university degrees.
b. National and international scientific societies, institutions and concerned organizations may contribute in organizing such seminars and sessions.
c. Participants may obtain certificates of these seminars and sessions acknowledging their attendance without the award of scientific degree, after the payment of fees.

Article (56):

The faculty may inaugurate new specializations for diplomas, master and PhD degrees awarded by the departments after the consent of the faculty and university boards.

Article (57): Applicability of the protocol

This protocol will be applied to postgraduate registered student from the date of issuing the ministerial agree that adopts this protocol. As for the student registered before that date, the internal regulation of 1995 and its rules will be applied.

1- Mathematics Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(M)	M. Sc. (600)	1- Pure Mathematics	(MP)
		2- Classical Applied Mathematics	(MC)
		3- Modern applied Mathematics	(MM)
		4- Statistical Mathematics	(MS)
		5- Computational Sciences.	(MCS)
	Ph. D. (700)	1- Pure Mathematics	(MP)
		2- Classical Applied Mathematics	(MC)
		3- Modern applied Mathematics	(MM)
		4- Statistical Mathematics	(MS)
		5- Computational Sciences.	(MCS)

1- M. Sc. Degree in Pure Mathematics (MP)

Code	Course Number	Course Case	CR. Hours
(MP)	The candidate studies (2) courses in each semester table (1)	Compulsory	8
	The candidate chooses (3) courses in the 1st semester& (2) courses in the 2nd semester table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MP 601-a	Algebra (1)	2	2	
	MP 602-a	Functional Analysis (1)	2	2	
Second	MP 601-b	Algebra (2)	2	2	
	MP 602-b	Functional Analysis (2)	2	2	
	The Total Cr.h. Required		8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MP 603-a	Mathematical Logic (1)	2	2	
	MP 604-a	Set Theory (1)	2	2	
	MP 605-a	Special Topics in History of Mathematics (1)	2	2	
	MP 606-a	Number Theory (1)	2	2	
	MP 607-a	Complex Analysis (1)	2	2	
	MP 608-a	Real and Harmonic Analysis (1)	2	2	
	MP 609-a	Theory of Differential and Difference Equations (1)	2	2	
	MP 610-a	Special Functions and Their Applications (1)	2	2	
	MP 611-a	Combinatorics and Graph Theory (1)	2	2	Also offered by Comput. Sci.
	MP 612-a	Approximation Theory (1)	2	2	
	MP 613-a	Numerical and Spectral Solutions of Differential Equations (1)	2	2	
	MP 614-a	Finite Element Method(1)	2	2	
	MP 615-a	Differential Geometry (1)	2	2	
	MP 616-a	Algebraic Geometry (1)	2	2	
	MP 617-a	Any Topic From Other Programs	2	2	
	The Total Cr.h. Required		6	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
Second	MP 603-b	Mathematical Logic (2)	2	2	
	MP 604-b	Set Theory (2)	2	2	
	MP 605-b	Special Topics in History of Mathematics (2)	2	2	
	MP 606-b	Number Theory (2)	2	2	
	MP 607-b	Complex Analysis (2)	2	2	
	MP 608-b	Harmonic Analysis	2	2	
	MP 609-b	Theory of Differential and Difference Equations(2)	2	2	
	MP 610-b	Special Functions and their application(2)	2	2	
	MP 611-b	Combinatorics and Graph Theory (2)	2	2	Also offered by Comput. Sci.
	MP 612-b	Approximation Theory(2)	2	2	
	MP 613-b	Numerical and Specteral Solutions of Differential Equations (2)	2	2	
	MP 614-b	Finite Element Method(2)	2	2	
	MP 615-b	Defferential Geometry (2)	2	2	
	MP 616-b	Algebraic Geometry (2)	2	2	
	MP 617-b	Any Topic From Other Programs	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 601 to 619
From 618 to 619 are codes No. for adding new courses

2- M. Sc. Degree in Classical Applied Mathematics (MC)

Code	Course Number	Course Case	CR. Hours
(MC)	The candidate studies (2) courses in each semester table (1)	Compulsory	8
	The candidate chooses (3) courses in the 1st semester& (2) courses in the 2nd semester table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MC 620-a	Fluid Mechanics (1)	2	2	
	MC 621-a	Mechanics of Continuous Media (1)	2	2	
Second	MC 620-b	Fluid Mechanics (2)	2	2	
	MC 621-b	Mechanics of Continuous Media (2)	2	2	
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MC 622-a	Non Linear Dynamics (1)	2	2	
	MC 623-a	Mathematical Theory of Elasticity (1)	2	2	
	MC 624-a	Mathematical Theory of Thermal Elasticity (1)	2	2	
	MC 625-a	Continuum Mechanics of Electromagnetic Media (1)	2	2	
	MC 626-a	Partial Differential Equations (1)	2	2	Also offered by Mod. App. Math.
	MC 627-a	Nonlinear Waves and Solitons	2	2	
	MC 628-a	Electromagnetic Theory (1)	2	2	
	MC 620-a	Any Topic From Other Programs	2	2	
		The Total Cr.h. Required	6	-	
Second	MC 622-b	Non Linear Dynamics(2)	2	2	
	MC 623-b	Mathematical Theory of Elasticity (2)	2	2	
	MC 624-b	Mathematical Theory of Thermal Elasticity (2)	2	2	
	MC 625-b	Continuum Mechanics of Electromagnetic Media (2)	2	2	
	MC 626-b	Partial Differential Equations (2)	2	2	Also offered by Mod. App. Math.
	MC 627-b	Nonlinear Waves and Solitons (2)	2	2	
	MC 628-b	Electromagnetic Theory (2)	2	2	
	MC 629-b	Any Topic From Other Programs	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 620 to 639
From 630 to 639 are codes No. for adding new courses

3- M. Sc. Degree in Modern Applied Mathematics (MM)

Code	Course Number	Course Case	CR. Hours
(MM)	The candidate studies (2) courses in each semester table (1)	Compulsory	8
	The candidate chooses (3) courses in the 1st semester& (2) courses in the 2nd semester table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MM 640-a	Advanced Quantum Mechanics (1)	2	2	
	MM 641-a	General Relativity (1)	2	2	
Second	MM 640-b	Advanced Quantum Mechanics (2)	2	2	
	MM 641-b	General Relativity (2)	2	2	
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MM 642-a	Theory of Relativistic Quantum Mechanics (1)	2	2	
	MM 643-a	Quantum Field Theory (1)	2	2	
	MM 644-a	Gauge Theory (1)	2	2	
	MM 645-a	Symmetry Groups in Particle Theory (1)	2	2	
	MM 646-a	Any Topic From Other Programs	2	2	
	MC 626-a	Partial Differential Equations (1)	2	2	Also offered by Class. App. Math.
		The Total Cr.h. Required	6	-	
Second	MM 642-b	Theory of Relativistic Quantum Mechanics (2)	2	2	
	MM 643-b	Quantum Field Theory (2)	2	2	
	MM 644-b	Gauge Theory (2)	2	2	
	MM 645-b	Symmetry Groups in Particle Theory(2)	2	2	
	MM 646-b	Any Topic From Other Programs	2	2	
	MC 626-b	Partial Differential Equations (2)	2	2	Also offered by Class. App. Math.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 640 to 659
From 647 to 659 are codes No. for adding new courses

4- M. Sc. Degree in Statistical Mathematics (MS)

Code	Course Number	Course Case	CR. Hours
(MS)	The candidate studies (2) courses in each semester table (1)	Compulsory	8
	The candidate chooses (3) courses in the 1st semester& (2) courses in the 2nd semester table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MS 660-a	Advanced Probabilities(1)	2	2	
	MS 661-a	Measure Theory (1)	2	2	
Second	MS 660-b	Advanced Probabilities(2)	2	2	
	MS 661-b	Measure Theory (2)	2	2	
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MS 662-a	Time Series Analysis (1)	2	2	
	MS 663-a	Queueing Theory (1)	2	2	
	MS 664-a	Markov Chains (1)	2	2	
	MS 665-a	Advanced Stochastic Processes (1)	2	2	
	MS 666-a	Advanced Multivariate Statistics (1)	2	2	
	MS 667-a	Advanced Non-Parametric Statistics (1)	2	2	
	MS 668-a	Advanced Sampling Theory (1)	2	2	
	MS 669-a	Advanced Applied Statistics (1)	2	2	
	MS 670-a	Advanced Experimental Design (1)	2	2	
	MS 671-a	Life Testing and Realibility (1)	2	2	
	MS 672-a	Quality Control (1)	2	2	
	MS 673-a	Advanced Bio-Statistics (1)	2	2	
	MS 674-a	Ecological Modeling (1)	2	2	
	MS 675-a	Advanced Estimation Theory	2	2	
		The Total Cr.h. Required	6	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
Second	MS 662-b	Time Series Analysis (1)	2	2	
	MS 663-b	Queueing Theory (1)	2	2	
	MS 664-b	Markov Chains (1)	2	2	
	MS 665-b	Advanced Stochastic Processes (1)	2	2	
	MS 666-b	Advanced Multivariate Statistics (1)	2	2	
	MS 667-b	Advanced Non-Parametric Statistics (1)	2	2	
	MS 668-b	Advanced Sampling Theory (1)	2	2	
	MS 669-b	Advanced Applied Statistics (1)	2	2	
	MS 670-b	Advanced Experimental Design (1)	2	2	
	MS 671-b	Life Testing and Realibility (1)	2	2	
	MS 672-b	Quality Control (1)	2	2	
	MS 673-b	Advanced Bio-Statistics (1)	2	2	
	MS 674-b	Ecological Modeling (1)	2	2	
	MS 675-b	Advanced Estimation Theory	2	2	
	MS-676	Biostatistics	2	2	Non Mathem-atician Students
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 660 to 679
From 677 to 679 are codes No. for adding new courses

5- M. Sc. Degree in Computational Sciences (MCS)

Code	Course Number	Course Case	CR. Hours
(MCS)	The candidate studies (2) courses in each semester table (1)	Compulsory	8
	The candidate chooses (3) courses in the 1st semester& (2) courses in the 2nd semester table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Number	CR. Hours	Exam Hours	Remarks
First	MP 611-a	Combinatorics and Graph Theory (1)	2	2	Also offered by Pure
	MCS 680-a	Mathematical Logic for Computer Science (1)	2	2	
Second	MP 611-b	Combinatorics and Graph Theory (2)	2	2	Also offered by Pure
	MCS 680-b	Mathematical Logic for Computer Science (2)	2	2	
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	MCS 681-a	Programming Language and Compilers (1)	2	2	
	MCS 682-a	Distributed Systems (1)	2	2	
	MCS 683-a	Parallel Systems (1)	2	2	
	MCS 684-a	Database Systems (1)	2	2	
	MCS 685-a	Theory of Computation (1)	2	2	
	MCS 686-a	Theory of Complexity (1)	2	2	
	MCS 687-a	Cryptography (1)	2	2	
	MCS 688-a	Information Security (1)	2	2	
	MCS 689-a	Abstract Algebra and its Applications in Computer Science (1)	2	2	
	MCS 690-a	Image Processing (1)	2	2	
	MCS 691-a	Artificial Intelligence (1)	2	2	
	MCS 692-a	Special Topics in Computational Methods	2	2	
		The Total Cr.h. Required	6	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
Second	MCS 681-b	Programming Languages and Compilers (2)	2	2	
	MCS 682-b	Distributed Systems (2)	2	2	
	MCS 683-b	Parallel Systems (2)	2	2	
	MCS 684-b	Database Systems (2)	2	2	
	MCS 685-b	Theory of Computation (2)	2	2	
	MCS 686-b	Theory of Complexity (2)	2	2	
	MCS 687-b	Cryptography (2)	2	2	
	MCS 688-b	Information Security (2)	2	2	
	MCS 689-b	Abstract Algebra and its Applications in Computer Science (2)	2	2	
	MCS 690-b	Image Processing (2)	2	2	
	MCS 691-b	Artificial Intelligence (2)	2	2	
	MCS 692-b	Special Topics in Computer Sciences	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 680 to 698
From 693 to 698 are codes No. for adding new courses

1- Ph. D. Degree in Pure Mathematics (MP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(MP)	The candidate chooses (2) courses in each semester table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	MP 701-a	Selected Topics of Mathematical Logic (1)	4	3
	MP 702-a	Selected Topics of Set Theory (1)	4	3
	MP 703-a	Special Topics in History of Mathematics (1)	4	3
	MP 704-a	Selected Topics of Algebra(1)	4	3
	MP 705-a	Selected Topics of Number Theory (1)	4	3
	MP 706-a	Selected Topics of Functional Analysis (1)	4	3
	MP 707-a	Selected Topics of Complex Analysis (1)	4	3
	MP 708-a	Selected Topics of Harmonic Analysis (1)	4	3
	MP 709-a	Selected Topics of Theory of Differential and Difference Equations (1)	4	3
	MP 710-a	Selected Topics of Special Functions and Their Applications (1)	4	3
	MP 711-a	Selected Topics of Combinatorics and Graph Theory (1)	4	3
	MP 712-a	Selected Topics of Approximation theory (1)	4	3
	MP 713-a	Selected Topics of Numerical Solutions of Differential Equations (1)	4	3
	MP 714-a	Selected Topics of Finite Element Method (1)	4	3
	MP 715-a	Selected Topics of Differential Geometry (1)	4	3
	MP 716-a	Selected Topics of Algebraic Geometry (1)	4	3
	MP 717-a	Any Topic From Other Programs	4	3
		The Total Cr.h. Required	8	

Table (2) Elective Courses

Semester	Course Code	Course Number	CR. Hours	Exam Hours
Second	MP 701-b	Selected Topics of Mathematical Logic (1)	4	3
	MP 702-b	Selected Topics of Set Theory (1)	4	3
	MP 703-b	Special Topics in History of Mathematics (1)	4	3
	MP 704-b	Selected Topics of Algebra(1)	4	3
	MP 705-b	Selected Topics of Number Theory (1)	4	3
	MP 706-b	Selected Topics of Functional Analysis (1)	4	3
	MP 707-b	Selected Topics of Complex Analysis (1)	4	3
	MP 708-b	Selected Topics of Harmonic Analysis (1)	4	3
	MP 709-b	Selected Topics of Theory of Differential and Difference Equations (1)	4	3
	MP 710-b	Selected Topics of Special Functions and Their Applications (1)	4	3
	MP 711-b	Selected Topics of Combinatorics and Graph Theory (1)	4	3
	MP 712-b	Selected Topics of Approximation Theory (1)	4	3
	MP 713-b	Selected Topics of Numerical Solutions of Differential Equations (1)	4	3
	MP 714-b	Selected Topics of Finite Element Method (1)	4	3
	MP 715-b	Selected Topics of Differential Geometry (1)	4	3
	MP 716-b	Selected Topics of Algebraic Geometry (1)	4	3
	MP 717-b	Any Topic From Other Programs	4	3
		The Total Cr.h. Required	8	

Note:- the code No. of the branch: from 701 to 719
From 718 to 719 are codes No. for adding new courses

2- Ph.D. In Classical Applied Mathematics (MC)

Table (1)

Code	Course Number	Course Case	CR. Hours
(MC)	The candidate chooses (2) courses in each semester table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	MC 720-a	Selected Topics of Statistical Mechanics (1)	4	3
	MC 721-a	Selected Topics of Mathematical Theory of Elasticity (1)	4	3
	MC 722-a	Selected Topics of Mathematical Theory of Thermal Elasticity (1)	4	3
	MC 723-a	Fluid Mechanics (1)	4	3
	MC 724-a	Continuum Mechanics (1)	4	3
	MC 725-a	Selected Topics of Continuum Mechanics of Electromagnetic Media. (1)	4	3
	MC 726-a	Selected Topics of Partial Differential Equations (1)	4	3
	MC 727-a	Selected Topics of Nonlinear Waves and Solitons (1)	4	3
	MC 728-a	Selected Topics of Electromagnetic Theory (1)	4	3
	MC 729-a	Any Topic From Other Programs	4	3
Second	MC 720-b	Selected Topics of Statistical Mechanics(2)	4	3
	MC 721-b	Selected Topics of Mathematical Theory of Elasticity (2)	4	3
	MC 722-b	Selected Topics of Mathematical Theory of Thermal Elasticity (2)	4	3
	MC 723-b	Fluid Mechanics (2)	4	3
	MC 724-b	Continuum Mechanics (2)	4	3
	MC 725-b	Selected Topics of Continuum Mechanics of Electromagnetic Media. (2)	4	3
	MC 726-b	Selected Topics of Partial Differential Equations (2)	4	3
	MC 727-b	Selected Topics of Nonlinear Waves and Solitons (2)	4	3
	MC 728-b	Selected Topics of Electromagnetic Theory (2)	4	3
	MC 729-b	Any Topic From Other Programs	4	3
		The Total Cr.h. Required	16	-

Note:- the code No. of the branch: from 720 to 739
From 730 to 739 are codes No. for adding new courses

3- Ph.D. Degree In Modern Applied Mathematics (MM)

Table (1)

Code	Course Number	Course Case	CR. Hours
(MM)	The candidate chooses (2) courses in each semester table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	MM 740-a	Selected Topics of Quantum Mechanics (1)	4	3
	MM 741-a	Selected Topics of Theory of Relativistic Quantum Mechanics (1)	4	3
	MM 742-a	Selected Topics of General Relativity (1)	4	3
	MM 743-a	Selected Topics of Quantum Field Theory (1)	4	3
	MM 744-a	Selected Topics of Gauge Theory (1)	4	3
	MM 745-a	Selected Topics of Partial Differential Equations (1)	4	3
	MM 746-a	Selected Topics of Symmetry Groups in Particle Theory (1)	4	3
	MM 747-a	Any Topic From Other Programs	4	3
Second	MM 740-b	Selected Topics of Quantum Mechanics (1)	4	3
	MM 741-b	Selected Topics of Theory of Relativistic Quantum Mechanics (1)	4	3
	MM 742-b	Selected Topics of General Relativity (1)	4	3
	MM 743-b	Selected Topics of Quantum Field Theory (1)	4	3
	MM 744-b	Selected Topics of Gauge Theory (1)	4	3
	MM 745-b	Selected Topics of Partial Differential Equations (1)	4	3
	MM 746-b	Selected Topics of Symmetry Groups in Particle Theory (1)	4	3
	MM 747-b	Any Topic From Other Programs	4	3
		The Total Cr.h. Required	16	-

Note:- the code No. of the branch: from 740 to 759
From 748 to 759 are codes No. for adding new courses

4- Ph.D. Degree In Modern Statistical Mathematics (MS)

Table (1)

Code	Course Number	Course Case	CR. Hours
(MS)	The candidate chooses (2) courses in each semester table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	MS 760-a	Selected Topics of Advanced Probability (1)	4	3
	MS 761-a	Selected Topics of Time Series Analysis (1)	4	3
	MS 762-a	Selected Topics of Queueing Theory (1)	4	3
	MS 763-a	Selected Topics of Markov Chains (1)	4	3
	MS 764-a	Selected Topics of Advanced Stochastic Processes (1)	4	3
	MS 765-a	Selected Topics of Advanced Multivariate Statistics (1)	4	3
	MS 766-a	Selected Topics of Advanced Non-Parametric Statistics (1)	4	3
	MS 767-a	Selected Topics of Advanced Estimation Theory (1)	4	3
	MS 768-a	Selected Topics of Advanced Sampling Theory (1)	4	3
	MS 769-a	Selected Topics of Advanced Applied Statistics (1)	4	3
	MS 770-a	Selected Topics of Advanced Experimental Design (1)	4	3
	MS 771-a	Selected Topics of Life Testing and Realibility (1)	4	3
	MS 772-a	Selected Topics of measure Theory (1)	4	3
	MS 773-a	Selected Topics of Quality Control (1)	4	3
	MS 774-a	Selected Topics of Advanced Bio-Statistics (1)	4	3
	MS 775-a	Selected Topics of Ecological Modeling (1)	4	3
	MS 776-a	Any Topic From Other Programs	4	3
		The Total Cr.h. Required	8	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
Second	MS 760-b	Selected Topics of Advanced Probability (2)	4	3
	MS 761-b	Selected Topics of Time Series Analysis (2)	4	3
	MS 762-b	Selected Topics of Queueing Theory (2)	4	3
	MS 763-b	Selected Topics of Markov Chains (2)	4	3
	MS 764-b	Selected Topics of Advanced Stochastic Processes (2)	4	3
	MS 765-b	Selected Topics of Advanced Multivariate Statistics (2)	4	3
	MS 766-b	Selected Topics of Advanced Non-Parametric Statistics (2)	4	3
	MS 767-b	Selected Topics of Advanced Estimation Theory (2)	4	3
	MS 768-b	Selected Topics of Advanced Sampling Theory (2)	4	3
	MS 769-b	Selected Topics of Advanced Applied Statistics (2)	4	3
	MS 770-b	Selected Topics of Advanced Experimental Design (2)	4	3
	MS 771-b	Selected Topics of Life Testing and Realibility (2)	4	3
	MS 772-b	Selected Topics of measure Theory (2)	4	3
	MS 773-b	Selected Topics of Quality Control (2)	4	3
	MS 774-b	Selected Topics of Advanced Bio-Statistics (2	4	3
	MS 775-b	Selected Topics of Ecological Modeling (2)	4	3
	MS 776-b	Any Topic From Other Programs	4	3
		The Total Cr.h. Required	8	

Note:- the code No. of the branch: from 760 to 779
From 777 to 779 are codes No. for adding new courses

5- Ph.D. Degree In Computational Sciences (MCS)

Table (1)

Code	Course Number	Course Case	CR. Hours
(MCS)	The candidate chooses (2) courses in each semester table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	MCS 780-a	Selected topics in Programming and Compliers (1)	4	3
	MCS 781-a	Selected topics in Distributed Systems (1)	4	3
	MCS 782-a	Selected topics in Parallel Systems (1)	4	3
	MCS 783-a	Selected topics in Database Systems (1)	4	3
	MCS 784-a	Selected topics in Theory of Computation (1)	4	3
	MCS 785-a	Selected topics in Theory of Complexity (1)	4	3
	MCS 786-a	Selected topics in Combinatorics ad Graph Theory (1)	4	3
	MCS 787-a	Selected topics in Cryptography (1)	4	3
	MCS 788-a	Selected topics in Information Security (1)	4	3
	MCS 789-a	Selected topics in Abstract Algebra and its Applications in Computer Science(1)	4	3
	MCS 790-a	Selected topics in Signal Processing (1)	4	3
	MCS 791-a	Selected topics in Mathematical Logic for Computer Science (1)	4	3
	MCS 792-a	Selected topics in Artificial Intelligence (1)	4	3
	MCS 793-a	Selected topics in Any Topic From Other Programs	4	3
		The Total Cr.h. Required	8	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
Second	MCS 780-b	Selected topics in Programming and Compliers (2)	4	3
	MCS 781-b	Selected topics in Distributed Systems (2)	4	3
	MCS 782-b	Selected topics in Parallel Systems (2)	4	3
	MCS 783-b	Selected topics in Database Systems (2)	4	3
	MCS 784-b	Selected topics in Theory of Computation (2)	4	3
	MCS 785-b	Selected topics in Theory of Complexity (2)	4	3
	MCS 786-b	Selected topics in Combinatorics ad Graph Theory (2)	4	3
	MCS 787-b	Selected topics in Cryptography (2)	4	3
	MCS 788-b	Selected topics in Information Security (2)	4	3
	MCS 789-b	Selected topics in Abstract Algebra and its Applications in Computer Science(2)	4	3
	MCS 790-b	Selected topics in Signal Processing (2)	4	3
	MCS 791-b	Selected topics in Mathematical Logic for Computer Science (2)	4	3
	MCS 792-b	Selected topics in Artificial Intelligence (2)	4	3
	MCS 793-b	Selected topics in Any Topic From Other Programs	4	3
		The Total Cr.h. Required	8	

Note:- the code No. of the branch: from 780to 798
From 794to 798 are codes No. for adding new courses

B- Course contents of M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Pure Mathematics (M P)
M P – 601 (a & b) (2 cr. h/ Semester)	**Algebra (1 & 2)** **الجبر (١ ، ٢)** Prerequisites: Third year course of algebra as taught at the department Outline of contents: Set theoretic notions, theory of categories, structure theory of groups, theory of rings and modules, field theory.
M P – 602 (a & b) (2 cr. h/ Semester)	**Functional Analysis (1 & 2)** **التحليل الدالي (١ ، ٢)** Prerequisites: The student is assumed to know: linear algebra (finite dimensional vector spaces and linear transformations), basic real analysis (multivariable calculus, series of numbers and series of functions), some topological notions (completeness and compactness, at least in metric spaces), elementary theory of the Lebesgue measure and integral and the basic theory of Hilbert spaces. Outline of contents: The content may vary according to student interests and those of the instructor. Typically the course would treat subjects from: Operators and their spectra, function spaces, spaces of distributions, the Fourier and Laplace transforms and applications. Some special topics may be treated if time allows.
M P – 603 (a & b) (2 cr. h/ Semester)	**Mathematical Logic (1 & 2)** **المنطق الرياضي (١ ، ٢)** Prerequisites: Mathematical Logic 2. Outline of contents: The foundations of mathematics, formal systems, metamathematics, computability and decidability, Church's thesis, applications to formal number theory and to predicate calculus, additional topics in predicate calculus.
M P – 604 (a & b) (2 cr. h/ Semester)	**Set Theory (1 & 2)** **نظرية المجموعات (١ ، ٢)** Prerequisites: Mathematical logic and set theory courses at the undergraduate level. Outline of contents: Axiomatic foundations. Operations on sets and relations. Images and set functions. Ordering, well-ordering, and well-founded relations; general principles of induction and recursion. Ranks of sets, ordinals and their arithmetic. Set-theoretical equivalence, definitions by abstraction. Arithmetic of cardinals. Axiom of choice, equivalent forms, and consequences.
M P – 605 (a & b) (2 cr. h/ Semester)	**Selected Topics in the History of Mathematics (1 & 2)** **موضوعات مختارة في تاريخ الرياضيات (١ ، ٢)** Prerequisites: consent of the instructor. Outline of contents: One or two subjects are treated in depth from: history of algebra, history of the theory of numbers, history of geometry, history of the calculus and infinitesimal methods.
M P – 606 (a & b) (2 cr. h/ Semester)	**Number Theory (1 & 2)** **نظرية الأعداد (١ ، ٢)** Prerequisites: all undergraduate algebra courses. Outline of contents: Valuations, units, and ideals in number fields, ramification theory, quadratic and cyclotomic fields, topics from class field theory, zeta-functions and L-series, distribution of primes, modular forms, quadratic forms, diophantine equations, P-adic analysis, and transcendental numbers.
M P – 607 (a & b) (2 cr. h/ Semester)	**Complex Analysis (1 & 2)** **التحليل المركب (١ ، ٢)** Prerequisites: Undergraduate course of complex analysis. Outline of contents: Complex analysis of one variable: Compactness and convergence in the space of analytic functions, Riemann mapping theorem, Weierstrass factorization theorem, Runge's theorem, Picard's theorems - Complex analysis of several variables: analytic functions of several variables, the integral formula of Cauchy, Hartog's phenomenon, d'' problem, spaces of holomorphic functions.

M P – 608 **(a & b)** **(2 cr. h/ Semester)**	**Real and Harmonic Analysis (1 & 2)** **التحليل التوافقي والحقيقي (١ ، ٢)** Prerequisites: consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Classical Fourier analysis, real variable methods in harmonic analysis, probabilistic methods in harmonic analysis, abstract harmonic analysis and Banach algebras, theories of integration.
M P – 609 **(a & b)** **(2 cr. h/ Semester)**	**Theory of Differential and Difference Equations (1 & 2)** **نظرية المعادلات التفاضلية والمعادلات الفرقية (١ ، ٢)** Prerequisites: Undergraduate courses of real analysis and ordinary differential equations. Outline of contents: Theory of ordinary linear differential equations, qualitative properties of solutions, linear difference equations, dynamical systems, nonlinear equations.
M P – 610 **(a & b)** **(2 cr. h/ Semester)**	**Special Functions and Applications (1 & 2)** **الدوال الخاصة وتطبيقاتها (١ ، ٢)** Prerequisites: Undergraduate analysis courses. Outline of contents: One or two subjects are treated in depth from: Orthogonal polynomials, special functions and boundary-value problems, numerical methods and special functions, wavelets and their computational applications, classical and basic special functions.
M P – 611 **(a & b)** **(2 cr. h/ Semester)**	**Combinatorics and Graph Theory (1 & 2)** **التوافيقيات ونظرية الأشكال (١ ، ٢)** Prerequisites: basic undergraduate course of algebra. Outline of contents: Combinatorial methods and other mathematical methods for combinatorial problems. Enumeration by bijections and generating functions, probabilistic methods for existence proofs and asymptotic analysis, randomized algorithms, Ramsey's theorem and related topics, combinatorial designs and their applications, geometric problems and methods. Graphs, directed graphs, flows in graphs, substructures of dense graphs, substructures of sparse graphs, Hamiltonian cycles.
M P – 612 **(a & b)** **(2 cr. h/ Semester)**	**Approximation Theory (1 & 2)** **نظرية التقريب (١ ، ٢)** Prerequisites: Undergraduate real and complex analysis courses. Outline of contents: Possibility of approximation, polynomials of best approximation, properties of polynomials and moduli of continuity, the degree of approximation by trigonometric polynomials, the degree of approximation by algebraic polynomials, approximation by rational functions, functions of several variables, approximation by linear polynomial operators.
M P – 613 **(a & b)** **(2 cr. h/ Semester)**	**Numerical and spectral solutions of differential equations (1 & 2)** **الحلول العددية والطيفية للمعادلات التفاضلية (١ ، ٢)** Prerequisites: Basic numerical analysis course at the undergraduate level. Outline of contents: Ordinary differential equations: one-step methods, multistep methods, difference methods for boundary value problems in ODE's - Partial differential equations: difference methods for parabolic, hyperbolic and elliptic PDE's - Spectral methods for ordinary and partial differential equations: weighted residual methods, variational methods.
M P – 614 **(a & b)** **(2 cr. h/ Semester)**	**Finite Elements Method (1 & 2)** **طريقة العناصر المحددة (١ ، ٢)** Prerequisites: First course of numerical analysis and calculus. Outline of contents: Introduction to FEM for elliptic problems - Some finite element spaces - Development of finite element programs - Two dimensional problems - Two dimensional element calculations.
M P – 615 **(a & b)** **(2 cr. h/**	**Differential Geometry (1 & 2)** **الهندسة التفاضلية (١ ، ٢)** Prerequisites: Real analysis, topology, algebra and differential geometry at the undergraduate level.

Semester)	Outline of contents: Differential calculus on manifolds - Differential forms and derivations, De Rahm cohomology - Linear connections - Nonlinear connections - Geometry of the tangent bundle and double tangent bundle - Theory of submanifolds - Vector bundles - Lie groups and Lie algebras - Some Riemannian geometry.
M P – 616 (a & b) (2 cr. h/ Semester)	**Algebraic Geometry (1 & 2)** **الهندسة الجبرية (١ ، ٢)** Prerequisites: Undergraduate courses of algebra. Outline of contents: Affine and projective algebraic varieties. Theory of schemes and morphisms of schemes. Smoothness and differentials in algebraic geometry. Coherent sheaves and their cohomology. Riemann-Roch theorem and selected applications.
M P – 617 (a & b) (2 cr. h/ Semester)	**The candidate study one course of the following** **يختار الطالب أى من هذه المقررات (١ ، ٢)** **1- Selected Topics in Mathematical Logic and the Foundations of Mathematics** Prerequisites: undergraduate mathematical logic course. Outline of contents: One or two subjects are treated in depth from: Algebraic logic, constructive mathematical logic, model theory, recursion theory, independence results in set theory, descriptive set theory and other topics. **2- Selected Topics in Algebra** Prerequisites: consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Commutative algebra, non-associative algebra, theory of rings amd modules, group representations and their applications, theory of near-rings, Galois theory, Hopf algebras and quantum groups. **3- Selected Topics in Geometry** Outline of contents: One or two subjects are treated in depth from: Riemannian geometry, Finsler Geometry, non-Euclidean geometry, projective geometry, finite geometries and their applications. **4- Selected Topics in the Topology** Prerequisites: consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Dimension theory, algebraic topology, differential topology, knot theory. **5- Selected Topics in Functional Analysis and Operator Theory** Prerequisites: consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Set-valued analysis, non-harmonic analysis, geometry of infinite dimensional spaces, algebras of operators, wavelets and their applications.

	2- M. Sc. Degree in Classical Applied Mathematics (M C)
M C – 620 (a & b) (2 cr. h/ Semester)	**Fluid Mechanics (1 & 2)** **ميكانيكا الموائع (١ ، ٢)** Prerequisites: Undergraduate applied mathematics courses. Outline of contents: Equations of motion in different coordinates (Euler, Lagrange and Miche) - Irrotational and rotational motion - Motion of a liquid in two and three dimensions - Viscous flow - Gravity waves - Tidal waves - Surface waves - Stratified fluids - Shallow water waves.
M C – 621 (a & b) (2 cr. h/ Semester)	**Mechanics of Continuous Media (1 & 2)** **ميكانيكا الأوساط المتصلة (١ ، ٢)** Prerequisites: Undergraduate applied mathematics courses. Outline of contents: Tensor analysis - Energy and entropy - General constitutive equations - Applications: Hypoelasticity - Elastic – perfectly plastic bodies -

	Viscoelastic materials.
M C – 622(a) **(2 cr. h)**	**Nonlinear Dynamics (1)** **ديناميكا غير خطية (١)** Equilibrium points of linear systems, Trajectories of linear systems, Stability criteria, Equilibrium points of approximately linear systems, Stability criteria of nonlinear systems, Liaponnov theorem, Limit cycles and periodic solutions, poincare' and Bendixon theorems, the logistic equation.
M C – 622(b) **(2 cr. h)**	**Nonlinear Dynamics (2)** **ديناميكا غير خطية (٢)** Coexisting species, Lotka-Volterra Model, Delay-Cogestic equation, Sealistic prey-prediator Model, logistic equation with diffusion, Nonlinear waves, Nagums equation, Coupled diffusion systems.
M C – 623 **(a & b)** **(2 cr. h/** **Semester)**	**The Mathematical Theory of Elasticity (1 & 2)** **النظرية الرياضية للمرونة (١ ، ٢)** Prerequisites: Undergraduate applied mathematics courses. Outline of contents: Equilibrium of aeolotropic elastic solid bodies - General theorems - Two-dimensional elastic systems - Theory of the integration of the equations of equilibrium of an isotropic elastic solid body - The equilibrium of an elastic sphere and related problems - Vibrations of spheres and cylinders - The propagation of waves in elastic solid media – Torsion.
M C – 624 **(a & b)** **(2 cr. h/** **Semester)**	**The Mathematical Theory of Thermoelasticity (1 & 2)** **النظرية الرياضية للمرونة الحرارية (١ ، ٢)** Prerequisites:. Undergraduate applied mathematics courses. Outline of contents: Basic relations and equations of thermoelasticity - Stationary three-dimensional thermoelastic problems - Quasi-static and quasi-stationary spatial thermoelasticity problems - Dynamic effects due to the action of a non-stationary temperature field - Dynamic problems of coupled temperature and strain fields - Stationary plane problems of thermoelasticity - Quasi-static and quasi-stationary two-dimensional thermoelastic problems - Two-dimensional dynamic thermoelastic problems.
M C – 625 **(a & b)** **(2 cr. h/** **Semester)**	**Continuum Mechanics of Electromagnetic Media (1 & 2)** **الميكانيكا المتصلة للأوساط الكهرومغناطيسية (١ ، ٢)** Prerequisites: Undergraduate applied mathematics courses. Outline of contents: Essential properties of electromagnetic solids - Elements of continuum mechanics - General equations of nonlinear electromagnetic media - Elastic dielectrics and piezoelectricity - Elastic conductors.
M C – 626(a) **(2 cr. h)**	**Partial Differential Equations (1)** **معادلات تفاضلية جزئية (١)** Laplace and wave equations, Fourier analysis, distributions, Sovler spaces, Applications.
M C – 626(b) **(2 cr. h)**	**Partial Differential Equations (2)** **معادلات تفاضلية جزئية (٢)** Linear elliptic equations, Heat and wave equations in bounded and unbounded domains, Cauchy-Kowalewsky theorem, geometrical optics.
M C – 627 **(a & b)** **(2 cr. h/** **Semester)**	**Nonlinear Waves and Solitons (1 & 2)** **الموجات اللاخطية والمتفردة (١ ، ٢)** Prerequisites: Undergraduate applied mathematics courses. Outline of contents: Mathematical development - Solitary and cnoidal waves - The KdV equation - Inverse scattering problem - Soliton solution of the KdV equation – Compactons.
M C – 628(a) **(2 cr. h)**	**Electromagnetic Theory (1)** **النظرية الكهرومغناطيسية (١)** Two dimensional potential distribution, Three dimensional potential distributions, Electric current, Magnetic interaction of currents.
M C – 628(b) **(2 cr. h)**	**Electromagnetic Theory (2)** **النظرية الكهرومغناطيسية (٢)** Electromagnetic induction, magnetism, plane electromagnetic waves, electromag-netic radiation, special relativity and the motion of charged particles.

M C – 629 (a & b) (2 cr. h/ Semester)	**Any Topic From Other Programs (1 & 2)** **أى مقرر من البرامج الأخرى (١ ، ٢)** Prerequisites: consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Theory of Relativity, Quantum Electrodynamics, Gauge Theory, Dynamics of Viscous Fluids, Gas Dynamics, Electromagnetic Induction, Advanced Methods of Mathematical Physics.

	3- M. Sc. Degree in Modern Applied Mathematics (M M)
M M – 640 (a & b) (2 cr. h/ Semester)	**Advanced Quantum Mechanics (1 & 2)** **ميكانيكا الكم المتقدمة (١ ، ٢)** Prerequisites: Undergraduate applied mathematics courses. Outline of contents: Relativistic wave mechanics: Klein-Gordon equations – Dirac equation – exclusion principle - Relativistic quantum mechanics: General aspects of symmetries in quantum mechanics - Quantum Lorentz transformations - The Poincaré algebra - One-particle states - Space inversion and time inversion and charge conjugation.
M M– 641(a) (2 cr. h)	**General of Relativity (1)** **نظرية النسبية (١)** Introduction: overview of special theory of relativity, relativistic electrodynamics, energy-momentum tensor – The basis of the general relativity: Mach's principle, principle of equivelance, principle if covariance, principle of minimal gravitational coupling, corresponding principle – Tensor analysis: tensor algebra and tensor density, affine connection and covariant differentiation, the Riemann tensor and the curvature tensor.
M M– 641(b) (2 cr. h)	**General of Relativity (2)** **نظرية النسبية (٢)** Einstein's field equations: general relativity field equations, perfect fluid and Newtonian limit, Schwarzchild solutions – Classical test of general relativity: the precession of the perihelion of Mercury, the bending of light, gravitational red shift – Cosmology: the Roberson-Walker Metric, Cosmological implications for general relativity.
M M– 642(a) (2 cr. h)	**Theory of Relativistic Quantum mechanics (1)** **نظرية ميكانيكا الكم النسبية(١)** Klein-Gordon equation, non-relativistic limit of klein-Gordon equation, Probability current in Klein-Gordon equation and its interpretation, linearization of the relativistic quantum mechanical equation and Dirac equation , the interprettation of the negative energy solution of Dirac equation , coveriont forms of Dirac equations , properties of the different types of the gamma matrices.
M M– 642(b) (2 cr. h)	**Theory of Relativistic Quantum mechanics (2)** **نظرية ميكانيكا الكم النسبية(٢)** Solution of the hedrogen atoss using Dirac eqation Applications.
M M– 643(a) (2 cr. h)	**Quantum field theory (1)** **نظرية المجالات الكمية (١)** Overview of particle physics, classical field theory, symmetric in physics and Noether's theorem, Klin-Gordisn equation, Dirac equation, predication of antiparticles, Dirac spinors and gamma matrices.
M M– 643(b) (2 cr. h)	**Quantum field theory (2)** **نظرية المجالات الكمية (٢)** Maxwell equation and electromagnetic fields, complex scalar fields in electromagnetic field, Dirac fields in electromagnetic field, the Yang-Mills fields, canonical quantization and particle interpretation.
M M– 644(a) (2 cr. h)	**Gauge theory (1)** **نظرية القدة (١)** Overview of particle physics, classical field theory, symmetry in physics and Noether,s theorem, klein – Gordan equation, Dirac equation, predication of antiparticles, Dirac spinors and gamma matrices, Maxwell equation and

	electromagnetic field , Dirac field in electromagnetic field, the Yong – Mills field, Realklein – Gordan fields , electromagnetic field.
M M– 644(b) (2 cr. h)	**Gauge theory (2)** **نظرية القدة (٢)** Path integral formulation, perturbation theory and S-Matrix, functional calculus, generating functional for scalar fields, free particles Green,s functions, generation functionals for interacting fields, Phi – 4 theory, scatterhng cross – section, propators and guage fields and folders –Popovmethod, self – energy operator and vertex function, word –Takhashi identities in QED, salavnov – taylor identities, ghosts and unitarity.
M M– 645(a) (2 cr. h)	**Symmetry Groups in Particle theorey (1)** **الزمر المتماثلة فى نظرية الجزيئيات (١)** Lie groups, in finitisemal generators of Lie groups, connected Lie groups, stracture constants, Lie algebras, abelian symmetries, study of the groups U(1), SU(2) and SU(3).
M M– 645(b) (2 cr. h)	**Symmetry Groups in Particle theorey (2)** **الزمر المتماثلة فى نظرية الجزيئيات (٢)** Lorenta transformations, Lorentz groups, double connectivety, lovering groups, Poncare algebra, translations and rotations, space inversion, time reversed and charge coujugation, symmetries and brokenuous lorentz group and isomorphism with $SU(2) \otimes SU(2)$.
M M – 646 (a & b) (2 cr. h/ Semester)	**Any Topic From Other Programs** **موضوعات مختارة من برامج أخرى**

	4- M. Sc. Degree in Statistical Mathematics (M S)
M S – 660(a) (2 cr. h)	**Advanced Probability (1)** **الاحتمالات المتقدمة (١)** Multidimensional random variables and their numerical characteristics, The law of large numbers, The strong law of large numbers, characteristic functions for multidimensional random variables, sum of independent random variables, moment generating function technique, distribution of sums of independent random variables, The transformation Y=g(x) and its Distribution, Probability Integral Transform.
M S – 660(b) (2 cr. h)	**Advanced Probability (2)** **الاحتمالات المتقدمة (٢)** The central limit theorem, the theory of infinitely divisible distribution laws, the theory of stochastic processes.
M S – 661(a) (2 cr. h)	**Measure Theory (1)** **نظرية القياس (١)** Systems of sets, Lebesque measure, generalized measures, measurable functions, theory of integration, applications.
M S – 661(b) (2 cr. h)	**Measure Theory (2)** **نظرية القياس (٢)** Measure in the product space, Fubini's theorem, absolute continuity, change of variables in Lebesgue integral, Lebesgue-Stiltjes integral, applications.
M S – 662(a) (2 cr. h)	**Time Series Analysis (1)** **تحليل السلاسل الزمنية (١)** Types of variation, stationary time series, time plot, transformations, Analyzing series which contain a trend, seasonal fluctuations, autocorrelation, tests of randomness, probability models for time series, estimating the auto covariance and autocorrelation functions, fitting an autoregressive process, fitting a moving average process.
M S – 662(b) (2 cr. h)	**Time Series Analysis (2)** **تحليل السلاسل الزمنية (٢)** Estimating the parameters of a mixed model, estimating the parameters of an integrated model, the Box- Jenkins seasonal model, residual analysis, general

	remarks on model building, introduction to forecasting, univariate procedures, multivariate procedures, a comparison of forecasting procedures, prediction theory.
M S – 663(a) **(2 cr. h)**	**Queueing Theory (1)** **نظرية الطوابير (١)** Markov Chains Defined. Transition Matrix, Discrete-Time Markov chains, Classification of Possible States, Continuous-Time Markov chains, The Birth-Death Process in Queueing, Basic Single Server Model with constant rates, Multiple Servers with an unlimited Queue, Other queueing Models, Theorem of Limiting Probabilities, Generalizing the DeMoivre-Laplace Theorem to a sequence of Chain Dependent Trials.
M S – 663(b) **(2 cr. h)**	**Queueing Theory (2)** **نظرية الطوابير (٢)** Selected topics will be chosen by the lecturer.
M S – 664(a) **(2 cr. h)**	**Markov Chains (1)** **سلاسل ماركوف (١)** Discrete-time Markov chains, recurrence and transience, convergence to equilibrium, Ergodic theorem, Q-matrices and their exponentials, continuous-time random walk, Poisson processes, jump chain and holding times, Explosion, Non-minimal chains.
M S – 664(b) **(2 cr. h)**	**Markov Chains (2)** **سلاسل ماركوف (٢)** Continuous-time Markov chains II, recurrence and transience, convergence to equilibrium, time reversal, Ergodic theorem, potential theory, electrical network, Brownian motion.
M S – 665(a) **(2 cr. h)**	**Advanced Stochastic Processes (1)** **العمليات العشوائية المتقدمة (١)** Basic theory of stochastic processes, discrete time Markov chains, continuous time Markov chains, second order processes, Brownian motions.
M S – 665(b) **(2 cr. h)**	**Advanced Stochastic Processes (2)** **العمليات العشوائية المتقدمة (٢)** Regularity of stochastic processes, convergence of random walk to Brownian motion, Brownian motion and its martingales, diffusion processes, stochastic integrals, stochastic differential equations, random time change and one dimensional diffusions, Brownian motion on the half-line, convergence of Markov chains to diffusions, reflected processes in higher dimensions.
M S – 666(a) **(2 cr. h)**	**Advanced Multivariate Statistics (1)** **الإحصاء المتقدمة فى أكثر من متغير (١)** Matrix algebra, multidimensional random variables, the multivariate normal distribution, samples from the multinormal population, correlation and regression, simultaneous inference about regression coefficients, inferences about the correlation matrix, samples with incomplete observations, tests of hypotheses on means and T -statistics, the case of two samples, the analysis of repeated measurements.
M S – 666(b) **(2 cr. h)**	**Advanced Multivariate Statistics (2)** **الإحصاء المتقدمة فى أكثر من متغير (٢)** Groups of repeated measurements, analysis of two independent groups, the power of tests on mean vectors, some tests with known covariance matrices, tests for outlying observations, testing the normality assumption, the multivariate general linear model, the multivariate analysis of variance, the multivariate analysis of covariance, multiple comparisons in the multivariate analysis of covariance, curve fitting for repeated measurements.
M S – 667(a) **(2 cr. h)**	**Advanced Non-Parametric Statistics (1)** **الإحصاء غير البارامترية المتقدمة (١)** Distribution of the order statistics, conditional distribution of the order statistics, the transformation F(x), Kolmogorov-Smirnov goodness-of-fit test, other goodness of fit tests, comparison of distributions, tests of randomness, one-sample singe test, the signed-rank test, asymptotic relative efficiency.
M S – 667(b)	**Advanced Non-Parametric Statistics (2)** **الإحصاء غير البارامترية المتقدمة (٢)**

(2 cr. h)	Inference concerning a cumulative distribution function, sample or empirical cumulative distribution function, confidence bands for cumulative distribution function, inference concerning quintiles, point and interval estimates of a quintile, tests of hypotheses concerning quintiles, tolerance limits, equality of two distributions, two-sample sign test, run test, median test, rank-sum test.
M S – 668(a) **(2 cr. h)**	**Advanced Sampling Theory (1)** **نظرية العينة المتقدمة (١)** Simple random sampling, sampling proportions and percentages, the estimation of sample size, stratified random sampling, ratio estimators.
M S – 668(b) **(2 cr. h)**	**Advanced Sampling Theory (2)** **نظرية العينة المتقدمة (٢)** Regression estimators, Systematic Sampling, Subsampling with units of equal sizes, Subsampling with units of unequal sizes.
M S – 669(a) **(2 cr. h)**	**Advanced Applied Statistics (1)** **الإحصاء التطبيقي المتقدم (١)** Probability distribution, generating random data, data summaries, classical univariate statistics, robust summaries, density estimation, bootstrap and permutation methods, an analysis of covariance example, model formulae and model matrices, regression diagnostics, robust and resistance regression, bootstrapping linear models, an unbalanced four-way layout, random and mixed effects.
M S – 669(b) **(2 cr. h)**	**Advanced Applied Statistics (2)** **الإحصاء التطبيقي المتقدم (٢)** Functions of generalized linear models, Binomial data, Poisson and multinomial models, A negative binomial family, Fitting non- linear regression models, Non-linear fitted model objects and method functions, Confidence intervals for parameters, General optimization and maximum likelihood estimation, Non-linear mixed effects models.
M S – 670(a) **(2 cr. h)**	**Advanced Experimental Design (1)** **تصميم التجارب المتقدم (١)** Principles of experimental design, Duncan's multiple range test, Latin squares and other orthogonal designs, Graeco-Latin squares, theory of variance stabilization, factorial experiments, general methods for computing coefficients for orthogonal designs.
M S – 670(b) **(2 cr. h)**	**Advanced Experimental Design (2)** **تصميم التجارب المتقدم (٢)** Experiments with many factors : confounding and fractional replication, confounding main effects-split-plot designs, criss-cross design, the analysis of covariance.
M S – 671(a) **(2 cr. h)**	**Life Testing and Reliability (1)** **أختبارات الحياة ونظرية الموثوقية (١)** Selected topics will be chosen by the lecturer.
M S – 671(b) **(2 cr. h)**	**Life Testing and Reliability (2)** **أختبارات الحياة ونظرية الموثوقية (٢)** Selected topics will be chosen by the lecturer.
M S – 672(a) **(2 cr. h)**	**Quality Control (1)** **سيطرة الجودة (١)** Statistical Quality Control, Control Charts for measurements, Control Charts for attributes, Acceptable sampling, Tolerance limits, Applications to Reliability, Exponential failure law, Simple serial systems, Simple active redundancy, Standby redundancy, Life testing, Reliability estimation with a known density form, Estimation with the exponential time to failure density, Demonstration and acceptance testing.
M S – 672(b) **(2 cr. h)**	**Quality Control (2)** **سيطرة الجودة (٢)** Selected topics will be chosen by the lecturer.
M S – 673(a) **(2 cr. h)**	**Advanced Bio-Statistics (1)** **الإحصاء البيولوجي المتقدم (١)** Normal distribution, T-distribution, χ^2-distribution, F -distribution, sampling error

	of a mean, a proportion, a variance a difference between two means, a ratio between two variances, comparison of two means, comparison of two proportions, comparison of two variances, Likelihood and Bayesian methods, regression and correlation, Sampling error in regression and correlation.
M S – 673(b) (2 cr. h)	**Advanced Bio-Statistics (2) الإحصاء البيولوجي المتقدم (٢)** The design of experiments, the size of a statistical investigation, tests of hypothesis, one-way analysis of variance, two-way analysis of variance.
M S – 674(a) (2 cr. h)	**Ecological Modeling (1) النمذجة البيئية (١)** Selected topics will be chosen by the lecturer.
M S – 674(b) (2 cr. h)	**Ecological Modeling (2) النمذجة البيئية (٢)** Selected topics will be chosen by the lecturer.
M S – 675(a) (2 cr. h)	**Advanced Estimation Theory (1) نظرية التقدير المتقدمة (١)** Mean squared error, consistency, efficiency, Reduction of variance, the method of moments, maximum Likelihood estimation, interval estimates.
M S – 675(b) (2 cr. h)	**Advanced Estimation Theory (2) نظرية التقدير المتقدمة (٢)** Methods of finding estimators, properties of point estimators, sufficiency, unbiased estimation, location or scale invariance, bayes estimators, vector of parameters, optimum properties of maximum-Likelihood estimation.
M S – 676 (2 cr. h)	**Biostatistics for Non-Mathematicians (M. Sc. Degrees & Diplomas)** **مقرر الإحصاء لطلبة تمهيدى الماجستير والدبلومات غير الإحصائيين** **Correlation and regression:** Correlation coefficient for ungrouped data – Correlation coefficient for grouped data Linear regression - Non-linear regression (Parabola - Exponential - Power). **Sampling distributions:** Sampling distribution of the Mean - Normal Distribution - t-Distribution - X-Distribution - F-Distribution - Sampling distribution of the difference of Means. **Statistical inference:** Classical method of estimation - Estimating of Mean – Estimating the difference between two Means - Estimating of Proportion - Estimating the difference between two Proportions - Estimating of the variance - Estimating of the ratio of two variances - Decision Theory. **Detests of hypotheses:** Statistical hypotheses - One-Tailed and Two-Tailed Tests – Tests concerning Means - Tests concerning Proportions - Tests concerning Variances – Tests concerning the difference between two Means - Tests concerning the difference between two Proportions - Tests concerning the ratio of two Variances. **Analysis of variance:** Analysis of Variance Technique - One-Way classification analysis of variance - Two-Way classification analysis of variance.

	5- M. Sc. Degree in Computational Mathematics (M C)
M C – 680 (a & b) (2 cr. h/ Semester)	**Mathematical Logic and its Applications to Computer Science (1 & 2)** **المنطق الرياضي لعلوم الحاسب (١ ، ٢)** Prerequisites: some knowledge of programming, logic, formal languages and abstract algebra. Outline of contents: Propositional logic, predicate logic, axiomatic theories, and theories with equality and induction. Interpretations, models, validity, proof. Automated deduction: polarity, skolemization, unification, resolution, equality. Strategies. Applications.
M C – 681 (a & b)	**Programming Languages and Compilers (1 & 2) لغات البرمجة والمترجمات (١ ، ٢)** Prerequisites: Undergraduate courses of compilers, operating systems, formal

(2 cr. h/ Semester)	languages and some expertise in programming. Outline of contents: Survey of programming languages. The design of modern programming languages. Principles and techniques of scanning, parsing, semantic analysis, and code generation. Implementation of compilers, interpreters, and assemblers. Overview of run-time organization and error handling.
M C – 682 (a & b) (2 cr. h/ Semester)	**Distributed Systems (1 & 2)** **النظم الموزعة (١ ، ٢)** Prerequisites: Undergraduate courses of operating systems and programming. Outline of contents: Distributed shared memory, object-oriented distributed system design, distributed directory services, atomic transactions and time synchronization, file access, process scheduling, process migration and remote procedure call focusing on distribution, scale, robustness in the face of failure, and security.
M C – 683 (a & b) (2 cr. h/ Semester)	**Parallel Systems (1 & 2)** **النظم المتوازية (١ ، ٢)** Prerequisites: Undergraduate courses of operating systems and programming and numerical analysis. Outline of contents: Parallel programming methods; distributed-memory model; shared-memory model with threads using open MP; object-based models using a problem-solving environment with parallel objects. Parallel numerical algorithms: numerical methods for linear algebraic systems, such as LU decomposition, QR method, Lanczos and Arnoldi methods, pseudospectra, CG solvers. Parallel implementations of numerical methods for PDEs, including finite-difference, finite-element, and shock-capturing schemes; particle-based simulations of complex systems. Implementation of adaptive mesh refinement. Grid-based computing, load balancing strategies.
M C – 684 (a & b) (2 cr. h/ Semester)	**Database Systems (1 & 2)** **نظم قواعد البيانات (١ ، ٢)** Prerequisites: Undergraduate courses of operating systems and database systems. Outline of contents: File organization and access, buffer management, performance analysis, and storage management. Database system architecture, query optimization, transaction management, recovery, concurrency control. Reliability, protection, and integrity. Design and management issues.
M C – 685 (a & b) (2 cr. h/ Semester)	**Theory of Computation (1 & 2)** **نظرية الحسابات (١ ، ٢)** Prerequisites: First course in mathematical logic and in the theory of algorithms. Outline of contents: Computability and computational complexity theory. Regular and context-free languages. Decidable and undecidable problems, reducibility, Turing machines, recursive function theory. Time and space measures on computation, completeness, hierarchy theorems, inherently complex problems, oracles, probabilistic computation, and interactive proof systems.
M C – 686 (a & b) (2 cr. h/ Semester)	**Theory of Complexity (1 & 2)** **نظرية التعقد (١ ، ٢)** Prerequisites: First course in mathematical logic and in the theory of algorithms. Outline of contents: Complexity classes and their properties, P and NP problems; reductions and complete problems; concrete representative problems from important complexity classes. Techniques for establishing limits on the possible efficiency of algorithms, and concrete lower bounds based on the following models of computation: decision trees, straight line programs, communication games, branching programs, PRAMs, Boolean circuits. Approximation algorithms and the complexity of approximations. Pseudorandomness and cryptography.
M C – 687 (a & b) (2 cr. h/ Semester)	**Cryptography (1 & 2)** **التشفير (١ ، ٢)** Prerequisites: Basic undergraduate course of algebra, knowledge of networks. Outline of contents: Encryption (single and double key), digital signatures, pseudo-random bit generation, authentication, electronic commerce (anonymous cash,

	micro payments), key management, PKI, zero-knowledge protocols. Elliptic curve systems, threshold cryptography, security analysis using random oracles, lower and upper bounds on factoring and discrete log.
M C – 688 (a & b) (2 cr. h/ Semester)	**Information Security (1 & 2)** **تأمين المعلومات (١ ، ٢)** Prerequisites: Basic undergraduate course of Algebra and some knowledge of computer networks. Outline of contents: physical security; discretionary and mandatory access control; biometrics; information-flow models of security; covert channels; elementary cryptography; public-key cryptography; logic of authentication; electronic cash; viruses; firewalls; electronic voting; risk assessment; secure web browsers.
M C – 689 (a & b) (2 cr. h/ Semester)	**Abstract Algebra with Applications in Computer Science (1 & 2)** **الجبر المجرد وتطبيقاته في علوم الحاسب (١ ، ٢)** Prerequisites: Basic undergraduate course of algebra. Outline of contents: Finite Fields and vector spaces over them, theory of equations on finite fields, applications in coding, cryptography and pseudo-random sequences.
M C – 690 (a & b) (2 cr. h/ Semester)	**Image Processing (1 & 2)** **معالجة الصور (١ ، ٢)** Prerequisites: Undergraduate course of real analysis and programming. Outline of contents: Convolution, Fourier series and transforms, sampling and discrete-time processing of continuous-time signals, modulation, Laplace and Z-transforms, and feedback systems. Representation, analysis, and design of two-dimensional signals and systems. Discrete Fourier transform, discrete cosine transform, and fast Fourier transform algorithms. Image processing basics. Image enhancement. Image restoration. Image coding.
M C – 691 (a & b) (2 cr. h/ Semester)	**Artificial Intelligence (1 & 2)** **الذكاء الاصطناعي (١ ، ٢)** Prerequisites: Undergraduate courses of Logic and the theory of algorithms. Outline of contents: Heuristic search, problem solving, game playing, knowledge representation, logical inference, planning, reasoning under uncertainty, expert systems, learning, perception, language understanding.
M C – 692(a) (2 cr. h)	**Special Topics in Computational Methods** **موضوعات مختارة في الطرق الحسابية (١)** Prerequisites: Consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Computational Geometry, Algebraic Algorithms, Randomness and Computation, Symbolic Programming, Computational Genomics, Advanced Methods in Matrix Computation.
M C – 692(b) (2 cr. h)	**Special Topics in Computer Sciences** **موضوعات مختارة فى علوم الحاسب (٢)** Prerequisites: Consent of the instructor. Outline of contents: One or two subjects are treated in depth from: Computer Vision, Learning Theory, Design of Programming Languages, Computer Graphics, Genetic Algorithms.

2- Physics Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(P)	Diploma (500)	1- Nuclear Reactors	(PNR)
		2- Radiation Physics	(PR)
		3- Solar Energy	(PSE)
		4- Material Science	(PM)
		5- Computational Physics	(PC)
	M. SC. (600)	1- Theoretical Physics	(PT)
		2- Nuclear Physics	(PN)
		3- Solid State Physics	(PS)
		4- Experimental Physics	(PE)
	Ph. D. (700)	1- Theoretical Physics	(PT)
		2- Nuclear Physics	(PN)
		3- Solid State Physics	(PS)
		4- Experimental Physics	(PE)

1-Diploma in Nuclear Reactors (PNR)

Code	Course Number	Course Case	CR. Hours
(PNR)	The candidate studies (10) courses in table (1)	Compulsory	24
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PNR 501	Quantum Mechanics	3	3	
	PNR 502	Theory of Reactors	3	3	
	PNR 503	Reactors and Neutrons	3	3	
	PNR 504	Physics of Nuclear Safety	3	3	
	PNR 505	Experimental studies (1)	2	2	
Second	PNR 506	Experimental studies (2)	2	2	
	PNR 507	Reactors Heat Transfer	2	2	
	PNR 508	Detectors and Nuclear Devices	2	2	Also offered by Radiatn
	PNR 509	Computer	2	2	
	PR 527	Plasma Physics	2	2	
	The Total Cr.h. Required		24	--	

Note:- the code No. of the branch: from 501 to 519
From 510to 519 are codes No. for adding new courses

2-Diploma in Radiation physics (PR)

Code	Course Number	Course Case	CR. Hours
(PR)	The candidate studies (10) courses in table (1)	Compulsory	24
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PR 520	Nuclear Physics	3	3	
	PR 521	Physics of Radiology	3	3	
	PR 522	Mathematical Physics	3	3	
	PR 523	Measurements of Doses	3	3	
	PR 524	Experimental studies(1)	2	2	
Second	PR 525	Experimental studies (2)	2	2	
	PR 526	Neutron Physics	2	2	
	PR 527	Detectors and Nuclear Devices	2	2	Also offered by Reactors.
	PNR 508	Plasma Physics	2	2	
	PNR 509	Computer	2	2	
		The Total Cr.h. Required	24	--	

Note:- the code No. of the branch: from 520 to 539
From 528to 539 are codes No. for adding new courses

3-Diploma in Solar Energy (PSE)

Code	Course Number	Course Case	CR. Hours
(PSE)	The candidate studies (12) courses in table (1)	Compulsory	24
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PSE 540	Semiconductors	2	2	Also offered by Material
	PSE 541	Photovoltaic Transfer	2	2	
	PSE 542	Thin Films	2	2	
	PSE 543	Utilization of Energy	2	2	
	PSE 544	Heat Transfer	2	2	
	PSE 545	Experimental Studies (1)	2	2	
Second	PSE 546	Experimental Studies (2)	2	2	
	PSE 547	Energy Storage	2	2	
	PSE 548	Mass Transfer	2	2	
	PSE 549	Nature of Radiation	2	2	
	PSE 550	Technology of Heating and Cooling	2	2	
	PM 560	Material Science	2	2	Also offered by Material
		The Total Cr.h. Required	24	--	

Note:- the code No. of the branch: from 540 to 559
From 551to 559 are codes No. for adding new courses

4-Diploma in Material Science (PM)

Code	Course Number	Course Case	CR. Hours
(PM)	The candidate studies (12) courses in table (1)	Compulsory	24
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PM 560	Material Science	2	2	Also offered by Solar.
	PM 561	Crystal Growth	2	2	
	PM 562	Symmetry and Lattice Dynamics of Materials	2	2	
	PM 563	Electron Microscope	2	2	
	PM 564	Experimental Studies(1)	2	2	
	PSE 540	Semiconductors	2	2	Also offered by Solar.
Second	PM 565	Experimental Studies (2)	2	2	
	PM 566	Modern Electronics	2	2	
	PM 567	Atomic and Molecular Spectra	2	2	
	PM 568	Magnetic Properties of Materials	2	2	
	PM 569	Properties of Superconducting Materials	2	2	
	PM 570	Technology of Nanometric Materials	2	2	
		The Total Cr.h. Required	24	--	

Note:- the code No. of the branch: from 560 to 579
From 571to 579 are codes No. for adding new courses

5-Diploma in Computational Physics (PC)

Code	Course Number	Course Case	CR. Hours
(PC)	The candidate studies (12) courses in table (1)	Compulsory	24
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	PC 580	Information Technology	2	2
	PC 581	Multimedia and Web Design	2	2
	PC 582	Programming with FORTRAN	2	2
	PC 583	Digital System Design	2	2
	PC 584	Communication and Optical Fibers Technology	2	2
	PC 585	Experimental Studies (1)	2	2
Second	PC 586	Experimental Studies (2)	2	2
	PC 587	Digital Electronic Circuits	2	2
	PC 588	Methods of Computational Science	2	2
	PC 589	Solution of Physical Problems using C++	2	2
	PC 590	Modeling and Simulation	2	2
	PC 591	Mont Carlo Methods and Simulations	2	2
		The Total Cr.h. Required	24	--

Note:- the code No. of the branch: from 580 to 598
From 592to 598 are codes No. for adding new courses

1- M. Sc. Degree in Theoretical Physics (PT)

Code	Course Number	Course Case	CR. Hours
(PT)	The candidate Studies (7) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	P 601	Advanced Quantum Mechanics	2	2	Also offered by all gps.
	P 602	Mathematical Physics.	2	2	
	P 603	Numerical Analysis and Computational Physics	2	2	
	P 604	Experimental Physics	2	2	
Second	PT 610	Quantum Field Theory	2	2	
	PT 611	Theory of Molecular Spectra	2	2	
	PT 612	Group Theory and its Applications	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PT 613	Theoretical Nuclear Physics	2	2	
	PT 614	Theoretical Condensed Matter Physics	2	2	
Second	PT 615	Elementary Particles and String Theory	2	2	
	PT 616	Selected Topics in Theoretical Physics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 610 to 629
From 617 to 629 are codes No. for adding new courses

2- M. Sc. Degree in Nuclear Physics (PN)

Code	Course Number	Course Case	CR. Hours
(PN)	The candidate studies (7) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	P 601	Advanced Quantum Mechanics	2	2	Also offered by all gps.
	P 602	Mathematical Physics.	2	2	
	P 603	Numerical Analysis and Computational Physics	2	2	
	P 604	Experimental Physics	2	2	
Second	PN 630	Elementary Particles	2	2	
	PN 631	Experimental Nuclear Reactions	2	2	
	PN 632	Nuclear Scattering	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PN 633	Reactors and Neutrons	2	2	
	PN 634	Nuclear Electronics	2	2	
	PN 635	Nuclear accelerators	2	2	
Second	PN 636	Nuclear Spectra	2	2	
	PN 637	Detectors and Nuclear Devices	2	2	
	PN 638	Selected Topics in Nuclear Physics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 630 to 649
From 639 to 649 are codes No. for adding new courses

3- M. Sc. Degree in Solid State Physics (PS)

Code	Course Number	Course Case	CR. Hours
(PS)	The candidate studies (8) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	P 601	Advanced Quantum Mechanics	2	2	Also offered by all gps.
	P 602	Mathematical Physics.	2	2	
	P 603	Numerical Analysis and Computational Physics	2	2	
	P 604	Experimental Physics	2	2	
Second	PS 650	Properties of Insulators	1	2	
	PS 651	Relaxation Theory	2	2	
	PS 652	Semiconductors	2	2	
	PS 653	Nuclear Magnetism	1	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PS 654	Crystal Growth	2	2	
	PS 655	Electron Microscope	2	2	
	PS 656	Physics of Polymers	2	2	
Second	PS 657	Thin Films	2	2	
	PS 658	Lattice Imperfections	2	2	
	PS 659	Radiation Damage in Solids	2	2	
	PS 660	Selected Topics in Condensed Matter Physics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 650 to 669
From 661 to 669 are codes No. for adding new courses

4- M. Sc. Degree in Experimental Physics (PE)

Code	Course Number	Course Case	CR. Hours
(PE)	The candidate studies (7) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	P 601	Advanced Quantum Mechanics	2	2	Also offered by all gps.
	P 602	Mathematical Physics.	2	2	
	P 603	Numerical Analysis and Computational Physics	2	2	
	P 604	Experimental Physics	2	2	
Second	PE 670	Atomic and Molecular Spectra	2	2	
	PE 671	Laser Physics	2	2	
	PE 672	Quantum and Nonlinear Optics	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PE 673	Plasma Physics	2	2	
	PE 674	Modern Electronics	2	2	
	PE 675	Interaction of Radiation With Matter	2	2	
	PE 676	Optoelectronics	2	2	
Second	PE 677	Chemical Physics and Liquid Crystals	2	2	
	PE 678	Mass Spectrometer	2	2	
	PE 679	Vacuum Technology	2	2	
	PE 680	Selected Topics in Experimental Physics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 670 to 689
From 681 to 689 are codes No. for adding new courses

1- Ph. D. Degree in Theoretical Physics (PT)

Table (1)

Code	Course Number	Course Case	CR. Hours
(PT)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PT 701	Gauge Theory of Elementary particle Physics	2	2	Also offered by Nuclear Phys.
	PT 702	Introduction to Computer Simulation	2	2	
	PT 703	Elementary Particles	2	2	
	PT 704	Quantum Chromodynamics	2	2	
	PT 705	String Theory	2	2	
	PT 706	Selected Topics in Theoretical Physics	2	2	
Second	PN 720	Theoretical Nuclear and Sub nuclear Physics	2	2	Also offered by Nuclear Phys.
	PN 721	The Relativistic Nuclear Many-Body problem	2	2	
	PN 722	Quarks and Leptons	2	2	
	PN 723	Introduction to High Energy Heavy-Ion Collision	2	2	
	PN 724	Computational Nuclear Physics	2	2	
	PN 725	Direct Nuclear Reaction	2	2	
	PN 726	Nuclear Structure Theory	2	2	
	PN 727	Accelerators and Colliders	2	2	
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 701 to 719
From 707 to 719 are codes No. for adding new courses

2- Ph.D. Degree in Nuclear Physics (PN)

Table (1)

Code	Course Number	Course Case	CR. Hours
(PN)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PN 720	Theoretical Nuclear and Sub nuclear Physics	2	2	Also offered by Theoretical Physics.
	PN 721	The Relativistic Nuclear Many-Body problem	2	2	
	PN 722	Quarks and Leptons	2	2	
	PN 723	Introduction to High Energy Heavy-Ion Collision	2	2	
	PN 724	Computational Nuclear Physics	2	2	
	PN 725	Direct Nuclear Reaction	2	2	
	PN 726	Nuclear Structure Theory	2	2	
	PN 727	Accelerators and Colliders	2	2	
Second	PN 728	Selected Topics in Nuclear Physics	2	2	
	PT 701	Gauge Theory of Elementary particle Physics	2	2	Also offered by Theoretical Physics.
	PT 702	An Introduction to Computer Simulation	2	2	
	PT 703	Elementary Particles	2	2	
	PT 704	Quantum Chromodynamics	2	2	
	PT 705	String Theory	2	2	
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 720 to 739
From 729 to 739 are codes No. for adding new courses

3- Ph.D. Degree in Solid State Physics (PS)

Table (1)

Code	Course Number	Course Case	CR. Hours
(PS)	The candidates chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PS 740	Many Body Theory of Solids	2	2	Also offered by Exp. Physics
	PS 741	Electric and Electromagnetic properties of Solids	2	2	
	PS 742	Phase Transformation	2	2	
	PS 743	Spectroscopic Methods of Analysis	2	2	
	PS 744	Quantum Processes in Semiconductor	2	2	
	PS 745	Semiconductor Optoelectronic Devices	2	2	
	PS 746	Magnetic Properties of Ordered Substances	2	2	
Second	PS 747	Surface Physics	2	2	Also offered by Exp. Physics
	PS 748	Group theory and its application in Solid State Physics	2	2	
	PS 749	Advanced Methods of Structural Investigations	2	2	
	PS 750	Selected Topics in Condensed Matter Physics	2	2	
	PE 760	Low-Noise-Electronic Measurement and Experimental Automation	2	2	Also offered by Exp. Physics
	PE 761	Ultra fast Lasers	2	2	
	PE 762	Physics of Nanometric Materials	2	2	
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 740 to 759
From 751 to 759 are codes No. for adding new courses

4- Ph.D. Degree in Experimental Physics (PE)

Table (1)

Code	Course Number	Course Case	CR. Hours
(PE)	The candidates chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	PS 740	Many Body Theory of Solids	2	2	Also offered by Solid State Physics
	PS 741	Electric and Electromagnetic properties of Solids	2	2	
	PS 742	Phase Transformation	2	2	
	PS 743	Spectroscopic Methods of Analysis	2	2	
	PS 744	Quantum Processes in Semiconductor	2	2	
	PS 745	Semiconductor Optoelectronic Devices	2	2	
	PS 746	Magnetic Properties of Ordered Substances	2	2	
Second	PS 747	Surface Physics	2	2	
	PS 748	Group theory and its application in Solid State Physics	2	2	
	PS 749	Advanced Methods of Structural Investigations	2	2	
	PE 760	Low-Noise-Electronic Measurement and Experimental Automation	2	2	
	PE 761	Ultra Fast Lasers	2	2	
	PE 762	Physics of Nanometric Materials	2	2	
	PE 763	Selected Topics in Experimental Physics	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 760 to 779
From 764 to 779 are codes No. for adding new courses

B- Course contents of Diploma

Code No.	Course name and contents
	1- Diploma in Nuclear Reactors (P NR)
P NR - 501 (3 cr. h)	**Quantum Mechanics** **مكيانيكا الكم** Review of the basic concept and assumption of Quantum Mechanics– The angular momentum and the spin – Identical particles– Relativistic wave equation for spin 0- particles.
P NR – 502 (3 cr. h)	**Theory of Reactors** **نظرية مفاعلات** The Nuclear Chain Reaction – Neutron diffusion – The Critical equation – The Non-Steady Nuclear Reactors – Condition affecting the Reactivity.
P NR – 503 (3 cr. h)	**Reactors and Neutrons** **مفاعلات و نيوترونات** Neutron Reactions – Nuclear Fission – Thermal Neutrons – Nuclear Chain Reaction – Neutron diffusion – The Critical equation.
P NR – 504 (3 cr. h)	**Physics of Nuclear Safety** **فيزياء الأمان النووى** The Structure of matter – Atomic theory of matter – Radio activity and X- rays – Interaction of radiation with matter – Radiation dosimetry – Basic standards of radiation protection – Protection against internal radiation – Protection against external radiation –Radiation Protection measurements.
P NR – 505 (2 cr. h)	**Experimental Studies (1)** **دراسات معملية (١)** **Experimental Study of absorption spectrum of nuclear radiation – Study of some special effects like back scattering – Characteristics of nuclear detectors and dosimetry.**
P NR – 506 (2 cr. h)	**Experimental Studies (2)** **دراسات معملية (٢)** ***Detectors (G.M., scintillation, semiconductor, plastic, sensitive films), Statistical and error treatment, absorption of alpha, beta and gamma, Data acquisition, collimated and broad beams, simple gamma spectrum, alpha and beta spectrum, X-ray spectrum, Analysis and modeling of data, Multi-channel analyzer, Complex gamma spectrum and Computer packages to study the absorption and transport of radiation in matter.***
P NR – 507 (2 cr. h)	**Reactors Heat transfer** **انتقال حرارة مفاعلات** **Thermal problems in reactor design– Heat Source in reactor systems – Differential equations of heat transfer– Heat generation in fuel elements – Thermal stresses in reactor components and some examples with uniform and exponential heat source.**
P NR – 508 (2 cr. h)	**Detectors and Nuclear Devices** **كاشفات و أجهزة نووية** ***The course deals with nuclear detectors (gas– solid) Scintillation and other special types – Nuclear instruments like ADC–DCA–TAC gates.***
P NR – 509 (2 cr. h)	**Computer** **حاسب آلى** ***Hardware structure– Networking concepts of programming languages – Flow Charts – Data Acquisition – Data Filling – Computational Analysis***

	2- Diploma in Radiation Physics (P R)
P R – 520 **(3 cr. h)**	**Nuclear physics** **فيزياء نووية** The nuclear-nuclear interaction – Nuclear models – Fission.
P R – 521 **(3 cr. h)**	**Physics of Radiology** **علم الأشعة** Radiation and matter – Gamma transitions – Alpha Decay – Beta Decay.
P R – 522 **(3 cr. h)**	**Mathematical Physics** **فيزياء رياضية** Ordinary and Partial differential equation – Harmonics (with special functions) – Laplace transform – Fourier series, Integral and Transforms – Probability and Statistics.
P R – 523 **(3 cr. h)**	**Measurements of Doses** **قياس جرعات** Calculation of Doses – Radiation Hazards and Protection – Measurement of Doses – External Radiation Protection – Lasers – Radio Frequency and Microwaves.
P R – 524 **(2 cr. h)**	**Experimental Studies (1)** **دراسات معملية (١)** Experimental Study of absorption spectrum of nuclear radiation – Study of some special effects like back scattering – Characteristics of nuclear detectors and dosimetry.
P R – 525 **(2 cr. h)**	**Experimental Studies (2)** **دراسات معملية (٢)** Detectors (G.M., scintillation, semiconductor, plastic, sensitive films), Statistical and error treatment, absorption of alpha, beta and gamma, Data acquisition, collimated and broad beams, simple gamma spectrum, alpha and beta spectrum, X-ray spectrum, Analysis and modeling of data, Multi-channel analyzer, Complex gamma spectrum and Computer packages to study the absorption and transport of radiation in matter.
P R – 526 **(2 cr. h)**	**Neutrons Physics** **فيزياء النيوترونات** Neutron Reactions – Nuclear Fission – Thermal Neutrons – Nuclear chain Reaction – Neutron Diffusion – The Critical equation.
P R – 527 **(2 cr. h)**	**Plasma Physics** **فيزياء بلازما** Single particle motions– Plasma as fluids – Introduction to plasma physics.

	3- Diploma in Solar Energy (P S)
P S – 540 **(2 cr. h)**	**Semiconductors** **أشباه موصلات** Different types of Semiconductors – Carrier transport Phenomena and application semiconductors – The electrical properties of Semiconductors– Optical properties of Semiconductors – Semiconductor devices and Integrated circuits.
P S – 541 **(2 cr. h)**	**Photovoltaic transfer** **تحويل فوتوفولطى** Solar cells and Sunlight – Review of Semiconductor Properties – Efficiency limits, losses and Measurements – Standard Silicon solar cell Technology – Improved Silicon solar cell Technology – Design of Silicon solar cells.
P S – 542 **(2 cr. h)**	**Thin Films** **أغشية رقيقة** Different Methods of Preparation Thin Films – The optical properties of thin films – Different types of coating – Different Methods of measuring reflectance and transmittance.
P S – 543 **(2 cr. h)**	**Utilization of energy** **أستخدامات الطاقة** The conversion of solar heat into work by beans of three thermodynamic cycles– The direct conversion of sunlight into electricity depending upon photoelectric, thermoelectric and thermo ionic effects.
P S – 544 **(2 cr. h)**	**Heat transfer** **تحويل حرارى** Theory of heat conduction, Steady and unsteady conduction – Heat conduction

	with moving boundaries – Free convection, mixed free and forced convection – Thermal radiation properties.
P S – 545 **(2 cr. h)**	**Experimental Studies (1)** **دراسات معملية (١)** Solar cell (I), Solar cell (II), Solar modul (I), Solar modul (II), Solar heater (I), Solar heater (II), Solar Crop dryer, Solar pump and Solar distelator.
P S – 546 **(2 cr. h)**	**Experimental Studies (2)** **دراسات معملية (٢)** Solar cell(III), Solar cell(III), solar heater(III), Heat transfere(I), Hydrogen production(I), Hydrogen production (II), Thermal conductivity (I) and Thermal conductivity (II) .
P S – 547 **(2 cr. h)**	**Energy Storage** **تخزين طاقة** Solar thermal energy –Hydropower and Hydroelectric systems – Power from the wind and turbine types – Ocean thermal energy conversion – Geothermal energy-the importance of storage.
P S – 548 **(2 cr. h)**	**Mass Transfer** **انتقال كتلى** Basic equation of two component gas mixtures – application to humid air – Diffusion laws – The mass transfer coefficient – Laminar boundary layer on a flat plate with mass and heat transfer.
P S – 549 **(2 cr. h)**	**Nature of Radiation** **طبيعة إشعاع** The Physical principle of electromagnetic radiation – Classification of radiation and its uses in solar energy – Interaction of radiation with matter – Technology of heating of radiation.
P S – 550 **(2 cr. h)**	**Technology of Heating and Cooling** **تكنولوجيا التسخين و التبريد** Passive solar and cooling system – Study the alternative methods of thermal storage and study the appropriate design parameters – Study the high cooling concepts of different solar cooling systems.

	4- Diploma in Material Science (P M)
P M – 560 **(2 cr. h)**	**Material Science** **علم المواد** The crystal structure – Crystal symmetry-lattice imperfection in solids – Mechanical properties of solids – Creep and Fatigue of solids – Electrical and magnetic properties of solids.
P M – 561 **(2 cr. h)**	**Crystal Growth** **انماء بللورى** Crystal growth from Solutions - Crystal growth from the melt - Crystal growth from vapor.
P M – 562 **(2 cr. h)**	**Symmetry and Lattice Dynamics of Materials** **تماثل و ديناميكا الشبكية للمواد** Crystal systems and elements of symmetry (32 point groups) – Space Groups – X-ray diffraction from crystals – Electron and Neutron Diffraction – Reciprocal lattice.
P M – 563 **(2 cr. h)**	**Electron Microscope** **ميكروسكوب الكترونى** Microscopy with light electrons – the electron microscopy family (TEM, SEM and STEM) – The specimen preparation and interpretation of micrographs – Specialized Techniques in electron microscopy – Examples of the use of electron microscopy.
P M – 564 **(2 cr. h)**	**Experimental Studies (1)** **دراسات عملية (١)** Some advanced experiments in heat transfer and energy storage by free convection and thermal radiation.
P M – 565 **(2 cr. h)**	**Experimental Studies (2)** **دراسات عملية (٢)** Some advanced experiments in heat transfer and energy storage by free convection and thermal radiation.
P M – 566	**Modern Electronics** **الكترونيات حديثة**

(2 cr. h)	Number systems – Digital electronics – Nanoelectronics – Data Acquisition.
P M – 567 **(2 cr. h)**	**Atomic and Molecular Spectra** **اطياف ذرية و جزيئية** Atomic structure – L-S coupling – Normal Zee man effect – Anomalous Zee man effect – Stark effect – Spectra of many electron atoms – Molecular orbits – Schrödinger equation for H2+ - Rotational, Vibrational and Electronic spectra – Microwave spectra – Infrared spectra – Visible and ultraviolet spectra.
P M – 568 **(2 cr. h)**	**Magnetic Properties of Materials** **الخواص المغناطيسية للمواد** Classifications of magnetic materials – Nuclear magnetic resonance (NMR) – Electron spin resonance (ESR) – Adiabatic Demagnetization.
P M – 569 **(2 cr. h)**	**Properties of Superconducting Materials** **خواص المواد فائقة التوصيل** The different modern theories of superconducting materials – electrical and magnetic properties of superconductors.
P M – 570 **(2 cr. h)**	**Technology of Nanometric Materials** **تكنولوجيا المواد النانونية** Physical chemistry of solid surfaces – One-Dimensional Nanostructures - Two - Dimensional Nanostructures.

	5- Diploma in Computional Physics (P C)
P C – 580 **(2 cr. h)**	**Information Technology** **تكنولوجيا المعلومات** An introduction to cutting edge information technologies– hardware– software – conceptual models that impact the way leaders make decisions.
P C – 581 **(2 cr. h)**	**Multimedia and Web Design** **وسائط متعددة و تصميم صفحات الويب** Basic Multimedia concepts (graphics – audio – Video) – Internet concepts – (Design– development – publishing of web pages – interactive web pages.
P C – 582 **(2 cr. h)**	**Programming with FORTRAN** **البرمجة بأستخدام لغة الفورتران** Introduction to computer concepts and structures– Problem solving and algorithm implementation using the FORTRAN programming language.
P C – 583 **(2 cr. h)**	**Digital System Design** **تصميم انظمة رقمية** Digital design methodology and techniques – control and timing – machine organization – instruction sequencing and data for flow control.
P C – 584 **(2 cr. h)**	**Communication and Optical Fiber Technology** **الإتصالات و تكنولوجيا الألياف الضوئية** Introduction to Physical Optics –The Physical Principle of Optical Fibers– The Technological application of Optical Fibers– The uses of Optical Fibers in Communication.
P C – 585 **(2 cr. h)**	**Experimental Studies (1)** **دراسات عملية (١)** The use of computers as data acquisition systems – coupling tasks to micro and mini- computers – controlling single and integrated systems and processes – Development of software and integration of existing digital and analog devices – Applications by means of the case study method.
P C – 586 **(2 cr. h)**	**Experimental Studies (2)** **دراسات عملية (٢)** Introduction to computer Communication through parallel port – serial port – UBS and Data acquisition cards.
P C – 587 **(2 cr. h)**	**Digital electronic Circuits** **دوائر الكترونية رقمية** Physics of Semiconductors – the Free- Electron Model – Energy bands inheory solids – Semiconductors theory – Semiconductors Devices.
P C – 588 **(2 cr. h)**	**Methods of Computational Science** **طرق العلوم الحسابية** Computer representation – Numerical differential – Numerical integration– Ordinary differential equations – Fourier transforms –Monte Carlo Simulation.
P C – 589	**Solution of Physical Problems Using C ++**

(2 cr. h)	**حل المسائل الفيزيائية بأستخدام السى بلس بلس** Programming language and graphics tools –Deterministic methods of simulating Physical systems – Monte Carlo techniques Application to Molecular dynamics – Numerical integration – Physics problem-Mass – Center-of - mass– Moment of inertia.
P C – 590 **(2 cr. h)**	**Modeling and Simulation** **النمذجة و المحاكاة** The Modeling and Simulation of Physical systems –Applying software methodologies to the solution of Physical problems – Lectures will typically involve a short review of some physics topic.
P C – 591 **(2 cr. h)**	**Mont Carlo Methods and Simulation** **طرق و محاكاة مونت كارلو** Monte Carlo, Random number Generators – Monte Carlo integration – the Metropolis Algorithm – Thermodynamic Averages– Molecular Dynamics – The Model and Method (the Physics)– Project- Quantum Monte Carlo Calculation .

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Theoretical Physics (P T)
P – 601 **(2 cr. h)**	**Advanced Quantum Mechanics** **مكيانيكا الكم المتقدمة** The Formal Theory of Scattering – Identical Particles – Applications of Second Quantization – Photon and the Electromagnetic Field – Relativistic Electron Theory – One-Electron Dirac Theory.
P – 602 **(2 cr. h)**	**Mathematical Physics** **فيزياء رياضية** Curved Coordinate – Tensors – Functions of a complex variable – Differential Equation – Group Theory.
P – 603 **(2 cr. h)**	**Numerical Analysis and Computational Physics** **تحليل عددي وفيزياء حسابية** Numerical differential and integration – Solution of ordinary differential equations – Boundary value and Eigen value problems – Matrix operations.
P – 604 **(2 cr. h)**	**Experimental Physics** **فيزياء عملية** Some Advanced experiments in nuclear and Solid State Physics.
P T – 610 **(2 cr. h)**	**Quantum Field Theory** **نظرية الكم للمجالات** Klein- Gordon equation – Dirac equation – Spin-1 Fields – Second Quantization – Matrix Expansions– Feynman diagrams – Some Elementary Processes.
P T – 611 **(2 cr. h)**	**Theory of Molecular Spectra** **نظرية الأطياف الجزيئية** Molecular Orbits – Schrödinger equation for H_2^+– Rotational, Vibrational & Electronic Spectra – Microwave Spectra – Infrared Spectra – Visible and ultraviolet Spectra.
P T – 612 **(2 cr. h)**	**Group Theory and its Applications** **نظرية الزمرات وتطبيقاتها** Group Theory– Some Important Group Theory – The Application of group theory in Solid and nuclear physics.
P T – 613 **(2 cr. h)**	**Theoretical Nuclear Physics** **فيزياء نووية نظرية** The nuclear-nuclear interaction – Nuclear models – Fission – Nuclear Astrophysics.
P T – 614 **(2 cr. h)**	**Theoretical Condensed Matter Physics** **فيزياء المواد المكثفة النظرية** Band theory and Crystal symmetry – Collective effects in solids – Lattice waves – Spin and Orbital magnetism – Interaction of particles and crystals.
P T – 615 **(2 cr. h)**	**Elementary Particles and String Theory** **جسيمات أولية ونظرية الأوتار** Four forces and Cosmic Rays– Pions & Muons – Strange Particles – Quarks – String Theory – String Interactions.

P T – 616 **(2 cr. h)**	**Selected Topics in Teoretical physics** **موضوعات مختارة فى الفيزياء النظرية**

	2- M. Sc. Degree in Nuclear Physics (P N)
P N – 630 **(2 cr. h)**	**Elementary Particles** **جسيمات اولية** Four forces and Cosmic Rays– Pions & Muons – Strange Particles – Quarks.
P N – 631 **(2 cr. h)**	**Experimental Nuclear Reactions** **تفاعلات نووية تجريبية** Types of Nuclear Reactions – Compound Nuclear Reactions – Resonance Theory of Nuclear-Reaction Cross Sections – Nuclear Parameters Determined from Nuclear Reactions.
P N – 632 **(2 cr. h)**	**Nuclear Scattering** **تشتت نووى** The first and second Born approximation – Elastic scattering by spherical well potential and determination of phase shift – Scattering by Nuclear and Coulomb Potentials - Deep Inelastic collisions.
P N – 633 **(2 cr. h)**	**Reactors and Neutrons** **مفاعلات و نيوترونات** Nuclear forces and Nuclear Binding – The compound Nuclear and Nuclear Reaction – Neutron Reaction – Nuclear Fission – Thermal Neutrons.
P N – 634 **(2 cr. h)**	**Nuclear Electronics** **الكترونات نووية** Nuclear Detectors – Some Applications of the Nuclear Detectors in the Cosmic-Ray field – Nuclear Emulsion – Some application in Nuclear Electronics.
P N – 635 **(2 cr. h)**	**Nuclear accelerators** **معجلات نووية** The Cockroft-Walton machine, Van de Graaff and Tandem accelerators, Cyclotron and synchrocyclotron, betatron and electron synchrotron, linear accelerators.
P N – 636 **(2 cr. h)**	**Nuclear Spectra** **اطياف نووية** Radioactivity: γ, α and β^+ problems – Special Experimental Techniques – Applications of Nuclear Spectroscopic Methods in solid state physics and chemical physics.
P N – 637 **(2 cr. h)**	**Detectors and Nuclear Devices** **كاشفات و اجهزة نووية** Nuclear Detectors and Devices – Nuclear Electronics – Spectrometers- Special Experimental Techniques.
P N – 638 **(2 cr. h)**	**Selected Topics in Teoretical physics** **موضوعات مختارة فى الفيزياء النووية**

	3- M. Sc. Degree in Solid State Physics (P S)
P S – 650 **(1 cr. h)**	**Properties of Dielectrics** **خواص العوازل** Electrostatic equations of dielectrics – Mechanisms of polarization – Methods of dielectric measurements – Breakdown in dielectrics – Ferro electricity description and classification.
P S – 651 **(2 cr. h)**	**Relaxation Theory** **نظرية إسترخاء** Structure- Defects in Structure- Linear theory of Elasticity – Nonlinearity and Elasticity theory- Thermodynamics of Relaxation- Thermo- Elasticity Relaxation.
P S – 652 **(2 cr. h)**	**Semiconductors** **أشباه موصلات** Absorption of direct and indirect Semiconductor transitions -Optical constants relations-Photo and electroluminescence-Photoconductivity – Semiconductor Nanotechnology.
P S – 653	**Nuclear Magnetism** **مغناطيسية نووية**

(1 cr. h)	Classification of magnetic materials – Nuclear magnetic resonance (NMR)- Electron spin resonance (ESR) - Adiabatic Demagnetization.
P S – 654 **(2 cr. h)**	**Crystal Growth** **إنماء بللورى** Crystal growth from solutions- Crystal growth from the melt – Crystal growth from vapour.
P S – 655 **(2 cr. h)**	**Electron Microscope** **ميكروسكوب إليكترونى** Microscopy with light and electrons – The Electron Microscope Family- Specimen preparations- Specialized Techniques in Electron Microscopy – Examples of the use of Electron Microscopy.
P S – 656 **(2 cr. h)**	**Physics of Polymers** **فيزياء البلمرات** Different Theories of Polymers – Electrical Properties of Polymers – Mechanical Properties of Polymers.
P S – 657 **(2 cr. h)**	**Thin Films** **خصائص رقائق** Methods of preparations of thin films- Mechanism of film formation- Electrical Properties of thin films.
P S – 658 **(2 cr. h)**	**Lattice Imperfections** **عيوب شبكية** Types of Defects in Crystalline materials – The Production of Defects in Solids – Effect of Lattice Defects on the Physical and Mechanical Properties of Solids- Interaction of Dislocations with Point Defects.
P S – 659 **(2 cr. h)**	**Radiation Damage in Solids** **التأثير الإشعاعى على المواد** Interaction of Radiation with Crystal lattice – The production of different types of Point Defect by Radiation – The annealing Behavior of Irradiated Solids.
P S – 660 **(2 cr. h)**	**Selected Topics in Condensed Matter Physics** **موضوعات مختارة في فيزياء المواد المكثفة** (Lattice Dynamics and Symmetry – Solar Energy).

	4- M. Sc. Degree in Experimental Physics (P E)
P E – 670 **(2 cr. h)**	**Atomic and Molecular Spectra** **الأطياف الذرية و الجزيئية** Atomic Structure – L-S coupling – Normal Zeeman effect – Anomalous Zeeman effect – Stark effect – Spectra of many electron atoms – Molecular Orbits – Schrödinger equation for H_2^+ – Rotational, Vibrational & Electronic Spectra – Microwave Spectra – Infrared Spectra – Visible and ultraviolet Spectra.
P E – 671 **(2 cr. h)**	**Laser Physics** **فيزياء الليزر** An introduction to laser –Stimulated transitions –Atomic rate equations – laser pumping a population inversion –laser amplifications & laser types.
P E – 672 **(2 cr. h)**	**Quantum and Nonlinear Optics** **بصريات الكم و البصريات الغير خطية** Electro magnetic theory –Basic theorem of quantum mechanics –Perturbation theory –Density matrix formalism –Interaction of time varying field and atomic system –The non linear optical susceptibility- wave equation –Description of Nonlinear optical interaction.
P E – 673 **(2 cr. h)**	**Plasma Physics** **فيزياء البلازما** The equations of plasma physics –The behavior of charged particles in electric & magnetic fields –The fluid approach with collisions –Orbital theory – The Interaction of Electromagnetic wave with Plasmas.
P E – 674 **(2 cr. h)**	**Modern Electronics** **الكترونيات حديثة** Number systems – Digital electronics – Nanoelectronic – Data Acquisition.
P E – 675 **(2 cr. h)**	**Interaction of Radiation with Matter** **تفاعل الأشعة مع المادة** Properties of laser Radiation – Interaction of laser beam with a material surface (Distribution of heat energy – temperature changes – phase changes) – Materials

	Processing Applications –Surface hardening –Semiconductors processing – laser welding – Micro wilding – laser cutting – Micromachining –Drilling – laser in median.
P E – 676 **(2 cr. h)**	**Optoelectronics** **الكترونيات ضوئية** Radiometry and photometry – radiation sources – lasers – radiation detectors – principal of fiber optics.
P E – 677 **(2 cr. h)**	**Chemical Physics and Liquid Crystals** **فيزياء كيميائية وبللورات سائلة** Introduction to liquid crystal – Identification of Mesophases of liquid crystals – Interaction of liquid crystal with electric & magnetic fields - liquid crystals Technology.
P E – 678 **(2 cr. h)**	**Mass Spectrometer** **مطياف الكتلة** Kind of Mass Spectrometry systems – Techniques of Molecular Ionization & Ion sources –Types of Ions formed in a mass Spectrometer and its analysis – Interpretation of Mass spectra.
P E – 679 **(2 cr. h)**	**Vacuum Technology** **تكنولوجيا التفريغ** Some relevant physical concepts – Vacuum measurements –Oil sealed mechanical rotary pumps – Diffusion pumps accessories – integrated vapor pumping groups and vapor boosters – Consideration in system design.
P E – 680 **(2 cr. h)**	**Selected Topics in Experimental Physics** **موضوعات مختارة في الفيزياء التجريبية** (Semiconductor – Solar Energy).

3- Chemistry Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(C)	Diploma (500)	1- Analytical Chemistry	(CA)
		2- Applied Organic Chemistry	(CAO)
		3- Biochemistry	(CB)
		4- Electrochemistry	(CE)
	M. SC. (600)	1- Inorganic Chemistry	(CI)
		2- Physical Chemistry	(CP)
		3- Analytical Chemistry	(CA)
		4- Organic Chemistry	(CO)
		5- Biochemistry	(CB)
		6 - Biotechnology	(CBIO)
	Ph. D. (700)	1- Inorganic Chemistry	(CI)
		2- Physical Chemistry	(CP)
		3- Analytical Chemistry	(CA)
		4- Organic Chemistry	(CO)
		5- Biochemistry	(CB)

1- Diploma in Analytical Chemistry (CA)

Code	Course Number	Course Case	CR. Hours
(CA)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (2) courses from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	CP 501	Forensic Chemistry (1)	1	1	1	3	Also offered by App.Org.
	CP 508	Spectral Analysis and Applied Spectroscopy	2	1	2	3	Also offered by Bio.
	CA 520	Electrochemical Analysis	2	1	2	3	
	CA 521	Modern Analytical Techniques	1	1	1	3	
Second	CP 502	Separation Techniques	2	1	2	3	
	CA 522	Organic and Food Analysis	2	1	2	3	
	CA 523	Thermal Methods of Analysis	1	1	1	3	
	CA 524	Environmental Analysis	1	1	1	3	
		The Total Cr.h. Required	12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CA 525	Biochemical Analysis	2	2	
	CA 526	Radio Analysis	2	2	
Second	CA 527	Advanced Spectral Analysis	2	2	
	CA 528	Advanced Analytical Methods	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 520 to 539
From 529to 539 are codes No. for adding new courses

2- Diploma in Applied Organic Chemistry(CAO)

Code	Course Number	Course Case	CR. Hours
(CAO)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (2) courses from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	CP 501	Forensic Chemistry (I)	1	1	2	3	Also offered by Analytical
	CAO 540	Polymer Chemistry	2	1	2	3	
	CAO 541	Applied Organic Spectroscopy	1	1	1	3	
	CAO 542	Natural Products	2	1	1	3	
Second	CP 504	Forensic Chemistry (2)	2	1	2	3	
	CAO 543	Petroleum and Petrochemicals	2	1	2	3	
	CAO 544	Natural Polymers	1	1	2	3	
	CAO 545	Chemistry of Dyes	1	1	2	3	
		The Total Cr.h. Required	12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CAO 546	Pharmaceutical Chemistry	2	2	
	CP 505	Physical Chemistry of Polymers	2	2	
	CP 506	Electroorganic Chemistry	2	2	
Second	CAO 547	Chemotherapy	2	2	
	CAO 548	Oil and Fats	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 540 to 559
From 549to 559 are codes No. for adding new courses

3- Diploma in Biochemistry (CB)

Code	Course Number	Course Case	CR. Hours
(CB)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (2) courses from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	CP 508	Spectral Analysis and Applied Spectroscopy	2	1	2	3	Also offered by Analytical
	CB 560	Enzymology	1	1	1	3	
	CB 561	Inborn Error of Metabolism	2	--	2	--	
	CB 562	DNA Technology	3	--	3	--	
Second	CB 563	Immunology	1	1	1	3	
	CB 564	Prophrines Metabolism	2	1	2	3	
	CB 565	Biochemical Disorders of Major Organs	2	1	2	3	
	CB 566	Endocrinology	2	--	2	--	
		The Total Cr.h. Required	15	5			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	CB 567	Nutrition	2	--	2	--	
	CB 568	Cancer Biology and Tumer Markers	2	--	2	--	
Second	CB 569	Biotechnology	1	1	2	3	
	MS 676	Biostatistics	2	--	2	--	From Statist. Math.
		The Total Cr.h. Required	4				

Note:- the code No. of the branch: from 560 to 579
From 570to 579 are codes No. for adding new courses

4- Diploma in Electrochemistry (CE)

Code	Course Number	Course Case	CR. Hours
(CE)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (2) courses from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	CE 580	Techniques of Electrochemistry	2	1	2	3	
	CE 581	Instrumental Analysis	2	1	2	3	
	CE 582	Surface Analysis	1	1	2	3	
	CE 583	Corrosion	1	1	2	3	
Second	CE 584	Industrial Electrochemistry and Electroplating	2	1	2	3	
	CE 585	Electrochemistry of Semiconductors and Electrometallurgy	2	1	2	3	
	CE 586	Energy Conversion	1	1	2	3	
	CE 587	Electroorganic Chemistry	1	1	2	3	
		The Total Cr.h. Required	12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CE 588	Environmental Electrochemistry	2	2	
	CE 589	Controlled Potential Electrolysis	2	2	
	CE 590	Electrochemistry in Molten Salts			
Second	CE 591	Statistics	2	2	
	CE 592	Electrochemical Kinetics	2	2	
	CE 593	Electrochemistry of Interfaces	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 580 to 589
From 594to 598 are codes No. for adding new courses

1- M. Sc. Degree in Physical Chemistry (CP)

Code	Course Number	Course Case	CR. Hours
(CP)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (2) courses from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP 601	Advanced Applied Spectroscopy	2	2	Also offered by all gps.
	CP 610	Advanced Physical Chemistry(I)	2	2	
	CI 630	Advanced Inorganic Chemistry	3	3	
		Bioinorganic Chemistry			
		Kinetics and Mechanisms in Inorganic Chemistry			
Second	CP 602	Structural, Dynamic and Macro-molecular Chemistry	3	3	Also offered by all gps.
	CP 611	Chemical and Statistical Thermodynamics	2	2	
		Applied Physical Chemistry			
	CA 620	Spectral Methods of Analysis	2	2	
		Environmental Chemistry			
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP 612	Computational Chemistry and Modeling	2	2	
	CP 613	Biophysical Chemistry	2	2	
	CP 614	Special Topics in Physical Chemistry	2	2	
Second	CP 615	Advanced Physical Chemistry (2)	2	2	
	CP 616	Applied Electrochemistry and Energy Conversion	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 601 to 619
From 617 to 619 are codes No. for adding new courses

2- M. Sc. Degree in Analytical Chemistry (CA)

Code	Course Number	Course Case	CR. Hours
(CA)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (2) courses from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP 601	Advanced Applied Spectroscopy	2	2	Also offered by all gps.
	CP 610	Advanced Physical Chemistry (I)	2	2	
	CI 630	Advanced Inorganic Chemistry	3	3	
		Bioinorganic Chemistry			
		Kinetics and Mechanisms in Inorganic Chemistry			
Second	CP 602	Structural, Dynamic and Macro-molecular Chemistry	3	3	Also offered by all gps.
	CP 611	Statistical Thermodynamics	2	2	
		Applied Physical Chemistry			
	CA 620	Spectral Methods of Analysis	2	2	
		Environmental Chemistry			
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CA 621	Volumetric Methods of Analysis and Quality Assurance	2	2	
	CA622	Electrometric Methods of Analysis	2	2	
	CA623	Separation Techniques and Radio Analysis	2	2	
Second	CA624	Thermal, Mass, Spectrometric and Kinetic Methods of Analysis	2	2	
	CA625	Special Topics in Analytical Chemistry	2	2	
	CA626	Instrumental Microanalysis	2	2	Biol.Depts.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 620 to 629
From 627 to 629 are codes No. for adding new courses

3- M. Sc. Degree in Inorganic Chemistry (CI)

Code	Course Number	Course Case	CR. Hours
(CI)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (2) courses from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP 601	Advanced Applied Spectroscopy	2	2	Also offered by all gps.
	CP 610	Advanced Physical Chemistry (I)	2	2	
	CI 630	Advanced Inorganic Chemistry	3	3	
		Bioinorganic Chemistry			
		Kinetics and Mechanisms in Inorganic Chemistry			
Second	CP 602	Structural, Dynamic and Macro-molecular Chemistry	3	3	Also offered by all gps.
	CP 611	Statistical Thermodynamics	2	2	
		Applied Physical Chemistry			
	CA 620	Spectral Methods of Analysis	2	2	
		Environmental Chemistry			
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CI 631	Synthesis and Physical Methods in Inorganic Chemistry	2	2	
	CI 632	Organometallic Chemistry	2	2	
	CI 633	Inorganic Sterochemistry	2	2	
Second	CI 634	Supramolecular Chemistry	2	2	
	CI 635	Nuclear Chemistry	2	2	
	CI 636	Special Topics in Inorganic Chemistry	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 630 to 639
From 637 to 639 are codes No. for adding new courses

4- M. Sc. Degree in Organic Chemistry (CO)

Code	Course Number	Course Case	CR. Hours
(CO)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (2) courses from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Required cr.h		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP601	Advanced Applied Spectroscopy	2	2	Also offered by all gps.
	CO640	Advanced Physical Organic Chemistry	2	2	
	CO641	Applied Organic Chemistry	3	3	
Second	CP602	Structural, Dynamic and Macro-molecular Chemistry	3	3	Also offered by all gps.
	CO642	Photochemistry and Pericyclic Reactions – Chemistry of Organic Laser	2	2	
	CO643	Organometallic Compounds, Catalysis in Organic Chemistry	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CO644	Introduction to Green Chemistry – Bioorganic Chemistry	2	2	
	CO645	Heterocyclic Chemistry	2	2	
	CO646	Petroleum and Petrochemicals	2	2	
	CO647	New Synthetic Reactions, Supramolecular Chemistry	2	2	
Second	CO648	Polymer Chemistry	2	2	
	CO649	Strategies and Tactics in Synthesis, Nonconventionl Organic Synthesis	2	2	
	CO650	Contemporary Organic Chemistry – Molecular Orbital Symmetry	2	2	
	CO651	Chemotherapy – Organic Design	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 640 to 659
From 652 to 659 are codes No. for adding new courses

5- M. Sc. Degree in Biochemistry (CB)

Code	Course Number	Course Case	CR. Hours
(CB)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (2) courses from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP 601	Advanced Applied Spectroscopy	2	2	Also offered by all gps.
	CB 660	Enzymology and Bioenergetic Metabolism	2	2	
	CB 661	DNA Technology and Proteomics, Functional Genomic	3	3	
Second	CP602	Structural, Dynamic and Macro-molecular Chemistry	3	3	Also offered by all gps.
	CB 662	Body Fluids and Cancer Biology	2	2	
	CB 663	Applied Biochemistry	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CB 664	Immunology	2	2	
	CB 665	Toxicology & Endocrinology	2	2	
	MS 676	Biostatistics	2	2	From Statist. Math.
Second	CB 666	Free Radical Biochemistry	2	2	
	CB 667	Bioinformatics	2	2	
	CB 668	Biotechnology and Tissue Culture	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 660 to 679
From 669 to 679 are codes No. for adding new courses

6- M. Sc. Degree in Biotechnology (CBIO)

Code	Course Number	Course Case	CR. Hours
(CBIO)	The candidate studies (6) courses in table (1)	Compulsory	12
	The candidate chooses (3) courses from table (2)	Elective	6
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CB 663	Applied Biochemistry	2	2	
	MS 676	Biostatistics	2	2	
	Z 601	Molecular Biology and Biotechnology	2	2	
Second	CB 667	Bioinformatics	2	2	
	BM 630	Bacteriology	2	2	
	CB 661	DNA Technology and Proteomics, Functional Genomic	2	2	
		The Total Cr.h. Required	12	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
	CB 666	Free Radical Biochemistry	2	2	
	CB 668	Biotechnology and Tissue Culture	2	2	
	CB 660	Enzymology and Bioenergetic Metabolism	2	2	
	BE 643	Environmental Stresses	2	2	
	BM 625	Advanced Virology	2	2	
	EB664	Biochemical genetics	2	2	
	ZMP 610	Neurosciences	2	2	
	ZI 640	Molecular Immunology	2	2	
	ZC677	Developmental Biology	2	2	
		The Total Cr.h. Required	6	-	

1- Ph. D. Degree in Physical Chemistry (CP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(CP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph. D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP701	Problem Seminars	2	2	Also offered by all gps.
	CO702	Symmetric & Asymmetric Catalysis in Organic Chemistry	2	2	
	CP703	Molecular Dynamics & Chemical Reactivity	2	2	
	CP704	Advanced Topics in Physical Chemistry	2	2	
	CP705	Computational Chemistry	2	2	
	CP706	Molecular Spectroscopy and group Theory	2	2	
Second	CP707	Phase Transitions and liquid Crystals	2	2	
	CP708	Chemical Applications of Synchroton Radiation	2	2	
	CP709	Application of Statistical Mechanics for Experimental to Cpmputer Simulation	2	2	
	CP710	Topics in Surface Science	2	2	
	CP711	Lasers in Chemistry, Theory, Simulations and Applications	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 701 to 719
From 712 to 719 are codes No. for adding new courses

2- Ph. D. Degree In Analytical Chemistry (CA) and Inorganic Chemistry (CI)

Table (1)

Code	Course Number	Course Case	CR. Hours
(CA)	The candidate chooses (8) courses from table (2)	Elective	16
(CI)	Ph. D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP701	Problem Seminars	2	2	Also offered by all gps.
	CO702	Symmetric & Asymmetric Catalysis in Organic Chemistry	2	2	
	CP703	Molecular Dynamics & Chemical Reactivity	2	2	
	CA720	Special Topics in Analytical Chemistry	2	2	
	CA721	Bioanalytical Chemistry	2	2	
	CI 730	Special Topics in Inorganic Chemistry	2	2	
	CI 731	Chemistry and Structure of Clusters and Colloids	2	2	
Second	CA722	Advanced Topics in Environmental Chemistry	2	2	
	CA723	Advanced Analytical Techniques in Environmental Chemistry	2	2	
	CA724	Analytical Sensors, Theory, Chemical and Biochemical Applications	2	2	
	CI 732	Solid State and Material Chemistry	2	2	
	CI 733	Industrial Chemistry	2	2	
	CI 734	Structural and Bioinorganic Chemistry	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 720 to 739
From 735to 739 are codes No. for adding new courses

3- Ph. D. Degree in Organic Chemistry (CO)

Table (1)

Code	Course Number	Course Case	CR. Hours
(CO)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph. D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP701	Problem Seminars	2	2	Also offered by all gps.
	CO702	Symmetric & Asymmetric Catalysis in Organic Chemistry	2	2	
	CP703	Molecular Dynamics & Chemical Reactivity	2	2	
	CO 740	Special topics in Organic Chemistry	2	2	
	CO 741	Electron transfer Reactions in Organic Chemistry	2	2	
	CO 742	Organosilicon and Organoalumineum Chemistry	2	2	
Second	CO 743	Stereochemistry	2	2	
	CO 744	Metal Catalyzed Organic Synthesis	2	2	
	CO 745	The Organic Chemistry of Nucleosides and Nucleotides	2	2	
	CO 746	Forensic Chemistry	2	2	
	CO 747	Advanced Mechanistic Organic Chemistry	2	2	
	CO 748	Advanced Applications of Spectroscopy (NMR and Maso)	2	2	
	CO 749	Advanced Organic Synthesis	2	2	
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 740 to 759
From 750 to 759 are codes No. for adding new courses

4- Ph. D. Degree in Biochemistry (CB)

Table (1)

Code	Course Number	Course Case	CR. Hours
(CB)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph. D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	CP701	Problem Seminars	2	2	Also offered by all gps.
	CO702	Symmetric & Asymmetric Catalysis in Organic Chemistry	2	2	
	CP703	Molecular Dynamics & Chemical Reactivity	2	2	
	CB 760	Special Topics In Chemistry and Biochemistry	2	2	
	CB 761	Recent Advances in Biotechnology	2	2	
	CB 762	Diagnostic Enzymes & Proteomics	2	2	
	CB 763	Molecular Genetic & Genetic Engineering	2	2	
Second	CB 764	Biosynthesis of Biomolecules	2	2	
	CB 765	Gene therapy & Human Genome	2	2	
	CB 766	DNA Technology	2	2	
	CB 767	Biochemical Evolution	2	2	
	CB 768	Bioinformatics & Biosensors	2	2	
	CB 769	Microbial Ecology & Pollutions	2	2	
	CB 770	DNA and Protein Sequencing Analysis & Vaccinization	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 760 to 779
From 771 to 779 are codes No. for adding new courses

B- Course contents for Diploma

Code No.	Course name and contents
	1- Diploma in Analytical Chemistry (C A)
C P – 501 **(2 cr. h)** **1h Th + 1h Pr**	**Forensic Chemistry (1)** **كيمياء الطب الشرعى (١)** Introduction, definition and characterization of poisons, differentiation of Poisons, procedures of deproteination and isolation of poisons, methods of extraction of poisons Identification of different types of poisons: volatile poisons - corrosive poisons - metallic poisons - acidic and neutral drugs - basic drugs – insecticides - Poisons of special methods of isolation - Preparation of standard solutions and reagents. **Practical Course** Identification of Ethanol in-pure solution and in beverage - Identification of Methanol in pure solution in red alcohol - Identification of Mineral corrosive acids in pure solution and on clothes - Identification of Alkalis in pure solution and on clothes - Identification of Cyanide ion - Identification of phenol and acetic acid - Identification of Analgesic drugs - Identification of Tranquilizer drugs - Identification of Hypnotic drugs - Separation and Identification of different drug mixtures.
C P – 502 **(3 cr. h)** **2h Th + 1h Pr**	**Separation Techniques** **تقنيات الفصل** Introduction to chromatographic separations, general description of chromatography, migration rates of solutes, zone broadening and column Efficiency, Optimization of column performance, applications of Chromatography, Gas chromatography, High performance liquid Chromatography. **Practical Course** Paper chromatography - Chromatographic separation of ink components - Chromatographic separation of sugars in mixture - Chromatographic separation Bismuth, Copper, Cadmium and lead - Thin layer Chromatography - Distribution coefficient - Ion exchange Chromatography -Determmation of ion exchange capacity of an ion –exchanger - Separation of Zinc and magnesium ions on an anion exchange resin - Stepwise Elution of simple cations - Determination of phosphate.
C P – 508 **(3 cr. h)** **2h Th + 1h Pr**	**Spectral Analysis and Applied Spectroscopy** **التحليل الطيفي وعلم الطيف التطبيقي** Introduction , components of optical instruments, UV-Visible Molecular absorption spectrometry and applications, introduction to IR spectrometry and applications, Raman spectroscopy, introduction To optical atomic spectrometry, atomic absorption and atomic fluorescence spectrometry, atomic enission spectrometry. **Practical Course** Determination of absorbance curve and concentration of a substance - Effect of temperature on absorbkivity - Effect of ionic strength on absorbkivity - Effect of time on absorbkivity - Effect of solvent on absorbkivity - Error in spectrophotometry (Twyman-Lothian plot, Rinbom-plot) - Photometric titrations - Continuous variation (Job's) method - Spectrophotometric determination of an equilibrium constant - Study of Kinetics oflodination of cyclohexanone - Determination of the dissociation constant ofp-nitrophenol - Instrumentation ofUV spectroscopy: Theoretical calculation of the expected uv spectra of some alcohols, ketones, enones and dienones - Determination of the uv spectra of some

	organic alcohols, ketones, enones and dienones - Companion between the calculated and practical uv spectra of enones and dines - Instrumentation of L R. spectroscopy: Study of the spectra of different carbonyl compounds and comparing the results with the expected values - Studying the different factors affecting the position of cahoryl groups - Identifying the different functional groups.
C A – 520 **(3 cr. h)** **2h Th + 1h Pr**	**Electrochemical Analysis** **التحليل الكهروكيميائي** Introduction to electroanalytical chemistry, electrochemical cells, Electrode potentials, calculation of cell potential from electrode potentials, current in electrochemical cells, types of electroanalytical Methods. Potentiometry: introduction, types of electrodes, reference electrode, Membrane electrodes, glass electrodes, solid state electrodes, liquid-Membrane electrodes, gas-sensing electrodes, enzyme-substrate electrodes, Selectivity coefficient, potentiometric titrations, applications , ion-Selective electrodes. Voltammetry: introduction and principles, dropping mercury electrode and Polarography, Ilkovic equation, characteristics of polarogamm, Modifications of voltammetric techniques, differential polarography, Cyclic voltammetry, anodic stripping voltametry, linear sweep voltammetry, Interference in votammetry, applications, amperometric titrations. Conductimetric titrations: definitions, principles, titration cell, examples of conductimetric titration, acid-base, preciptimetry. Electrogravimetry: Coulometry: controlled potential coulometry, coulometric titrations. **Practical Course** Determination of standard electrode potential of silver - Measurement of solubility product of sparingly soluble salt - Determination of ionization constant of a weak acid - Determination of pH of unknown solution - Acid-base titration of strong acid against strong base - Determination of ferrous ion by potentiometer titration - Determination of molar conductance of strong electrolyte and estimation of its molar conductance at infinite dilution - Conductmetric determination of a dissociation constant of weak acid - Conductmetric determination of the solubility and solubility product of sparingly soluble salt - Conductmetric titration of strong acid with strong base - Conductmetric titration of weak acid with strong base - Conductmetric titration of mixture weak acid strong base.
C A – 521 **(2 cr. h)** **1h Th + 1h Pr**	**Modern Analytical Techniques** **تقنيات التحليل الحديثة** Automated methods of analysis, overview of automatic instruments, Instrumentation, flow injection analysis, discrete automatic systems, Analysis based upon multilayer films. **Practical Course** Introduction to analytical chemistry - Preparation of standard solution and standardization of solutions - Neutralization titration: Analysis of vinegar, Analysis of ammonia, Alkalinity and acidity of waste water - Complex formation titration: Hardness of water, Analysis of mixture, Determination of Ca and Mg in hard water, Determination of Cu in coin - Analysis of waste water sample.
C A – 522 **(3 cr. h)** **2h Th + 1h Pr**	**Organic and Food Analysis** **التحاليل العضوية و تحليل الأغذية** Organic microanalysis: Methods for quqntitative estimation of: Hydroxyl compounds (alcohol, phenols,enol) – Unsaturation - Carbonyl compounds (ketones, aldehydes, carbohydrate) - Carboxyl group (acids) - Derivatives of acids - Alkoxyl group - Amino group and azo compound - Amino acids – Thiols – Hydrocarbons - Food analysis: Milk, meat, edible fats and oils, cereals,

	legumes, honey, food additives. **Practical Course** Organic Microanalysis: Analysis of milk (sugar and protein) - Estimation of Amino acids e.g. Glycire (S-Amino acids) - Estimation of formaline solution - Estimation of reduced sugars e.g. lactose, maltose, glucose, Estimation of invert sugar (cane sugar after hydrolysis with hydrochloric acid) - Estimation of aniline hydrochloride - Determination of saponification value and Iodine number of fats and oils - Determination of neutralization equivalent of organic acid (aliphatic acid e.g. formic, acetic , oxalic, tartaric and citric acid) - Determination of saponification equivalent of triglycerides and esters - Determination of acetyl salicylic acid in aspirin tablets - Determination of the no. of hydroxylic groups in unknown alcoholic or phonetic compound - Determination of acetone in unknown solution - food Analysis: Extraction of caffeine - Extraction of chlorophyll (paper chromatography) - Extraction of piperine - Analysis of diet - Extraction of color of wood (Juice, Jam, Jelly....) - Extraction of mono and disaccharides - Extraction of limonene.
C A – 523 **(2 cr. h)** **1h Th + 1h Pr**	**Thermal Methods of Analysis** **طرق التحليل الحراري** Thermogravimetric methods (TG), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC). **Practical Course** Analysis of cement - Analysis of solder alloy - Analysis of Brass - Analysis of white alloys.
C A – 524 **(2 cr. h)** **1h Th + 1h Pr**	**Environmental Analysis** **التحاليل البيئية** Air pollution: air pollutants, sampling, monitoring and methods of Analysis (SO_x, NO_x, CO, PM, soots, metal ions). Water pollution : water pollutants, water quality parameters (TDS,TSS, DO,BOD, COD, pH, temp, sediments, hardness, metal ions, oil, grease, Anions, ...etc). Soil analysis. **Practical Course** Water analysis: Determination of total dissolved solids TDS - Biological oxygen Demand BOD - Chemical oxygen Demand COD - Drug analysis - Spectrophotometric determination of pharmaceutical compounds applying solvent extraction technique - Potentiometric determination of pharmaceutical compounds applying ion selective electrodes.
C A – 525 **(2 cr. h)**	**Biochemical Analysis** **التحليل الكيميائي الحيوي** Biochemical analysis of liver: Liver function, liver enzymes (GOT , GPT, GGT)& liver tests - Biochemical assessment of liver function. use of the laboratory in the diagnosis & management of liver diseases - Biochemical analysis of kidney: Nitrogen metabolites & renal function: mainly urine formation - Biochemical function of kidneys - Biochemical tests of renal function - Disorder of renal function - Acid – base disorder - Biochemical & laboratory diagnosis & management of kidney diseases - Renal transplantation - Renal diseases, renal calculi - Biochemical analysis of urine:- Biochemical constituents of urine - The normal & abnormal constituents of urine - Examination of urine constituents special calculi - Examination of urine deposit microscopically - Biochemical Aspects of Hematology :- blood picture - Biochemical function of Hb - Myoglobin - Vit B 12& folic acid - Blood clotting factors - Iron & metabolism - Disorders of erythrocyte metabolism - Biochemical Analysis of Vitamin: Biochemical analysis of fat soluble vit - Biochemical analysis of water soluble vit Estimation of vit C in blood , urine & juice - Estimation of vit A&B

	12 - Estimation of folic acid - Biochemical Analysis of Milk: Estimation of lact Albumine - Estmation of lact glob Estimation of casein in milk -Estimation of fat in milk - Estimation of lactose in milk.
C A – 526 **(2 cr. h)**	**Radio Analysis** **التحليل الاشعاعي** Radioactive isotopes, instrumentation, neutron activation methods, Isotopes dilution methods.
C A – 527 **(2 cr. h)**	**Advanced Spectral Analysis** **تحليل طيفي متقدم** Molecular mass spectrometry, nuclear magnetic resonance spectroscopy, and microscopy Surface characterization by spectroscopy.
C A – 528 **(2 cr. h)**	**Advanced Analytical Methods** **طرق تحليلية متقدمة** Concepts of quality and quality systems - Requirements of accreditation of laboratories - Proficiency testing-validation of methods- collaborative studies - Sampling techniques, principles of choosing chemicals, equipments and consumables-choice of methods- Data representation and evaluation- Good lab. Practice-safty in AC laboratories.

	2- Diploma in Applied Organic Chemistry (C AO)
C P – 504 **(3 cr. h)** **2h Th + 1h Pr**	**Forensic Chemistry II** **الكيمياء الطبية الشرعية II** Basic Concepts – Tools and materials of writing – Uniqueness and properties of Arabic alphabet – Factors affecting hand writing act – Comparison models – Methods of forgery of documents and their securing and examination – Introduction in the systematic examination of forged currency and their scientific systematic identification. **Practical part** Tools and materials of writing – Identification of Arabic writing – Ink separation: sampling, Ink extraction, colour separation, comparison – Banknotes counterfeiting: preparation of printing plate for different types of printing, printing of counterfeited banknotes.
C P – 505 **(2 cr. h)**	**Physical Chemistry of Polymers** **الكيمياء الفيزيائية للبلمرات** Introduction – Polymerization - Polymer structure and physical properties - Relative molecular mass and its determination - Kinetics of stepwise polymerization - Kinetics of addition polymerization (Free radical polymerization - Ionic polymerization – Copolymerization (Kinetics of copolymerization - Copolymer composition) - Ring-opening polymerization - Thermal properties of polymers - Characterization of polymers.
C P – 506 **(2 cr. h)**	**Electroorganic Chemistry** **كيمياء كهربية عضوية** Principle of electrochemistry – Electrical potential – cell parameters – electrochemical reactions – electroreduction – electroreduction of conjugated compounds – electrooxidation.
C AO – 540 **(3 cr. h)**	**Polymer Chemistry (Theoretical Part)** **كيمياء البوليميرات** Synthetic Polymers Polymerization: General Review. Classification of Polymerization – Functionality - Addition Polymerization Mechanisms: Free-radical Polymerization, and Ionic Polymerization (Anionic Polymerization and Cationic Polymerization) - Condensation Polymerization - Industrial Polymerization: Bulk Polymerization, Solution Polymerization, Emulsion Polymerization, Suspension Polymerization, and Interfacial Polymerization. Carbon-Chain Polymers: Poly(olefins): Poly(ethylene), Poly (propylene), and Poly(styrene) - Poly(dienes): Poly(butadiene), Poly(isoprene), and

	Poly(chloroprene) - Poly(aromatic hydrocarbons): Poly(phenylenes), Poly(p-xylene), and Phenolic Resins - Poly(vinyl compounds): Poly(vinyl acetate), Poly(vinyl alcohol), and Poly(N-vinyl pyrrolidone) - Poly(halogeno hydrocarbons): Poly(tetrafluoroethylene), Poly(vinyl fluoride), and Poly(vinyl chloride) - Poly(acrylic compounds): Poly(acrylic acid), Poly(acrylamide), and Poly (acrylonitrile). Carbon-Oxygen Chain Polymers: Aliphatic Polyethers: Poly(ethylene oxide), Poly (epichlor-ohydrine), and epoxide resins - Aromatic Polyesters: Polycarbonates, Poly (ethylene terephthalate), and Alkyd resins. Carbon-Nitrogen Chain Polymers: Polyamides: Nylon Series, Perlon Series, and Aromatic Polyamides - Polyureas and related compounds: Polyurea, and Polyhydrazides – Polyurethanes - Polyazoles: Poly(benzimidazoles), and Poly(oxadiazoles). **Practical Course** Tests for the physical properties of high polymers - Molecular weight determination - Depolymerization of some natural polymers - Depolymerization of some synthetic polymers - Bulk polymerization technique - Solution polymerization technique - Synthesis of some addition polymers - Polymerization Kinetics - Synthesis of some condensation polymers - Modification of natural polymers by grafiting technique - Degradation and Stabilization of Polymers.
C AO – 541 **(2 cr. h)**	**Applied Organic Spectroscopy** **علم الاطياف التطبيقى المتقدم العضوى** Ultraviolet, Infrared spectroscopy and their biological applications. PMR and C13 NMR, two dimension NMR, Principles and application of mass spectrometry. **Practical Course** Instrumentation of UV spectroscopy: Theoretical calculation of the expected UV spectra of some alcohols, ketones, enones and dienones - Determination of the UV spectra of some organic alcohols, ketones enones and dienones - Companion between the calculated and practical UV spectra of enones and dienones - Instrumentation of I. R. spectroscopy: Study of the spectra of different carbonyl compounds and comparing the results with the expected values - Studying the different factors affecting the position of carbonyl groups - Identifying the different functional groups - Structural study by NMR: Spin states -mechanism of absorption -chemical shift- Pascal triangle-coupling constant .The types of hydrogen in different compounds - Mass spectrometry: molecular weight determination- different fragmentation patterns Application of different fragmentation and identification.
C AO – 542 **(3 cr. h)** **2h Th + 1h Pr**	**Natural Products** **المنتجات الطبيعية** Terpenoids: isolation of mono and requileipenoidr, methods of determination of the structure – correlation of conjugations, cyclic and a cyclic terpenes, biosynthesis, rubber stereoselective synthesis, thermodynamic control, kinetic control - Steroids: sterols, cholesterol, properties and stereochemistry, absolute conjugation, Nomenclature, reactions, synthesis, biosynthesis, hormones, artificial hormones – steroidal glycosides, steroidal alkaloids - Alkaloides: extraction, properties, methods of determination of structure – classification and biosynthesis. **Practical Course** Aspirin – Phena - Nicotine from tobacco - Caffeine from tea - Cholesterol from Gallstones - Isopenty 1 acetate (Banana 0: 1) - Methy 1 salicylate - Fats and oils

	- Preparation of soap - Insect attractants and repellents - Preparation of effedrine - Forensic Chemistry II: Tools and materials of writing - Identification of Arabic writing - Ink separation: Sampling, InK extraction, colour separation, Comparison - Banknotes counterfeiting: Preparation of printing plate for different types of printing, Printing of counterfeited banknotes.
C AO – 543 **(3 cr. h)** **2h Th + 1h Pr**	**Chemistry Petroleum and Petrochemicals** **كيمياء البترول والبترو كيماويات** Origin of Petroleum – Classification of crude oils- Chemical and physical determinations of crude oil quality – Petroleum gases – Petroleum composition – Hydrocarbons and non-hydrocarbons –Preparation for processing – Refining processes – Physical processes – Conversion processes – Hydrocarbon products: composition and properties – classification – Non – hydrocarbon products . Petrochemicals – Petrochemical from: methane – methanol – n-paraffins – high – molecular weight paraffins – ethylene – propylene and higher olefins – benzene, toluene and xylene (BTX). **Practical Course** Gasoline – Kerosene - Fuels of Compression Ignition Engines - Lubricating Oils - Lubricating Greases - Asphaltic Bitumen.
C AO – 544 **(2 cr. h)** **1h Th + 1h Pr**	**Natural Polymers** **البوليميرات الطبيعية** The covalent backbone – physical properties – crystallinity – stereochemistry – types of polymers – fibers structure characteristics of fibers – natural fibers (cotton – silk – wool). **Practical Course** Determination of number of hydroxyl groups in glucose - Analysis of Cellulosic pulps through determination of: A, B & C - cellulose, pentose content, Degree of polymerization, CrystaI linty percent, Chemical reactivity, Lignin content.
C AO – 545 **(2 cr. h)** **1h Th + 1h Pr**	**Chemistry of Dyes** **كيمياء الأصباغ** Classification-Important chromophores-Organic Pigments-Textile dyes –Non-textile dyes –Leather and hair dyes –Food dyes-Photographic dyes –Indicator dyes – D_2T_2 printing –ink jet dyes for printers. **Practical Course** Synthesis of 8- Arene azotheophylline - Synthesis of 5 - azobarbituric acid - Preparation of diazoamino benzene - Preparation of dye complex - Preparation of 2- phenyl-4-phenylazo-5-oxazolone - Preparation of nitroso uracil dyes - Preparation of 1,5- diphenyl formazane - Preparation of methyl barbituric acid - Preparation of orange II - Synthesis of fluorescene - Synthesis of Eucin - Synthesis of phenolphthalein - Synthesis of para- red - Synthesis of methyl orange.
C AO – 546 **(2 cr. h)**	**Pharmaceutical Chemistry** **الكيمياء الصيدلانية** A- Designing Drugs – Mechanism of Action: Anti-inflammatory – Contraceptives – Antithrombosis – Pain killers – Anti-asthma drugs – Anti-ulcer drugs – Antihistaminics – Reducers of hypertension – Hypocholestaemic agents – Antibiotics – Antimetabolites – Antiviral – Anticancer drugs. B- Designing Pesticides – Mechanism of Action: Insecticides – Herbicides – Fungicides.
C AO – 547 **(2 cr. h)**	**Chemotherapy** **العلاج الكيميائى** Introduction – General principles of chemotherapy – Antimalarials – Antibacterial drugs. Antiseptives and disinfectants – Sulphonamides – Antibiotics – Arsenical drugs – Analgesics and hypnotics – Tranquilizers.
C AO – 548 **(2 cr. h)**	**Oil and Fats** **الدهون والزيوت** Simple glycerides for saturated and unsaturated acids – preparation of simple and

	mixed glycerides – properties and reactions of fats and oils – Quantitative determination of fats and oils (iodine number – uses of fats and oils).

	3- Diploma in Biochemistry (C B)
C B – 560 **(2 cr. h)** **1h Th + 1h Pr**	**Enzymology** **علم الانزيمات** General properties of enzyme and its specificity. Preparation and purification of enzymes – Structure, function of enzymes and coenzymes – Methods of enzymes and isoenzymes separation – Catalytic mechanisms of enzymes: acid-base catalysis, covalent catalysis – Biochemical assay of enzymes and isoenzymes such as LD, CK, ACP, ALP and ALD – Enzymes tests in hepatobility, cardiovascular, gastrointestinal, uterus and bone disease ..etc – Nucleic acid enzymes tools for molecular biology: restriction enzymes, cutting DNA - DNA modifying enzymes: nucleases – polymerases – enzymes that modify the end DNA molecules – Enzymes utility in biotechnology and biodegradation. **Practical Course** Estimation of cardial enzymes: Estimation of total CK - Estimation of CK, MB - Estimation of LDH - CSF estimation - Miscellaneous enzymatic tests.
C B – 561 **(2 cr. h)**	**Inborn error of metabolism** **الايض والعيوب الوراثية** Basic genetic principles, screening, methods of treatment – Understanding of selected disorders including chloinsterase deficiency, amino acid disorders involving phenylalanine, tyrosine, methionine and homocysteine – Renal tubule transport disorders cystinuria – Hartnup disease, organic acidurias, Glycogen storage disease, galactosaemia, erythrocyte defects, mucopolysaccharidoses and cystic fibrosis.
C B – 562 **(3 cr. h)**	**DNA technology** **تكنولوجيا الدنا** DNA technology includes study of DNA, RNA and protein, gene cloning gene expression and gene regulation. Methodology – PCR, RT-PCR and proteomics.
C B – 563 **(2 cr. h)**	**Immunology** **علم المناعة** The module introduce the study to: The immune response, autoimmune disease, immunodeficiency states, renal calculi, infertility, pregnancy, Downs screening, fetoplacental function, free radicals, cytokines and the acute phase response. Methodology: medical ethics, counseling, evidence-based medicine, sources of information. **Practical Course** Serology: Determination of CRP (Semiquati) - Determination of ASOT (Semiquati) - Determination of Ralatey (Semiquati) - Determination of Widal (Semiquati) - Determination of Brucella (Semiquati) - Determination of VDRL (Semiquati) - Determination of Monospot
C B – 564 **(3 cr. h)** **2h Th + 1h Pr**	**Prophrines Metabolism** **ايض البورفرينات** The module introduce the study to: Hemoglobin physiology, iron and ferritin metabolism, porphyrins and the porphyrias, purine metabolism, B12 and folate. Methodology: DNA probe Methodology, principles and practice of chromatography, mass spectrometry. **Practical Course** Part I: Collection and handling of Blood - Reference ranges and normal values - Preparation and staining methods for blood - Part II: (A) Complete blood picture (CBC): Estimation of Hb Conc - Total leucocytic count - Differential count - Red blood cell count – Haematocrite - Blood indices - Platelets count – (B) Reticulocytic count: Blood grouping and Rh factor - Coombis test (direct&

	indirect) - Anti – Dtitre - (C) Osmotic fragility: ESR - Coagulation profile - Prothrombin time & Conc (PT) – PTT - Bleeding time (BT) - Clotting time (CT) - Fibrinogen Conc – FDPs - Lupus anticoagulant - (D) GbpD: Demonstration of some important films e.g. Malaria - Automation techniques - Isolation, Separation and identification of some enzymes and proteins - Determination of some hormons, tumormarkers, proteins,and hepatitis markers levels by using Elisa &RIA techniques - Tests for blood bank.
C B – 565 **(3 cr. h)** **2h Th + 1h Pr**	**Biochemical Disorders of Major Organ** **الاضطرابات الكيميائية الحيوية لاعضاء الجسم الرئيسية** Biochemical Disonders of the pansies: Diabetes Mellitus – type I(autoimmune disease) – type II diabetes in eldery – Symptoms – causes – tseatment - Biochemical clisondes of the lwien: jaundice – types: prehepatic (toxic jcunsclice – hepatic (viral jaunclice) post hepatic (o bstsuctue jaunclice) – Elevated enzyme level (GOT- GPT - &GT(GGT) – alkaline phosphates- Fatty liver – Symptoms – causes – treatment - Biochemical disorder of the kidneys: Kidney disfunction on mal function renal failure – renal ischemia-Renal glucosuria – Renal calculi on stones - Biochemical disorders of the brain: Brain in toxication and urea – parkinsons disease (Dopamine deficiency Brain damage due to oxygen or glucose deficiency - Biochemical disorders of cells and tissues: Cell metamorphosis – Cell transformate due to viral infection – Biochemical disorders of blood cells – sickle cell anemia. **Practical Course** Estimation of glucose in blood - Estimation of urea in blood & urine - Estimation of Creatinine in Blood & urine - Creatinine clearance - Estimation of uric acid in urine &blood - Blood sugar curve Lipid Profile: Estimation of total cholesterol - Estimation of triglycerides - Estimation of HDL cholesterol - Estimation of LDE cholesterol - Liver Profile: Determmationof serum transaminases (ALT &AST) by chemical & Kinetic methods - Determination of serum alkaline phosphatase - Determination of GOT - Estimation of total and direct bilirubin - Estimation of serum Lalhnnnn and total proteins. Estimation of some electrolytes and minerals: Estimation of serum calcium - Estimation of serum phosphates - Estimation of serum magnesium - Estimation of serum chloride - Estimation of serum sodium - Estimation of serum potassium.
C B – 566 **(2 cr. h)**	**Endocrinology** **علم الغدد الصماء** Endocrien Control: the pituitary gland – Anterior pituitary lobe – posterior pituitary lobe . Types of hormones secreted from each lobe – factors controlling hormonal secretion- Hormone binding in plasma - Anterior pituitary hormones: Regulation of anterior pituitary hormones by the hypothalamus – TSH- ACTH – LH/ FSH/ GH- prolactin (PRL) - Thyroid / parathyroid glands: thyroid gland hormones (T3/ T4)- chemical composition – properties – binding major function in regulation of basal metabolic rate parathyroid gland and parathyroid hormone (PTH).
C B – 567 **(2 cr. h)**	**Nutrition** **علم التغذية** Introduction and definition – composition of adequate diet – caloric value of food – energy release from carbohydrates and proteins – basal metabolism – distribution of calories in the diet – elements of nutrition (vitamins – minerals – water).
C B – 568 **(2 cr. h)**	**Cancer Biology and Tumer Markers** **بيولوجيا الاورام السرطانية ودلالات الاورام** Cellular structure – mechanisms of development – metabolisms (spread cancer cells) – carcinogenic compounds – types of cancer – tumor markers (important

	tool for diagnosis).
C B – 569 **(2 cr. h)** **1h Th + 1h Pr**	**Biotechnology** **التكنولوجيا الحيوية** How to clone a gene, how to genetically modify microbes, plants and animals, how Biotechnology is likely to impact, your life, environment, how different scientists view Biotechnology and how Biotechnology influences and influenced by ….ethical, legal economic and social issue. **Practical Course** Preparation of some nutrient media - Methods for identification of some types of bacteria - Aerobic & anaerobic cultures - Sensitivity tests.
M S – 676 **(2 cr. h)**	**Biostatistics** **إحصاء حيوى** **From M. Sc. in Statistical Mathematics**

	4- Diploma in Electrochemistry (C E)
C E – 580 **(3 cr. h)** **2h Th + 1h Pr**	**Techniques of Electrochemistry** **تقنيات الكيمياء الكهربية** DC methods - Impedance measurements - Impedance plots - Applications of electrochemical impedance spectroscopy (EIS) - AC voltammeter. **Practical Course** Construction of cells and electrodes - Preparation of reference electrodes - Preparation of working electrodes - Preparation of indicator electrodes - Preparation of solvents and supporting electrodes - Maintenance of inert atmospheres - Measurements of voltage, current, charge, resistance, capacitance, impedance and inductance - Recording of data - Extraction of signal form noise.
C E – 581 **(3 cr. h)** **2h Th + 1h Pr**	**Instrumental analysis** **التحليل باستخدام الأجهزة** Non electrochemical analytical techniques - Electrochemical analytical techniques –Sensors - Membrane covered electrodes - Preconcentration techniques - Stripping analysis. **Practical Course** Determination of titanium in steel electrometrically - Determination of titanium in steel photometrically - Diffraction studies of powdered copal - First -order decay of the triplet stats - Computerized data acquisition of a second -order reaction.
C E – 582 **(2 cr. h)** **1h Th + 1h Pr**	**Surface analysis** **تحليل سطحى** In situ spectroscopic techniques: ellipsometry - Ex situ spectroscopic techniques: photoelectron spectroscopy - In situ microscopic techniques: scanning tunneling microscopy - Ex situ microscopic techniques: electron microscopy. **Practical Course** Construction of cell & electrodes - Measurement of electrode area - Measurement of Current, Voltage, resistance & impedance - Thermodynamic data from electromotive force measurement - Electro oxidation of methanol - Activity coefficient from limiting cured - Diffusion coefficient from limiting correct measurement - Conductance of electrolytic solution.
C E – 583 **(2 cr. h)** **1h Th + 1h Pr**	**Corrosion** **التآكـل** Electrochemical aspects - Thermodynamics and kinetics of corrosion - Environmental effects - Metallurgical and other effects - Forms of corrosion - Testing and prevention **Practical Course** Electrolyses plating - Corrosion In melts - Kinetic of a medic growth - Corrosion of in libation of stain less steel pitting - Pamivity breakdown of 304 stainless

	steel - EIS evolution of filiform corrosion of Al - Construction of cell & electrodes - Surface treatment of electrodes.
C E – 584 **(3 cr. h)** **2h Th + 1h Pr**	**Industrial Electrochemistry and Electroplating** **الكيمياء الكهربية الصناعية والطلاء الكهربى** Fundamental considerations - Electrochemical reactors - Types of electrodes: porous and packed-bed - Examples of industrial electrolysis - Metal processing - Aims of the process - Quality of the deposit - Controlling of the process - Composite deposits. **Practical Course** Preparation of cells electrodes - Preparation of reference Electrodes - Preparation of solvent & supporting electrodes - Measurement of current, charge, resistance, capacitance, impedance & conductance - Maintenance of inert atmosphere - Recording of data - Extraction of signal from noice - Polar graphic succession reactions.
C E – 585 **(3 cr. h)** **2h Th + 1h Pr**	**Electrochemistry of Semiconductors and Electrometallurgy** **الكيمياء الكهربية لأشباه الموصلات والتعدين الكهربى** Semiconductor electrodes - Space charge region - Thin solid films – Passivity - applications of titanium oxide - Types of anodes - Bulk electrolysis - Current efficiency – Electroseparations. **Practical Course** Photo electrochemical behaviour of thin anodic oxida film on titanium - Photo electrochemical behaviour of n-GaAs and p-GaAs in the presence of H_2O_2 - Capacitance study of thermally grown oxide films on iron - Electrometallurgy: Electroseparation of Co from Ni - Flow electrolysis of waste water for rescaling it - Stripping analysis of polluted water.
C E – 586 **(2 cr. h)** **1h Th + 1h Pr**	**Energy Conversion** **تحولات الطاقة** Batteries - Fuel cells – Photoelectrochemistry – Photocells. **Practical Course** Investigation of the absorption spectrum of cadmium telluride - Determination of the absorption coefficient of p-type germanium and relation photoreceptors of p-type -indium -doped germanium - Photolysis of water using TiO_2.
C E – 587 **(2 cr. h)**	**Electroorganic Chemistry** **الكيمياء الكهروعضوية** Non-aqueous electrolysis - Flow electrolytes - Monsanto process – Bioelectrocatalysis – Bioelectroanalysis. **Practical Course** Transference numbers by the moving boundary method - Conductance of electrolytic solutions - Thermodynamic data from electromotive force measurements - Activity coefficient from electromotive force measurements - Diffusions coefficient from limiting current measurements. Preparation of reference electrodes: For use in aqueous solutions, For use in aprotic solutions, For use in non polar solutions, For use in fused salt systems. Preparation of indicator electrodes: Surface pretreatments, Measurement of electrodes area - Constriction of cell and electrodes - Main ten ace of inert atmosphere - Preparation of solvents and supporting electrodes - Measurement of voltage, current, charge, resistance, capacitance and impedance - Recording of data - Extraction of signal form noise – Experiments - Electro less plating - Corrosion in melts - Single and multiple pickling - Kinetics of growth of anodic - Corrosion and inhibition of stainless steel pitting - Passivity breakdown of 304 stainless steel - EIS evaluation of the filiform corrosion of aluminum - Electro-

	oxidation ofmethanol - Polarographic successive resections.
C E– 588 **(2 cr. h)**	**Environmental Electrochemistry** **الكيمياء الكهربية البيئية** Advantages of this technique - Detection of pollutants - Separation, conversion and - recycling of pollutants - Developing of materials (electrodes and membranes).
C E – 589 **(2 cr. h)**	**Controlled Potential Electrolysis** **تحليل كهربي بالتحكم فى الجهد الكهربى** Potential step under diffusion controlled - Extensions to Ilkovic equation - Paleographic analysis - Sampled current voltammetry - Information from irreversible waves – Chronoamperometry.
C E – 590 **(2 cr. h)**	**Electrochemistry in Molten Salts** **الكيمياء الكهربية للاملاح المنصهرة** Chemistry of melts - Cell design - Reference electrodes - Extraction of aluminum - Corrosion in melts.
C E – 591 **(2 cr. h)**	**Statistics** **الإحصاء** Maxwell-Boltzmann statistics – Probability - Applications in chemistry – Fluctuations.
C E – 592 **(2 cr. h)**	**Electrochemical Kinetics** **الكيمياء الكهربية الكيناتيكية** The theoretical treatment of electrochemical mathematics and rate of reaction.
C E – 593 **(2 cr. h)**	**Electrochemistry of interfaces** **الكيمياء الكهربية للحد الفاصل** Principle of catalysis at interfaces – charge transfer reactions.

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Physical Chemistry (C P)
C P – 601 **(2 cr. h)**	**Advanced Applied Spectroscopy** **علم الاطياف التطبيقى المتقدم** Ultraviolet, Infrared spectroscopy and their biological applications - PMR and C13 NMR, two dimension NMR - Principles and application of mass spectrometry.
C P – 602 **(3 cr. h)**	**Structure, Dynamic and Macro-molecular Chemistry** **دراسات على تركيب ودينا ميكية الجزيئات الكبيرة** This course develops a molecular - level description of chemical kinetics, reaction dynamics, and energy transfer in both gases and liquids. Topics will include potential energy surfaces, collision dynamics and scattering theory, reaction rate theory, collisional and radiationaless energy transfer, molecule-surface interactions, Brownian motion, time correlation functions, and computer simulations. Advanced level discussion of electrochemical principles and mass transport processes, corrosion. Discussion of applications to organic and inorganic systems.
C P – 610 **(2 cr. h)**	**Advanced Physical Chemistry I** **كيمياء فيزيائية متقدمة (١)** **Molecular Electronic Structure** **Quantum Chemistry, Spectroscopy and Group Theory** The theory is applied to the description of the electronic structure of molecules. Simple MO theories are introduced. Applications of wave mechanics to spectroscopy are presented. Introduction to the principles of symmetry and group theory and their application to the description of molecular structure in terms of the chemical bonding models (VB, MO, and LF) and spectral properties (magnetic, vibrational and electronic.
C P – 611 **(2 cr. h)**	**Chemical and Statistical Thermodynamics** **الديناميكا الحرارية الكيميائية والاحصائية** Thermodynamics of equilibrium systems and that in solution are discussed, the

	general theory of statistical mechanics is applied to thermodynamics. Various perfect systems, some special distributions, and selected topics are examined. **Applied Physical Chemistry** **كيمياء فيزيائية تطبيقية** Physical Chemistry of macromolecules. Surface reactions and Catalysis. Studies on the physical metallurgy and different types of steel treatments. Studies of the different types of electrodes and electrochemical cells in different molten salts.
C P – 612 **(2 cr. h)**	**Computational Chemistry and Modeling** **كيمياء الحسابات والنماذج** Numerical analysis. Molecular mechanics and molecular dynamics simulations. Calculations of the geometric and electronic structure of molecules . Modeling of chemical systems.
C P – 613 **(2 cr. h)**	**Biophysical Chemistry** **كيمياء فيزيائية حيوية** The course develops a physicochemical description of biological systems. Topics include macromolecules, fluid-phase lipid-bilayer structures in aqueous solution, biomembrane mechanics. Control of biomolecular assembly, computer simulation of biomolecular system.This course develops a physicochemical description of biological systems. Topics include macromolecules, fluid –phase lipid-bilayer structures in aqueous solution, biomembrane mechanics, control of biomolecular assembly , computer simulation of biomolecular systems.
C P – 614 **(2 cr. h)**	**Special Topics in Physical Chemistry** **موضوعات مختارة في الكيمياء الفيزيائية** Designed to acquaint students with advanced topics of physical chemistry.
C P – 615 **(2 cr. h)**	**Advanced Physical Chemistry II** **كيمياء فيزيائية متقدمة (٢)** Radiation Chemistry: Radiation effects in gases, liquids and solids; dosimetry; ion and free radical reactions; photo-chemical reactions *Solid state Chemistry:* Crystal structure-theory of band density and gap-phase transition and liquid crystals. Industrial Applications.
C P – 616 **(2 cr. h)**	**Applied Electrochemistry and Energy Conversion** **كيمياء كهربية تطبيقية وتحويل الطاقة** The objective of this course is to give the graduate physical chemistry student an idea about solar energy conversion and the inter –relation between photoelectrochemical and photovoltaic cells. The stability and photodecomposition of semiconductors, the base material of solar cells, represent important subjects. The importance of fuel cells as energy sources of the future and their relation to solar energy conversion and production of clean fuel is a main concern. Applied Electrochemistry: Electrode kinetics and electro organic chemistry.

	2- M.Sc. Degree in Analytical Chemistry (C A)
C A – 620 **(2 cr. h)**	**Spectral methods of analysis and environmental chemistry** **طرق التحليل الطيفي وكيمياء البيئة** **Spectral methods of analysis.** Molecular absorption and emission. Visible-ultraviolet, infrared, atomic absorption and emission. Recent trends and analytical applications, X-ray diffraction, X-ray fluorescence, surface analyses, Raman, and nuclear magnetic resonance spectra. Recent. **Environmental chemistry.** Air, water and earth chemistry . Air pollution technology. Water resources and waste water treatment. Risk-based analysis for environmental management.
C A – 621 **(2 cr. h)**	**Volumetric methods of analysis and quality assurance** **طرق التحليل الحجمى وضبط الجودة**

	Titration in non-aqueous and aqueous media, Complexometric titrations, applications to real samples and new trends in research. Quality assurance and quality control.
C A – 622 **(2 cr. h)**	**Electrometric methods of analysis** **طرق التحليل الكهربية** Potentiomertric analysis emphasizing on Ion-selective electrodes. Voltammetric methods of analysis. Recent advances and analytical applications. Colourimetry, Electrogravimetry, Conductometry, Electrophoresis, Recent trends and analytical applications.
C A – 623 **(2 cr. h)**	**Separation techniques and radio analysis** **طرق الفصل الكيميائي والتحليل الاشعاعي** Chromatographic and non-chromatographic methods, principles, instrumentations and applications. New trends in chromatographic techniques and their applications. Neutron activation analysis. Methods involving addition of radionuclide. Statistical consideration in radiochemical analysis.
C A – 624 **(2 cr. h)**	**Thermal, Mass and spectrometric and kinetic methods of analysis** **طرق التحليل الحراري وطيف الكتلة** Thermogravimetry, differential methods of analysis, differential scanning calorimetry, thermometric titrations. Mass spectrometry, theory, instrumentation and applications. Basis of kinetic methods of analysis. Methods for determining of single species and methods for mixtures. The reaction mechanism. Recent trends and applications.
C A – 625 **(2 cr. h)**	**Special Topics in Analytical Chemistry** **موضوعات مختارة في الكيمياء التحليلية**
C A – 626 **(2 cr. h)**	**Instrumental Microanalyses** **أجهزة التحاليل الدقيقة** General laboratory techniques, Procedures and Safety: Laboratory operations - Biological solutions - Buffer solutions and their actions - Units of measurement - Safety. An introduction to chromatographic separations: Gas Chromatography - High Performance Liquid Chromatography - Thin Layer Chromatography - Elecrophoresis. Spectrophotometric methods of analysis: Photometry and Spectrophotometry - Nephelometry and Turbidometry - Atomic Absorption Spectrophotometry - Molecular Fluorescence and Phosphorescence.

	3- M.Sc. Degree in Inorganic Chemistry (C I)
C I – 630 **(3 cr. h)**	**Advanced Inorganic Chemistry – Kinetics and mechanisms in inorganic chemistry – Bioinorganic chemistry** **كيمياء غير عضوية متقدمة - الحركية والميكانيكية في الكيمياء غير العضوية - كيمياء غير عضوية حيوية** **Advanced Inorganic Chemistry:** Chemistry of complex formation equlbria . Binary and ternary complexes-factors favoring formation of ternary complexes – Dynamics of ternary complex formation – Reactions of coordinated by and in ternary complexes (electron – tranlfer reactions, Decarboscyltion of hetoacels, Pertide synthesis, eskr hydrlysis), Applications of ternary complexes. **Kinetics and Mechanisms in Inorganic Chemistry:** Kinetics and mechanisms of inorganic reactions, especially of transition metal complexes. Substitution reactions; electron-transfer and redox processes; photo kinetics of inorganic complexes. Mechanisms of inorganic reaction of biological interest. **Bioinorganic Chemistry:** Life is inorganic too. Biocoordination chemistry of metals in biological systems. Stability and complex equilibria, Determination of stability constants using spectrometric and electrometric methods. Mixed ligands

	complexes and deriving forces behind their formation. Metal complexes having biological significance. Therapeutic uses of coordination compounds, Antitumor Drugs, Metalloporphyrines, ChlorophyII, Heme protein, Metal Ions and chelating agents in medicine (over doses &deficiency).
C I – 631 **(2 cr. h)**	**Synthesis and Physical Methods in Inorganic Chemistry** **التحضير والطرق الفيزيائية في الكيمياء غير العضوية** Preparative chemistry of main group and transition metal compounds including polynuclear species. Synthetic strategy in inorganic chemistry. Physical methods for characterization of inorganic molecules: NMR, PES, IR, UV, and X-ray crystallography.
C I – 632 **(2 cr. h)**	**Organometallic Chemistry** **كيمياء عضوية معدنية** The preparation and properties of Organometallic compounds, notably those of the transition elements, their reactions, and the concepts of homogeneous catalysis are discussed.
C I – 633 **(2 cr. h)**	**Inorganic Stereochemistry** **الكيمياء الفراغية غير العضوية** This course covers the geometrical and optical isomerism of coordination and Organometallic compounds. Included are topological and conformational dissymmetry, stereo selectivity, design of multidentate chelates, practicality optical activity and circular dichroism, chiral induction, asymmetric synthesis and catalysis, and diastereselectivity.
C I – 634 **(2 cr. h)**	**Supramolecular Chemistry** **كيمياء فوق الجزيئية** The course is devoted to developing the concepts of supramolecular chemistry and its applications. In order to provide a background to metal-based supramolecular systems and introduction to coordination chemistry will be given. The chemistry and physical properties of transition metal complexes will be presented. Included in this presentation are introductions to crystal field theory, molecular orbital theory , magnetism and electronic spectra. Discussion of supramolecular chemistry includes both organic and metal-based systems. The principles involving self-assembly of supramolecular structures and those associated with molecular recognition will be presented with examples. This discussion will provide the background for using supramolecular systems for stabilizing unstable molecules within supramolecular structures, for promoting chemical reactions within supramolecular structures, for promoting chemical reactions within supramolecular cavities and for demonstrating primitive forms of molecular evolution and self-replication. Molecular motors are the engines of life and the course will deal with some of these biological systems. In particular, the mechemistry by which molecular motors operate will be presented and reference will be made to synthetic systems that attempt to emulate biological molecular motors.
C I – 635 **(2 cr. h)**	**Nuclear Chemistry** **كيمياء نووية** Physical description of the nucleus of the atom, its properties and behavior; radioactive decay; nuclear stability, nuclear reactions, fission, magnetic and electric moments, nuclear models.
C I – 636 **(2 cr. h)**	**Special Topics in Inorganic Chemistry** **موضوعات مختارة في الكيمياء غير عضوية**

	4- M.Sc. Degree Organic Chemistry (C O)
C O – 640 **(2 cr. h)**	**Advanced Physical Organic Chemistry** **كيمياء عضوية فيزيائية متقدمة** Structure resonance theory and its application in correlation of physical, spectral and chemical properties of areneas –Dewar number and site selectivity in reactions of areneas Dual parameter linear free energy relations –Yukawa – Tsuno equation and taft equations and their applications in elucidation of reaction mechanisms-Transmission of electronic effects- Azo-hydrazone, ring chain and annular types of tautomerism –Selectivity phenomena in organic cycloaddition reactions: regioselectivity, site selectivity stereo –selectivity and peri –selectivity. Applications of FMO and HSAB theories –Tandem and intermolecular dipolar cycloaddition reactions –Homogenous nucleophilic and electrophilic catalysis.
C O – 641 **(3 cr. h)**	**Applied Organic Chemistry** **كيمياء عضوية تطبيقية** **Polymer Chemistry I:** Chemical Technology of High polymers: Rubber: natural and synthetic, polymerization; mechanism and methods, additives, vulcanization, moulding techniques. Synthetic fibers: manufacturing of Nylon fibers, polyesters, acrylic fibers and modified natural fibers by graphting technique . Plastic: manufacturing of commodity plastics (thermoplastics and thermosetting), additives for plastic technology and moulding techniques. **Chemistry of Modern Colourants:** Classification-Important chromophores – Organic Pigments-Textile dyes – Non-textile dyes – Leather and hair dyes – Food dyes – Photographic dyes – Indicator dyes – D_2T_2 printing – ink jet dyes for printers. **Developing Approaches in Medicinal and Agrochemical Industries:** Some top drugs and their synthetic routes – principles of process research and chemical development in pharmaceutical industry – Chemistry of antibacterial and antiviral agents-medicines from nature – discovering pesticides – disruptures of the nervous system – respiratory inhibitors – photosynthesis disruptures – inhibitors of amino-acid synthesis – inhibitors of lipid synthesis –fugicides – membrane disruptures – inhibition of cell division – POP's and agrochemicals.
C O – 642 **(2 cr. h)**	**Photochemistry and Pericyclic Reactions – Chemistry of Organic Laser** **الكيمياء الضوئية والتفاعلات الحول حلقية ـ ليزر الكيمياء العضوية** **Photochemistry and Pericyclic Reactions:** Molecular Orbital Theory and Frontier orbital concepts, static and dynamic properties of excited states, classification and theory of Pericyclic reactions, spin multiplicity, sensitization and quenching, techniques of photochemistry , kinetics of alkenes and related compounds, aromatics, carbonyl compounds, imines, nitrile compounds. Photo-oxidation of alkenes. Photochemistry in nature and applied photochemistry. **Chemistry of Organic Laser:** Laser as a valuable tool for chemists –Nature of Laser –Production of and types of lasers – Nitrogen, Iodine, Exciplex and dye lasers –Structure and properties of laser dyes –Synthesis and spectral properties of various classes of laser dyes (coumarin, xanthene, oxazine laser dyes).
C O – 643 **(2 cr. h)**	**Organometallic Compounds - Catalysis in Organic Chemistry** **المركبات العضوفلزية – التحفيز فى الكيمياء العضوية** **Organometallic Compounds:** Introduction –organoalkali reagents-organo

	lithium – industrial applications and handling –organomagnesium. Titanium in organic synthesis – synthetic procedures involving organo copper reagents- organo boron chemistry - organoaluminium. compounds - organotin compounds. Environmental issues connected with Organometallic utility. **Catalysis in Organic Chemistry:** Homogeneous catalysis: Acid and Base catalysis –Specific and general catalysis – Mechanism of some acid –catalysed reactions –catalysis by non- covalent binding. Neighboring group effects- catalysis by transition metal complexes – Stereochemistry of homogeneous hydrogenation – the oxoprocess – metal hydride reductions – oxidation with chromium and manganese compounds.
C O – 644 **(2 cr. h)**	**Introduction to Green Chemistry – Bioorganic Chemistry** **مقدمة للكيمياء الخضراء ـ الكيمياء العضوية الحيوية** **Introduction to Green Chemistry:** Need for greening –waste minimization in pharmaceutical and agrochemical industries –atom economy –industrial processes using ecofriendly catalysts: solid acids-polymer-supported catalysts – envirocats- timplated silicas and catalysts in green chemistry –working in ionic liquids –recent developments in phase transfer catalysis –aqua –thermolysis. **Bioorganic Chemistry:** A goal of this course is to relate chemical phenomena with biological activities. The course will cover two main areas: chemical modifications of biological macromolecules and their potential effects, and the applications of spectroscopic methods to elucidate the structure and dynamics of biologically relevant molecules.
C O – 645 **(2 cr. h)**	**Heterocyclic Chemistry** **الكيمياء الحلقية غير المتجانسة** Synthesis and reactions of 1,3,4-thiadiazoles – pyrimidine derivatives – pyrazolopyrimidines - Uses of nitrilimines, nitrile oxides and enaminones in heterocyclic synthesis - Biosynthesis of some heterocyclic natural products - Toxicity of heterocycles – Application as pharmaceuticals – Use as Agrochemicals, Veterinary products and photographic and Reprographic techniques.
C O – 646 **(2 cr. h)**	**Petroleum and Petrochemicals** **البترول والكيماويات البترولية** Origin of Petroleum – Classification of crude oils- Chemical and physical determinations of crude oil quality – Petroleum gases – Petroleum composition – Hydrocarbons and non-hydrocarbons –Preparation for processing – Refining processes – Physical processes – Conversion processes – Hydrocarbon products: composition and properties – classification – Non – hydrocarbon products . Petrochemicals – Petrochemical from : methane – methanol – n-paraffins – high – molecular weight paraffins – ethylene – propylene and higher olefins – benzene , toluene and xylene (BTX). **Polymer Chemistry II:** Degradation and Stabilization of High Polymers: Various thermal and photodegradation mechanisms of some - Commodity plastics, thermal and photostabilizers as well as UV - Absorbers or quenchers.
C O – 647 **(2 cr. h)**	**New Synthetic Reactions – Supramolecular Chemistry** **طرق اصطناعية جديدة ـ كيمياء الجزيئات الكبيرة** **New Synthetic Reactions and Catalysis:** Catalysis: Solid acids and bases and their industrial applications – Micelle-templated silicas as catalysts –polymer – supported catalysis –biocatalysts advances in phase transfer catalysis –green catalysts for industry . New Organic Reactions: Strock enamine reaction and modern applications-olefin metathesis – Simons –Shmith reaction –sharpless epoxidation –Ramberg – Buckland reaction – Peterson olefination – Nazarov reaction- McMurry reaction-

	Heck reaction –Ester pyrolysis and related gas phase reactions –Bamford – Stevens reaction – Barton reaction. **Supramolecular Chemistry:** From molecular to Supramolecular – Anion coordination chemistry and recognition of anionic substrate. Coreseptor molecules and multiple recognition – Supramolecular reactivity and catalysis – Molecular and supramolecular devices – self processes – programmed supramolecular systems.
C O – 648 **(2 cr. h)**	**Polymer Chemistry** **كيمياء البلمرات** Additives in Plastic Technology: Classification and full description and modes of action of various additives commonly used for plastic technology – various types of antioxidants, plasticizers , fillers, antistatic agents, coloring materials, lubricants, hardeners (or curring agents).
C O – 649 **(2 cr. h)**	**Strategies and Tactics in Synthesis –NonConventional Organic Synthesis** **الاستراتيجية والتكتيك في تشييد المركبات العضوية غير التقليدية** **Strategies and Tactics in Synthesis:** Introduction –disconnection approach –C-C bond formation: sources of carbanionic and electron rich species –enamines phosphorus yields -Excessive aromatics: sources of electron –deficient species, Carbocations, functionally substituted alkenes and alkynes - Umpouling – protecting group's approach-asymmetric synthesis – Transition metals in synthesis: Principle and applications – cyclmetalltion and its utility - Fictionalizations of aromatics – Olefin metasises Grup's and related catalysts – Fine chemicals synthesis – Transition metals in synthesis – Biotransformation – Electroorganic chemistry. **Non-conventional Organic Synthesis:** Electroorganic Synthesis: MO considerations – direct oxidation and reduction – electrochemical umpouling – indirect electrosynthesis- Microwaves in organic synthesis: principles , comparison with conventional heating and experimental techniques- Microwave synthesis on inorganic support, the MORF technology and applications- Biotransformation in organic chemistry- sonochemistry- solvent free organic synthesis.
C O – 650 **(2 cr. h)**	**Contemporary Organic Chemistry - Molecular Orbital Symmetry** **الكيمياء العضوية المعاصرة ـ تماثل المدارات الجزيئية** **Contemporary Organic Chemistry:** Stereoelectronic effects- organic stereochemistry – stereselectivity in organic reactions- sonochemistry – Electroorganic chemistry – microwave in organic and medicinal chemistry – ionic liquids in synthesis – modern organic synthesis using supercritical solvents – solvent – free organic synthesis – combinational chemistry. **Molecular Orbital Symmetry:** M. O. S. according to M. O. theory - Some definitions - TYPES of Pericyclic Reactions - Rules of Pericyclic Reactions - Special aspects towards cycloaddition reactions, electrocyclic reactions and 1,3 & 1,5 proton shift - Applications using Journals for some concerted reactions.
C O – 651 **(2 cr. h)**	**Chemotherapy - Organic Design** **الكيمياء العلاجية ـ التصميم العضوى** Introduction –general principles – antimalarials – antibacterial drugs-antiseptives and disinfectants – sulphonamides – antibiotics – arsenical drugs-analgesics and antipyretics – sedatives and hypnotics – tranquilizers. **Organic Design** The disconnection approach – synthesis of aromatic compounds – one group C-X Disconnections – chemoselectivity – Two group C-X disconnection – cyclization reactions-one group C-C disconnection- Two group C-C disconnection – aromatic Heterocycles – nucleosides and nucleotides.

	5- M.Sc. Degree in Biochemistry (C B)
C B – 660 **(2 cr. h)**	**Enzymology and Bioenergetic Metabolism** **علم الأنزيمات وايض الطاقة الحيوية** Classification, nomenclature, units of activity, enzyme kinetics, inhibitors of enzymatic activity, environmental factors affecting enzyme activity, Assay of enzyme activity. Enzyme and cell engineering, biocatalyst characterization deactivation, mass transfer problems and industrial application, industrial fermentation of bulk chemicals, pharmaceutical chemicals, energy molecule biosynthesis and industrial enzymes energy transudation between mitochondria and cytoplasm control of mitochondria.
C B – 661 **(3 cr. h)**	**DNA technology, proteomics, functional genomic** **تكنولوجيا الحامض النووي الديؤكسي والبروتيوم والجينوم الوظيفى** DNA as genetic material, modification system, DNA supplication, genetic code, gene and operon, lac to proteomics, sample preparation and fractionation techniques, protein interactions. A look at HPLC, Mud PII, and 2-DE. As exploration of the choice of material, the handling and storage of samples and the statistical analysis of samples.
C B – 662 **(2 cr. h)**	**Body Fluids and Cancer Biology** **السوائل البيولوجية و بيولوجيا الأورام السرطانية** **Cancer Biology:** Cellular Structure : Structure of normal living cell reticulum - cyolgi apparatus –lysosomes-mitochondia function of each cell onganell –cancer cell-difference in Structure between normal cell and cancer cell - Mechanism of development : the change of a normal to a cancer cell biological changes and biochemical alterations involving the DNA and the nuclear materials - Metastases (spruced of cancer cells): the meaning of metastases –nature of tumor cells and the natures of spreading types of tumors –nomenclature of the tumors according to their sites in the infected organ - Carcinogens (substances causing cancer) chemical and biological carcinogens: ionizing radiation (a- β and rays particles) pollutants and insecticides pesticides hydrocarbon deviates …. Etc - Types of cancer : Cancer cells affecting different organs skin cancer – lung cancer – breast cancer lever cancer – pancreatic cancer –stomach colon and rectal cancer- Ovarian and uterine cancer- bladder cancer - Tumor Markers – Important tools for diagnosis: Nature of tumor markers –Use of tumor markers – Monitoring treatment – Assessing follow up- Diagnosis – Prognosis – Screening for the presence of the disease – Tumor markers with established domical values. **Body Fluids:** Urine: the major excretory fluid of the human body . physical properties of urine colour – pH – specific gravity – volume chemical – constituents normally found in urine –pathological constituents of urine – Renal calculi and stones and chemical changes observed during various diseases - Milk: importance of milk – physical properties of milk- carbohydrate – Fat – Protein and Vitamins content of milk – pH- Specific gravity – volume – secreted. Differentiation between human and other mammalian milk regarding different constituents and nutritive values. importance of milk as an immunologic fluid for babies and newborns (colostrums) - Blood: Major circulating body fluid physical properties of blood: pH – viscosity volume . Types of blood cells (R.Bc's – WBC's blood platelets) – origin –development –function of each type chemical composition of blood. Blood clotting and coagulation – theories of blood clotting and different factors involved – major functions of blood. Abnormal blood cells and association with various diseases – blood groups. Blood cells count - Seminal fluid: Importance – composition – pH- volume – Structure of the sperm

	and spermatogenesis – chemical components of the fluid and its relation to fertility sperms efficiency and count - Cerebrospinal fluid (CSF) origin – importance – chemical – composition – a abnormalities - Other body fluids: tears – saliva – synovial fluid sweat …etc . their physical - chemical properties composition.
C B – 663 **(2 cr. h)**	**Applied Biochemistry** **الكيمياء الحيوية التطبيقية** Abnormalities of carbohydrate Metabolism Diabetes Mellitus – Type (1) NIDDM and type (II) IDDM- Differences – characteristic – causes – treatment complications and side effects on different organs: nephropathy – retinopathy and neuropathy - Abnormalities of lipid metabolism: Lipoprotein classes-composition metabolism – properties – Relationship between lipoprotein levels in blood and coronary heart diseases (CHD) different types of cholesterol HDL. LDL theirs impact on health treatment of lipids abnormalities - Abnormalities of Nucleoprotein: metabolism – hyperuricemia- Gout properties – symptoms – treatment – Defficeent enzymes responsible for the cause of both hyperunicemia and Gout – the difference between the two states - Abnormalities of calcium metabolism: Normal composition of blood cilium hypocalcaemia – characteristics – censes symptoms – treatment. Hypocalcaemia – characteristics – causes symptoms and treatment – Bone diseases e.g. Osteomalcia – Rickets and Osteoporosis – causes- treatment - Iron Metabolism and deficiency different types of anemia – pernicious anemia hypochromic macrocytic anemia causes – treatment - Acquired Immuno difficency syndrome (AIDS): Nature of HIV – Mechanism of HIV infection – how the immune system affected – major causes and susceptible groups – symptoms – complications- treatment.
C B – 664 **(2 cr. h)**	**Immunology** **علم المناعة** Section One: Basic Concepts and Components of the immune system: Innate immunity - Components of the immune system - Active and passive immunity - Phases of an immune response. Section Two: Antigen Recognition Molecules: B and T cell receptors (BCR and TCR) - Major histocompatibility complex molecules - Antibody – antigen interaction - Antibody diversity - The T-cell receptor. Section Three: Physiology of the Immune System: Antigen processing and presentation - Lymphocyte activation – Hematopoiesis - Organs and tissues of the immune system - B cell development - T cell Development - Cell – cell interaction in generating lymphocytes - Immunological memory. Section Four: Innate (Native) Immunity / Acquired immunity: Constitutive defenses including complement - Phagocytes - Kiling in the immune system – Inflammation. Section Five: The immune system in health and diseases - Infections and vaccines - Hypersensitivity reactions - Immediate hypersensitivity (type I) allergy – Autoimmunity - Antibody mediated hypersensitivity (type II) - Immune complex disease (type III hypersensitivity) - Delayed hypersensitivity (type IV) - Delayed hypersensitivity (type IV) - Primary immunodeficiency - Secondary immunodeficiency and HIV – Transplantation - Tumor immunology - Integration of the immune system with other systems.
C B – 665 **(2 cr. h)**	**Toxicology and Endocrinology** **علم السموم والغدد الصماء** Endocrien Control: the pituitary gland – Anterior pituitary lobe – posterior pituitary lobe . Types of hormones secreted from each lobe – factors controlling hormonal secretion- Hormone binding in plasma - Anterior pituitary hormones: Regulation of anterior pituitary hormones by the hypothalamus – TSH- ACTH –

	LH/ FSH/ GH- prolactin (PRL) - Thyroid / parathyroid glands: thyroid gland hormones (T3/ T4)- chemical composition – properties – binding major function in regulation of basal metabolic rate parathyroid gland and parathyroid hormone (PTH). **Toxicology:** Introduction, drug receptor interaction, toxicity doses, fate of drug molecules inside the body, drug biotransformation, carcinogenic compounds (type, mechanism and tests).
C B – 666 **(2 cr. h)**	**Free Radical Biochemistry** **بيوكيمياء الشوارد الحرة** Aspect of animal biochemistry with emphasis on free radical mediated disease process mammals.
C B – 667 **(2 cr. h)**	**Bioinformatics** **المعلومات الحياتية** Definitions, need, development, application of computer in Bioinformatics, molecular biological information resources: nucleic acid and protein sequence database, specialized data base. Bioinformatics in pharmaceutical industry.
C B – 668 **(2 cr. h)**	**Biotechnology and Tissue Culture** **التكنولوجيا الحيوية وزراعة الأنسجة** How to clone a gene, how to genetically modify microbes, plants and animals, how Biotechnology is likely to impact, your life, environment, how different scientists view Biotechnology and how Biotechnology influences and influenced by ….ethical, legal economic and social issue. **Tissue Culture:** Introduction to animal cell culture, types and characteristics of cells in culture, growth and maintenance, cell culture requirements and conditions, methods of cell count, cell line monitoring, genetic engineering of animal cells in culture.
M S – 676 **(2 cr. h)**	**Biostatistics** **الاحصاء الحيوية** Correlation and regression – Sampling distributions – Statistical inference – Tests of hypotheses – Analysis of variance.

	6-- M. Sc. Degree in Biotechnology (CBIO)
C B – 660 **(2 cr. h)**	**Enzymology and Bioenergetic Metabolism** **علم الأنزيمات وايض الطاقة الحيوية** Classification, nomenclature, units of activity, enzyme kinetics, inhibitors of enzymatic activity, environmental factors affecting enzyme activity, Assay of enzyme activity. Enzyme and cell engineering, biocatalyst characterization deactivation, mass transfer problems and industrial application, industrial fermentation of bulk chemicals, pharmaceutical chemicals, energy molecule biosynthesis and industrial enzymes energy transudation between mitochondria and cytoplasm control of mitochondria.
C B – 661 **(2 cr. h)**	**DNA technology, proteomics, functional genomic** **تكنولوجيا الحامض النووي الديوكسي والبروتيوم والجينوم الوظيفى** DNA as genetic material, modification system, DNA supplication, genetic code, gene and operon, lac to proteomics, sample preparation and fractionation techniques, protein interactions. A look at HPLC, Mud PII, and 2-DE. As exploration of the choice of material, the handling and storage of samples and the statistical analysis of samples.
C B – 663 **(2 cr. h)**	**Applied Biochemistry** **الكيمياء الحيوية التطبيقية** Abnormalities of carbohydrate Metabolism Diabetes Mellitus – Type (1) NIDDM and type (II) IDDM- Differences – characteristic – causes – treatment complications and side effects on different organs: nephropathy – retinopathy and neuropathy - Abnormalities of lipid metabolism: Lipoprotein classes-composition metabolism – properties – Relationship between lipoprotein levels in blood and coronary heart diseases (CHD) different types of cholesterol HDL. LDL theirs

	impact on health treatment of lipids abnormalities - Abnormalities of Nucleoprotein: metabolism – hyperuricemia- Gout properties – symptoms – treatment – Defficeent enzymes responsible for the cause of both hyperunicemia and Gout – the difference between the two states - Abnormalities of calcium metabolism: Normal composition of blood cilium hypocalcaemia – characteristics – censes symptoms – treatment. Hypocalcaemia – characteristics – causes symptoms and treatment – Bone diseases e.g. Osteomalcia – Rickets and Osteoporosis – causes- treatment - Iron Metabolism and deficiency different types of anemia – pernicious anemia hypochromic macrocytic anemia causes – treatment - Acquired Immuno difficency syndrome (AIDS): Nature of HIV – Mechanism of HIV infection – how the immune system affected – major causes and susceptible groups – symptoms – complications- treatment.
C B – 666 **(2 cr. h)**	**Free Radical Biochemistry** **بيوكيمياء الشوارد الحرة** Aspect of animal biochemistry with emphasis on free radical mediated disease process mammals.
C B – 667 **(2 cr. h)**	**Bioinformatics** **المعلومات الحياتية** Definitions, need, development, application of computer in Bioinformatics, molecular biological information resources: nucleic acid and protein sequence database, specialized data base. Bioinformatics in pharmaceutical industry.
C B – 668 **(2 cr. h)**	**Biotechnology and Tissue Culture** **التكنولوجيا الحيوية وزراعة الأنسجة** How to clone a gene, how to genetically modify microbes, plants and animals, how Biotechnology is likely to impact, your life, environment, how different scientists view Biotechnology and how Biotechnology influences and influenced by ….ethical, legal economic and social issue. **Tissue Culture:** Introduction to animal cell culture, types and characteristics of cells in culture, growth and maintenance, cell culture requirements and conditions, methods of cell count, cell line monitoring, genetic engineering of animal cells in culture.
M S – 676 **(2 cr. h)**	**Biostatistics** **الاحصاء الحيوية** Correlation and regression – Sampling distributions – Statistical inference – Tests of hypotheses – Analysis of variance.
Z - 601 **(2 cr. h)**	**Molecular Biology and Biotechnology** **البيولوجيا الجزيئية والتكنولوجيا الحيوية** DNA as genetic material - Structure of DNA and RNA - Bacterial Restriction/Modification System - DNA modifying Enzymes - Intro to Prokaryotic DNA Replication - Prokaryotic DNA Replication, cont - DNA supercoiling DNA Supercoiling, topoisomerases - Introduction to bacteria - Bacterial Reproduction and Growth, Bacterial Growth, cont - Extra chromosomal elements, Plasmids, Selectable Markers - Central Dogma; Genetic Code - Gene and Operon, The lac Operon, CAP Sit, DNA Foot printing - Transcriptional Regulation : Transcription termination and the transcription operon - mRNA Translation - Gel Electrophoresis - DNA sequence analysis - Polmerase Chain Reaction (PCR), PCR, cont - Cloning PCR products - Prokaryotic expression vectors - Protein sequencing, peptide mapping, synthetic genes - cDNA libraries, Genomic libraries - Protein Purification : Assay, initial steps, resins - Protein purification: Ion exchange elutions, dialysis, concentra-tion - Protein purification : Types of Resins - Protein purification : Running the experiment, resolving peaks - Bacteriophage M13, bacterial display, DNA binding prot ein display libraries - SELEX system - Protein-protein recognition probed using yeast transcriptional activator system - Molecular imprinting - T B A.

Z MP - 610 **(3 cr. h)**	**Neurosciences** **علوم الأعصاب** **Overview of chemical transmission:** Chemical synapses - Neurotransmitters & Neuromodulators: Acetylcholine – Amines – Amino acids – Peptides - Nitric oxide gas - Neurotransmitter receptors: Chemically-regulated gated ion channels - Ligand operated - G-protein operated - Modification of synaptic transmission by drugs and diseases. **Neuromuscular junction is a chemical synapse:** Muscle receptors: Stretch receptors (muscle spindle) - Tension receptors (Golgi tendon organ). **Supportive elements of the CNS:** Cerebrospinal fluid - Blood-brain barrier. **Mechanisms of Neural Actions:** Donnan theory of membrane potential - Origin of transmembrane potential - Subthreshold phenomena (cable properties) - Threshold phenomena in elongated cells - Excitation and propagation of an impulse. **Cardiovascular Physiology:** Heart beat Coordination: Cardiac action potentials, sequence of excitation, the electrocardiogram, excitation-contraction coupling, refractory period of the heart - Mechanical Events of the Cardiac Cycle: Mid-diastole to late diastole, systole, early diastole - The Cardiac Output: Control of heart rate, control of stroke volume, relationship between end-diastolic volume and stroke volume: Starling's law of the heart - The Vascular System: Arteries, Arterioles, Capillaries, Veins - Integration of Cardiovascu-lar Function: Regulation of systemic arterial pressure (Baroreceptor reflexes) - Blood volume and long-term regulation of arterial pressure - Cardiovascular Patterns in Health and Disease: Causes of hypotension, hypertension, heart failure, coronary artery disease. **Neuroethology:** Communication and Acoustic Behavior: Physiology of vocalization - Physical nature and analysis of the acoustic signal - Acoustic signal and information reduction - Perception of the acoustic signal - Perceptual meanings in the spectrum of mating call in frogs - Voice print in human - Human Consciousness and Behavior: States of Consciousness: Electroencephalogram - The Waking State – Sleep - Conscious Experiences: Direct Attention - Neuronal Mechanisms for Conscious Experiences – Emotion Altered States of Consciousness: Psychoactive drugs, Tolerance, and Addiction - Learning and Memory in Human: Memory : Nature and keeping of information - The location of memory - Molecular Formation of Memory. "The Memory Trace" - Improvement of Memory : Enriched Environment and Plasticity.
Z I - 640 **(2 cr. h)**	**Molecular Immunology** **المناعة الجزيئية** Cells and molecules of the immune system: - Eosinophils - Basophils and mast cells - Neutrophils and macrophages - The metabolic burst - Dendritic cells - Natural killer cells - B cells and immunoglobulin genes - T cells and TCR genes; Development of T cells in the thymus - The MHC in man. Molecules and processes of the immune system: Fc receptors - Adhesion molecules - Exogenous pathway of antigen presentation - Endogenous pathway of antigen presentation - Signaling and activation of T cells - Activation of B cells - The cytokine network - The cytokine network (cont) - The alternate pathways of complement activation - Granzymes and perforins - Leukotrienes and prostaglandins - Hypersensitive reactions and tolerance.
Z C – 677 **(2 cr. h)**	**Developmental Biology** **البيولوجيا التكوينية** This course is mainly concerned with the biology of development or analysis of events of development on a molecular and genetic level. It is one of the advanced courses for students of higher classes . Students, however, cannot go through study of developmental biology without being first familiar with Descriptive of

	Classic Embryology.
B M – 625 **(3 cr. h)**	**Advanced Virology** **فيروسات متقدمة** Viral Taxonomy: The classification and nomenclature of viruses: Viruses multiplying in vertebrates and other hosts - Viruses multiplying only in vertebrates - Viruses multiplying only in invertebrates - Viruses multiplying only in plants - Viruses multiplying only in Algae, fungi and protozoa - Viruses multiplying only in bacteria - Satellite viruses: plant bacterial and animal viruses: Viroids: Nomenclature of plant viruses and the cryptogram - Virus isolates, variants and strains - Replication of Viruses (Life cycle of Viruses) Adsorption of virion (animal , plant and bacterial viruses) - Entry of the nucleic acid or the whole particle into the cell (Direct entry , phagocytosis or picnocytosis or viropexis) - Uncoating - Transcription and translation - Genome replication - Assembling of new viruses - Release of virions from the cell - Replication of DNA viruses: Replication of Adenovirus (double stranded DNA virus) - Replication of large DNA bacteriphoges (Esherichia coli phage mainly T.even phages) - Replication of RNA viruses: Single stranded RNA virus (Poliovirus) - Tobacco mosaic virus - enveloped single stranded RNA virus (Influenza virus) - Life cycle of filamentous bacterio phages: Replication of f_2 single stranded RNA phage - Replication of M13 DNA phages – Interferon: Viruses as vectors in genetic engineering - Tumour viruses(Oncogenic viruses) - Retroviruses: Sarcoma viruses and Ieukaemia viruses - Replication of Retroviruses: Human retroviruses - AIDS(Acquired immune Deficiency syndrome) Characters, structure - stages of the disease, opportunistic infections, source of infection, routs of infection and replication of virus - Methods of transmission of plant viruses: Direct passage in living higher plants: through the seeds, vegetative propagation, grafting, dodder - Transmition by organisms other than higher plants: Invertebrates: Nematodes and Arthropoda -Types of aphid relation ship , persistent and non persistant viruses - stylet borne and circulative viruses - Fungi: - Mechanical transmission: - The Interaction of Antibody with Antigen – Imunoglobulins - Diagnostic reactions of Viurses - Antigen antibody reactions or serolegical reactions - Precipitation - Agglutination - Complement fixation test - Immune electron microscopy - Fluorescent antibody techniques - Enzyme – linked immunosorbit assay (ELISA) - DAS ELIZA , The direct double antibody sandwich - Modification of ELISA Process.
B M – 630 **(2 cr. h)**	**Bacteriology** **بكتريولوجى** Criteria for classification of bacteria - Bacterial groups: Gram - negative bacteria: Sprirochaetes - aerobic spiral and curved rods - aerobic rods and cocci - Facultative anaerobic bacteria - Anaerobic rods and cocci - Sulfate reducing bacteria - Rickettsiae and chlamydias - Mycoplasmas - Other Gram negative bacteria: Photo trophs - Chemotrophs - Glinding bacteria - Sheathed bacteria - budding and or appendaged bacteria - Gram - Pasitive bacteria: Gram positive cocci - Lactic acid bacteria - Gram positive rods - Endospore - forming bacteria - Asporogenous gram positive rods - Streptomyces and related bacteria - The Archaeobacteria: Methanogenic bacteria - Extreme halophiles - Sulfer dependent extreme thermophiles.
B E – 643 **(2 cr. h)**	**Environmental stresses** **الإجهادات البيئية** Definitions and concepts of environmental stress. The response of plants to environmental stress with primary focus on drought, salinity, temperature, light, radiation and pollution stress. The stress arising from natural environmental factors and artificial activities. Ecology and evolution of stress-tolerant, stress-

	resistant and stress-avoiding plants. The amelioration of environmental stress in different habitats and ecosystems.
E B – 664 **(2 cr. h)**	**Biochemical Genetics** **الكيمياء الحيويةالوراثية** Structural basis of the genes. Organization of DNA in genomes. DNA packaging in chromatin and chromosomes. The nucleus. The cell cycle. DNA replication. Nuclear and cell division. Regulation of the cell cycle. Sexual reproduction. Meiosis. Segregation and assortment of alleles. Recombination and crossing over. Gene expression. The genetic code and transcription. Translation. Posttranslational processes. Regulation of gene expression. Genomic control. Transcriptional control. Posttranscriptional control. Variation and genetic linkage. Giant chromosomes and genes. Linkage groups and chromosomes. Sex determination. Sex linkage. Gene interactions. Incomplete dominance. Multiple alleles. Lethal genes. Gene complex. Epistasis. Polygenic inheritance. Variation and sources. Chromosomal mutations. Gene mutations.

4- Botany Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(B)	Diploma (500)	1- Applied Microbiology	(BA)
		2- Bacteriology	(BB)
	M.Sc. (600)	1- Phycology	(BP)
		2- Microbiology	(BM)
		3- Plant Ecology	(BE)
		4- Plant Physiology	(BP)
		5- Flora and Taxonomy	(BFT)
		6- Cytology and Genetics	(BCG)
	Ph.D. (700)	1- Phycology	(BP)
		2- Microbiology	(BM)
		3- Plant Ecology	(BPE)
		4- Plant Physiology	(BPP)
		5- Flora and Taxonomy	(BFT)
		6- Cytology and Genetics	(BCG)

1- Diploma in Applied Microbiology (BA)

Code	Course Number	Course Case	CR. Hours
(BA)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	BA 501	Microbiological Analysis	2	1	2	2-3	
	BA 502	Virology	1	1	2	2-3	Also offered by Bact.
	BA 503	Applied Microbiology	2	1	2	2-3	
	BB 527	Physiology of Bacteria	2	1	2	2-3	Also offered by Bact.
Second	BA 504	Physiology of Fungi	1	1	2	2-3	
	BA 505	Food Microbiology	1	1	2	2-3	
	BA 506	Biological Chemistry	2	1	2	2-3	
	BB 507	Environmental Pollution by Microbes	1	1	2	2-3	
		The Total Cr.h. Required	12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	BA 508	Disease Control	1	1	2	2-3	
	BA 509	Actinomycetes and Antibiotics	1	1	2	2-3	Also offered by Bact.
Second	BA 510	Microbial Toxins	1	1	2	2-3	
	BA 511	Hydrobiology	1	1	2	2-3	
	BB 523	Molecular Biology	1	1	2	2-3	Also offered by Bact.
		The Total Cr.h. Required	2	2			

Note:- the code No. of the branch: from 501 to 519
From 512to 519 are codes No. for adding new courses

2- Diploma in Bacteriology (BB)

Code	Course Number	Course Case	CR. Hours
(BB)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	BB 520	Applied Bacteriology	2	1	2	2-3	
	BB 521	Biochemistry	1	1	2	2-3	
	BB 522	Bacteriological Analysis	1	1	2	2-3	
	BB 523	Molecular Biology	1	1	2	2-3	Also offered by Micro.
Second	BB 524	Medical Bacteriology	2	1	2	2-3	
	BB 525	Immunology	1	1	2	2-3	
	BB 526	Bacterial Disease & Control	2	1	2	2-3	
	BB 527	Physiology of Bacteria	2	1	2	2-3	Also offered by Micro.
	The Total Cr.h. Required		12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	BB 528	Soil Microbiology	1	1	2	2-3	
	BA 502	Virology	1	1	2	2-3	Also offered by Micro.
Second	BA 509	Actinomycetes and Antibiotics	1	1	2	2-3	Also offered by Micro.
	BB 529	Bacterial Diversity and Classification	1	1	2	2-3	
	The Total Cr.h. Required		2	2			

Note:- the code No. of the branch: from 520 to 539
From 530to 539 are codes No. for adding new courses

1- M. Sc. Degree in Phycology (BP)

Code	Course Number	Course Case	CR. Hours
(BP)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	B 601	Radiobiology	2	2		Also offered by all gps.
	MS 676	Biostatistics	2	2	Statist. Math	
	CA 626	Instrumental Microanalysis	2	2	Analyt. Chem.	
Second	BP 610	Soil Algae	2	2		
	BP 611	Marine Algae	3	3		
	BP 612	Fresh Water Algae	3	3		
		The Total Cr.h. Required	12	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 613	Identification of Water Algae	2	2	
	BP 614	Biotic Relation In Aquatic Habitat	2	2	
Second	BP 615	Limnology	2	2	
	BP 616	Phytoplanktons	2	2	
		The Total Cr.h. Required			

Note:- the code No. of the branch: from 610 to 624
From 617 to 624 are codes No. for adding new courses

2- M. Sc. Degree in Microbiology (BM)

Code	Course Number	Course Case	CR. Hours
(BM)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	B 601	Radiobiology	2	2		Also offered by all gps.
	MS 676	Biostatistics	2	2	Statist. Math	
	CA 626	Instrumental Microanalysis	2	2	Analyt. Chem.	
Second	BM 625	Advanced Virology	2	2		
	BM 626	Host Parasite Interaction	3	3		
	BM 627	Soil Microbiology	3	3	Also offered by Env.	
	The Total Cr.h. Required		14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BM 628	Identification of Water Algae	2	2	Also offered by Physiol.
	BPP 657	Biotic Relation In Aquatic Habitat	2	2	Also offered by Physiol. & cytol.
Second	BM 629	Seed Microbiology	2	2	
	BM 630	Bacteriology	2	2	
	The Total Cr.h. Required		4		

Note:- the code No. of the branch: from 625to 639
From 631 to 639 are codes No. for adding new courses

3- M. Sc. Degree in Environmental Sciences (BE)

Code	Course Number	Course Case	CR. Hours
(BE)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	B 601	Radiobiology	2	2		Also offered by all gps
	MS 676	Biostatistics	2	2	Statist. Math	
	CA 626	Instrumental Microanalysis	2	2	Analyt. Chem.	
Second	BE 640	Advanced Vegetation	3	3		
	BE 641	Environmental Indicators	2	2		
	BE 642	Agrometeorology and Environmental Factors	3	3		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BM 627	Soil Microbiology	2	2	Also offered by Micro.
	BE 643	Environmental Stresses	2	2	
Second	BE 644	Desert Ecology	2	2	
	BE 645	World Vegetation	2	2	
	BE 646	Advanced Topics In Plant Ecology	2	2	Also offered by cytol.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 640to 654
From 647 to 654are codes No. for adding new courses

4- M. Sc. Degree in Plant Physiology (BPP)

Code	Course Number	Course Case	CR. Hours
(BM)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	B 601	Radiobiology	2	2		Share with all
	MS 676	Biostatisticis	2	2	Statist. Math	
	CA 626	Instrumental Microanalysis	2	2	Analyt. Chem.	
Second	BM 628	Biochemistry	2	2	Also offered by Micro.	
	BPP 655	Advanced Enzymology	3	3	Also offered by cytol.	
	BPP 656	Plant Growth Regulators	3	3		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BPP 657	Tissue Culture and Biotechnology	2	2	Also offered by Microb. & cytol.
	BPP 658	Plant Water Relations	2	2	
Second	BPP 659	Ultrastructure and Function of Cell Components	2	2	
	BPP 660	Mineral Nutrition and Solute Transport	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 655to 669
From 661 to 669are codes No. for adding new courses

5- M. Sc. Degree in Flora and Taxonomy (BFT)

Code	Course Number	Course Case	CR. Hours
(BFT)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	B 601	Radiobiology	2	2		Share with all
	MS 676	Biostatistics	2	2	Statist. Math	
	CA 626	Instrumental Microanalysis	2	2	Analyt. Chem.	
Second	BFT 670	Modern Taxonomy	3	3		
	BFT 671	Plant Nomenclature	2	2		
	BFT 672	Applied Floristic Studies	3	3		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BFT 673	Chemotaxonomy	2	2	
	BFT 674	Specialized Field Studies	2	2	
Second	BFT 675	Paleanology	2	2	
	BFT 676	Cytotaxonomy	2	2	Also offered by cytol.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 670to 684
From 677 to 669are codes No. for adding new courses

6- M. Sc. Degree in Cytology and Genetics (BCG)

Code	Course Number	Course Case	CR. Hours
(BCG)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	2
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	B 601	Radiobiology	2	2		Also offered by all gps.
	MS 676	Biostatistics	2	2	Statist. Math	
	CA 626	Instrumental Microanalysis	2	2	Analyt. Chem.	
Second	BCG 685	Cytology	3	3		
	BCG 686	Advanced Genetics	2	2		
	BCG 687	Genetic Engineering	3	3		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BPP 657	Tissue Culture &Biotechnlogy	2	2	Also offered by Physiol& Microb.
	BPP 655	Advanced Enzymology	2	2	Also offered by Physiol
Second	BFT 676	Cytotaxonomy	2	2	Also offered by Tax.
	BE 646	Advanced Topics In Plant Ecology	2	2	Also offered by Env.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 685to 698
From 688 to 698are codes No. for adding new courses

1- Ph. D. Degree in Phycology (BP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by all gps. & Entomology
	B&E 702	Scientific Design and Data Analysis	2	2	
	BP 710	Physiology of Microalgae	2	2	
	BP 711	Advanced Studies on Ultra-Structure of Algae	2	2	
	BP 712	Applied Phycology	2	2	
Second	BP 713	Algal Flora of Egypt	2	2	
	BP 714	Secondary Metabolites of Alage	2	2	
	BP 715	Genetics of Algae	2	2	
	BP 716	Algae as Biodetctors of Pollution	2	2	
	BP 717	Evolutionary Tendencies in Algae	2	2	
	The Total Cr.h. Required		16	-	

Note:- the code No. of the branch: from 710 to 724
From 718to 724 are codes No. for adding new courses

2- Ph. D. Degree in Microbiology (BM)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BM)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by all gps. & Entomology
	B&E 702	Scientific Design and Data Analysis	2	2	
	BM 725	Biological Control	2	2	
	BM 726	Nitrogen Fixation	2	2	
	BM 727	Yeast life	2	2	
	BM 728	Microbial Genetics	2	2	Also offered by Cytol.
Second	BM 729	Microbial Ecology	2	2	
	BM 730	Secondary Metabolites in Microorganisms	2	2	
	BM 731	Molecular Virology	2	2	
	BM 732	Medical Microbiology	2	2	
	BM 725	Microbial Interaction and Immunology	2	2	
		The Total Cr.h. Required	16	-	

Note:- the code No. of the branch: from 725 to 739
From 734to 739 are codes No. for adding new courses

3- Ph. D. Degree in Environmental Sciences (BE)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BE)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by all gps. & Entomology
	B&E 702	Scientific Design and data Analysis	2	2	
	BE 740	Plant Diversity & Conservation Ecology	2	2	
	BE 741	Environmental Systems	2	2	
	BE 742	Environmental Impact Assessment	2	2	
	BE 743	Plant Population Ecology	2	2	
Second	BE 744	Restoration Ecology	2	2	
	BE 745	Applied Ecology	2	2	
	BE 746	Ecological Modelling	2	2	
	BE 747	Biogeography	2	2	
	BE 748	Specialized Course	2	2	
	The Total Cr.h. Required		16	-	

Note:- the code No. of the branch: from 740 to 754
From 749to 754 are codes No. for adding new courses

4- Ph. D. Degree in Plant Physiology (BPP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BPP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by all gps. & Entomology
	B&E 702	Scientific Design and Data Analysis	2	2	
	BPP 755	Growth and Development	2	2	
	BPP 756	Stress Physiology	2	2	
	BPP 757	Nitrogen Assimilation	2	2	
Second	BPP 758	Phytochemistry	2	2	
	BPP 759	Photobiology in Higher Plant	2	2	
	BPP 760	Translocation in Phloem	2	2	
	BPP 761	Excretory Function in Higher plants	2	2	
	BPP 762	Plant Defense Mechanisms	2	2	
	The Total Cr.h. Required		16	-	

Note:- the code No. of the branch: from 755 to 769
From 763to 769are codes No. for adding new courses

5- Ph. D. Degree in Flora and Taxonomy (BFT)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BFT)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by all gps. & Entomology
	B&E 702	Scientific Design and Data Analysis	2	2	
	BFT 770	Palaeobotany	2	2	
	BFT 771	Biological Flora	2	2	
	BFT 772	Modern Taxonomy	2	2	
	BFT 773	Bryoflora	2	2	
Second	BFT 774	Medicinal Plants	2	2	
	BFT 775	Archaeobotany	2	2	
	BFT 776	Plant Conservation	2	2	
	BFT 777	Documentation of Plant Resources	2	2	
	BFT 778	Biodiversity in Egyptian Flora	2	2	
	BCG 792	Plant Genetic Resources	2	2	Also offered by cytol.
		The Total Cr.h. Required	16	-	

Note:- the code No. of the branch: from 770 to 784
From 779to 784are codes No. for adding new courses

6- Ph. D. Degree in Cytology and Genetics (BCG)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BCG)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by all gps. & Entomology
	B&E 702	Scientific Design and Data analysis	2	2	
	BCG 785	Cell Differentiation	2	2	
	BCG 786	Cytological Analysis	2	2	
	BCG 787	Molecular Genetics	2	2	
	BM 728	Microbial Genetics	2	2	Also offered by Microb.
Second	BCG 788	Growth Regulators	2	2	
	BCG 789	Cell Physiology	2	2	
	BCG 790	Plant Biotechnology	2	2	
	BCG 791	Cytochemistry of Nucleus	2	2	
	BCG 792	Plant Genetic Resources	2	2	Also offered by Taxonomy.
	BCG 793	Breeding and Grafting	2	2	
		The Total Cr.h. Required	16	-	

Note:- the code No. of the branch: from 785 to 798
From 794to 798are codes No. for adding new courses

B- Course contents for Diploma

Code No.	Course name and contents
	1- Diploma in Applied Microbiology (B A)
B A – 501 **(3 cr. h)** **2h Th + 1h Pr**	**Microbiological analyses** **تحليلات ميكروبيولوجية** Sterilization, Disinfection and Antisepsis - Growth and Death measurements: Exponential growth - Synchronous growth - Growth parameters - Death measurement - Microbiological analyses of special environments: Water, Milk, Foods, Air, Soil - Antimicrobial analysis: Selective toxicity - Mechanism of action of antimicrobial drugs - Resistance and sensitivity to antimicrobial drugs - Antimicrobial activity in vitro - Antimicrobial activity in vivo - Combined antimicrobial action - Immunological analysis: Immune response - Antibodies , structure and function - Antigen - antibody reactions - Serological reactions - Precipitation reactions - Agglutination reactions - Toxin - antitoxin reactions - Diagnosis of some pathogenic microorganisms - *Staphylococci*, *Streptococci* , *Enterococci* , *Bacillus anthrax*, - Hepatitis viruses, Dermatophytes (*Microsporum* , *Trichophyto*) - Mycosis (*Candida albicans* , *Aspergillus fumigatus*). **Practical Course** Techniques for isolation of pure cultures: Techniques of discrete colonies from a mixed culture - Isolation of pure cultures from a cultivation and Morphology of Molds - Serial dilution-agar plating procedure for quantitative viable cells - Culture characteristics of bacterial colonies - Cultivation and Morphology of Molds - Identification of unknown fungi - Biochemiical activities of bacteria: Carbolydrate fermentation - Voges-Prauskauer test - Indol production test - Methyl red test - Citrate utilization - Hydrogen Sulfide test - Urease test - Litmus milk reactions - Nitrate reduction test - Catalase test - Oxidase test. Bacteriological analysis of water: Standard qualitative analysis of water - Determination of the most probable number: Presumptive test - Confirmed test - Completed test. Quantitative analysis of water, using membrane filter method - Bacteriological analysis of soil: Bacterial populations in soil. Enumeration.
B A – 502 **(2 cr. h)** **1h Th + 1h Pr**	**Virology** **علم الفيروسات** Virus purification in Relation to Diagnosis: The taxonomic approach - Stepwise determination - Virus systematics - Electron Microscopy of In Vitro Preparations: Size calibration - Grids and support films - Sample preparation - Negative staining – Immunosorbent methods - Decoration methods - Gold labeling - Serological Methods for Virus Diagnosis: Principles and Definitions - Types and structure of immunoglobulins - Interaction between antibody and antigen - Preparation of polyclonal antisera for viruses - Monoclonal antibodies - Serological tests: Tests based on precipitation in liquid - Precipitation and microprecipitation - The latex agglutination test - Gel diffusion techniques - Single-diffusion tests - Double-diffusion tests - Immunoenzymatic Assays: Double-antibody sandwich (DAS-ELISA) - Purification and antibodies conjugation with enzyme - Triple antibody sandwich ELISA (TAS-ELISA) - Pencillinase ELISA - Amplification ELISA - ELISA on nitorcellulose membrane (NCM-ELISA) - Tissue-blot immunobinding assays - Electrophoresis followed by electroblot immunoassay - Serologically specific electron microscopy (SSEM). **Practical Course** Shape of Virus Particles - Symptoms of Plant Viruses - Haemagglutination Test

	of Viruses - Effect of Temperature on the Haemagglutinating activity - Effect of Chemicals on the Haemagglutinating activity - Haemagglutination Inhibition Test - Serology of Plant Viruses - Inoculation of Tomato Plants with TOMV - Inoculation of Datura Plants with TMV - Physical Properties of TSWV: DEP, TIP, Aging - Shape of Virus Particles - Symptoms of Plant Viruses - Histopathology – Cytopathology.
B A – 503 **(3 cr. h)** **2h Th + 1h Pr**	**Applied Microbiology** **ميكروبيولوجيا تطبيقية** Fermentation Industry: Requirememts of industrial fermentation - Elements of industrial fermentation - Equipments (batch and continuous proceses) - Product Recovery - Waste disposal and by - products - Quality Control of industrial products - Production of Pharmaceuticels: Antibiotics (Penicillin - Streptomcycin) - Steroids - Human proteins - Vaccines - Vitamins - Production of organic acids: - acetic acid -gluconic-acid - citric acid - Itaconic acid - Gibberellic acid - Lactic acid - Production of amino acids (Lysine - glutamic acid) - Production of enzymes (Proteases- amylases) - Production of Solvents - Production of Fuels (ethanol - methane) - Recovery of mineral resources - microbial mining - Microbial Production of food & beverages: fermented dairy products (Yoghourt and cheese) - Leavening of bread - Single cell protein - fermented of beverages (beer & wine) - Distilled Liquors. **Practical Course** Test For amylase on solid + Liquid media - Effect of heavy metals on amylase activity - Effect of PH on amylase activity - Effect of Temperature amylase activity - Effect of gamma – radiation on amylase activity - Test for collagenase on liquid medium - Test for lipase on solid medium - Test – for protease enzyme - Antibiotics.
B A – 504 **(2 cr. h)** **1h Th + 1h Pr**	**Physiology of Fungi** **فسيولوجا فطريات** Role of fungi in nature - Morphological and physiological characters of fungi - The chemical composition of the fungal cell.[Cell wall, Major constituents of cytoplasm, Mineral constituents of the fungal cell and Enzymes (exo., endoenzymes and permeases)] - Culture media: [Types of culture media according to their: use, physical state and chemical composition] - Growth of fungi: Growth criteria for the unicellular fungi - Growth measurement of unicellular fungi (yeast) - Phases of growth of unicellular fungi: Growth of filamentous fungi - Methods of measuring growth of filamentous fungi - Factors affecting fungal growth: Internal factors (Genetic composition, Age, Ability to synthesizc essential metabolites, Pathogenicity) - External factors: (Temperature, pH value, Water and Relative Humidity (RH) Osmotic Pressure, Effect of oxygen, CO2, Light, Radiation (lonizing rays, (UV-Light), Vitamin and Growth Factors) - Fungal nutrition: Inorganic nutrition (Macro and Microelements) - Organic nutrition: Carbon compounds utilized by fungi (Different Types of Carbohydrates, Hydrocarbons, Lipids and Proteins) - Carbohydrates Metabolism - From the anabolic point of view - From the catabolic point of view - Nitrogen nutrition and metabolism (NO3, NO2 , NH3, Amino acids, Amides, Peptides and Proteins) - The prevention of fungal growth: (By sterilization, Changing Environmental condition, Biological control, Antifungal agents (Fungicides)) - Fungicides: Inorganic (Cu. Hg. S) - Organic (Hg, Aldehydes Dyes) - Sites of action of inhibitors - Fungal metabolites: (Iry and 2ry metabolites) Aliphatic compounds - Oxygen heterocycles - Aromatic metabolites - Quinones and their derivatives - Nitrogenous metabolites - Mycotoxins (Aflatoxins B1, B2, G1, G2 Zearalenone, Trichothecene toxins, Ochratoxins A,B,C Patulin, Ergot toxins,

	Mushroom toxins) – **Practical Course** Types of media & methods of inoculation and their effect on growth - Effect of elimination of constituents of medium on the fungal growth - Effect of different carbon sources on fungal growth - Effect of different carbon concentrations on fungal growth - Effect of different nitrogen sources on fungal growth - Effect of different nitrogen concentration on fungal growth - Effect of different temperatures on fungal growth - Effect of different PH on fungal growth – Antifungal tests.
B A – 505 **(2 cr. h)** **1h Th + 1h Pr**	**Food Microbiology** **ميكروبيولوجيا الاغذية** Food as substrate for microorganisms - The important microorganisms in foods microbiology - Food contamination - Food Spoilage - Food preservation - Food borne diseases - Fermented food and beverages - Fermented dairy products - Food sanitation, control, and inspection. **Practical Course** Microbial Content of foods: Examination of flours, sugars, starch - Detection of thermophiles, anaerobes - Examination of tomato and potato - Plating of surface of tomato - Test for sterility of inner tissue - Bacteriological examination of cabbage , Eggs ,Marketmeats - Molds important in foods - Yeasts in foods - Examination of frozen foods (Fruits, Fish, Meat, dried fruits) - Examination of bottled beverage – unspoiled canned food - Comparative heat resistance of spores of yeasts, molds and bacteria - Effect of pH of substrate on heat resistance of bacterial spores. Preservation of foods: by Canming - chilling temperature - Storage of meat - Of eggs at room and chilling temperature - Salts as preservative - Preservation by pickling (Saur teraut) - Preservation by Sodium benzoate - Preservation by organic acids. Food Spoilage: Spoilage of Fruits and vegetables - Spoilage of Meats + Fishes - Spoilage of Flours + cereals - Spoilage of bread - Spoilage of pickles - Spoilage of Commercial canned foods - Dairy Microbiology: Bacteral count and direct examination of milk - Effect of temperature of storage on growth of bacteria in milk - Review and comparison methods used in milk quality control (for pasteurization) - Methylene blue and phospatase tests - Effect of heating milk on the types of organisms that grow during storage - Test for efficiency of milk sterilization - Tests for bacteria digesting protein + Casein - Startar cultures - Isolation of lactic acid bacteria from fermented milk - Plate count of yeasts and molds in butter - One of the role of acid forming bacteria in cheese.
B A – 506 **(3 cr. h)** **2h Th + 1h Pr**	**Biological Chemistry** **الكيمياء البيولوجية** The plant cell and its molecular components: The application of biological chemistry in plant classification - Classification based on 2^{ry} m etabolites - Classification based on DNA data - The eukaryotic plant cell nucleus and microbodies - The plant cell wall or extra cellular matrix: Structure of plant cell wall (higher plant and microorganisms - Interaction of plant cell wall polysaccharides - Biosynthesis of structural polysaccrarides - Metabolic turnover of structural components of cell wall - Plant membranes: Membrane lipids biogenesis - Lipid catabolism and turnover - Cutins , suberins and wax membranes - Genetics of host / pathogen interactions: Mechanisms of pathogenicity - Mechanisms of plant resistance: Constitutive defense mechanism - Induced phytochemical response - Plant cell biotechnology: Nuclear genes - Organellar genes - Signalling mechanism in gene regulation - Transgenic plants – Micropropagation - Commercial exploitation of plant biotechnology.

	Practical Course Extraction of polysaccharides in the microbial cells – Assay of wall degrading enzymes (catinases, cellulases, hemicellulases, ligninases, pectinases, lipases and amylases) – Tissue culture techniques – Plant explants and callus formation.
B A - 507 **(2 cr. H)**	**Environmental Pollution by Microbes** **التلوث البيئى بالميكروبات** Introduction - Microbial dynamics: Microbial metabolism - Microbial diversity - Population dynamics - Microbial interactions - Methods of transmission and dispersion of microbial pollutants - Microbial contamination of air - Microbial contamination of water - Microbial contamination of soil - Microbial contamination of food - Evaluation of risks related to microbiological contamination - Microbial eco-toxicology: Micro-organisms as test objects - Tests to detect toxicants - Tests to detect disturbances of microbial communities - Control and effectiveness of interventions to minimize the risks of microbial contamination (sterilization and disinfection (general information, physical methods, chemical methods). **Practical Course** Isolation and preservation of airspora – Isolation and preservation of soil spores from polluted sites – biological assays for insecticides herbicides fungical & bactericides on microorganisms (inhibition zone – dry biomass and mycelial growth).
B A – 508 **(2 cr. h)** **1h Th + 1h Pr**	**Diseae control** (or Disease management) **مقاومة الامراض** History of plant pathology: Significance of disease - Parasitism and disease development - Measurement of plant disease and yield loss - Environmental factors that cause plant disease - Plant disease caused by fungi - bacteria - viruses and parasitic higher plants - Resistance of plants against pathogens: Structural defence - Physiological or biochemical defence - Inactivation of pathogen enzymes - Principles of disease control: Eradication of the parasite - Fungicides and antibiotics - Growth regulators - Systemic induced resistance - Biological control - Genetic engineering and tissue culture. **Practical Course** Mechanical and biochemical resistances of hosts - Effect of phenolic compounds on spore germination - Pathogenicity test - Cellulase assay method (by viscometer) - Pectinase assay method.
B A - 509 **(2 cr. h)** **1h Th + 1h Pr**	**Actinomycetes and Antibiotics** **الأكتينوميسيتات والمضادات الحيوية** General characteristics of actinomycetes - Ecology of actinomycetes: Actinomycetes in soil - Actinomycetes in compost , manure and related materials - Actinomycetes in aquatic environments - Nitrogen fixing actinomycetes - Phytopathogens - Actinomycetes as human and animal pathogens - Factors affecting activity and abundance of actinomyctes - Importance of actinomycetes and their role in ecosystem: Degradation of polymers . Role in soil structure - Biological control of plant diseases - Role in compost and related materials - Production of hormones and promotion of plant growth - Production of important pharmaceutical and industrial products (e.g. antibiotics and enzymes) - Morphology of actinomycetes - Fine structure - Selective methods and media for isolation of actinomycetes from natural habitat - Classification and identification of actinomycetes - Criteria used for classification and identification of actinomycetes - Morphological characteristics of mycelium and spores - Cultural and physiological characteristics - Chemotaxonomy of actinomycete cell wall - Genetic characteristics - Different groups of actinomycetes and representive genera for each group - History and discovery of antibiotics - Chemical nature of

	antibiotics - Sources of antibiotics - Pathways for antibiotic biosynthesis - Mechanism of action of antibiotics - Characteristics of an ideal antibiotic for therapeutic purpose - Resistance to antibiotics - Principal classes of antibiotics - Characterization of new antimicrobial agents - Application of antibiotics - Function in nature. **Practical actinomycetes and antibiotics** Isolation of actinomycetes from soil and other sources - Morphological, cultural and physiological characteristics of actinomycetes - Metabolic activities of actinomycetes: Production of plant growth regulators - Production of antibiotics - Production of enzymes, protease, chitinase, xylanase, cellulase, amylase, dextrinase - Isolation of antibiotic - producing microorganisms - Screening antimicrobial agent from different origin - Determination of antibiotic spectrum - Methods of determination of antibiotic activity - Determination of MIC and MBC - Separation and detection of different antimicrobial agents by biochromatography - Isolation and extraction of antibiotics from different sources - Factors affecting production of antibiotics from microbial origin.
B A - 510 **(2 cr. h)** **1h Th + 1h Pr**	**Microbial Toxins** **السموم الميكروبية** Toxigenic microorganisms - Structure and formation of Microbial toxins - Implications of microbial toxins in human and animal diseases - Natural occurrence of microbial toxins - Control of microbial toxins . **Practical course** Isolation of pathogenic micro organisms toxicity tests – Antagonism between microorganisms – Antibiotic tests.
B A - 511 **(2 cr. h)** **1h Th + 1h Pr**	**Hydrobiology** **بيولوجيا المياه** Life in water: Water as a substance-Properties of water-The hydrologic cycle - Different aquatic ecosystems: The geography, structure of the aquatic ecosystems and their algal – communities - Freshwater Ecosystems: Ice and snow flora (kryoflora) - Springs: cold and hot springs - Streams and rivers - Bogs and swamps - Ponds and lakes (eutrophic and oligotrophic lakes) - Marine Ecosystems: Oceans and seas: open water and littoral regions - Shallow marine waters: kelp forests and coral gardens - Mangrove swamps and associated salt marshes, seaweeds – Estuaries – Environmental effects affecting algal distribution in aquatic ecosystems: Temperature: direct and indirect effects - Water movement: water currents, waves and tides - Light: utilization of solar rays, compensation point, chromatic adaptation - Oxygen and carbon dioxide concentrations in different water bodies, dial and seasonal changes - Salinity: physiological effects of the salt content on the organisms - Metabolic requirements of algae - Species interactions: competition, Predator-prey relationships, and symbiosis - Human influences - Ecosystem Processes: Carbon in ecosystem: models of ecosystem carbon cycles-carbon storage - Nitrogen in ecosystems and global levels: nitrogen cycle-nitrogen fixation - other sources of nitrogen input to living organisms - decomposition rates and nitrogen immobilization – nitrogen mineralization. - Ecosystems processes for some other elements: phosphorus, silica, and sulfur - Annual succession of algal communities - Eutrophication and pollution - Red water or red tide phenomenon. **Practical Course** Isolation and Purification of algae: Different methods of isolation using soil and water samples - Different methods of purification for maintaining axenic cultures (ultrasonic, centrifugation and antibiotic treatment) - Purification of an algal sample using the antibiotics - Preparation of different nutrient media (Bold Basal

	& Chu 10) - Different types of unicellular(*Euglena, Chlorella, Closterium*) and colonial organization of algae (*Pediastrum, Volvox, Scenedesmus, Gonium*) - To study the effect of different intensities and different qualities of light on the growth of algae - Measurement of growth parameters: cell number, relative growth rate, generation time, dry biomass, chlorophyll content - Different types of filamentous organization of algae (unbranched filaments: *Oscillatoria, Nostoc, Rivularia* and branched filaments: *Cladophora, Draparlandia, Bactrachospermum*) - Standard curve of carbohydrate. Estimation of carbohydrate content in different algal samples - Measurement of dissolved oxygen (OD) using Winkler´s method (light and dark bottles) - Measurement of respiration rate, net production and gross photosynthesis - Measurement of COD and BOD - Measurement of BOD_5 of a phytoplanktonic sample - Different types of chloroplasts (*Chlammydomonas, Spirogyra, Zygnema, Ulothrix, Vaucheria, Oedogonium*) - Estimation of total alkalinity, total chloride and reactive silicate in a water sample - Evaluation and comparative discussion of the results.

	2- Diploma in Bacteriology (B B)
B B – 520 **(3 cr. h)** **2h Th + 1h Pr**	**Applied Bacteriology** **بكتريولوجيا تطبيقية** Fermentation Industry: Requirememts of industrial fermentation - Elements of industrial fermentation - Equipments (batch and continuous proceses) - Product Recovery - Waste disposal and by - products - Quality Control of industrial products - Fermented Industrial Products: Pharmaceuticals Products: Antibiotics (Penicillin - Streptomycin) - Steroids - hormones (insulin) - Vaccines - Vitamins - Production of Organic Products: organic acids - Alcohols - Amino acids (Lysine - glutamic acid) - Enzymes (Proteases- amylases) - Solvents - Fuels (ethanol - methane) – Cellulose - Petroleum products - Recovery of mineral resources - microbial mining - Bacterial Activities in: Bioremediation - Deterioration of materials as paper products, textiles and painted surfaces - Production of toxins for insect control - Food Microbiology: Food spoilage and preservation - Fermented beverages - Dairy products - Single cell protein - Water microbiology: Distribution of bacteria in water - Role of aquatic bacteria in the food chains - Analysis of water - Treatment of disposal water - Air microbiology: Techniques for sampling bacteria from air - Origin of bacteria of the atmosphere - Kinds of bacteria in the atmosphere. **Practical Course** Lactic acid production - Veniger Production - Youghurt Production - Canned Food Spoilage - Selective & differential media.
B B – 521 **(2 cr. h)** **1h Th + 1h Pr**	**Biochemistry** **كيماء حيوى** The function of secondary metabolites in plants: a secondary metabolites often protect plants from pathogenic micro-organisms and herbivores - Formation of phytoalexins in response to microbial infection - Alkaloids comprise avariety of heterocylic secondary metabolites - Some plants emit prussic acid or volatil mustard oil when wounded - Plants protect themselves by tricking herbivores with false amino acids - Biochemistry of plant defense reactions: Oxidative stress: Reactive oxgyen species (Structure and sources) - Anti oxidant defense system pathway - Ascorbate - glutathione cycle and non enzymatic antioxidants - Regulation of enzyme activity - Allosteric regulation - Covalent modifications of protein structure - Association and dissociation of subunits. **Practical Course**

	Separation of amino acids columns (Dow 50) - a. Quantitative estimation of amino acids. - b. Quantitative estimation of proteins - Separation of proteins using column chromatography DEAF cellulose sephadex G100 - Polyacrylamide gel electrophoresis, SDS Page - Estimation of DNA and RNA - Estimation of alkaloids and phenolic compounds (anthocyanin and Belacyanin) - Quantitative estimation of reducing and non-reducing sugars using spectrophotometric method - Separation and estimation of plant pigments using thin layer - Chromatography.
B B – 522 **(2 cr. h)** **1h Th + 1h Pr**	**Bacteriological Analysis** **تحليلات بكتريولوجية** Culture transfer technique - Techniques for isolation of pure cultures: Isolation of discrete colonies from a mixed culture - isolation of pure cultures from a: Spread - plate or Streak - plate preparation - Culture characteristics of bacterial colonies - Serial dilution-agar plating procedure for quantitative viable cells - Biochemical activities: Carbohydrate fermentation - Voges - prauskauer test - Indol production test - Methyl red test - Citrate utilization - Hydrogen sulfide test - Urease test - Litmus milk reactions - Nitrate reduction test - Catalase test - Oxidase test - Chemical agents of the control of bacterial growth : Disinfectants and antiseptics: Phenol coefficient - Agar plant sensitivity method - Bacteriological analysis of food: Bacteriological analysis of food products: Bacterial count - Bacteriological analysis of water: Standard qualitative analysis of water - Determination of the most probable number: Presumptive test - Confirmed test - Completed test - Quantitative analysis of water using membrane filter method - Bacteriological analysis of soil: Bacterial populations in soil : Enumeration - Bacterial genetics: Isolation of streptomycin resistant mutant. **Practical Course** Culture transfer technique - Techniques for isolation of pure cultures: Isolation of discrete colonies from a mixed culture - Isolation of pure cultures from a: Spread-plate - Streak-plate preparation. - Culture characterstics of bacterial colonies - Serial dilution-agar plating procedure for quantitative viable cells - Biochemical activities: Carbohydrate fermentation - Voges- Prauskauer test - Indol production test - Methyl red test - Citrate utilization - Hydrogen sulfide test - Urease test - Litmus milk reactions - Nitrate reduction test - Catalase test - Oxidase test. Chemical agents for bacterial growth: Disinfectants and antiseptics: Phenol coefficient - Agar plate sensitivity method. Bacteriological analysis of food: Bacteriological analysis of food products: Bacterial count - Bacteriological analysis of water - Standard qualitative analysis of water - Determination of the most probable number: Presumptive test - Confirmed test - Completed test - Quantitative analysis of water using membrane filter method - Bacteriological analysis of soil: Bacterial populations in soil: Enumeration - Bacterial genetics: Isolation of streptomycin resistant mutant.
B B – 523 **(3 cr. h)** **2h Th + 1h Pr**	**Molecular Biology** **البيولوجيا الجزيئية** The chromosome - The gene - Nucleic acid (chemical structure) - DNA replication - RNA and protein synthesis: Transcription - Translation - Genetic code - Regulation of gene expression - Repression and induction - Operon Model of gene expression - Recombinant - DNA and Biotechnology: The advent of recombinant DNA technology - Genetic engineering - Recombinant DNA procedures - Biotechnology tools and techniques - Restriction enzymes - Vectors - Methods of inserting foreign DNA into cells - Source of DNA - Gene libraries - Complementary DNA - Synthetic DNA - Selecting clone - Application of genetic engineering: Medical therapy - DNA finger print - Gene therapy - PCR - Agricultural application - Safty issues - Future of genetic engineering.

	Practical Course Prokaryotic and Eukaryotic cells - The Nucleus - Chromosomes and cell divisions - Extraction of DNA (concept and protocol) – Primers - Polymerase Chain Reaction (concept and protocol) - Extraction of RNAs (concept and protocol) - cDNA synthesis (Reverse transcriptase) - DNA and cDNA - Gene sequencing (models) - Sites and software used for alignments of gene sequences - Gene cloning - Gene expression - How to use molecular biology in biotechnology.
B B – 524 **(3 cr. h)** **2h Th + 1h Pr**	**Medical Bacteriology** **بكتريولوجيا طبية** Basic Bacteriology: Classification of medically important pathogens - Normal flora – Pathogenesis - Laboratory diagnosis - Antimicrobial drugs: Mechanism of action – Resistance - Bacterial vaccines -Clinical Bacteriology: Overview of the major pathogens and introduction to anaerobic bacteria - Gram-positive cocci & rods - Gram-negative cocci & rods - Gram-negative rods related to enteric tract - Gram-negative rods related to respiratory tract - Mycobacteria - Actinomycetes - Mycoplasmas - Spirochaetes - Chlamydiae - Rickettsiae - Basic Virology: Classification of medically important viruses - Pathogenesis - Host defense - Laboratory diagnosis - Antiviral drugs - Viral vaccines - Clinical Virology: DNA & RNA enveloped viruses - DNA & RNA nonenveloped viruses - Examples: Hepatitis, tumor viruses AIDS - Mycology: Overview of the major mycological diseases - Cutaneous & subcutaneous mycoses - Systemic mycoses - Opportunistic mycoses – Parasitology: Intestinal & urogenital protozoa - Blood & tissue protozoa – Cestodes - Trematodes Nematodes. **Practical Course** Laboratory investigation for bacterial diseases infecting: respiratory system – gastrointestinal system – urinary system food – poi-seining – Laboratory investigation for fungal dermatophytes.
B B – 525 **(2 cr. h)** **1h Th + 1h Pr**	**Immunity** **المناعة** Means of pathogen transmission - Entry of pathogen - Types of diseases - Toxins: Exotoxins - Endotoxins - Resistance of diseases: Non susceptibility - Natural resistance (general, physical, chemical, biological) - Immunity - lnnate - Acquired - Characteristics of immune systems: Properties of antigens - Properties of antibodies - Structure of antibodies - Classes of antibodies - Cells and Tissues of the lmmune system - Properties of lmmune Responses - Factors that Modifying lmmune Responses - lmmunological Disorders - Hypersensitivity: - lmmediate (type I) - Cytotoxic (type II) - lmmune complex (type III) - Delayed (type IV) - Autoimmune Disorders - lmmunodifficiency diseases - Practical Aspects of lmmunity - Measurememts of Humoral lmmunity (Antibodies): Precipitation Reactions – lmmunoelect-rophoresis - Agglutination Tests - Complement Fixation tests - Radioimmunoassays. **Practical Course:** Immunity and Serology Serological Reactions - Serological Reactions – Neutralization - Precipitation – Agglutination – Flocculation - Complement fixation - Fluorescent Antibody Techniques - Radioimmuno assay (RIA) - The Radio allergosorbent test (RAST) - Enzyme-Linked Immuno sorbent Assay (ELLSA) 629 - Monoclonal Antibody - Gene Probes.
B B – 526 **(3 cr. h)** **2h Th + 1h Pr**	**Bacterial plant Diseases and control** **أمراض بكتيريه ومقاومه** Plant pathology: The concept of disease in plants - Types of plant disease - Parasitism and pathogenicity - Host range of pathogens - Development of disease in plants - Stages in the development of disease - Host parasite interaction - How pathogen attack plants: Mechanical foree - Chemmical foree - Environmental

	Effects on the development of infectious plant disease: Effect of Temperature - Effect of Moisture - Effect of Wind - Effect of Light - Effect of Soil PH and structrue - Effect of Host - plant nutrition - Effect of - Herbicides - Control of plant diseases - plant diseases cased by bacteria - Baeterial spots and blights - Bacterial blights of bean - Angular leaf spot of cucumber - Angular leaf spot of cotton - Bacterial leaf spot and blight of cereals and grasses - Bacterial leaf spot of tomato and pepper - Bacterial spot of stone fruits - Bacterial speck of tomato - Bacterial Vascular wilt: Bacterial wilt of cucurbits - Fire bight of pear and apple - Ring rot of potato - Bacterial canker and wilt of tomato - Blak rot of crucifers - Southern bacterial wilt of solonaceous plant - Bacterial soft rots: Bacterial soft rots of vegetables- Bacterial galls: Crown gall - Bacterial cankers: Bacterial canker and gammosis of stone fruit trees - Citrus canker - Bacterial scabs: Common scab of potato - Mycoplasmas and Mycoplasma - like organisms as plant pathogens: Mycoplasma diseases of potato - Plant diseases caused by MLOS - Grassy shoot diseases of sugarcane - Citrus greening - Little leaf of Eggplant. **Practical Course** Different types of pacterial diseases in plants – Parasitism and pathogenecity – Host range – Development of disease in plants – Host parasite interaction – How pathogen attack plants: mechanical, chemical or environmental methods – environmental effects on the disease development: temperature, humidity – wired light, soil pH, soil structure – Effect of host – Plant nutrition – herbicides – Control of the following plant diseases: bacterial spots and blights of bean, cucumber, cotton, cereals, grasses, tomato, pepper, stone fruits – Vascular wilt of cucurbits, pear & apple, sloanaceous plant and cruciferae Crowngall – bacterial cancer common scab of potato – mycoplasure in potato gammosis.
B B – 527 **(3 cr. h)** **2h Th + 1h Pr**	**Physiology of Bacteria** **فسيولوجيا البكتريا** Enzymes: General Characters &Nomenclature - Genetic expression & specificity - Classification & Factors affecting activity - Allosteric enzmes - Isozymes & ribozymes - Regulation of enzmes: Induction - Repression & derepression – Proenzmes - Organization of multienzme system - Clinical Enzmes - Metabolic Regulation & Channeling - The intercom-nectedness of biochemical reactions: Carbohydrate metabolism (catabolism & synthesis) - Protein merabolism (catabolism & synthesis) - Lipid metabolism (catabolism & synthesis) - Nutritional patterns among organisms Practical course: The bacterial Growth curve - Serial - Dilution Agar plating - Antibiotics as Chemotherapeutic agents - Clinical Enzymes: - Transaminases (SGOT & SGPT) - Alkaline & acid phosphatases - Amylase - Nitrate reductase - Proteases - Lipases. **Practical Course** The bacterial growth curve - Quantitative determination of nitrate reductase - Quantitative determination of transferase (SGOT, SGPT) - Quantitative determination of phosphatase - Quantitative determination of amylase - Quantitative determination of cellulase - Quantitative determination of protease - Qualitative determination of lipase.
B B – 528 **(2 cr. h)** **1h Th + 1h Pr**	**Soil Microbiology** **ميكروبيولوجيا التربة** Microbial ecology: The soil environment - general – description - profiles and horizons - differences among soils - Physical and chemical considerations - organic (humus) - Microbial groups: distribution and abundance - environmental influences - Microbial and generic group - Nutrition and dominant flora - activity and function of : Bacteria , actinomycetes, Fungi, algae, protozoa ,Non -

	Protozoan fauna Viruses, phages, lysis , lysogeny , practical and ecological significance - Some Aspects of Microbiol physiology: Nutrition – growth - Biochemical considerations- Enzmatic activity in soil - The carbon cycle and organic matter decomposition: Changes during decomposition - Flora - assimilation and Mineralization - Microbiology, Factors governing decomposition, Flora, Biochemistry of: Cellulose, Hemicelluloses, lignin, Other Polysaccharides(starch, pectic substances, inulin, chitin) - The Nitrogen cycle: Mineralization and immobilization - Microbiology - environmental influences - Nucleic acid - Urea - Nitrification - Denitrification - Nitrogen fixation - Microbial Transformation of phosph-orrus, Mineralization and lmmobilization - solubilization - Flora - Microbial Transformations of sulfur : mineralization and immobilization - Transformations of other elements - Pesticides: their effects - persistence - their metabolism. **Practical Course** Effect of different depths on microbial population - Effect of different soil types on microbial population - Effect of different ammendments to soil - Effect of reclamation on microbial population - Effect of different biocides on microbial population -Determination of calcium carbonate % in soil.
B B – 529 **(2 cr. h)** **1h Th + 1h Pr**	**Bacterial Diversity and Classification** **تنوع بكتريولوجى وتقسيم البكتريا** Criteria for classification of bacteria - Bacterial groups: Gram - negative bacteria: Sprirochaetes - aerobic spiral and curved rods - aerobic rods and cocci - Facultative anaerobic bacteria - Anaerobic rods and cocci - Sulfate reducing bacteria - Rickettsiae and chlamydias - Mycoplasmas - Other Gram negative bacteria: Photo trophs - Chemotrophs - Glinding bacteria - Sheathed bacteria - budding and or appendaged bacteria - Gram - Pasitive bacteria: Gram positive cocci - Lactic acid bacteria - Gram positive rods - Endospore - forming bacteria - Asporogenous gram positive rods - Streptomyces and related bacteria - The Archaeobacteria: Methanogenic bacteria - Extreme halophiles - Sulfer dependent extreme thermophiles. **Practical Course** Laboratory equipments and Culture media - Techniques for isolation of pure cultudre - Determination of the quantitative viable cells - Bacterial staining - Culture characterization - Biochemical activities of bacteria - Hydrolysis, casein, gelatin liquefaction, carbohydrate fermentation, indol, citrate, urease, oxidase, litmus milk nitrate reduction catala - Microbiology of food - Microbiology Water - Microbiology soil - Isolation of antibiotic producing bacteria and determination of antimicrobial spectrum of isolates.

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Phycology (B P)
B – 601 **(2 cr. h)**	**Radiation Biology** **بيولوجيا اشعاعية** Nature of Radioactivity: Atomic Structure - Isotope - Type of Radioactive decay -Radiation Energy - Radioactive Decay and Half - life – Radioactivity: Unit of radioactivity - Carrier and Specific Activity - Interaction of Radioactivity With matter: Alpha Particle - Negatron particle - Gamma Ray - Detection and Measurement of Radioactivity - The Scintillation Counter: Solid Scintillation Counter - Gamma Counter Calibration - Liquid Scintillation Counter: Quenching of liquid Scintillation - Quenching Correction: Internal Standard Methods - Channels ration method - Application of radioisotopes in biological Science Metabolism: Metablic Pathways - Studies of absorption, Accumulation and Translocation - Pharmacological studies - Analytica Application: Enzymatic studies - Isotope Dilution Analysis (IDA) - Radioimmunoassay - Radiodating - Molecular Biology - Clinical Diagnosis - Sterilization of food and equipment – Mutagen.
M S – 676 **(2 cr. h)**	**Biostatistics** **إحصاء حيوى** **From M. Sc. in Statistical Mathematics**
C A – 626 **(2 cr. h)**	**Instrumental Microanalyses** **أجهزة تحاليل دقيقة** **From M. Sc. in Analytical Chemistry**
B P – 610 **(2 cr. h)**	**Soil Algae طحالب التربة** Terrestrial Algae: Aerophytes: Epiphyllophytes – Epiphloeophytes – Epizoophytes – Lithophytes - Edaphophytes: Epiterranean – Subterranean – Casuals - Subterranean Algae: Deserts - The Antarctic - Depth Distribution - Soil Stabilization and conditions - Algae and Soil Types - Nitrogen Fixation - Temporary Algal Associations - Factors Affecting Soil Algal Maintenance and Distribution: The physical Environment: Temperature – Illumination – Soil Moisture – Soil Texture – Topography of Soil - The Chemical Environment: Nutrients – Gases – Toxins - The Biological Environment - Effects of Alagal Populations on Physics and Chemistry of Soil - Productivity and Importance - Succession of Soil Algae.
B P – 611 **(3 cr. h)**	**Marine Algae الطحالب البحرية** Marine Algal Habitats and General Conditions of Life: Open water - The Littoral Region: Sub-littoral zone – Intertidal zone – Supratidal zone - Marine Communities: Lithophytic communities – Psammophytes – Epiphytes and drifts –Coral reefs – Sea coasts (sporling and crustose stages) – The belts of algae (Epipsammon – Endopsammon – Endolithon – Artificial surfaces) – Mangrove communities – Phytoplankton communities - Kinds of Marine Algae: Chlorophyceae – Cyanophyceae – Chrysophyceae – Xanthophyceae – Rhodophyceae – Phaeophyceae – Diatoms – Dinophytes - Biology of Seaweeds: Cell structure – Thallus structure – Population biology – Life histories – Morphogenesis of algal thalli – Germination and attachment of Spores – Reproduction. The Ecology of Seaweeds, Zonation and Succession: General features of biological zonation on rocky shores - Quantitative ecological studies of zonation - Factors controlling distribution of seaweed species - Succession in seaweed communities - The Sea as Environment for Algal Growth: Light in the sea -

	Temperature and salinity within the photic zone - Chemistry of the photic zone - Environmental problems unique to intertidal habitahs - Nutrient uptake - Primary productivity in the sea - Importance of seaweeds - Problems caused by seaweeds - Management practices of seaweeds: Algicides – Harvesting – Biological controls.
B P – 612 **(3 cr. h)**	**Fresh-Water Algae** **طحالب المياه العذبة** The structure of aquatic ecosystems and their algal composition: Snow and ice flora (Kryoflora): Aerial epiphytic algae and aerial epilithic algae - Springs and flowing waters: Springs: Cold and hot springs - Streams and rivers: epiphytic, epilithic-epipelic and phytoplankton communities - Bogs and swamps - Ponds: Temporarily attached communities- phytoplankton- epiphytic - endophytic - epilithic- epipelic- epipsammic- epizooic- endozooic- rhizobenthos - Factors affecting the growth and distribution of algae: Ecological factors: Physiographic factors: Degree of shelters or exposure to waves- wave action- tidal range- tidal currents- silt load - Intertidal exposure- continuous exposure and submergence - Physical factors: Substrate, pressure, illumination (quality of light penetration- light duration- light intensity, chromatic adaptation), temperature (seasonal variations, thermal stratification, upwelling, heat cycles, fall overturn, heating and cooling of the epilimnion or mixed layer) - Chemical factors: pH - inorganic and organic nutrients-O_2 and CO_2 content (measurements, diffusion from the atmosphere, photosynthesis, diel and seasonal changes in streams) - Biological factors: Antagonism, synergy, competition, allelopathy, grazing, parasitism. Production and Productivity - Organisms in streams: The major groups of organisms, algae and macrophytes - Phytoplankton: measurement, effect of cell shape, change in density, effect of size, seasonal variation - Algal assemblages in wetlands: the role of algae in wetlands, species composition and production - Nuisance freshwater algae and their control.
B P – 613 **(2 cr. h)**	**Identification of Water Algae التعرف على طحالب المياه** Collection methods of both marine and fresh water algae - Collection stations of freshwater algae - Common genera of freshwater algae - Collection stations of marine algae - Distribution of marine algae on different locations - Synopsis of the algal phyla - Methods used in the study of planktonic species - Preservation and storing of the catch - Counting of the different organisms - Examination and description of the samples - Unialgal cultures as a means for species identification - Preparation for electron microscopy - General hints for identification - Key to the order and species and how to use the different keys.
B P – 614 **(2 cr. h)**	**Biotic Relationships in Aquatic Habitats** **العلاقات البيولوجية فى البيئات المائية** Populations: Annual, Pseudo-annual, biannual, and perennial - Communities: Structure and characterization - Ecosystems: Freshwater, estuarine and marine ecosystems - Succession and modeling strategies - Algae in biotic associations: Types and importance of algal biotic associations: Algal symbiotic relationships - Gymnosperm & alga (*Cycus* & *Nostoc* sp.) - Angiosperm &alga (*Gunnera* & *Nostoc punctiforme*) - Fern & alga (*Azolla* & *Anabaena*) - Fungus & alga (lichens): Types and morphology of lichens, types of algae & fungi found in such type of associations, structure and reproduction of lichens - Algae - Invertebrate associations: *Platymonas* & *Convoluta* - *Chlorella* & *Hydra* - *Chlorella* & *Paramecium* - Zooxonthellae & Coelenterates - Algae as Parasites or pathogens: Algae defenses against pathogen - Detrital food webs and pathogens of algae - Biotic interactions of seaweeds: Competition: Interference competition, epiphytism, alellopathy , exploitative competition - Grazing: Impact of

	grazing on community structure and zonation - Seaweed - herbivor interactions.
B P – 615 **(2 cr. h)**	**Limnology** **علم البحيرات** Lakes: Origin: Morphometry, zonation, water shed, physical, chemical and biological structure, water shed - Water and light: Properties of water, light & heat, light in the atmosphere & in water, lake color & reflection - Heat: Thermal stratification, thermocline formation, Flow of heat - Water movement: Motion in epilimnion, motion in thermocline, motion in hypolimnion - Nutrients: Nitrogen cycle, phosphorus cycle, inorganic carbon, major elements (Si, Ca, Mg, Na, K, S, Cl), trace elements (Mn, Zn, Cu, Mo, Co) - Gases: Oxygen and Carbon dioxide - Planktonic communities: Littoral communities - Sediments & micro-flora - Organic carbon cycling & detritus - Productivity of lakes - Estuaries: Origin - Measurements - Variable salinity and the salt " Wedge" - Eutrophic estuaries - The biota - Marsh plants, seaweeds, phytoplankton - Tropical estuaries - Mangrove swamps.
B P – 616 **(2 cr. h)**	**Phytoplankton** **العوالق النباتية** What is phytoplankton? Terminology - Planktonic organisms - Planktonic algae (general features - planktonic forms belong to different algal groups - Factors affecting phytoplankton growth & distribution: Temperature: direct & indirect effects, thermal stratification - Salinity: the physiological effects of salt - content on the organisms - Light: light intensity, light quality, compensation depth, chromatic adaptation - Oxygen and carbon dioxide contents - Waves & tides - Metabolic requirements: Inorganic substances (macro- and micro-elements, cycles of some elements) , Organic substances - Species interactions: Symbiosis, Competition, and Predator - Prey relationships, interaction with zooplantom (Grazing and Exclusion) - Spatial and temporal distribution of phytoplankton: Distribution patterns: vertical & horizontal distribution - Temporal variation in abundance and composition - Spring outbursts and species succession in the sea, lakes and ponds - species succession in summer , Autumn and winter - Buoyancy of phytoplankton: Phytoplankton suspension: the problem of suspension, the nature of water movements, particle behavior in turbulent columns, phytoplankton setting velocities - Mechanism of suspension: morphology of phytoplankton cells, physiological regulation of cell density (fat reserves, gas vacuoles, control of ionic composition of cell sap, physical factors due surrounding medium, improved flotation or reduced sinking rate of phytoplankton - Phytoplankton manual: Sampling techniques (water bottles, pumps, nets) - Preservation and storage of samples - Counting methods and identification - Measuring of primary productivity (Chlorophyll, CO_2 uptake oxygen, carbohydrate measurements) - Man - made effects: - Eutrophication (sources, effects, modeling and controlling eutrophcation) - Man - made lakes, fishponds - Pesticides, oil spills and emulsifiers, detergents, heavy metals, radioactive substances.

	2- M. Sc. Degree in Microbiology (B M)
B M – 625 **(3 cr. h)**	**Advanced Virology** **فيروسات متقدمة** Viral Taxonomy: The classification and nomenclature of viruses: Viruses multiplying in vertebrates and other hosts - Viruses multiplying only in vertebrates - Viruses multiplying only in invertebrates - Viruses multiplying only in plants - Viruses multiplying only in Algae, fungi and protozoa - Viruses multiplying only in bacteria - Satellite viruses: plant bacterial and animal viruses:

	Viroids: Nomenclature of plant viruses and the cryptogram - Virus isolates, variants and strains - Replication of Viruses (Life cycle of Viruses) Adsorption of virion (animal , plant and bacterial viruses) - Entry of the nucleic acid or the whole particle into the cell (Direct entry , phagocytosis or picnocytosis or viropexis) - Uncoating - Transcription and translation - Genome replication - Assembling of new viruses - Release of virions from the cell - Replication of DNA viruses: Replication of Adenovirus (double stranded DNA virus) - Replication of large DNA bacteriphoges (Esherichia coli phage mainly T.even phages) - Replication of RNA viruses: Single stranded RNA virus (Poliovirus) - Tobacco mosaic virus - enveloped single stranded RNA virus (Influenza virus) - Life cycle of filamentous bacterio phages: Replication of f_2 single stranded RNA phage - Replication of M13 DNA phages – Interferon: Viruses as vectors in genetic engineering - Tumour viruses(Oncogenic viruses) - Retroviruses: Sarcoma viruses and Ieukaemia viruses - Replication of Retroviruses: Human retroviruses - AIDS(Acquired immune Deficiency syndrome) Characters, structure - stages of the disease, opportunistic infections, source of infection, routs of infection and replication of virus - Methods of transmission of plant viruses: Direct passage in living higher plants: through the seeds, vegetative propagation, grafting, dodder - Transmition by organisms other than higher plants: Invertebrates: Nematodes and Arthropoda -Types of aphid relation ship , persistent and non persistant viruses - stylet borne and circulative viruses - Fungi: - Mechanical transmission: - The Interaction of Antibody with Antigen – Imunoglobulins - Diagnostic reactions of Viurses - Antigen antibody reactions or serolegical reactions - Precipitation - Agglutination - Complement fixation test - Immune electron microscopy - Fluorescent antibody techniques - Enzyme – linked immunosorbit assay (ELISA) - DAS ELIZA , The direct double antibody sandwich - Modification of ELISA Process.
B M – 626 **(2 cr. h)**	**Host-Parasite Interaction** **علاقة الطفيل بالعائل** Contents: Enzymes in plant diseases - Composition of cell wall materials and middle lamella; cuticular wax - Enzymes for waxes and cutins - Pectic enzymes - Macerating enzymes – Hemicellulases - Lignolytic enzymes - Proteolytic enzymes - Lipolytic enzymes - Inactivation of enzymes - Toxins and plant diseases: Classification of toxins – Phytotoxin – Vivotoxins – Pathotoxins - Fusaric acid - Defense mechanism in plants: Morphological or structural defense mechanism - Defense structures existing before infection - formed after infection - Biochemical defense mechanism: Defense Through induced synthesis of proteins and enzymes - formation of substrates resisting the enzymes of the pathogen - Defense Through detoxification of pathogen toxin - altered respiration - hypersensitive reaction.
B M – 627 **(3 cr. h)**	**Soil Microbiology** **ميكروبيولوجيا التربة** Microbial ecology : The soil environment - general – description - profiles and horizons- differences among soils - Physical and chemical considerations - organic (humus) - Microbial groups : distribution and abundance -environmental influences - Microbial and generic group - Nutrition and dominant flora - activity and function of : Bacteria , actinomycetes, Fungi, algae, protozoa, Non - Protozoan fauna - Viruses , phages, lysis , lysogeny , practical and ecological significance - Some Aspects of Microbiol physiology : Nutrition– growth - Biochemical considerations- Enzmatic activity in soil - The carbon cycle and organic matter decomposition - Changes during decomposition - Flora - assimilation and Mineralization - Microbiology ,Factors governing

	decomposition, Flora, Biochemistry of : Cellulose, Hemicelluloses, lignin, Other Polysaccharides (starch, pectic substances, inulin, chitin) - The Nitrogen cycle : Mineralization and immobilization - Microbiology - environmental influences - Nucleic acid - Urea - Nitrification - Denitrification - Nitrogen fixation - Microbial Transformation of phosphorus , Mineralization and lmmobilization - solubilization - Flora - Microbial Transformations of sulfur : mineralization and immobilization - Transformations of other elements - Pesticides : their effects - persistence - their metabolism.
B M - 628 **(2 cr. h)**	**Biochemistry** **كيميـــاء حيويـــة** Nucleic Acids: Nucleotide structure & nomenclature - Purine & pyrimidine metabolism - Structure deoxy ribonucleic acid & classes of ribonucleic acid - Storage and Transformation of Genetic Information: Replication & repair DNA - Recombination of DNA - Transcription: synthesis of RNA - Protein Synthesis: Expression of gentic information - The genetic code - Transfer RNA - Expression of the genetic code - Structure of prokaryotic & Eukaryotic genes - Levels of Protein Structure: Amino Acids Families and Classification: Biosynthesis and utilization of amino acids - Non - protein amino acids - Carbohydrates: Structure and biosynthesis of carbohydrates - Lipid Metabolism: Structure and roles of fatty acids - Fatty acids synthesis - Metabolism of triacylglycerols - Oxidation of fatty acids.
B M – 629 **(2 cr. h)**	**Seed Microbiology** **ميكروبيولوجيا البذور** Contents: Introduction - Methods of detection of seedborne microorganisms: Examination of dry seeds and non-cultural tests – Examination of seed washing - Blotter test - Agar test - Seedling symptoms test - Use of light in detecting seed borne microorganisms - Virulence tests - Microbiological Factors affecting occurrence of seedborne microorganisms (moisture, temperature, oxygen, debris and foreign materials, insects and mites) - Seed saprophytic microorganisms - Seed pathogenic microorganisms - Role of seedborne pathogens in transmission of diseases - Production of toxins by seedborne microorganisms - Role of seedborne microorganisms in quality loss - Control of seedborne microorganisms (including genetical, physical, chemical, biological and integrated controls).
B M – 630 **(2 cr. h)**	**Bacteriology** **بكتريولوجى** Criteria for classification of bacteria - Bacterial groups: Gram - negative bacteria: Sprirochaetes - aerobic spiral and curved rods - aerobic rods and cocci - Facultative anaerobic bacteria - Anaerobic rods and cocci - Sulfate reducing bacteria - Rickettsiae and chlamydias - Mycoplasmas - Other Gram negative bacteria: Photo trophs - Chemotrophs - Glinding bacteria - Sheathed bacteria - budding and or appendaged bacteria - Gram - Pasitive bacteria: Gram positive cocci - Lactic acid bacteria - Gram positive rods - Endospore - forming bacteria - Asporogenous gram positive rods - Streptomyces and related bacteria - The Archaeobacteria: Methanogenic bacteria - Extreme halophiles - Sulfer dependent extreme thermophiles.

	3- M. Sc. Degree in Environmental Sciences (B E)
B E – 640 **(3 cr. h)**	**Advanced Vegetation** **غطاء نباتى متقدم** Ecological principles and concepts of plant communities at all levels of hierarchy. Techniques of vegetation sampling and survey in different habitat types. Classification and ordination of plant communities. Direct and indirect gradient analysis. Application of vegetation studies in related and distant fields of

	plant community ecology.
B E – 641 **(2 cr. h)**	**Environmental Indicators** **كاشفات بيئية** Principles of plant-environment relationships as a measure of environmental factors. Types of plant indicators (bio- or phytoindicators) at different levels of organization. Characteristic features of plant environmental indicators. Plant indicators in different environments. Structural and functional behaviour of phytoindicators.
B E – 642 **(3 cr. h)**	**Agrometeorology and Environmental Factors** **إرصاد زراعية وعوامل بيئية** Overview of the earth and its atmosphere from ecological point of view. Environmental complex in relation to plant distribution, growth and productivity. Microclimate and macroclimate of agricultural crop production and processing. Methodology, principles and applications of agricultural meteorology. Importance of agricultural meteorology in building regional and global scenarios for the expected climate change.
B E – 643 **(2 cr. h)**	**Environmental stresses** **الإجهادات البيئية** Definitions and concepts of environmental stress. The response of plants to environmental stress with primary focus on drought, salinity, temperature, light, radiation and pollution stress. The stress arising from natural environmental factors and artificial activities. Ecology and evolution of stress-tolerant, stress-resistant and stress-avoiding plants. The amelioration of environmental stress in different habitats and ecosystems.
B E – 644 **(2 cr. h)**	**Desert Ecology** **بيئة الصحراء** Arid climate and classification of drylands. Desert landforms, geomorphology, water resources and surface deposits (desert soils). Types of dryland ecosystems and human impact on deserts. Desertification and sustainable development of deserts.
B E – 645 **(2 cr. h)**	**Vegetation of the World** **الكساء النباتى فى العالم** The course covers distribution and classification of ecological systems and hierarchy of ecological units of the entire world's geo-biosphere. Ecological cause-and-effect relationships of natural vegetation zones or zonobiomes in the world. Emphasis is on climate and the biotic procedures that represent the most important factors affecting ecosystems. Classification of world zonobiomes and their biotic and abiotic characteristics. Global review on ecological and environmental problems affecting vegetation.
B E – 646 **(2 cr. h)**	**Advanced Topics in Plant Ecology** **موضوعات متقدمة فى إيكولوجيا النبات** Lectures, reports and discussions on major current research topics in plant ecology. Quaternary ecology and impact on climate change and biogeography. History and concepts of species evolution, speciation, distribution and extinction. Biological responses of plant species and populations with emphasis on dispersion, pattern, age and area.

	4- M. Sc. Degree in Plant Physiology (B PP)
B PP – 655 **(3 cr. h)**	**Advanced Enzymology** **علم الأنزيمات المتقدم** Enzyms Structure: Primary, secondary, tertiary and quaternary structure of proteins - Classification by 3 dimensional structure - Native and denaturated proteins - Theoretical Background of Enzyme Purification: Ion exchange chromatography (cation and anion) - Size exclusion chromatography - Affinity chromatography - Dye- ligand chromatography - Polyacrylamide gel

	electrophoresis - Methods of molecular weight estimations - Energy and Enzymes: Changes in free energy determine the direction in which reaction proceed - ΔG° Determine the direction in which reaction proceed under standard condition - ΔG Determine the direction in which chemical reaction actually proceed inside cells - Mechanism of Enzyme Action: Catalysts speed up reactions by lowering the activation energy ΔG - Enzymes lower activation energy by reducing the energy and / or changes associated with transition state - Enzyme specificity is explained by the shape of the active site - The catalytic efficiency of the active site is based on a combination of factors - Coupled reactions and role of ATP - Multi substrate reactions - The Kinetics of Enzymatic Catalysis: Reaction rate for a simple enzyme - catalyzed reaction - Michaelis - Menton kinetics - Expressing reaction rates for multistep reactions - The significance of K_m, K_{cat} and K_{cat} / K_m. Analysis - Isozymes: Separation and identification Application as a taxonomic marker, as diagnostic value - Isozymes are products of the expression of closely related genes - Enzyme Regulation: Substrate level control - Feed back control - Allosteric regulation - Control mechanisms that affect allosteric enzyme - Models for the behavior of allosteric enzymes - The concerted and sequential models Covalent modification (phosphorylation , methylation, acetylation, ribosylation etc) - Association and dissociation of subunits - Metal Cofactors: Metal ions in enzymes - Role of metal ions in enzyme activity - Coenzymes: Mechanism of action the following coenzymes: Thiamine pyrophosphate - Pyridoxal phosphate - Nicotinamide coenzymes (NAD, NADP) - Flavin coenzymes (FMN, FAD)- 4` phosphopantetheine coenzyme - $\propto$ - Lipoic acid – Biotin - The Diversity of Enzymatic Function: Classification of protein enzymes - Molecular engineering of new and modified enzymes - Nonprotein biocatalysts (Ribozymes).
B PP - 656 (3 cr. h)	**Plant Growth Regulators** **منظمات النمو للنبات** Natural Growth Regulators (Plant Hormones): Auxins - Gibberellins - Cytotokinins - Abscisic acid - Ethylene - The study of Discovery - Structure - Properties - Measurements - Distribution in plants - Biosynthesis - Transport - Metabolism - Physiological effects - Molecular mechanism of hormone action - Other Biologically Active Compounds and Hypothetical Hormones - Polyamines - Coumarin - Triacontil , brossins - florigen , Vernalin - Synthetic Growth Regulators: Various Classes - Structure - applications and commercial importance.
B PP - 657 (2 cr. h)	**Plant Tissue Culture and Biotechnology** **زراعة الأنسجة والتكنولوجيا الحيوية** History - Methodology: initiation , nutrition and maintenance of plant cell and tissue cultures, callus cultures and cell suspension cultures - Morphogenesis and Regeneration - Propagation Techniques: Micropropagation from preexisting meristems: Shoot tips, buds and node cultures - Propagation from non-meristematic tissues: Direct and indirect organogenesis - Non -zygotic embryogenesis: Establishment, growth and differentiation of non-zygotic embryos, synthetic seed technology - Culture of haploid reproductive cells: Anther, pollen grain, and ovule cultures (Androgenesis and Gynogenesis) - Plant protoplast: Isolation , culture and fusion, somatic hybridization - Applications of cryopreservation techniques in germplasm preservation - Cell culture for the Production of Secondary Metabolites - In vitro Plant Pathology - Plant Transformation: Engineering agronomic traits: Engineering pathogen resistance in crop plants, engineering herbicide resistance, and engineering of stress and senescence tolerance - Engineering quality and yield traits - Engineering lipids,

	vitamins, iron, lignin, carbohydrates,storage proteins contents in plants , and metabolic engineering of plant secondary metabolites - Engineering developmental traits - Engineering phytochromes,plant architecture,flowering time,flower pigmentation, and seed germination - Engineering molecular farming and pharmaceutical traits - Engineering crop plants for molecular farming, production of pharmaceutical proteins using viral vectors,plants as a source for subunit vaccines, plants as enzyme factories - Engineering Non-food crops - Future of Plant Biotechnology and Challenges Ahead.
B PP – 658 **(2 cr. h)**	**Plant Water Relations** **العلاقات المائيـــه للنبات** Physiological Aspects: Water Potential: The components of water potential - Methods of measuring water potential and its components - Turgor Maintenance by Osmotic Adjustment: Evidence for osmotic adjustment - Factors affecting osmotic adjustment - Beneficial of osmotic adjustment - Limitation of osmotic adjustment - Water Balance of Plants: Water in the soil - Water absorption by roots - Water transport through the xylem - Water movement from the leaf to atmosphere - Ecological Aspect: Historical review of water relations - Ecological importance of water - Water relations in sand-dune plants under natural conditions - Water relations in psammophytes - Water supply in desert plants - Water economy and seasonal dimorphism of desert and Mediterranean chamaeophytes - Water relations in wind -break trees.
B PP – 659 **(2 cr. h)**	**Ultrastructure and Functions of Cell Components** **التركيب الدقيق ووظائف مكونات الخلية** Plant Life: Unifying principles - Overview of Plant Structure - The Plant Cell: Biological membranes - The nucleus - The endoplasmic reticulum - Golgi apparatus - The central vacuole - Mitochondria and chloroplasts: Setes of energy conversion - Microbodies – Oleosomes - The Cytoskeleton: Microtubules, microfilaments and intermediate filaments - Cell Cycle Regulation - Plasmodesmata.
B PP - 660 **(2 cr. h)**	**Mineral Nutrition and Solute Transport** **التغذية المعدنيه وإنتقال الذائبات** Introduction and historical review - Chemical and mineralogical properties of soils - Weathering processes of mineral rocks -The soil as a medium for plant growth - The colloidal fraction of the soil - Materials and methods used in the study of mineral salt absorption - Mechanism of ion transport and the carrier concept - Factors affecting salt absorption - The elemental composition of plants (macro - and micronutrients) - Methods of studying plant mineral nutrition - Functions of mineral elements and symptoms of deficiencies - The biogeochemical cycles of certain nutrient elements - Tolerance to heavy metals - Fall- out and radioactive elements.

	5- M. Sc. Degree in Flora and Taxonomy (B FT)
B FT – 670 **(3 cr. h)**	**Modern Taxonomy** **تصنيف حديث** Introduction - Systems of classification - Phylogenetic considerations - Diversity of phyletic concepts - Modern trends in taxonomy - Biosystematics and Modern taxonomy: Biosystematic studies &their significance - The role of Herbaria in Modern plant taxonomy - Biosystematic categories - Application of numerical methods - The Role of Protein & Nucleic Acid Research: Isozyme & Allozyme analyses - Amino Acid Sequence Analysis - Electrophoresis of the Storage Protein - Taxonomic Relations based on chloroplast DNA (Cp DNA = rbcl)

B FT – 671 **(2 cr. h)**	**Plant Nomenclature** **تسمية نباتية** Introduction: History of classification - Systems of classification (Artificial, Natural, Phylogenetic, modern) - History of Nomenclature (different codes) - Rules of Nomenclature: Priniciples - Ranks of taxa , and the terms denoting them - Names of taxa (Definitions, Typification, Kinds of types, Priority, Iimitation of the principle of priority) - Nomenclature of taxa according to their rank (Names of taxa above the rank of family, names of families and subfamilies, names of genera, names of species, names of plants in cultivation) - Publication: Effective and valid pubication - Conditions and dates of valid publication of names - Citation of authors names and of literature for purpose of precision - Retention , choice , and rejection of names and epithets.
B FT – 672 **(3 cr. h)**	**Applied Floristic Studies** **فلورا تطبيقية** Introduction: The importance of floristic studies in the field of plant taxonomy and flora. How to construct plans for field studies. The importance of Herbaria in the study of taxonomy and flora. Contents: Preparations of scientific excursions. Study of field and Herbarium techniques. Establishing a personal Herbarium. Analyzing the results of the studies using different computer programs.
B FT – 673 **(2 cr. h)**	**Chemotaxonomy** **التصنيف الكيميائى** Introcluction: Compounds useful in plant taxonomy: Primary metabolites - Secondary metabolites – Semantides - Value of chemotaxonomy: Contribution to plant systematics - Contribution to phylogony.
B FT – 674 **(2 cr. h)**	**Specialized Field studies** **دراسات حقلية متخصصة** Introduction: Floristic studies are not isolated from other related sciences. Different fields of study that significantly relate to these studies include geography, ecology, environmental sciences, geology, climatology and many others. These varieties of studies reflect various approaches to the floristic accounts, and embody the integration of science. The variation within these approaches manifests the significance of plant taxonomy, and the flora as its compartment - Syllabus Contents: Essentials of plant taxonomy: an overview - Different approaches in the floristic studies - Weed flora of Egypt: origin, diversity (spatial & temporal) and biology - Floristic diversity wthin ecological groups: case studies - Quantitative approach in floristic analysis and data processing: case studies - Biogergaphical studies based on environmental parameters - Urban flora and vegetation composition.
B FT – 675 **(2 cr. h)**	**Palynology** **علم حبوب اللقاح** Introduction - Pollen and spore morphology - Structure of sporangium - Polarity and symmetry - NPC- system - Sporoderm structure - Spore and pollen Morphology in Relation to plant taxonomy - Microfossils other than pollen and spores - Pollen Analysis
B FT – 676 **(2 cr. h)**	**Cytotaxonomy** **التصنيف الخلوى** Embryology: Embryo formation – Parthenogenesis – Agamospermy - Types of ovule axes - Chromosomes in Angiosperms: Structure – Types – Numbers – Behavior - Influence of environment - Methods of study - Karyotypes and polyploidy and their taxonomic applications - Chromosomes diversity within species (population, ecotypes, landraces, cultivars with case a study in each) - Breeding, hybridization and introgression - Characterization of hybrids and polyploidy by molecular tools.

	6- M. Sc. Degree in Cytology Gentics (B CG)
B CG – 685 **(3 cr. h)**	**Cytology** **الخليـــة النباتية** Cell Structure - General morphology and chemistry of the cell - Cellular organization - General chemistry proteins - Nucleic acids – Lipids – Carbohydrates - Inorganic Comstituents - Structure and function of cytoplasmic organelles: Mitochondria - Plastids – Lysosomes - Endoplasmic Reticulum – Microsomes - Cytoplasmic matrix - Golgi Complex - Cell membrane – Vacuoles - Structure and function of the nucleus: General morphology and chemistry - Nuclear Envelope – Nucleoplasm – Nucleolus - Chromocenters – Chromosomes - Some biochemical considerations: DNA – RNA - Proteins – Lipids.
B CG – 686 **(2 cr. h)**	**Advanced Genetics** **وراثة متقدمة** Mendelian Genetic: Fundamental of mendelian Genetics extension and applications, Chromosomes and heredity genetic linkage - Molecular Genetics: gene mutation, Transposable elements, gentics of bacteria and phages, developmental genetics extranuclear inheritance - Population Genetics: an introduction to population genetics extensions and applications of population genetics.
B CG – 687 **(3 cr. h)**	**Genetic Engineering** **هندســـة وراثيـــة** Genes: Genes are DNA, From genes to genomes, how many genes are there - Proteins: m DNA, Peotein Synthesis, Using the genetic code - MRNA: transcription , the operon - DNA : replicon , DNA replication,recombination and repair,rearrangement of DNA - Cells : Protein trafficking, cell cycle and growth regulation, gradients, cascades, and signaling pathways - Plant transformation - Molewlar beeding.

5- Zoology Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(Z)	Diploma (500)	1- Enviromental Sciences	(ZE)
		2 - Invertebrates and Parasitology	(ZIP)
		3- Applied Bioscience	(ZBS)
	M. Sc. (600)	1- Molecular and integrated physiology	(ZMP)
		2- Invertebrates and Parasitology	(ZIP)
		3- Immunology	(ZI)
		4- Animal Ecology	(ZAE)
		5-Cell Biology, Histology and Genetics	(ZC)
		6- Comparative Anatomy and Embryology	(ZCA)
	Ph. D. (700)	1 - Molecular and Integrated Physiology	(ZMP)
		2- Invertebrates and Parasitology	(ZIP)
		3- Immunology	(ZI)
		4- Animal Ecology	(ZAE)
		5- Cell Biology, Histology and Genetics	(ZC)
		6- Comparative Anatomy & Embryology	(ZCA)

1- Diploma in Environmental Sciences (ZE)

Code	Course Number	Course Case	CR. Hours
(ZE)	The candidate studies (10) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	ZE 501	Coastal Ecology	1	1	2	2-3	
	ZE 502	Environmental Geology	1	1	2	2-3	
	ZE 503	Physiological Ecology	1	1	2	2-3	
	ZE 504	Environmental Analysis	1	1	2	2-3	
	MS 676	Biostatistics	2	--	2	--	From Statis. Math
Second	ZE 505	Applied Industrial and Environmental Biotechnology	1	1	2	2-3	
	ZE 506	Biological Waste Processing	1	1	2	2-3	
	ZE 507	Environmental Impact Assesment	1	1	2	2-3	
	ZE 508	Environmental Laws and Ethical Issues	2	--	2	--	
	ZE 509	Field Ecology	1	1	2	2-3	
		The Total Cr.h. Required	12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	ZE 510	Principles of Paleontology	1	1	2	2-3	
	ZE 511	Radiobiology	1	1	2	2-3	
Second	ZE 512	Applied and Environmental Microbiology	1	1	2	2-3	
	ZE 513	Geographic Information System (GIS)	1	1	2	2-3	
		The Total Cr.h. Required	2	2			

Note:- the code No. of the branch: from 501 to 519
From 514to 519 are codes No. for adding new courses

2- Diploma in Invertebrates & Parasitology (ZIP)

Code	Course Number	Course Case	CR. Hours
(ZIP)	The candidate studies (10) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Tale (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	ZIP 520	Biology of Parasitic Protozoa	2		2		
	ZIP 521	Biology of Parastitic Protozoa (Practical Course)		2		2-3	
	ZIP 522	Biology of Parasitic Helminths	2		2		
	ZIP 523	Biology of Parasitic Helminths (Practical Course)		2		2-3	
	ZIP 524	Medical Entomology (Lectures & Practical Courses)	1	1	2	2-3	
Second	ZIP 525	Lab. Techniques in Parasitology (Practical Courses)		2		2-3	
	ZIP 526	Immunology of Parasitic Infections (Lectures & Practical Courses)	1	1	2	2-3	
	ZIP 527	Electron Microscop and itsApplication in Biology (Lectures & Practical Courses)	1	1	2	2-3	
	ZIP 528	Control Measures of Parasitic Infections and Epidemiology (Lectures & Practical Courses)	1	1	2	2-3	
	ZIP 529	Functional Genomics of Vectors and Parasites and Biostatistics	2		2		
		The Total Cr.h. Required	10	10			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	ZIP 530	Parasitological Problems in Fisheries and Fish Production (Lectures & Practical Courses)	1	1	2	2-3	
	ZIP 531	Physiology of Parasite (Lectures & Practical Courses)	1	1	2	2-3	
Second	ZIP 532	Parasitology – Immunology (Lectures & Practical Courses)	1	1	2	2-3	
	ZIP 533	Parasite and Tissue Cultures (Lectures & Practical Courses)	1	1	2	2-3	
		The Total Cr.h. Required	2	2			

Note:- the code No. of the branch: from 520 to 539
From 534to 539 are codes No. for adding new courses

3- Diploma in Applied Bioscience (ZBS)

code	Course number	Course case	Cr. Hours
(ZBS)	The candidate studies (10) courses in table (1)	Compulsory	20
	The candidate choose (1) course / semester from table (2)	Elective	4
	The Total Cr. h. Required		24

Table (1): Compulsory Courses

semester	Code	Course name	Cr. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First semester	ZBS 540	Biological Analysis	2	-	2	-	
	ZBS 541	Genetics and Molecular Biology	1	1	2	2-3	
	ZBS 542	Endocrinology and Metabolism	1	1	2	2-3	
	ZBS 543	Neurophysiology	1	1	2	2-3	
	ZBS 544	Immune System Diseases and Immunodiagnosis	2	-	2	-	
Second semester	ZBS 545	Applied Toxicology and Histopathology	1	1	2	2-3	
	ZBS 546	Parasitology	1	1	2	2-3	
	ZBS 547	Applied Immunology	1	1	2	2-3	
	ZBS 548	Field Ecology	1	1	2	2-3	
	ZBS 549	Cardiac Electrophysiology	1	1	2	2-3	
	The Total Cr. h. Required		12	8			

Table (2): Elective Courses

semester	Code	Course name	Cr. Hours		Exam Hours	
			Th	Pr	Th	Pr
First semester	ZBS 550	Bioinformatics	2	-	2	-
	ZBS 551	Developmental Biology	2	-	2	-
	ZBS 552	Biology of Parasites	2	-	2	-
Second semester	ZBS 553	Tissue Culture	2	-	2	-
	ZBS 554	Cancer Biology	2	-	2	-
	ZBS 555	Stem cell	2	-	2	-
	The Total Cr. h. Required		4	-		

Note: the code No. of the branch: from 540 to 560
From 556 to 560 are codes No. for adding new courses

1- M. Sc. Degree in Molecular and Integrated Physiology(ZMP)

Code	Course Number	Course Case	CR. Hours
(ZMP)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	Z 601	Molecular Biology and Biotechnology	2	2	Also offered by all gps.
	ZMP 610	Neuro Sciences	2	2	
	ZMP 611	Pharmacology and Toxicology	3	3	
Second	Z 602	Data Analysis Experimentation and	2	2	Also offered by all gps.
	ZMP 612	Advanced Endocrinology	2	2	
	ZMP 613	Environmental Physiology	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZMP 614	Invertebrate Ecology & Physiology	2	2	
	ZMP 615	Histochemistry and Histopathology	2	2	
	ZMP 616	Immunochemistry & Bioenergetic	2	2	
Second	ZMP 617	*Neuroendocrinology*	2	2	Also offered by Immun.
	ZMP 618	Radiobiology	2	2	Also offered by Immun.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 610 to 624
From 619 to 624 are codes No. for adding new courses

2- M. Sc. Degree in Invertebrates and Parasitology(ZIP)

Code	Course Number	Course Case	CR. Hours
(ZIP)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	Z 601	Molecular Biology and Biotechnology	2	2	Also offered by all gps.
	ZIP 625	Biology of protozoa – Biology of Helminths and Parasitological Diagnosis	3	3	
	ZIP 626	Physiology of Parasite – Immunoparasitology	2	2	
Second	Z 602	Experimentation and Data Analysis	2	2	Also offered by all gps.
	ZIP 627	Invertebrate Histology – Electron Microscopy and Ultrastructure of Protozoa	3	3	
	ZIP 628	Advanced Helminthology and Nematology	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZIP 629	Invertebrate Embryology and Developmental Biology	2	2	
	ZIP 630	Advanced Protozoology	2	2	
Second	ZIP 631	Biology of Aquatic Invertebrates and Medical Malacology	2	2	
	ZIP 632	Ecology of Parasites and Endocrinology of Invertebrates	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 625 to 639
From 633 to 639 are codes No. for adding new courses

3- M. Sc. Degree in Immunology (ZI)

Code	Course Number	Course Case	CR. Hours
(ZI)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	Z 601	Molecular Biology and Biotechnology	2	2	Also offered by all gps.
	ZI 640	Molecular Immunology	2	2	
	ZI 641	Cellular Immunology and Applied Immunology	3	3	
Second	Z 602	Experimentation and Data analysis	2	2	Also offered by all gps.
	ZI 642	Immune System Diseases and Immunodiagnosis	3	3	
	ZI 643	Immunochemistry	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZI 644	Comparative Immunology Developmental and	2	2	Also offered by Antomy.
	ZC 672	Cytogenetics and Molecular Genetics	2	2	Also offered by Cell Bial.
	ZI 645	Immunoparasitotogy	2	2	
Second	ZMP 617	Neuroendocrinology	2	2	Also offered by Physiol.
	ZMP 618	Radiobiology	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 640 to 654
From 646 to 654 are codes No. for adding new courses

4- M. Sc. Degree in Animal Ecology (ZAE)

Code	Course Number	Course Case	CR. Hours
(ZAE)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	Z 601	Molecular Biology and Biotechnology	2	2	Also offered by all gps.
	ZAE 655	Aquatic & Terrestrial Ecology	3	3	
	ZAE 656	Ecological conservation and Communication	2	2	
Second	Z 602	Experimentation and Data Analysis	2	2	Also offered by all gps.
	ZAE 657	Neuroethology&Behavioral Endocrinology	2	2	
	ZAE 658	Ecotoxicology and Histopathology	3	3	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZAE 659	Biodiversity	2	2	
	ZAE 660	Thermoregulation and Photoperiodism in Vertebrates	2	2	
Second	ZAE 661	Anatomy and Physiology of Vertebrate Sense Organs	2	2	
	ZAE 662	Population Dynamics and Principles of Taxonomy	2	2	Also offered by Antatomy
	ZAE 663	Environmental Remote Sensing	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 655 to 669
From 664 to 669 are codes No. for adding new courses

5- M. Sc. Degree in Cell Biology, Histology & Genetics(ZC)

Code	Course Number	Course Case	CR. Hours
(ZC)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	Z 601	Molecular Biology and Biotechnology	2	2	Also offered by all gps.
	ZC670	Cell Biology and Cancer Biology	3	3	
	ZC671	*Tissue Biology*	2	2	Also offered by Anatomy
Second	Z 602	Experimentation and Data analysis	2	2	Also offered by all gps.
	ZC672	Cytogenctics and Molecular Genetics	2	2	Also offered by Immun.
	ZC673	Tissue Culture & Electron Microscopy	3	3	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZC674	Toxicology and Histopathology	2	2	
	ZC675	Radiobiology and Immunobiology	2	2	
	ZC676	Reproductive Biology & Molecular Endocrinology	2	2	
Second	ZC677	Developmental Biology	2	2	
	ZC678	Vertebrate & Invertebrate Histology	2	2	
	ZC679	Histochemistry	2	2	
	ZC680	Human Genetics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 670 to 684
From 681 to 684 are codes No. for adding new courses

6- M. Sc. Degree in Comparative Anatomy and Embryology(ZCA)

Code	Course Number	Course Case	CR. Hours
(ZCA)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	Z 601	Molecular Biology and Biotechnology	2	2	Also offered by all gps.
	ZCA685	Comparative Anatomy of Nervous System, Cranial / Nerves and Sense Organ	3	3	
	ZCA686	Comparative Anatomy of Skeletal System and Muscular System	2	2	
Second	Z 602	Experimentation and Data Analysis	2	2	Also offered by all gps.
	ZCA687	Molecular Taxonomy and Vertebrate Fauna	2	2	
	ZCA688	Developmental Biology & Electron Microscopy	3	3	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZCA689	Physiology of Excretion and Respiration	2	2	
	ZI 644	Developmental and Comparative Immunology	2	2	Also offered by Immune.
Second	ZAE662	Population Dynamics and Principles of Taxonomy	2	2	Also offered by Ecology
	ZC671	Tissue Biology	2	2	Also offered by Cell Biol.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 685 to 698
From 690 to 698 are codes No. for adding new courses

1- Ph. D. Degree in Molecular and Intergrated Physiology (ZMP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ZMP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZMP 701	Neuropsychopharmacology	2	2	
	ZMP 702	Mechanistic Toxicology	2	2	
	ZMP 703	Prostaglandins	2	2	
	ZMP 704	Physiology of Aging	2	2	
	ZM 736	Cytokines	2	2	Also offered by Immune.
	ZC 763	Cell Signaling and Regulation	2	2	Also offered by Anatomy & Cell Biol.
Second	ZMP 705	Physiology of Sense Organs	2	2	
	ZMP 706	Physiology of Exercise	2	2	
	ZMP 707	Protein Dynamics	2	2	Also offered by Cell Biol.
	ZMP 708	Seminar	2	2	
	ZC 760	Structural and Functional Genomics	2	2	Also offered by Cell Biol.
	ZC 761	Bioinformatics	2	2	Also offered by Cell Biol.
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 701 to 714
From 709 to 714 are codes No. for adding new courses

2- Ph. D. Degree in Invertebrates and Parasitology(ZIP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ZIP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZIP 715	Biochemistry of Parasites	2	2	
	ZIP 716	Computational Genomics and Biostatistics	2	2	
	ZIP 717	Cellular and Molecular Host-parasite Interactions	2	2	
	ZIP 718	Advanced Immunoparasitology	2	2	
	ZIP 719	Pathology of Helminth Infection	2	2	
	ZIP 720	Pathogenesis and Defence of Protozoa	2	2	
	ZIP 721	Epidemiology : Intraspecific Variations	2	2	
Second	ZIP 722	Control Measures of Parasitic Diseases	2	2	
	ZIP 723	Molecular Taxonomy of Invertebrate	2	2	
	ZIP 724	Molecular Biology of Infectious Diseases	2	2	
	ZIP 725	Parasitological Problems in Fisheries	2	2	
	ZIP 726	Biology of Parasites and Vectors	2	2	
	ZIP 727	Seminar	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 715 to 729
From 728 to 729 are codes No. for adding new courses

3- Ph. D. Degree in Immunology(ZI)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ZI)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZI 730	Immunogenetics	2	2	
	ZI 731	Tumour Immunology	2	2	
	ZI 732	Immunotoxicology	2	2	
	ZI 733	Cellular and Molecular Basis of Immune Dysfunction	2	2	
	ZI 734	Nutrition and Immunity	2	2	
	ZCA 782	Mechanisms of Mammalian Cell Growth	2	2	Also offered by Anatomy
Second	ZI 735	Vaccine Biotechnology	2	2	
	ZI 736	Cytokines	2	2	Also offered by Physiol.
	ZI 737	Immunology, Evolution and Logic	2	2	
	ZI 738	Advaned Cell Regulation	2	2	
	ZI 739	Mucosal Immunology	2	2	
	ZI 740	Seminar	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 730 to 744
From 741 to 744 are codes No. for adding new courses

4- Ph.D. Degree in Animal Ecology (ZAE)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ZAE)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZAE 745	Herpetology	2	2	
	ZAE 746	Fish Ecology	2	2	
	ZAE 747	Avian Physiology and Ecology	2	2	
	ZAE 748	Ecology of Parasites			
	ZAE 749	Environmental Biotechnology	2	2	
	ZCA 780	Mitochondrial DNA Taxonomy	2	2	Also offered by Anatomy
Second	ZAE 750	Animal Behavioral and Psychology	2	2	
	ZAE 751	The Groundwater Pollution and the Remediation	2	2	
	ZAE 752	Genecology and Evolution	2	2	
	ZAE 753	Mammology			
	ZAE 754	Oceanography	2	2	
	ZAE 755	Seminar			
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 745 to 759
From 756 to 759 are codes No. for adding new courses

5- Ph. D. Degree in Cell Biology, Histology and Genetics(ZC)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ZC)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZC 760	Structural and Functional Genomics	2	2	Also offered by Physiol.
	ZC 761	Bioinformatics	2	2	
	ZC762	Animal Cell Growth & Regulation	2	2	
	ZC 763	Cell Signaling & Regulation	2	2	Also offered by Physiol. & Anatomy
	ZC 764	Pathobiology			
	ZMP 707	Protein Dynamics	2	2	Also offered by Physiol.
Second	ZC 765	Cancer Biology	2	2	
	ZC 766	Tissue Remodeling & Cell Motility	2	2	
	ZC 767	Developmental Genetics	2	2	Also offered by Anatomy
	ZC 768	Genetic Engineering & Gene Technology	2	2	
	ZC769	Stem Cell Biology	2	2	Also offered by Anatomy
	ZC770	Current Topics in Cell Biology	2	2	
	ZC771	Seminar	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 760 to 774
From 772 to 774 are codes No. for adding new courses

6- Ph. D. Degree in Comparative Anatomy & Embryology(ZCA)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ZCA)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ZCA775	Isolating Mechanisms and Speciation	2	2	
	ZCA776	Numerical Taxonomy	2	2	
	ZCA777	Molecular Mechanisms in Development	2	2	
	ZCA778	Molecular Phylogeny and Evolution	2	2	
	ZCA779	Biology of Regeneration	2	2	
	ZC 769	Stem Cell-Biology	2	2	Also offered by Cell Biol.
Second	ZCA780	Mitochondrial DNA taxonomy	2	2	Also offered by Ecology
	ZCA781	Comparative Anatomy and Evolution of the Gastrointestinal Tract	2	2	
	ZCA782	Mechanisms of Mammalian Cell Growth	2	2	Also offered by Immun.
	ZCA783	Seminar			
	ZC 763	Cell Signaling and Regulation	2	2	Also offered by Physiol. & Cell Biol.
	ZC 767	Developmental Genetics	2	2	Also offered by Cell Biol.
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 775 to 789
From 784 to 789 are codes No. for adding new courses

B- Course contents for Diploma

Code No.	Course name and contents
	1- Diploma in Environmental Sciences (Z E)
Z E - 501 **(2 cr. h)** **1h Th + 1h Pr**	**Coastal Ecology** **البيئة الساحلية** The objective of this course is critically examine principles governing coastal processes and landform development as a basis for research on a range of scientific and management problems of current interest in coastal environments. Particular emphasis is given to relationships between work carried out elsewhere and the distinctive nature of the Egyptian environment. Topics: include consideration of the nature of beaches, estuaries and rocky shores and the factors that cause change in them, and the many other direct and indirect influences of human use of coasts. Also considered is a range of strategies used in coastal management in the context of the Resource Management Act. The course will include field work, as well as a substantive research project. **Practical Course** Organisms and ecosystems in different coastal habitats will be compared with the emphasis on Mediterranean Sea and Red Sea - Techniques include measuring geological, chemical and physical nearshore properties, estimating the abundance and diversity of plankton, nekton, benthos and use of modern data recording and analyzing system - The students will learn techniques of underwater visual census (UVC) and data collection methods for the assessment of fish, invertebrates and algae biodiversity.
Z E – 502 **(2 cr. h)** **1h Th + 1h Pr**	**Environmental Geology** **جيولوجيا البيئة** This course deals with how geology can improve human life. Lectures include industrial minerals and rocks-waste disposal alternative energy sources – urban geology – geologic hazards – landslides, floods, erosion, subsidence, volcanism, earthquakes, and seismic sea waves. **Practical Course** Identifying the major systems of the environment and detecting the ways in which the contaminants enter and transported in the geological environment - Detection of different types of rocks and cycling minerals as factors affecting animal distribution. The diversity of animals and plants in different rocky shores - Field studies concerning the effect of: a- erosion, transportation, deposition on the organisms living in marine and deserts. b- sand dunes on desert animals.
Z E – 503 **(2 cr. h)** **1h Th + 1h Pr**	**Physiological Ecology** **فسيولوجيا البيئه** This course is intended to study have an animal cops with its environment concerning the respiratory and excretory systems. It includes structural and functional studies of the respiratory and excretory systems of aquatic and terrestrial vertebrates. Respiratory System - Excretory System. **Practical Course** Measurements of metabolic rate - Measurements of respiratory gases and blood oxygen affinity - Effect of environmental stress - Morphological and physiological adaptations to different environmental condition to give picture about tolerance and resistance.
Z E – 504 **(2 cr. h)** **1h Th + 1h Pr**	**Environmental Analysis** **التحليل البيئى** Environmental Analysis is a national testing and advisory company associated with various Chemical, Biological, and Environmental Hazards that are either

	present or emanating into, around or out of our client's facilities. Today, our client base extends into multiple industrial classifications in addition to health care facilities. Techniques and models of systems analysis and concepts of general system theory as applied to comprehensive study, planning, evaluation, and management of environmental decision systems. Experimentation will be done with relevant computer programs. The Environment: Beogeochemical cycles - Environmental pollution - Environmental Standards - Environmental Analysis: Aims of analysis - Types of Analysis - Stages of analysis - Analytical Methods: Classical analysis - Instrumental analysis - Test kits and portable laboratories. **Practical Course** It includes chemical and biological analyses in different ecosystem: Chemical analysis: It comprises measurements of the concentration of organic and inorganic toxic elements - Biological analysis: Detailed with determination of type of toxic bacteria and its effect on the population growth and other biological aspects.
M S – 676 **(2 cr. h)**	**Biostatistics** **الإحصاء الحيوى** **From M. Sc. in Statistical Mathematics**
Z E – 505 **(2 cr. h)** **1h Th + 1h Pr**	**Applied Industrial and Environmental Biotechnology** **التكنولوجيا الحيوية البيئية والصناعية** This course provides an evaluation current biotechnology tools used in pharmaceutical trees industries, and in environmental remediation. New technologies and genomic approaches that can be applied to these processes are also discussed. The specific application of molecular biology and metabolic capability of microorganisms for exploitation of many areas of biotechnology to reverse and prevent environmental problems. Topics: will cover: sewage treatment, pollution control of domestic, agricultural and industrial wastes, bioremediation, energy and biofules, and mineral resource recovery. **Practical Course** Practical course deals with: Mapping of the industrial and agricultural waste products - Collection and analysis of water, air and soil samples of the studied areas - Measurements of total dissolved salts (TDS), total suspended substances (TSS), pH….etc, with referring to their effects on population dynamics - Application of different bioremediation techniques - Green house gases.
Z E – 506 **(2 cr. h)** **1h Th + 1h Pr**	**Biological Waste Processing** **المعالجة البيولوجية للمخلفات** Fundamental concepts of biological processes that are important in natural and engineered environmental systems, especially those affecting water quality. Incorporates basic fundamentals of microbiology into a quantifiable engineering context to describe, predict, and control behavior of environmental biological systems. Topics: include the stoichiometry, energetics and kinetics of microbial reactions, suspended and biofilm processes, carbon and nutrient cycling, and bioremediation applications. Characteristics of water and airborne wastes; treatment processes and process kinetics; treatment system design. Aeration, thickening, biological processes, design of biological treatment systems. Hydraulics and reaction kinetics, gas transfer, adsorption, particle characteristics, flocculation, gravitational separations, filtration, membranes, and disinfection. Chemical reaction engineering; coagulation and flocculation; granular filtration; sedimentation; carbon adsorption; gas transfer; disinfection; oxidation; and

	membrane processes. Fundamentals of environmental engineering microbiology; kinetics of microbial growth and biological oxidation; applications for activated sludge, gas transfer, fixed-film processes, aerobic and anaerobic digestion, sludge disposal, and biological nutrient removal. **Practical Course** Practical work deals with: Types and characteristics of wastes - Principles and aims of biological waste treatment - Analysis of solid biological waste (sampling, measuring of waste weight, volume, bulk density) - Composition of waste components (wet, dry, ash).
Z E – 507 **(2 cr. h)** **1h Th + 1h Pr**	**Environmental Impact Assessment** **تقييم الأثـر البيـئى** An examination of environmental issues at global and local levels, system principles, environmental legislation, environmental assessment techniques. In addition, this course introduces the students to many aspects of hazardous waste management as it affects municipalities, industries and public. Waste minimization and risk assessment strategies will be included. Physico-chemical, thermal and biochemical methods to remediate hazardous waste will also be included. Study and evaluation of the impacts of large scale projects on the quality of the environment with emphasis on the assessment of physical and community impacts. **Practical Course** Practical lessons deal with identification of elements and compounds of EIA studies. Training on methodologies, preparation and review of EIA studies in different developmental projects. White, grey and black list project forms and studies. Field visits to some developmental projects to demonstrate the implantation of EIA rules. Training on preparation of a complete EIA study.
Z E – 508 **(2 cr. h)**	**Environmental Laws and Ethical Issues** **أخلاقيات وقوانين البيـئة** Air and Groundwater quality are national priority issue of immense and ever-growing proportions. The government must pass stricter regulations to protect air and groundwater quality and to clean up currently polluted aquifers, and should make comprehensive and long-term legislation such as the Resource Conservation and Recovery Act (RCRA), the superfund Amendments and Reauthorization Act (SARA), the Safe Drinking Water Act and the Pollution Prevention Act. These laws and regulations affect all sources of air and groundwater contamination, including chemical industries, gasoline stations, industrial landfills and lagoons, refineries, hazardous solid waste management units, municipal and private solid waste activities, nuclear waste disposal practices, mining practices and pesticide/fertilizer agricultural practices. Hundreds of lawsuits against private industries, involving the leukemia deaths of several children (documented in the book and film), have brought a public awareness and determination. A measure of this concern is the vigorously enforced regulations, which cover all aspects of the problem from prevention to cleanup.
Z E – 509 **(2 cr. h)** **1h Th + 1h Pr**	**Field Ecology** **بيـئة حـقليه** Topics covered: Application of ecological theory and principles to solve environmental problems, including conservation biology, assessment of environmental impacts, and restoration ecology and mitigation of environmental impacts - Sampling methods and field techniques applicable to the biota. Field experience and study of plant and animal life in selected habitats, including geographical distribution, climatic and soil relationships - Organisms, Communities, and Ecosystems - Ecosystem (Terrestrial and Aquatic

	Ecosystems) - Ecology of Populations – Succession - Collecting and identifying - Survey and recording techniques - Town Ecology - Human Ecology: Resource Use - Human Ecology: Pollution. **Practical Course** Practical course deals with: Techniques for data collection, followed by analysis with appropriate statistical analysis - Methodological techniques in terrestrial and aquatic fields - Basic concepts of chemical measurements in environmental media, with emphasis on water, soil, air and tissue - Techniques for bioremediation - Species and habitat diversity – Succession - Assessment of organisms by quadrates, line transect, mark-recapture analysis - Fish aquaculture - Coastal environments.
Z E – 510 **(2 cr. h)** **1h Th + 1h Pr**	**Principles of Paleontology** **أساسيات علم الحفـــريات** This course is concerned with the study of the morphological characteristics, evolution and classification of the major taxa of past geological ages. The course comprises the nature and scope of invertebrate paleontology, fossil preservation, classification of the major animal groups and nomenclature of the organisms with the study of some major invertebrate phyla including mollusca, Echinodermata and Bryozoa. **Practical Course** Marine invertebrate organisms: Foraminifera: Taxonomy and ecological distribution - Sponges: Distribution of calcareous and siliceous types - Coral reefs: Identification of coral reef organisms, microscopic features of coral skeleton, microstructures of coral skeleton, geochemical analysis of coral skeleton - Geochemical analysis of shells - Coastal Processes: Classification of beaches, coastal hazards - Ancient Vertebrate Organisms: Main vertebrate fossil groups in Egypt - Evolution of the Egyptian vertebrates - Distribution of vertebrate fossils in Egypt: A field trip to Fayoum Area as a site for vertebrate fossils as well as a field trip to Maadi National Park to study ancient flora.
Z E – 511 **(2 cr. h)** **1h Th + 1h Pr**	**Radiobiology** **بيولوجيا إشعاعية** Nature of radiation - Types of radioactive material - Radiation units - Biological effects of radiation - Products formed from water - Alteration of biologic molecules - Effect of radiation on DNA - Effect of radiation on chromosomes - Radiation effects on cell membranes - Radiation effects on energy metabolism - Radiation genetics (genetic and somatic mutations) - Radiation effect on major organ systems in mammals. **Practical Course** Types of radioactive material - Radiation units - Radiation detection and measurement - Application of radiation effect on major organ system in mammals.
Z E – 512 **(2 cr. h)** **1h Th + 1h Pr**	**Applied and Environmental Microbiology** **تطبيقات ميكروبيولوجية وبيئية** Roles of microorganisms in decomposing environmental pollutants, biogeochemical cycling, agriculture waste, food and drug manufacturing, fermentation, water quality and waste treatment. Industrial applications of microorganisms will be included. PRACTICAL: The laboratories will emphasis the application of principles of food and industrial microbiological processes. Laboratory work involves demonstrations of fundamental concepts and applications to handle and identify different types of microbes including culturing of aerobes, anaerobibes and facultative anaerobes. Field trips will emphasis food, water, and wastewater treatment.

	Practical Course Microbes in their natural habitats: terrestrial, air, aquatic and extreme environment - Modeling microbial population dynamics - Microbial nteraction: interaction among microbial population, interaction between microorganisms with plant and animals - Study of microbial diversity using gel electrophoresis - Culturing of aerobes and anaerobes microorganisms - Field trips to emphasis food, water, and wastewater treatment.
Z E – 513 **(2 cr. h)** **1h Th + 1h Pr**	**Geographic Information Systems (GIS)** **نظم المعلومات الجغرافية** This course includes survey of GIS applications in science (geography, geology, oceanography, archaeology and meteorology), government, and business (marketing, sales and management). Topics: include food chain, bioaccumulation in terrestrial and aquatic ecosystems, data acquisition, accuracy, analysis, presentation, techniques and legal issues for various GIS applications. In addition, the course will provide students with an introduction to spatial data analysis and the application of geographic information systems (GIS) to environmental problem solving. It will examine a range of spatial statistical techniques, spatial estimation methods, and data visualization tools. Moreover, the course explains the character and sources of remotely sensed data. It will discuss the suitability of these data, and assess their importance, for a range of environmental investigations. **Practical Course** Digital image processing of satellite-derived remotely sensed data for earth resource analysis and application - Advanced techniques in GIS including: database creation, management, complex geographic data analysis, modeling, and benefits and limitation to methodology - GIS analysis of the biodiversity of fauna and flora of the marine and terrestrial ecosystems.

	2- Diploma in Invertebrates & Parasitology (Z IP)
Z IP – 520 **(2 cr. h)**	**Biology of Parasitic Protozoa** **بيولوجيا الأوليات الطفيلية** A. Subkingdom Protozoa: Phylum Sarcomastigophora - The biology of kinetoplastida - Diversity of kinetoplastida - Summary of revised classification - Biology of trypanosomes infecting different vertebrates, development and transmission pathogenicity and immunity, control - Sarcodins, their biology, pathological effects and control - Phylum Apicomplexa: Main characteristics & general revised classification - Gregarines and coccidian : morphology, life cycles, host specificity - Eimeria and its economic importance, pathogenicity - Cyst-building coccidians (Sarcocystis, Taxoplasma, Besnoitia and Frenkelia) - Malaria parasites and other haemosporidia - Avian and mammalian haemoproteid – Leucocytozoidae – Piroplasms - Phylum Myxozoa (Myxosporidia): New aspects in the study of the life cycle, hosts and transmission and the new element of classification - Phylum microsporidia. Main characteristics, life cycle, economic importance, pathologenicity.
Z IP – 521 **(2 cr. h)**	**Biology of Parasitic Protozoa (Practical Course)** **بيولوجيا الأوليات الطفيلية (عملى)** This course aims to acquaint students with the current techniques in the diagnosis of parasitic protozoa.
Z IP – 522 **(2 cr. h)**	**Biology of Parasitic Helminths** **بيولوجيا الديدان الطفيلية** This course presents host-parasite relationships, particularly with reference to parasitic helminths, from an ecological and evolutionary perspective. Lectures

	in this course emphasize the parasites of man and domestic animals but do not follow a traditional format where medically important parasites are discussed in detail as individual species. Instead, stages in the life cycle of parasites are considered with reference to their success as parasites. This course also ends with a discussion of mathematical modeling techniques for host-endoparasite relationships and their applications to the study of parasite ecology.
Z IP – 523 **(2 cr. h)**	**Biology of Parasitic Helminths (Practical Course) بيولوجيا الديدان الطفيلية (عملى)** Examination of natural infected mollusks for trematode infection - Types of trematode cercariae - Establishing trematode life cycle in the laboratory - Laboratory rearing of medically important snails - Laboratory infection of snails - Shell collection technique - Fixation and preservation - Preparation of permanent mount of genitalia and radulae - Methods of study of molluscan hemolymph - Shipping of snails.
Z IP – 524 **(2 cr. h)** **1h Th + 1h Pr**	**Medical Entomology علم الحشرات الطبية** This course involves an initial segment on the major taxa of insect vectors of diseases. Lectures organized along phylogenetic line consider in detail the medically important true bugs, flies, fleas and lice. These lectures stress recognition characters, and physiological morphological and behavioral factors sharing vector ability with respect to viral, bacterial, protozoan and helminth pathogens. The ecology of each group is discussed in the context of the epidemiology of specific vector associated diseases. The course ends with a general presentation on mathematical ecology of vector associated pathogens emphasizing perturbations introduced by vaccination, chemotherapy and vector control. **Practical Course** Study the morphological characters recognizing the insect vectors of the different diseases and the cxlassification of the insects.
Z IP – 525 **(2 cr. h)** **Practical**	**Laboratory Techniques in Parasitology التقنيات المعملية فى علم الطفيليات** Collection and processing of feces for parasitology - Saturated salt flotation - Zinc sulfate (centrifuge) flotation - Ethyl acetate sedimentation - Direct smear - Stoll egg counting technique - Modified Wisconsin sugar flotation technique - Blood parasite procedures - Proper use of the microscope.
Z IP – 526 **(2 cr. h)** **1h Th + 1h Pr**	**Immunology of Parasite Infections علم مناعة العدوى الطفيلية** This course presents and in-depth examination of the immune response to a selected group of parasitic infections. Topics covered are malaria, trypanosomiasis, leishmaniasis - Filiarias, schistosomiasis, trichinosis and other gastrointestinal nematodiases. **Practical Course** Topic coverage begins with lectures on the general aspects of the disease and disease immunological characteristics of human infections. Coverage continues with specific immune mechanisms and strategies parasites have adopted to avoid immunological responses.
Z IP – 527 **(2 cr. h)** **1h Th + 1h Pr**	**Electron Microscopy and its Applications in Biology** **الميكروسكوب الإلكترونى وتطبيقاته فى البيولوجي** **Electron Microscopy:** Basic therapy of microscopy: Basic principles of optics - Types of lens - Limits of magnification and useful magnification - Resolving power and its limiting factors - Transmission electron microscopy: General structure and physical basis - Image and contrast formation in microscopy - Resolving power in TEM - Lens defects - Theory of image formation in light and electron microscopy.

	Biological Applications of Electron Microsocpy: (Practical Course) Preparation methods: Embedding and sectioning: Fixation – Buffers - Embedding media - Preparation of semi-thin and ultra-thin sections - Section staining and theory of contrast enhancement - Negative staining: Theoritical background and its applicability - Different specimen preparations and methods - Autoradiography: Theoretical background (radioactivity and radiation emitted, useful radiotracers, detection of radiation emitted in microscopy) - Preparation of radio-labeled specimens for light and electron microscopy - Interpretation of results.
Z IP – 528 **(2 cr. h)** **1h Th + 1h Pr**	**Control Measures of Parasitic Infections and Epidemiology** **مقاومة العدوى الطفيلية ووبائيتها** **Control Measures of Parasitic Infectons:** Snail and insect vector control: Ecological control - Chemical control - Biological control - Parasite control: Causes of the disease - Vaccines / drugs - Chemotherapy control and biological control. **Epidemiology: (Practical Course)** Basic concepts of Health & Epidemiology: Definition of health and requirements to achieve over all goal of health people - Definition of the disease, natural history of the diseases - Scope of epidemiology, disease process, mechanism of transmission – Immunity - Morbidity & Mortality measures: Mortality, morbidity, fertility rates - Demography and factors in population dynamics - Epidemiologic methods: Descriptive study (time / person / place, quality control, cross sectional study) - Analytic study (case-control-cohort study) - Experimental study (clinical trials) - Prevention epidemiology (infectious & chronic disease) - Medical statistics: Definition - Collection of data (Tabular, graphical and math) - Measures of central of tendency (mean, mode, median, mid range) - Measures of dispersion (standard of deviation) - Normal distribution curve (bell shape curve) - Analysis of data (test of sign significance) - Quantitative (student t-test) - Qualitative (chi square test).
Z IP – 529 **(2 cr. h)**	**Functional Genomics of Vectors and Parasites and Biostatistics** **الجينوم الوظيفى لناقلات المرض والطفيليات والإحصاء الحيوى** **Functional Genomics of Vectors and Parasites:** This course focuses on the functional analysis expressed as genes and their products. Course contents include the construction and screening of normalized cDNA libraries; analysis of expressed sequence tags (EST_s), functional analysis by gene knock-onts: localization of gene products by gene-Knock-ins; transcription profiling; systematic identification of proteins; and functional analysis of proteins by detection of protein-protein interactions. **Biostatistics:** It includes introductory probability theory. Principles 1 of statistical methods. Problems of estimation and hypothesis testing in biology and related areas. A survey of computational problems and solutions in modern systematic biology. Topics include platform options and limitations, numerical analyses, database management, information dissemination and retrieval, and computer taxonomy.
Z IP – 530 **(2 cr. h)** **1h Th + 1h Pr**	**Parasitological Problems in Fisheries and Fish Produciton** **مشاكل التطفل فى الأسماك والإنتاج السمكى** Parasitological problems in fisheries and fish production, Identification of pathogens in wild fish, Identification of pathogens in cultured fish **Practical Course**

	Diagnostic techniques – Pathogenesis - Prophylaxis, Quarantine measures, Management operations - Biological control methods, Cleaner fish, Others - Parasito-immunology, Prospects for antiparasitic vaccines - Medical control methods, Antiparasitic drugs - Problems with resistance in parasites against antiparasitic drugs.
Z IP – 531 **(2 cr. h)** **1h Th + 1h Pr**	**Physiology of Parasites** **فسيولوجيا الطفيليات** This course aims to through light and the nutrition and metabolism of parasitic protozoa and helminths. **Practical Course** It includes bioenergetics and the role of oxygen, nucleic acid metabolism and synthesis, amino acid metabolism, and protein, liquid metabolism as well as parasite hormones.
Z IP – 532 **(2 cr. h)** **1h Th + 1h Pr**	**Parasito-Immunology** **مناعة طفيليات** This course provides an overview on the use of biotechnology in vaccine and drug industry. **Practical Course** Viral and bacterial genomics and their genetic manipulation are emphasized.
Z IP – 533 **(2 cr. h)** **1h Th + 1h Pr**	**Parasite and Tissue Culture** **الطفيليات وزراعة الأنسجة** The course introduces the student to the principles of cell and tissue culture techniques in biology and medicine and the requirements of a tissue culture system, laboratory equipments, culture control of infection, evaluation of growth potentials, maintenance. **Practical Course** Methods of examination of cells and tissues, types of microscopy - Applications of tissue culture: general and medical - Requirements of a tissue culture system - Equipments of a tissue culture laboratory - Control of infection in tissue culture: sterilization & septic techniques - Tissue culture media: natural & synthetic - Common types of tissue culture - Common primary explanation techniques - Evaluation of growth potentials in tissue culture: growth rate - Evaluation of growth potentials in tissue culture: growth morphology - Maintenance of culture: feeding and transfer - Tissue disaggregation and cell cloning - Organ culture and fate of cultures - Preservation of cultures.

Code No.	**3- Applied Bioscience**
ZBS 540 **(2 cr. h)**	**BIOLOGICAL ANALYSIS** The purpose of this course is to provide students with knowledge of the sample preparation, subcellular fractionation by differential centrifugation, biochemical techniques, methods of enzymatic analysis, enzymes in clinical diagnosis, proteins in plasma and urine, tumour markers and measurement of cerebral blood flow. I. Sample preparations II. Differential centrifugation (Subcellular fractionation) III. Biochemical techniques. 1. Chromatography. a) Paper chromatography. b) Column chromatography.

c) Thin layer chromatography

d) Gas-liquid chromatography.

e) Ion-exchange chromatography.

2. Electrophoresis
3. Electrofocusing.
4. Chromatofocusing.

IV. Methods of enzymatic analysis.

1. Choice of substrate.
2. Enzyme preparations.
3. Choice of assay method

a) Spectrophotometric methods.

b) Manometric methods.

c) Electrode methods.

d) Fluorescence methods.

e) Sampling methods.

f) Biological methods.

g) Radioactive isotope methods.

V. Enzymes in clinical diagnosis

1. Assessment of cell damage and proliferation.
2. Causes of raised plasma enzyme activities.
3. Abnormal plasma enzyme activities.

Transaminases, lactate dehydrogenase, creatine kinase, α-amylase, alkaline phosphatase, acid .phosphatase, γ-glutamyl transferase.

4. Plasma enzyme patterns in disease

a) Myocardial infarction, liver disease, muscle disease.

b) Enzymes in malignancy.

c) Haematological disorders.

d) Plasma cholinesterase and suxamethonium sensitivity.

VI. Proteins in plasma and urine

1. Functions of plasma proteins.
2. Qualitative methods of assessing plasma proteins.

* Electrophoretic pattern in disease.

3. Albumin and causes of hypoalbuminaemia.
4. Proteins.in urine.

a) Renal protenuria.

	b) Protenuria with normal renal function. c) Nephrotic syndrome. d) Laboratory findings: - Protein abnormalities. - Lioprotein abnormalities. VII. Tumour markers 1. Definition of tumour markers. 2. Clinical limitation of tumour markers. 3. Classification of tumour markers. 4. Laboratory testing of tumour markers. VIII. Measurement of cerebral blood flow: 1. Whole brain (Kety method). 2. Regional flow.
ZBS 541 **(2 cr. h)** **1h th +** **1h Pr**	**GENETICS AND MOLECULAR BIOLOGY** The course is designed to cover the basic principles of classical and molecular genetics - the course covers the chromosome theory of inheritance, structure and function of nucleic acids — inheritance of genetic diseases - basic tools of molecular biology - biochemical and molecular diagnosis of human disorders with emphasis on prevalent genetic diseases in Egypt — definition and applications of biotechnology and genetic engineering in industrial, agricultural, pharmaceutical and biomedical fields. **Practical Course:** Laboratory work covers karyotyping of different samples and their applications - genetic toxicology tests used for detection of genotoxic substances - basic techniques in molecular biology which include isolation and manipulation of nucleic acids, DNA amplification (PCR), agarose and polyacrylamide gel electrophoresis, restriction enzymes and their different uses in diagnosis and mutation detection.
ZBS 542 **(2 CR. H.)** **1 H. TH. +** **1 H. PR.**	**ENDOCRINOLOGY AND METABOLISM** 1- Tumour markers affecting hormonal level in serum. 2- Food additives and water pollution causing hormonal disturbances. 3- Drug abuse (e.g. antibiotics, contraceptives, sedatives and hypnotics) and hormonal imbalance. 4- Organ function tests (heart, kidney, liver, pancreas, prostate, stomach, ovary). **Practical :** 5- Hormonal Bioassay (Eliza, radioimmuno assay, HLPC). 6- Tumour markers. 7- Organ function tests. 8- PCR for measurement of different viruses

ZBS 543 **(2 cr. h)** **1h Th +** **1 h Pr**	**NEUROPHYSIOLOGY** **Overview of chemical transmission:** Chemical Synapses – Neurotransmitters & Neuromodulators: Acetylcholine – Amines – Amino acids – Peptides – Nitric oxide gas – Neurotransmitter receptors: Chemically regulated gated channels – Ligand-operated channels – G-protein-operated channels – Modification of synaptic transmission by drugs and diseases. **Neural control of skeletal muscles:** Muscle spindle apparatus. Supportive elements of the CNS: Neuroglia – meninges – cerebrospinal fluid – blood-brain barrier. Practical : 1- Analysis of different neurotransmitters in brain tissue by HPLC: The course describes the handling and care of experimental animals, the functional neuroanatomy of the brain, preparation of tissue samples for HPLC, derivatization techniques, what is the HPLC and types of liquid chromatographic separations, the different components of the HPLC system and the analysis of different neurotransmitters using qualitative and quantitative methods. 2- Enzyme Analysis: This includes the analysis of enzymes used in neurotransmission (e.g. Mono amine oxidase, Acetylcholinesterase).
ZBS 544 **(2 cr. h)**	**IMMUNE SYSTEM DISEASES AND IMMUNODIAGNOSIS** **Immune system diseases:** Mechanisms of immunodeficy: Antibody (B-cell) Immunodeficiency disorders – (T-cell) immunodeficiency disorders – (B & T-cell) Immunodeficiency disorders – pagocytic dysfunction diseases – complement deficiencies – Mechanisms of disordered immune reaction: Multi factorial pathogenesis of Autoimmunity – Rheumatic diseases: Systemic lupus Erthermatoosus – Rheumatoid Arthritris – Gastrointestinal Diseases: Cebiac Disease – Food hypersensitivity – Crohn's Disease – Ulcerative Colitis – Mechanisms of Immunity to Infection – Non immunologic defenses against infection – Immunology of infection – Bacterial Infections: Serodiagnisis – Exotoxins & endotoxins – Toxigenic bacterial diseases – Viral infections: Influenza virus – Respiraiory syncytial virus – Hepatitis A virus – Fungal Infections: Introduction – Primary pathogens with examples – Opportunistic pathogens with examples – Immune Response to Parasites: African Trypanosomiaisis – Leismassiasis – Malare – Ambiasis – Toxoplasmosis – Schistosomiasis – Intestinal nematodes – Immunologic Therapy: Antigen – specific therapy – Antigen – Non specific therapy – Modulation of the inflammatory response – Immunization: Types of immunization – Active immunization. **Immunodia gnosis:** This course deals with the principles underlying the different Immunodiagnosic techniques used to detect antigens and antibodies in relevant diseases. Special emphasis is given to the comparison of Immunodiagnosic

	assays in different parasitic diseases. Preparation of antibodies and antigens – Purification of antibodies and antigens – Column chromatography principles and theories – Applications of column chromatography – Immunodiagnostic techniques – Conventional vs. Immunodiagnostic assays in diagnosis of parasites – Diagnosis of protozan diseases – Diagnosis of nematodes trematodes … etc.
ZBS 545 **(2 cr. h)** **1h Th +** **1 h Pr**	**APPLIED TOXICOLOGY AND HISTOPATHOLOGY** • Applied Toxicology - General principles of drug-actions - Drug-receptor interactions. - Types of toxicity and general toxicity tests - Dose-response relationships. - Drug absorption, distribution & excretion. - Drug biotransformation (toxification / detoxification). - Mechanisms and response in cellular injury - Oxidative stress - Chemical carcinogenesis - Immunotoxicity - Necrotic & apoptotic cell death. - Specific examples for biochemical mechanisms of toxicity: o (benzo-a-pyrene, isoniazid, thalidomide, heavy metals, insecticides & natural toxins) - Environmental toxicity testing - Biomonitoring and biological monitors. - Bioindicators. - Community and higher level indicators. - Environmental factors affecting contaminant toxicity (Biotic & abiotic factors). - Bioaccumulation and bioconcentration in aquatic organisms. - Fate & behavior of chemicals in the environment - Examples of contaminant sources & effects Agriculure drainwater, petroleum, lead & mercury … etc.). - Risk assessment - Population modeling and its role in toxicological studies. - Legislation o E P A framework - Regulatory toxicology. • **Histopathology** • Study of the pathological changes which occur in different cells and tissues after their exposure to different harmful compounds, depression, radiations or genetic defects. • The study includes the important body organs which have a role in detoxification such as the liver, kidney, lung, alimentary canal, nervous system, and others, and comparing different pathologic conditions with normal controls. • The study show different protective methods and mechanisms which protect organs and recover the pathologic ones if possible. • The study includes how to investigate various tissue diseases. • **Practical part** • Demonstration of samples of different organs of the body suffering from

	different pathological conditions, comparing with the normal conditions. • Demonstration of histological sections of the diseased organs, and comparing them with sections of normal (control) organs.
ZBS 546 **(2 cr. h)** **1h th +** **1h Pr**	**Parasitology** - This course aims to discuss the host-parasite relationships especially parasites of Man and his domesticated animals as well as their arthropod vectors or other animals. - Laboratory diagnosis of parasites. Modes of laboratory infections, preservation of parasites and planning of experiments. - Making fresh and permanent tissue preparations for examination and identification. Parasite diagnosis in stool, Blood and tissues
ZBS 547 **(2 cr. h)** **1h Th +** **1h Pr**	**APPLIED IMMUNOLOGY** The course deals with various applied immunological methods. These methods tend to detect, measure (quantitave and qualitative) and identify both antigen and antibodies. In addition other methods deal with identification of lymphoid cell lines. Immunization: Antigens and haptens – Routes of immunization – Effect of antigen dose – Adjuvants – Detection, measurement and characterization of antibodies (antigen / antibody reaction): - Radionimmunoassay (RIA) – Enzyme – linked immunosorbant assay (ELISA) – Anti – immunoglobulin antibodies production – Immunofluorescence microscopy – Isolation and identification of lymphocytes (Detection of surface membrane antigen): Flow cytometery and FACS analysis – Isolation of homogeneous T – cell lines – Characterization of lymphocyte specificity, frequency and function: ELISPOT – Identification of functional subsets of T cells by staining for cytokines – Stimulation of lymphocyte proliferation by treatment with polyclonal – Mitogens or specific antigen: Radioactive method – Colorimetric method – Measurement of cytokines: RT – PCR – In situ – hybridization – Capture ELISA. **Practical Session:** - Detection, measurement and characterization of antibodies (antigen / antibody reaction) - Enzyme – linked immunosorbant assay (ELISA) - Immunofluorescence microscopy - Detection of various lymphocytes population and subpopulations in the blood. - Mixed lgmphocytes reactions test. - Mitogen responses test - Measurement of cytokines: RT – PCR – In situ – hybridization – Capture ELISA.
ZBS 548	**FIELD ECOLOGY** Topics covered: Application of ecological theory and

(2 cr. h) **1h Th +** **1h Pr**	principles to solve environmental problems, including conservation biology, assessment of environmental impacts, and restoration ecology and mitigation of environmental impacts - Sampling methods and field techniques applicable to the biota. Field experience and study of plant and animal life in selected habitats, including geographical distribution, climatic an soil relationships – Organisms , Communities, and Ecosystems - Ecosystem (Terrestrial and Aquatic Ecosystem) - Ecology of Populations - Succession - Collecting and identifying - Survey and recording techniques - Town Ecology - Human Ecology: Resource Use - Human Ecology: Pollution **Practical Course** Practical course deals with: Techniques for data collection, followed by analysis with appropriate statistical analysis –Methodological techniques in terrestrial and aquatic fields - Basic concepts of chemical measurements in environmental media, with emphasis on water, soil, air and tissue - Techniques for bioremediation - Species and habitat diversity — Succession - Assessment of organisms by quadrats, line transect, mark-recapture analysis - Fish aquaculture - Coastal environments.
ZBS 549 **(2 cr. h)** **1h Th +** **1 h Pr**	**CARDIAC ELECTROPHYSIOLOGY** - This course deals with the changes in the ECG which are diagnostic of certain abnormal conditions such as: ○ Varying rhythm ○ Rapid rhythm ○ Heart blocks ○ Hypertrophy ○ Ischemia ○ Myocardial infarction. - Practical work deals with the recording of the bioelectrical activity of the heart: ○ Normal Eletrocardiogram (ECG). ○ Einthoven's triangle . ○ Limb leads (I, II, III, AVR , AVL, AVF). ○ Chest leads (V1, V2, V3, V4, V5, V6). ○ Examination of the ECG to determine the abnormal conditions.
ZBS 550 **(2 Cr. h)**	**BIOINFORMATICS** ○ The course will discuss current and latest techniques on the use of modern information technology to reach data banks for protein and DNA sequence on the internet to identify and extract key information concerning the genetic basis of some inherited diseases. The course provides a set of computer methods used to analyze the information about gene sequences and gene mapping.
ZBS 551 **(2 cr. h)**	**DEVELOPMENTAL BIOLOGY** Embryology, in its widest sense, is the science of study of the changes that occur before hatching or birth of animals. It is an essential course for undergraduate students of Biology and Medical sciences. Application of advanced knowledge and techniques from other disciplines such as Molecular Biology , Genetics and Cell Biology has created a new trend of investigation of the different stages of development. This trend is known as Analytical Embryology, Modern Embryology or preferably Developmental Biology. Developmental Biology is an exciting disciplines. It mainly concerns with the biology of development or analysis of events of development on a molecular and genetical level. It is one of the advanced courses for students of higher

	classes. Students, however, can not go through study of developmental biology without being, first, familiar with descriptive or classic embryology. This course includes the study of stages of animal development , effect of environment on development, environment and sex determination, adaptation of embryos to their environment , genome constancy, RNA localization techniques, fertilization, mechanisms of Developments and embryonic induction.
ZBS 552 **(2 cr. h)**	**BIOLOGY OF PARASITES** - This course aims to study the host – parasite relationships – Effects of Parasites on their hosts (Physiology and Pathogenicity) and the Biology of the parasites themselves (life cycles) in : ○ Protozoa (Flagellates – Apicomplexa – ciliates and Myxozoa). ○ Metazoa (Platyhelminthes – Nematodes and Arthropoda).
ZBS 553 **(2 cr. h)**	**TISSUE CULTURE** • Introduction • In-vivo and in-vitro culture • Tissue culture lab and equipments • Types of contamination • Sterilization Techniques used in tissue culture • Bacterial and Viral culture • Commercial cell lines • Origin of cell lines • Types of cell lines • Culture Media for different Cell Lines • Maintaining cells in culture • Tissue culture protocols • Live-Cell Imaging technique • Choosing cell lines for cell imaging • Tissue culture models • Organ models • Industrial Application of Tissue culture
ZBS 554 **(2 cr. h)**	**STEM CELL** Stem cells are primal undifferentiated cells which retain the ability to differentiate into other cell types. This ability allows them to act as a repair system for the body, replenishing other cells as long as the organism is alive. Medical researchers believe stem cell research has the potential to change the face of human disease by being used to repair specific tissues or to grow organs. Yet as government reports point out, "significant technical hurdles remain that will only be overcome through years of intensive research" This course deals with the study of the types of stem cells and the methods of treatments in Cancer, Spinal cord injury, Muscle damage, Heart damage, Low blood supply, Baldness, Missing teeth and Blindness.
ZBS 555 **(2 CR. H)**	**CANCER BIOLOGY** The course provides the student with a basic understanding of cancer biology. This includes: - The nomenclature of tumors according to their presence in the different

	organs. - The types of tumors. - The main characteristics of the malignant cells. - The etiology of the disease. - The spread of cancer(metastasis). - The carcinogenic substances and the mechanism of carcinogenesis. - The tumor markers. - The angiogenesis. - The nature of the tumor markers.

C- Course contents for M. Sc. Degree

Code No.	Subject name and contents
	1- M. Sc. Degree in Molecular and Integrated Physiology (Z MP)
Z MP - 601 (2 cr. h)	**Molecular Biology and Biotechnology** **البيولوجيا الجزيئية والتكنولوجيا الحيوية** DNA as genetic material - Structure of DNA and RNA - Bacterial Restriction/Modification System - DNA modifying Enzymes - Intro to Prokaryotic DNA Replication - Prokaryotic DNA Replication, cont - DNA supercoiling DNA Supercoiling, topoisomerases - Introduction to bacteria - Bacterial Reproduction and Growth, Bacterial Growth, cont - Extra chromosomal elements, Plasmids, Selectable Markers - Central Dogma; Genetic Code - Gene and Operon, The lac Operon, CAP Sit, DNA Foot printing - Transcriptional Regulation : Transcription termination and the transcription operon - mRNA Translation - Gel Electrophoresis - DNA sequence analysis - Polmerase Chain Reaction (PCR), PCR, cont - Cloning PCR products - Prokaryotic expression vectors - Protein sequencing, peptide mapping, synthetic genes - cDNA libraries, Genomic libraries - Protein Purification : Assay, initial steps, resins - Protein purification: Ion exchange elutions, dialysis, concentra-tion - Protein purification : Types of Resins - Protein purification : Running the experiment, resolving peaks - Bacteriophage M13, bacterial display, DNA binding prot ein display libraries - SELEX system - Protein-protein recognition probed using yeast transcriptional activator system - Molecular imprinting - T B A.
Z MP - 602 (2 cr. h)	**Experimentation and Data Analysis** **التجارب العلمية وتحليل البتائج** Introduction to sources of information - Search strategies and types of information - The research process - Recording information - The research paper - Information online - Information in the library - Reference materials - Other sources of information - Information management - Communicating information - Protocol development - Project proposal writing - Experimental design - Different scientific methods - Ethical issues and committees - Introduction to GLP and instrument validation - Data collection and documentation - Data base development - Choice of data analysis methods – Biostatistics - Different PC statistical packages - Interpretation and conclusion of the research results - Presentation development.
Z MP - 610 (3 cr. h)	**Neurosciences** **علوم الأعصاب** **Overview of chemical transmission:** Chemical synapses - Neurotransmitters

	& Neuromodulators: Acetylcholine – Amines – Amino acids – Peptides - Nitric oxide gas - Neurotransmitter receptors: Chemically-regulated gated ion channels - Ligand operated - G-protein operated - Modification of synaptic transmission by drugs and diseases. **Neuromuscular junction is a chemical synapse:** Muscle receptors: Stretch receptors (muscle spindle) - Tension receptors (Golgi tendon organ). **Supportive elements of the CNS:** Cerebrospinal fluid - Blood-brain barrier. **Mechanisms of Neural Actions:** Donnan theory of membrane potential - Origin of transmembrane potential - Subthreshold phenomena (cable properties) - Threshold phenomena in elongated cells - Excitation and propagation of an impulse. **Cardiovascular Physiology:** Heart beat Coordination: Cardiac action potentials, sequence of excitation, the electrocardiogram, excitation-contraction coupling, refractory period of the heart - Mechanical Events of the Cardiac Cycle: Mid-diastole to late diastole, systole, early diastole - The Cardiac Output: Control of heart rate, control of stroke volume, relationship between end-diastolic volume and stroke volume: Starling's law of the heart - The Vascular System: Arteries, Arterioles, Capillaries, Veins - Integration of Cardiovascu-lar Function: Regulation of systemic arterial pressure (Baroreceptor reflexes) - Blood volume and long-term regulation of arterial pressure - Cardiovascular Patterns in Health and Disease: Causes of hypotension, hypertension, heart failure, coronary artery disease. **Neuroethology:** Communication and Acoustic Behavior: Physiology of vocalization - Physical nature and analysis of the acoustic signal - Acoustic signal and information reduction - Perception of the acoustic signal - Perceptual meanings in the spectrum of mating call in frogs - Voice print in human - Human Consciousness and Behavior: States of Consciousness: Electroencephalogram - The Waking State – Sleep - Conscious Experiences: Direct Attention - Neuronal Mechanisms for Conscious Experiences – Emotion Altered States of Consciousness: Psychoactive drugs, Tolerance, and Addiction - Learning and Memory in Human: Memory : Nature and keeping of information - The location of memory - Molecular Formation of Memory. "The Memory Trace" - Improvement of Memory : Enriched Environment and Plasticity.
Z MP – 611 **(2 cr. h)**	**Pharmacololgy and Toxicology** **الفارماكولوجيا وعلم السموم** General principles of drug action - Structure activity relationship and drug design - Drug-receptor interactions - Types of receptors; regulation of receptors - Drug actions not mediated by receptors - Quantitation of drug-receptor interactions - Drug – drug interactions - Physiochemical factors in transfer of drugs across membranes - Drug absorption - Drug distribution - Drug excretion - Drug biotransformation toxification detoxification: Oxidation pathways: mixed – function oxidases - Cytochrome P-450 - Reductive pathways - Hydrolytic pathways - Conjugative pathways - Glutathione and chemical detoxification - Factors affecting disposition and metabolism of drugs - Molecular mechanisms of xenobiotic toxicity - Oxidative stress - Endogenous defenses - Genetic toxicity – Teratogenesis - Chemical carcinogenesis - Apoptosis and necorsis – Immunotoxicity - Specific examples for biochemical mechanisms of toxicity: Benzo-a-pyrene; dimethylnitrosamines - Liver necrosis - Carbon tetrachloride; paracetamol; isoniazid - Kidney damage - Chloroform; halokanes & alkenes - Lung damage

	– Paraquat – Nurotoxicity - 6-hydroxydopamine; isoniazid - Physiological and biochemical effects: Aspirin; ethionine; cyanide - Teratogenesis: Thalidomide - Immunotoxicity: Penicellin - Multi-organ toxicity: Ethylene glycol, methanol, metals (Cd, Mg, Pb).
Z MP - 612 **(2 cr. h)**	**Advanced Endocrinology** **علم الغدد الصماء المتقدم** **Biochemistry of hormones:** Chemistry and structure of hormones and pathways of biosynthesis - Metabolism of hormones - Synthetic compounds of hormones and their medical uses - Methods used for hormonal estimation - Update on recently discovered hormones. **Reproductive endocrinology:** Female reproduction: Endocrine control of folliculogenesis, ovulation, and luteogenesis. Hormonal regulation of menstrual cycle and contraception. Menopause and hormone replacement. Endocrine control and hormonal changes during pregnancy - Male reproduction: Endocrine control of testicular function, hormonal control of spermatogenesis. Endocrine roles of sex hormones. **Endocrine homeostasis:** Hormonal control of calcium homeostasis - Effect of estrogen, growth hormone, thyroxine and corticosteroids on bone metabolism - Blood volume homeostasis - Hormonal control of electrolytes - Hormones of cardiovascular system -Renin-angiotensin-aldosterone system
Z MP – 613 **(3 cr. h)**	**Environmental Physiology** **فسيولوجيا بيئية** **Respiratory and excretory systems:** **Respiratory System:** The atmosphere - Composition of dry atmosphere - Water vapor in air - Comparing water and air as respiratory medium - Respiration in water - Animals without specialized respiratory organs - Animals with respiratory organs: Origin of gills - Lungs in fishes - Swim-bladder - Examples of lung fishes - Respiration of tetrapods: Respiration of Amphibia (Frog) - Bucco-pharyngeal movement - Pulmonary ventilation - Cutaneous respiration - Respiration of Reptiles - Terrestrial and aquatic reptiles - Pulmonary ventilation - Cutaneous respiration in some forms of reptiles - Respiration of Birds - Structure of respiratory system - Gas flow through the avian lung and mechanics of breathing - Arrangement of parabronchi with respect to blood capillaries, and the exchange of gases - Chemical transport of the respiratory gases - Respiration and Metabolism - Problems of diving and high altitude. **Excretory System:** Structure as related to function of various excretory organs of the different animals group - Nitrogen excretion - Ammonotelic animals - Ureotelic animals: Uricotelic animals - Water and osmotic regulation: In aquatic environment – Marine – Fresh – Brackish - In terrestrial environment. **Hematology:** Introduction: Evolution of blood - Physical characteristics of blood and circulation - The red blood cells (Erythrocytes): Erythrocyte characteristics and formation - Erythrocyte disorders (classification and manifestation) - The respiratory pigment, hemoglobin: Biosynthesis and chemistry of hemoglobin - Structure of some common types of hemoglobin - Degradation of hemoglobin - Iron metabolism: Transport and storage of iron - Metabolism and regulation of the total body iron - The white blood cells (Leukocytes): Types and general characteristics - Leukocyte disorders (classification and manifestation) - Hemostasis and Blood coagulation: Hemostasis in man and vertebrate animals - Hemostasis in invertebrate animals - Hemostasis disorders.
Z MP - 614	**Invertebrate Ecology and Physiology** **بيئة وفسيولوجيا اللافقاريات**

(2 cr. h)	**Biological Rhythms:** Circadian rhythms - Geophysically dependent rhythms - Lunar-related rhythms - Annual rhythms - Space, time, responses to geoelectromagnetic fields. **Bioluminescence:** Introduction - The chemistry of light production - Occurrence of bioluminescence in invertebrate animals - The control of bioluminescence - Functional significance of bioluminescence - **Photoreception and vision:** Invertebrate rhabdomeric - The compound eye - Visual pigments - The link between photon capture and conductance change - Synaptic connections - Information processing - Endocrine Mechanisms: Insects and Crustaceans - Importance of chemoreception for social and mating in certain invertebrate species - Hearts and body fluids - Habits and habitats (water and terrestrial) - Effects of ecological factors and succession on populations and communities – Pollution
Z MP - 615 **(2 cr. h)**	**Histochemistry and Histopathology** **كيمياء الأنسجة وأمراض الأنسجة** **Histochemistry:** Histochemical detection of enzymes, requirements of enzyme histochemical reactions, preparation of tissues, fixation of enzymes - Principles of reaction in enzyme histochemistry - Biological activities and localization of some histochemically demonstrable enzymes: oxidoreductases, transferases, hydrolases, lyases, isomerases, ligases - Some applications of enzyme histochemistry in biology and pathology - Principles of immunohistochemistry - Some applications of immunohistochemistry in biology and pathology - Molecular histochemical techniques - Lectin histochemistry - Histochemical detection of biogenic amines and inorganic constituents - **Histopathology:** Cell injury and its manifestations: Sites and types of cell injury, free radical, lysosomes, stress proteins, bacterial toxins, radiation - Some morphologic expressions in cell injury - Mechanisms of cell protection and recovery - Cell and Tissue death: Morphological changes in cell death – Apoptosis – Necrosis - Acute inflammation: Causes and characteristics Cellular events and chemical mediators - Regeneration and wound healing.
Z MP - 616 **(2 cr. h)**	**Immunochemistry and Bioenergetic** **كيمياء المناعة والطاقة الحيوية** **Immunochemistry:** Antigens – Antibodies - Antigen-antibody interaction: Binding forces - Antibody affinity - Antibody avidity – Valency - Cross reactivity - Detection of antigen/antibody interactions: Immunodiffusion: Double immunodiffusion - Radial immunodiffusion - Detection of antigen/antibody interactions: - **Immunoprecipitation** - Precipitation curve - Lattice theory - Factors affecting precipitation - Precipitation reactions in gel - Detection of antigen/antibody interactions: Immunoelectrophoresis - Counter immunoelectro-phoresis - Two – Dimensional - Rocket immunoelectrophoresis - SDS-PAGE - Use of antigen / antibody interactions: **Chromatography principles and theories:** Ion exchange chromatography - Gel filtration - Immunoaffinity chromatography - **Enzymatic labeled assays**: Enzyme-linked immunoelectrotransfer blotting (Western blot) - Enzyme- linked immunosorbant assay (ELISA). **Bioenergetics:** Energy needs-basal metabolic rat – variation in energy demand - Energetics of open and closed systems: Free energy change ΔG^o. Standard free energy change ΔG^o - Sample calculation of ΔG^o - Additive nature of the standard free energy change - ATP as an energy carrier – Energy carried by ATP - The ATP

	cycle – standard free energy of hydrolysis of ATP - Electron transport chain release of free energy through and oxidative phosphorylation - Occurrence and properties of ATP, ADP & AMP - The role of AMP and pyrophosphate - Exergonic and endergonic reactions - The standard free energy of hydrolysis of phosphate compounds - The transfer potential of the phosphate group - The structural basis of the free-energy change during hydrolysis of ATP - Enzymatic transfer of phosphate group to ADP - Transfer of phosphate groups from ATP to various acceptors - The enzymatic pathways of phosphate transfers - The standard free energy changes and biological reversibility of enzymatic reactions. **Nutrition:** Nutrient requirements in humans - Nutrition and chronic disease - Energy requirements in humans - Protein – calorie malnutrition - Integration of metabolism in: Well feed state - Starvation, diabetes mellitus, and injury.
Z MP - 617 **(2 cr. h)**	**Neuroendocrinology** **الغدد الصماء العصبية** Neuroendocrinology/neurosecretion: The dual nature of neurosecretory cells - electrical activity typical of neurons - (Peptide) secretory activity typical of endocrine cells - The final common pathway for conversion of largely electrical processing (in neural integration, including chemical neurotransmitters) into chemically mediated long-distance signaling. Neuroendocrine Axis: Classical example: hypothalamo-hypophyseal system - Stimuli (physico-chemical, nervous, hormonal, immune) received by sensory cells - Information coded and transmitted to CNS - Integration / analysis - Response directed to neurosecretory cells of hypothalamus - hormone secretion by neurosecretory cells - Paraneuron = a recepto-secretory cells: - Performs functions II.A.1 through 5 above - Can be located singly or in groups throughout the body - example : cells of the diffuse (neuro) endocrine system of the gut Morphology of the hypothalamo-hypophysial neurosecretory system: Steps in peptide neurohormone secretion - peptide neurohormone synthesis on rER - Packaging into vesicles at Golgi apparatus - Transport along axon - Storage at neurosecretory nerve terminals - Release in response to electrical activity - neurohemal organ = collection of neurosecretory nerve terminals and blood capillaries: site of neurohomone release and delivery into bloodstream - example : median eminence of hypothalamus, posterior lobe of the pituitary, urophysis, crustacean sinus gland, insect corpus cardiacum. Neuroendocrine Regulation: “Orders” of neuroendocrine arrangement - Feedback (closed loop) - short loop - long loop - Neuroendocrine reflex arc (open loop) - programmed response to threshold stimulus - examples: suckling reflex (“milk let down”) - “fight-or-flight” and “alarm” responses - reflex ovulation observed in some organisms (e.g.,rabbit) Influence of endocrine system on nervous system: Development effects - Behavioral effects - Immuno-neuro-endocrinology: Close interaction between endocrine and immune system - Cytokines = chemical messengers that mediate immune responses.
Z MP - 618 **(2 cr. h)**	**Radiobiology** **بيولوجيا الإشعاع** Nature of radiation - Types of radioactive material - Radiation units - Biological effects of radiation - Products formed from water - Alteration of biologic molecules - Effect of radiation on DNA - Effect of radiation on chromosomes - Radiation effects on cell membranes - Radiation effects on energy metabolism - Radiation genetics (genetic and somatic mutations) - Radiation effects on major organ systems in mammals.

	2- M. Sc. Degree in Invertebrates and Parasitology (Z IP)
Z IP - 625 (3 cr. h)	**Biology of Protozoa - Biology of Helminths - Parasitological Diagnosis** **بيولوجيا الأوليات- بيولوجيا الديدان - تشخيص الطفيليات** **Biology of protozoa** **Subkigdom Protozoa:** Phylum Sarcomastigophora: The biology of kinetoplastida - Diversity of kinetoplastida - Summary of revised classification - Biology of trypanosomes infecting different vertebrates, development and transmission, pathogenicity and immunity, control - Sarcodins, their biology, pathological effects and control - Phylum Apicomplexa: Main characteristics & general revised classification - Gregarines and coccidian: morphology, life cycles, host specificity - Eimeria and its economic importance, pathogenicity - Cyst-building coccidians (Sarcocystis, Toxoplasma, Besnoitia and Frenkelia) - Malaria parasites and other haemosporidia - Avian and mammalian haemoproteid – Leucocytozoidae – Piroplasms - Phylum Myxozoa (Myxosporidia): New aspects in the study of the life cycle, hosts and transmission and the new element of classification - Phylum Microsporidia. Main characteristics, life cycle, economic importance pathologenicity. **Biology of helminthes** General characters of phylum platyhelminthes – Classification - The tegument study, using TEM, with slide presentation of studied cases - Adaptations of these organisms to become parasites - Class Digenea: Introduction to trematodes, life cycles, nutrient uptake and immune evasion - The life cycle and pathology - Class Cestoda: Introduction to cestodes, anatomy and biology, medical and economic importance, disease manifestations, TEM of the tegument - Class Nematoda: Introduction to nematodes, biology, morphology and life cycles - Parasite control: Chemotherapy; drug resistance mechanisms, genetics of resistance, vaccines - Evolution of parasitism: Preadaptation, symbiont acquisition, interspecific gene transfer, co evolution of parasites and hosts. **Parasitological diagnosis:** This course aims to give the students a general survey of the different macro- and microscopic techniques applied for the diagnosis of infectious diseases and to indicate the salient points which should be studied when examining microscopic preparations. Microscope: Care and Calibration for measurements - Examination of Stool specimens - Examination of Blood, Other body Fluids and Tissues, Sputum and Urine - Animal Inoculation.
Z IP – 626 (2 cr. h)	**Physiology of Parasites - Immunoparasitology** **فسيولوجيا الطفيليات - مناعة الطفيليات** **Physiology of parasites:** Nutrition & Metabolism: Introduction – Nutrition - Nutrition in Protozoans - Nutrition in Helminths - Metabolism of parasitic protozoans & helminthes: Bioenergetics & the role of oxygen (cartbohydrate metabolism) - Kinetoplastid flagellates - Aerotolerant Anaerobic protozoans - Malarial parasites - Other protozoans - Adult helminths. Larval helminthes - Nucleic acids: Metabolism of purine & pyrimidine nucleotides in protozoans - Synthesis & properties of nucleic acids in protozoans - Kinetoplast DNA - Purine & properties of nucleic acids in protozoans -

	Synthesis & properties of nucleic acids in helminthes - Proteins: Amino acid metabolism in protozoans - Protein biosynthesis in protozoans - Amino acid metabolism & protein - Lipid metabolism in protozoans & helminthes: Metabolic regulation in endoparasites - Nutrition & metabolism of ticks - References & further reading - Parasites & Hormones: Introduction -Parasite hormones: Ecdysteroids – Cestoda – Trematoda – Nematoda – Insecta - Other Taxa - Juvenile hormones - Peptide hormones - Influence of parasites on the host's endocrine system - Importance of host hormones for parasites - Therapeutic use of a better understanding of parasite's endocrine systems - Conclusions & Outlook - Bibliography. **Immunoparasitology:** Introduction: Definitions : Infection – Natural – Acquired - Mechanisms of Natural Resistance: External factors - Internal factors - Intracellular Protozoa: Survival within cells - Plasmodium and Malaria - Leishmania and leishmaniasis - Schistosomes and Schistosomiasis: Immune response - Protective immunity – Immunopathology - Gastrointestinal Nematodes: - Immunity within the intestine - Immune response within the intestine - Protective immunity against intestinal nematodes - Antigens involved in immunity - Chronic infection.
Z IP - 627 **(3 cr. h)**	**Invertebrate Histology - Electron Microscopy - Ultrastructure of Protozoa** **أنسجة لافقاريات - ميكروسكوب إلكتروني - التركيب الدقيق للأوليات** **Invertebrate histology:** This course gives a theoretical and a detailed study of the histological organization of representive organs and tissues of selected invertebrates as Cnidaria, Annelida, Arthropoda, Mollusca and Echinodermata, and study of tissues using light microscopy, transmission electron microscopy and scanning electron microscopy. The relationship between structural changes and physiological changes during life cycle of organisms, histopathology with respect to tissue responses to infection and to damages by toxic agents. Tegument tissues - Muscle tissues - Lymphatic tissues - Hepatopancreatic tissue - Nervous tissue - Endocrine tissue **Electron microscopy:** The course introduces the fundamentals and main elements of electron microscopy and its practical applications in the field of biological studies with special concentration on the most common processes in preparing the different cells and tissues and the various related techniques such as negative staining and autoradiography will be introduced. Basic theory of microscopy: Basic principles of optics - Types of lens - Limits of magnification and useful magnification - Resolving power and its limiting factors - Transmission electron microscopy: General structure and physical basis - Image and contrast formation in microscopy - Resolving power in TEM - Lens defects - Theory of image formation in light and electron microscopy - Preparation methods: Embedding and sectioning: Fixation – Buffers - Embedding media - Preparation of semithin and ultrathin sections - Section staining and theory of contrast enhancement - Negative staining: Theoretical background and its applicability - Different specimen preparations and methods - Autoradiography: Theoretical background (radioactivity and radiation emitted, useful radiotracers, detection of radiation emitted in microscopy) - Preparation of radio-labeled specimens for light and electron microscopy - Interpretation of results

	Ultrastructure of protozoa: This course deals with the micro-morphology of the different main examples of the subkingdom Protozoa at the cellular level. The main ultrastructural characteristics of these examples and role of this level of investigation in the study of the life cycles, classification, host-parasite relationships and the pathological effects of these parasites on their hosts at the cellular level.
Z IP – 628 **(2 cr. h)**	**Advanced Helminthology – Nematology** **علم الديدان المتقدم - علم الديدان الخيطية** **Advanced helminthology:** This course deals with the adaptation of the different organs of parasites to perform their function under the parasitic existence and the emphasis on the convenience of these adaptation to the parasites. Surface coat: Composition and function - Metazoan organization – Tegument – Platyhelminths – Nematoda – Cuticle – Hypodermis - Muscles: - Platyhelminths - Muscles of the body wall - Parenchymal muscles - Subtegumentary muscles - Muscles of organs – Nematoda - Intestine & Food Uptake: Platyhemlinths – Nematodes - Nutrition in Helminths - Sites of absorption - Reproductive organs: Platyhelminths - Male reproductive system - Female reproductive system - Nematoda - Male reproductive system - Female reproductive system - Reproduction: Platyhelminths - Sexual process - Asexual processes – Polyembryony - Typical asexual reproduction – Nematoda – Oogenesis - Fertilization and Eggshell formation – Embryogenesis - Spermatogenesis. **Nematology:** Nematology considers, the nematodes in all inclusive way, their taxonomy, their morphology, anatomy and biochemistry, their physiology, their development, their genetics and phylogeny, their ecology and their overall role as an entity in nature and particularly their significance for man and his health and his economy. The field of nematology in its broad formation is immense. Introduction - General morphology - Morphological characters of importance in taxonomy - Cephalic structure – Amphids – Phasmids – Oesophagus - Excretory system - Some body measurements and ratio indices of taxonomic importance - Classification of Nematodes - Functional organization of the nematode's head: (Lips, buccal capsule & stoma) - Feeding of Nematodes - Anatomy of the nematode oesophagus - General features - Anatomy of the stomodaeum - Feeding performance - Rates of pulsation & fluid uptake - Types of food & ingestion mechanism - Sense organs and their secretion - Morphology of the sense organ/secretory cell relationships - Amphidial sense organ - The supporting cell - The secretory cell - The receptor cell - Phasmidial sense organ – Papillae - Mechanism of secretion - Secretion of sense organs - Nervous system - Morphology & Function – Parasitism: The evolution of parasitism - Zooparasitic Nematodes - Phytoparasitic Nematodes - Host/Parasite Relationships - Plant parasitic Nematodes - Animal parasitic Nematodes - Nematodes of the alimentary canal - Nematodes of blood and lymph - Host reactions to nematodes - Vertebrate defence reaction - Immune evasion - Life Cycle: Basic pattern - The growth curve & function of moulting - Mechanics & control of moulting - Cuticle formation – Hatching - Diapause phenomena.
Z IP - 629 **(2 cr. h)**	**Invertebrate Embryology and Developmental Biology** **علم أجنة اللافقاريات والبيولوجيا التكوينيه** **Invertebrate Embryology:**

	This course deals with the development of the embryo of the different invertebrate phyla. All animals above the Protozoa undergo at the beginning of their existence rapid growth and considerable changes of form and structure. During these changes, which constitute the development of the animal, the young organism may be incapable of leading a free life and obtaining its food in this case it is called embryo. Embryology includes not only a study of the embryos but also a study of larvae. Embryology includes all the developmental processes taking place as a result of sexual reproduction. Atypical invertebrate development : the sponges - Development of Diploblastic invertebrates: - Cnidaria – Ctenophora - Development of triploblastic invertebrates: Protostomes (Spiral determinate clearage) – Acoelomates - Flatworms: turbellarians - Development of trematodes and cestodes (Polyembryony) – Rhynchocoela (Development of an anus and a blood system) - Blastocoelomates: (Pseudocoelomates) Aschelminthes – Acanthocephala – Entoprocta - Protostome coelomates: Types of coelom and their formation - Indirect and direct development of the different phyla, Classes and Orders: Mollusca – Annelida - Arthropoda (Chelicerata, Crustacea, Uniramians: Myriapoda & Hexapoda) - Arthropodan allies - The lophophorates - Deuterostome coelentrates – Echinodermata. **Developmental biology:** This course deals with the cellular and molecular mechanisms regulating development. The production and storage of genetic information - Sperm-egg interaction - Nuclear and cytoplasmic determinants - Morphogenetic movements - Inductive interactions and the development of primary organ reduments – Organogenesis - Growth, differentiation and morphogenesis - Mechanisms of aging and regeneration.
Z IP – 630 **(2 cr. h)**	**Advanced Protozoology** **أوليات متقدم** Morphology: - Cytoplasm (ground cytoplasm – structures) - The pellicle - The Nucleus (the resting nucleus and the chromosomes – Nuclear division – Nuclear dimorphism and the polygenomic state in foraminifera and ciliates) – Reproduction - Fertilization and Sexuality: - Gametogamy – Autogamy – Gamontogamy (gamontogamy with gamete formation) - (gamontogamy without gamete formation) - (conjugation and mating types) - Alternation of generations – Motility: Locomotion (Pseudopodia, flagella and cilia, absence of locomotor organelles) - Change in shape - Nutrition (Permeation, Pinocytosis, Phagocytosis) - General taxonomic survey and modern systems of classification
Z IP - 631 **(2 cr. h)**	**Biology of Aquatic Invertebrates and Medical Malacology** **بيولوجيا اللافقاريات المائية والرخويات الطبية** **Biology of aquatic invertebrates:** This course deals with the structures and functions of various invertebrates selected to illustrate morphological, physiological and ecological adaptations. The oceans and seas of our planet: Main divisions of the sea - The marine environment: Physicochemical properties: temperature, O_2 content, light, salinity, pH, winds, waves, currents, tides - Vertical distribution of marine invertebrates (littoral, pelagic, benthic borers and burrowers - Main invertebrate groups: - Sponges - Hydroids, medusae, soft corals, anemones and strong corals - Coral reefs - Comb jellies – Turbellarians - Proboscis worms - Polychaetes, Sipuncula, Echiura – Molluscs - Arthropods: King crabs,

	Pycnogonids, Mites, Crustaceans - Lophophorates: Ectoprocta, Brachiopoda – Echinodermata - Arrow worms - Hemichordates and Urochordates - The marine plankton - Marine invertebrates as resources: For food : lobsters, crabs, shrimps, crayfish, oysters, mussels, squids, cuttlefish - For: pearls industry - For: decoration - Farming. **Medical malacology:** Phylum Mollusca: Main characteristics & Taxonomy - Functional Morphology & Biology - Economic mollusks (Gastropods, bivalves and cephalopods) - Molluscs of medical importance (Medical Malacology) - Gastropods as vectors of trematodes (Schistosomes, *Fasciola Heterophyes*, etc.): *Biomphalaria, Bulinus, Lymnaea, Pirenella……..* as vectors of nematodes (*Angiostrongylus*): *Lanistes carinatus* - Control of medically important snails – Chemical – Biological – Environmental - Laboratory techniques: Snail collection, narcotization, preservation of snails, morphology and anatomy - Estableshing trematode life cycles - Field work: equipments & methods - Poisonous molluscs (toxoglossa) e.g. Conidae, Terebridae.
Z IP - 632 **(2 cr. h)**	**Ecology of Parasites and Endocrinology of Invertebrates** **بيئة الطفيليات وعلم الغدد الصماء للافقاريات** **Ecology of parasites:** Parasitic population growth, host and parasite as a system, control and stability of host-parasite system - Dispersal and location of hosts – Specificity - Inter- and intra-specific relationships within a host - Parasite population changes in intermediate hosts - Parasite population changes in definitive hosts - Epidemiology and models of host-parasite system. **Endocrinology of invertebrates:** The study will deal with the following, allatrophic hormone, thoracotrophic hormone, the corpus allatum, the corpus cardiacum, metabolic hormones; adipokinetic hormone and lipid metabolism, hypertrehalosemic hormone and carbohydrate metabolism; diurectic hormone and water conservation; prothoracic gland, ecdysteroids and moulting; cuticular tanning and bursicon; crustacean X and Y organs; hormones in Coelenterata, Turbellaria, Nematoda, Echinodermata, Annelida and Mollusca; pheromones, juvenile hormones, antillatrophins and anti-ecdysteroids and their applications in pest management and control. Overview/Definitions and criteria for hormones - Neurosecretory cells and neurosecretion - Methodologies and techniques - Methodologies and techniques/Hormones of Parasites - Hormones of Helminths (Cestodes & Trematodes) - Hormones of Nematodes - Hormones of Annelida - Hormones of the Arthropods Crustacea - Hormones of the Arthropods Arachnida (Araneae: Spiders) - Hormones of the Arthropods: Arachnida (Scorpionida) - Hormones of Mollusca - Neuropeptides.

	3- M. Sc. Degree in Immunology (Z I)
Z I - 640 **(2 cr. h)**	**Molecular Immunology** **المناعة الجزيئية** Cells and molecules of the immune system: - Eosinophils - Basophils and mast cells - Neutrophils and macrophages - The metabolic burst - Dendritic cells - Natural killer cells - B cells and immunoglobulin genes - T cells and TCR genes; Development of T cells in the thymus - The MHC in man. Molecules and processes of the immune system: Fc receptors - Adhesion

	molecules - Exogenous pathway of antigen presentation - Endogenous pathway of antigen presentation - Signaling and activation of T cells - Activation of B cells - The cytokine network - The cytokine network (cont) - The alternate pathways of complement activation - Granzymes and perforins - Leukotrienes and prostaglandins - Hypersensitive reactions and tolerance.
Z I – 641 **(3 cr. h)**	**Cellular Immunology and Applied Immunology** **المناعة الخلوية والمناعة التطبيقية** **Cellular immunology:** Cells involved in immune response: Lymphoid cells - T-cells - B-cells - Natural killer cells - Phagocyte cells - Mononuclear phagocytic system - Polymorphonuclear granulocytes - Antigen-presenting cells - Cell cooperation in the antibody response: Types of antigen presenting cells - Antigen presenting cells and T-cells - Interaction of B-cells and T-cells - T-dependent and T-independent antigens - Cell-mediated immune reactions: T-cell-independent cell-mediated defense mechanisms – Phagocytosis - Cytokines release - T-cell dependent cell- mediated responses - The regulatory role of TH cells - Cell - mediated cytotoxicity - Antibody-independent - Antibody-dependent – Mechanisms - Granuloma formation - Regulation of the immune response: By antigen - By antibody - By immune complex - By lymphocytes - Neuroendocrine modulation - Genetic control - MHC-linked immune response genes - Non-MHC-linked immune response genes - Immunological tolerance: T-cell tolerance to self antigens - B-cell tolerance to self antigens - Artificially induced tolerance - Therapeutic application of tolerance - Tumor immunology: Immune surveillance - Tumor antigens - Immune response to human tumors – Immunodiagnosis – Immunotherapy - Hypersensitivity: Type I - Type II - Type III - Type IV - Transplantation and rejection: Barriers to transplantation - Genetics of transplantation - The laws of transplantation. **Applied immunology:** This course deals with various applied immune ological methods these methods tend to detect, measure (quantita vely and qualitative) and identify both antigen and antibodies. In addition other methods deal with identification of lymphoid cell lines. Immunization: Antigens and haptens - Routes of immunization - Effect of antigen dose – Adjuvants - Detection, measurement and characterization of antibodies (antigen/ antibody reaction): - Radioimmunoassay (RIA) - Enzyme – linked immunosorbant assay (ELISA) - Anti – immunoglobulin antibodies production - Immunofluorescence microscopy - Isolation and identification of lymphocytes (Detection of surface membrane antigen): Flow cytometery and FACS analysis - Isolation of homogeneous T – cell lines - Characterization of lymphocyte specificity, frequency and function: ELISPOT - Identification of functional subsets of T cells by staining for cytokines - Stimulation of lymphocyte proliferation by treatment with polyclonal - Mitogens or specific antigen: Radioactive method - Colorimetric method - Measurement of cytokines: RT – PCR - In situ – hybridization - Capture ELISA.
Z I – 642 **(3 cr. h)**	**Immune System Diseases and Immunodiagnosis** **أمراض الجهاز المناعي والتشخيص المناعي** **Immune system diseases:** Mechanisms of immunodeficiency: Antibody (B-cell) Immunodeficiency disorders - (T-cell) Immunodeficiency disorders - (B& T-cell) Immunodeficiency disorders - phagocytic dysfunction diseases - Complement

	deficiencies - Mechanisms of disordered immune reaction: Multi factorial pathogenesis of Autoimmunity - Rheumatic diseases: System lupus Erthematosus - Rheumatoid Arthriris - Gastrointestinal Diseases: Cebiac Disease - Food hypersensitivity - Crohn's Disease - Ulcerative Colitis - Mechanisms of Immunity to Infection - Non immunologic defenses against infection - Immunologic defenses against infection - Immunopahology of infection - Bacterial Infections: Serodiagnisis - Exotoxins & endotoxins - Toxigenic bacterial diseases - Viral infections: Influenza virus - Respiratory syncytial virus - Hepatitis B virus - Hepatitis A virus - Fungal Infections: Introduction - Primary pathogens with examples - Opportunistic pathogens with examples - Immune Response to Parasites: African Trypanosomiasis – Leismassiasis – Malaria – Ambiasis – Toxoplasmosis – Schistosomiasis - Intestinal nematodes - Immunologic Therapy: Antigen – specific therapy - Antigen – Non specific therapy - Modulation of the inflammatory response – Immunization: Types of immunization - Active immunization - Passive immunization. **Immunodiagnosis:** This course deals with the principles underlying the different Immunodiagnosic techniques used to detect antigens and antibodies in relevant diseases. Special emphasis is given to the comparison of Immunodiagnosic assays in different parasitic diseases. Preparation of antibodies and antigens - Purification of antibodies and antigens - Column chromatography principles and theories - Applications of column chromatography - Immunodiagnostic techniques - Conventional vs. Immunodiagnostic assays in diagnosis of parasites - Diagnosis of protozoan diseases - Diagnosis of nematodes trematodes…….etc.
Z I - 643 **(2 cr. h)**	**Immunochemistry** **كيمياء المناعة** This course deals with many techniques. The use of antigen – antibody reactions as the basis to detect, characterize, or quantitate constituents in blood and other body fluids. These constituents can range from small – molecular weight drugs and their metabolites to large molecular weight proteins. Antigens – Antibodies - Antigen – antibody interaction: Binding forces - Antibody affinity - Antibody avidity – Valency - Cross reactivity - Detection of antigen / antibody interactions: Immunodiffusion - Double immunodiffusion - Radial immnodiffusion - Detection of antigen / antibody interactions: Immunoprecipitation - Precipitation curve - Lattice theory - Factors affecting precipitation - Precipitation reactions in gel - Detection of antigen / antibody interactions: Immunoelectrophoresis - Counter immunoelectro-phoresis - Two – Dimensional - Rocket immunoelectrophoresis - SDS – PAGE - Uses of antigen / antibody interactions: Chromatography principles and theories: Ion exchange chromatography - Gel filtration - Immunoaffinity chromatography - Uses of antigen / antibody interactions: Enzymatic labeled assays - Enzyme – linked immunoelectro-transfer blotting (Western blot) - Enzyme – linked immunosorbant assay (ELISA).
Z I - 644 **(2 cr. h)**	**Developmental and Comparative Immunology** **المناعة التكوينية والمقارنة** Understanding the overall relationship of immunity on a biological phenomenon requires analysis of immune system in all animals, not exclusively of mammals. Thus, the theory of immunology has greatly benefited from the comparative approach, emphasizing the phylogenetic

	emergence of lymphoid cells and tissues. Regulatory role of temperature on the development of ectothermic vertebrate immune system - Molecular evolution of the vertebrate immune system - Metamorphosis and amphibian immune system - Seasonal and cyclic changes in the immune system of ectothermic vertebrate - Neuroimmune modulation in amphibians, fish and reptiles - Hormonal and nervous regulation of immune system of nonmammalian vertebrates - Stress, the relaxation response and immunity of ectothermic vertebrates - The evolutionary paradox of invertebrate cytokines - Invertebrate ACTH: immuno – neuroendocrine regulation - Neuroendocrine system regulate the immune response during parasitic infections - Environmental pollution and fish immunity - Phylogenic studies on the immune system of non – mammalian – Vertebrates.
Z I - 645 **(2 cr. h)**	**Immunoparasitology** **مناعة الطفيليات** This is a study of the relation between various parasites and the immune system. The student would know the various aspects of immune responses against parasites. Introduction: Definitons: Infection – Resistance – Natural - Acquired - Mechanisms of Natural Resistance - External factors - Internal factors - Intracellular Protozoa: survival within cells - Plasmodium and Malaria - Leishmania and leishmaniasis - Schitosomes and Schistosmiasis: Immune response - Protective Immunity – Immunopathology - Gastrointestinal Nematodes: immunity within the intestine - Immune response within the intestine - Protective immunity against intestinal nematodes - Antigens involved in Immunity - Chronic infection

	4- M. Sc. Degree in Animal Ecology (Z AE)
Z AE – 655 **(3 cr. h)**	**Aquatic and Terrestrial Ecology** **البيئة المائية والبرية** **Aquatic ecology** **Freshwater and Estuarine Ecology** Freshwater and Estuarine Ecology: It emphasizes mainly the study of relationship between organisms and the freshwater or estuarine environments. Study of all aspects of physical, chemical, geological, and biological factors of freshwaters termed limnology. Freshwater Ecology: Abiotic factors - Biotics: Competition, predation, parasitism and symbiosis - Food web interactions, in freshwater ecosystems - Environment and conservation - Stress factors (limiting factors) - Main characteristics of water - General adaptation syndromes - Main physiological tests to the effects of environmental stresses - Fresh water teleost and their adaptation to fresh water - Marine water teleost and their adaptation to seawater - Structure of gills - Comparison between fresh and salt water fish - Osmotic and ionic regulation - Endocrinology of osmotic and ionic regulation -Transfer of fish from fresh water to salt water - Transfer of fish from salt water to fresh water - Estuarine Ecology: An estuary is a semi-enclosed coasted body of water which has a free connection with the open sea, thus strongly affected by tidal action, and within which sea water is mixed with freshwater from land drainage. Estuaries may be considered as transitional zones between the freshwater and marine habitats - Characteristics of the estuarine environment - Life spane of an estuary - Nature of the fuana and flora: Benthos and benthic feeders – Plankton - Food and food webs: Detritus and micro-organisms - Detritus feeders – Predators - The food web –

	Adaptations: Anatomical specialization - Physiological specialization - Behavioral specialization - Estuarine biology vs population and industrial pressure: Ships - People and industry - Discharge to the estuary - The scientific studies of estuaries: Field studies of distribution and abundance - Observations of animal behavior - Laboratory studies. **Marine Ecology** The Oceans: Extent and depth - Ecological aspects of the marine environment - Elementary classification of the marine environment - Introduction to Ecology: Predator-prey relationships – Competition – Symbiosis - Mutualism, commensalism, parasitism intraspecific – Interaction - Temperate Streams: Factors that affect distribution - Physical, chemical & biological factors, predator-prey – Interactions - Competitive interactions, symbiotic interaction - intraspecific interactions - Zoogeographical Factors - Zonation (general zones) - Epipelagic Zone - Adaptation for pelagic life - Ecological Types - Factors that affect distribution and abundance - Migration and movement - Epipelagic Zone - Adaptation for pelagic life - Ecological Types - Factors that affect distribution and abundance - Migration and movement - Migration and movement - Deep sea habitats – Adaptations - Reproductive strategies - Factors that affect distribution - Polar Regions - Arctic fishes - Antarctic fishes - Problem affect fishing - Recommendations needed for the future. **Terrestrial ecology** Definition of a desert - Desert types - Notes on some deserts - Sand Dunes – Microclimates - Temperature: Solar radiation - Heat Metabolic production - Radiant heat transfer - Conduction & Convection - Evaporative heat loss - Water in desert: Water balance in animals - Water storage - Animals life in deserts - Morphological adaptation: Vertebrate integument - Pelage & plumage - Animal colour - Shape & size - Physiological and behavioral adaptations - Tolerance to high temperature & dehydration - Adaptive heterothermy - Behavioural thermeregulation – Osmoregulation - Specialized respiration & excretion – High Altitude Ecology: High altitude biology deals with mountain autochthonous plants and animals, the environment in which they exist, their functions and habits, adaptations, their origins and evolution and their ecological interrelations to life at lower altitudes in the plains. In addition, a study of man permanently resident at high altitudes and of the effects of exposure of the sea-level residents to high altitude conditions and their acclimation to high mountain regions. High altitude biology is thus essentially the biology of mountains: of high altitude ecosystem. The high altitude environment: Reduced atmospheric pressure - Atmospheric temperature - Soil temperature – Microclimate - The high altitude environment versus the low land environment - The high altitude plants: High altitude vegetation compared with other - ecological types - Characters of high altitude plants - The high altitude animals: Characters of high altitude animals - Temperature and pressure orientated animals - Some typical high altitude animals - High altitude insects: Peculiarities of high altitude insects - Examples of high altitude insects - Lowland animals at high altitude - Man at high altitude.
Z AE – 656 **(2 cr. h)**	**Ecological Conservation Biology and Communication** **الحفاظ والاتصال في البيئة** **Conservation biology**

	The principles of conservation of natural resources: how we treat our natural resources will determine the future of mankind. The nature of natural resources - Soil conservation - Civilization and water Land and wild animal life - Water and fisheries - The conservation of environments - The problem of population - Conservation of species - Why do species become extinct. **Ecological communication (stimuli and communication)** Sign stimuli (key features) - Diverse sensory capacities - Acoustic behavior in vertebrates and invertebrates - Sound box - Analysis of the acoustic signals - Perception of the acoustic signals - Effect of acoustic signals on aggressive and courtship behaviors – Communication by language signals - Communicator signals during orientation and migration of birds, fishes, and insects - Communication by light signals (bioluminescence) – Echolocation - Colouration – Chemoreception.
Z AE – 657 (2 cr. h)	**Neuroethology and Behavioral Endocrinology السلوك العصبى والهرمونى** **Neuroethology** Typically, a behavior pattern is the eventual resultant of an interaction between certain environmental stimulus and the motivation of the living organism. Of all the information conveyed to the brain from the environment by the sense organs, only a limited portion is biologically important. Consequently, for an animal, the environment can only be what the system properties of sense organs and nerve nets, which process the signals, allow. Learning in animals is known to be restricted and guided, directly or indirectly, by the original instinctive behavior of the animal. It is usually defined by a modification in the behavior that can not be accounted for by sensory adaptation, central excitatory states, endogenous rhythms, motivational states or maturation. Neural bases of behavior: Environmental stimuli and information reduction - Innate and acquired releasing mechanisms - Key stimuli, Dummies, and releasing mechanisms - Habituation phenomena - 2- Determinants of behavior: Motivation and change of meaning - Reticular formation - Appetitive behavior and consummatory acts - Control of the motivated behavior - Physiology of communication: Acoustic behavior: Physiology of vocalization - Physical nature and analysis of the acoustic signal - Acoustic signal and information reduction - Perception of the acoustic signal - Perceptual meanings in the spectrum of mating call in frogs - Voice print in humans - Learning in animals: Classic reflex conditioning - Operant learning - Insight learning - Learning set tests – Imprinting - Human consciousness and behavior: States of consciousness: Electroencephalogram - The walking states – Sleep - Conscious experiences: Directed attention - Neuronal mechanisms for conscious experiences - Emotions - Altered states of consciousness: Psychoactive drugs, tolerance, and addiction - Learning and memory in human: Memory: Nature and keeping of information - The location of memory - Molecular formation of memory. "The memory trace" - Improvement of memory: Enriched environment and plasticity. **Behavioral endocrinology** This course will deal with the two-way relationship that exists between the physiological effects of hormone release and behavior by studying multiple examples in humans and animals. Techniques of behavioral endocrinology

	will be studied. Reproductive behavior: Sexual development and differentiation - Hormonal control of sexual behavior - Neural control of sexual behavior - Affiliative and aggressive behavior - Homeostasis and behavior: Fluid balance - Energy balance – Stress - Biological rhythms: Exogenous versus endogenous control of biological rhythms - Types of biological clocks and rhythms - Memory and learning – Migration – Hibernation.
Z AE – 658 **(3 cr. h)**	**Ecotoxicology and Histopathology** **التسمم البيئي وعلم أمراض الأنسجة** **Ecotoxicology** Pollutants and their fate in ecosystems: Major classes of pollutant: Organic pollutants - Organometalic compounds - Radioactive isotopes - Gaseous isotopes - Routes by which pollutants enter ecosystems in air and water - Long-range movement and distribution of pollutants - The fate of metals and radioactive isotopes in contaminated ecosystems (terrestrial and aquatic ecosystems) - The fate of organic pollutants in individuals and ecosystems - Effects of pollutants on individual organisms: Toxicity testing in the field, terrestrial and aquatic organisms - Biochemical effects of pollutants - Physiological effects of pollutants at the cellular, organ and whole organism levels - Effects of pollutants on populations and communities: Changes in numbers (population dynamics) - Population growth rate - Interactions between species - Population growth rate depends on the properties of individual organisms - Evolution resistance to pollution - Changes in communities and ecosystems in response to pollution - Biomarkers in population studies: DDE-induced eggshell thinning in raptorial and fish eating birds - Reproductive failure of molluscs caused by tributyl tin - Reproductive failure of fish eating birds **Histopathology** The pathologic changes that occur in the cell and tissues when exposed to injury or stress and the mechanisms of cell protection and recovery. Cell injury and its manifestations: Sites and types of cell injury, free radical, lysosomes, stress proteins - Bacterial toxins and radiation - Some morphologic expressions in cell injury - Mechanisms of cell protection and recovery - Cell and Tissue death: Morphological changes in cell death – Apoptosis – Necrosis - Acute inflammation: Causes and characteristics - Cellular events and chemical mediators - Regeneration and wound healing – Chronicity.
Z AE – 659 **(2 cr. h)**	**Biodiversity** **التنوع البيئي** Species biodiversity - Habitat biodiversity - Genetic biodiversity - Indices of diversity - Diversity on environmental gradients - Determinants of diversity: Local factors (number of species) - Global factors.
Z AE – 660 **(2 cr. h)**	**Thermoregulation and Photoperiodism in Vertebrates** **الفترة الضوئية والتنظيم الحرارى فى الفقاريات** **Thermoregulation in vertebrates** Thermoregulation in aquatic ectothermic vertebrates - Thermorermoregulation in terrestrial ectotherms (amphibians and reptiles): Thermoregulation in amphibian - Thermal acclimation - Behavioral thermoregulation - Physiological thermoregulation - Thermoregulation in reptiles: Behavioral control of body temperature - Physiological control changes in body temperatures - New methods for determination of body temperature and operative temperature: Determination of body temperature using radio telemetry - Thermal infrared remote sensing detectors - Estimation of operative temperatures by using biological

	models - Thermoregulation in terrestrial endotherms (birds and mammals) - Human thermoregulation. **Photoperiodism** Animal cycles and environmental synchronizers -Photoperiodism in birds: The photoperiod and migration - The photoperiod and gonad response - The refractory period - Interspecific and intraspecific differences in photosensitivity - The photoperiod and moult - Photoperiod in mammals: - Long-day photoresponses - Short-day - Photoperiod and delayed implantation - Moult and antler cycles - Photoperiodism in lower vertebrates - Photoperiodism in invertebrates - Timing of diapause - Temperature modification of the photoperiodic response - Photoperiodic adaptation in geographical races - The physiological clock and day-length measurement - Photoperiodic regulation of non-seasonal cycles: Behavioral photoperiodism - Photoperiodic effects on the oestrus cycle and ovulation.
Z AE – 661 **(2 cr. h)**	**Anatomy and Physiology of Vertebrate Sense Organs** **تشريح وفسيولوجيا أعضاء الحس فى الفقاريات** **Anatomy of vertebrate sense organs:** (from sec. comparative anatomy) Structure and classification of sensory receptors and the places in which they are present. Sense of vision (Eye) - Development of the eye - Structure of the eye - Lens and accommodation(Ciliary body) - Accessory structures(eyelids, lacrimal gland) - Cavities of the eyeball - Sense of hearing and equilibrium - Development of the ear - Structure of the ear(Histology of the organs of the hearings and equilibrium) - Evolution of the cochlea - Olfactory sense: Olfactory structure - Histology of nasal mucosa - Jacobson's organ - Nasal glands - Sense of taste (Histology of taste buds and the organs in which they are distributed) - Lateral line organs - Simple sense organs. **Physiology of vertebrate sense organs: (from section physiology)** Multicellular animals on the whole respond adaptively to various internal and external factors. Some of cells are specialised according to their functions. If the change is qualitative or quantitative of an environmental factors is large enough to be detected by an organ it constitutes a stimulus. The stimulus evokes in living organisms is known as response. Exteroreceptors - They receive stimuli from external environment - Mechanical stimuli: Tangoreceptorm – Phonoreceptor – Algesireceptor – Rheoreceptor - Chemical stimuli: Olfactory receptors – Gustoreceptors - Radiant stimuli: Thermoreceptors – Photoreceptors – Ineteroreceptors - They receive stimuli from internal environment – Proprioreceptors – Visceroreceptors - Labyrinthine receptors.
Z AE – 662 **(2 cr. h)**	**Population Dynamics and Principles of Taxonomy** **ديناميكية العشائروأساسيات التصنيف** **Population ecology** Some basic concepts: - Rates of population growth - Birth-rates and death-rates (effects of age and density) – Dispersal - Animal life tables (time-specific life tables and age- specific life tables) - Dynamic aspects of ecosystem: Patterns of distribution among organisms (Zoogeographical distribution) - Modes of dispersal of organisms - Climax and polyclimax succession - Evolutionary aspects of change: Evolution as a reaction to changing environments - Phyletic evolution and speciation - The problem of extinction - Population limitations within ecosystem: Methods of estimating

	population - Birth, death, and growth rates - The importance of age - Genetic factors – Migration - Density-dependent and density-independent - Competition: Intra-specific competition - Inter-specific competition - Under population - Social behavior: Territorial behavior - Social hierarchies - Qualitative changes in individuals: Phase changes in insects - Genetic changes - Natural enemies: Disease and predators - Weather: Effects on survival - Effects on reproduction - Effects on habitat - Detailed population studies in fish or bird or insect - Population cycles - Application of population ecology: Pest species (chemical pest control, biological control of pests) - Predation by Man (Fish populations, Marine mammals populations) - Nature conservation and protected areas. **Principles of taxonomy:** (from section comparative anatomy) Kinds of taxonomic characters - Morphological characters - Ecological characters - Physiological characters - Immunological chatracters - Hierarchy of taxonomy - Vertebrate fauna - Fishes of Egypt - Amphibian of Egypt - Reptiles: Lizards, Snakes, Crocodiles, Turtles and Tortoises - Birds known to occur in Egypt - Mammals of Egypt.
Z AE – 663 **(2 cr. h)**	**Environmental Remote Sensing** **الاستشعار عن بعد للبيئة** Remote sensing scoped for solving environmental problems and knowledge of their details, whether before problem occur, during their interaction, or after their implementation, in order to modify actions or maintain them. Definition of environmental remote sensing and its importance - Ecological and environmental monitoring - The food chain - Bioaccumulation in terrestrial and aquatic ecosystems - Applications in natural and agro-ecosystems - Monitoring of selected biota – methods of calculation.

	5- M. Sc. Degree in Cell Biology, Histology and Genetics (Z C)
Z C – 670 **(3 cr. h)**	**Cell Biology and Cancer Biology** **بيولوجيا الخلية وبيولوجيا الأورام** **Cell biology** The course covers recent advances in molecular structure and function of animal cells such as molecular assembly, intracellular compartments and protein sorting, intracellular vesicular traffic, cell communication, cell growth regulation at the molecular level, molecular interactions between cells and response to signals. **Cancer biology** Introduces the bases of cancer biology, characteristic features of cancer, carcinogenesis, cancer etiology and tumour spread.
Z C – 671 **(2 cr. h)**	**Tissue Biology** **بيولوجيا الأنسجة** The course discusses the ultrastructural-functional relationship in cells and tissues with examples from various epithelial and connective tissue cells; the extracellular matrix and cell-matrix interactions, the lives and deaths of cells and tissues and the renewal by stem cells as well as a preview of stem cell engineering.
Z C – 672 **(2 cr. h)**	**Cytogenetics and Molecular Genetics** **وراثة خلوية ووراثة جزيئية** **Cytogenetics** The course describes the structure and packaging of viral, bacterial and eukaryotic chromosomes and the essential features of cell division . It also introduces the student to the world of chromosome abnormalities and genetic diseases and the recent trends dealing with chromosome engineering.

	Moreover, it emphasizes some laboratory skills and cytogenetic techniques used in mapping and diagnosis of genetic diseases.
Z C – 673 **(3 cr. h)**	**Tissue Culture and Electron Microscopy** **زراعة الأنسجة و ميكروسكوب الكترونى** **Tissue culture** The course introduces the student to the principles of cell and tissue culture techniques in biology and medicine and the requirements of a tissue culture system, laboratory equipments, culture control of infection, evaluation of growth potentials, maintenance. **Electron microscopy** The course introduces the fundamentals and main elements of electron microscopy and its practical applications in the field of biological studies with special concentration on the most common processes in preparing the different cells and tissues and the various related techniques such as negative staining and autoradiography will be introduced.
Z C – 674 **(2 cr. h)**	**Toxicology and Histopathology** **علم السموم وعلم أمراض الأنسجة** **Toxicology** The course aims to explain the general basis of toxicology and the possible mechanisms behind it. It also explains the various type of toxicities encountered in biological systems and the toxic agents involved. **Histopathology** The pathologic changes that occur in the cell and tissues when exposed to injury or stress and the mechanisms of cell protection and recovery.
Z C – 675 **(2 cr. h)**	**Radiobiology and Immunobiology** **بيولوجيا الإشعاع وبيولوجيا المناعه** **Radiobiology** The course addresses a general study of the biological effects of radiation including its nature, types and units, with particular emphasis on the effect of radiation on DNA, chromosomes, biological molecules, cell membranes , cell organelles, cell division and radiation effects on major systems in mammals are also considered. **Immunobiology** The course tends to acquaint the student with the basic and advanced topics in relation to the immune system. As immunology is a highly progressive field of science, it is of vital importance to give a general idea of its various aspects.
Z C – 676 **(2 cr. h)**	**Reproduction Biology and Molecular Endocrinology** **بيولوجيا التكاثر و علم الغدد الصماء الجزيئى** **Reproduction biology** The course deals with the study of the physiological aspects of reproduction and hormones responsible for the regulation of the reproductive system and bahaviour with emphasis on structural, regulatory, behavioural and evolutionary aspects of reproduction. **Molecular endocrinology** The course focuses on the chain of molecular events initiated by the hormone which culminates in its physiologic effect.
Z C – 677 **(2 cr. h)**	**Developmental Biology** **البيولوجيا التكوينية** This course is mainly concerned with the biology of development or analysis of events of development on a molecular and genetic level. It is one of the advanced courses for students of higher classes . Students, however, cannot go through study of developmental biology without being first familiar with Descriptive of Classic Embryology.
Z C – 678	**Invertebrate and Vertebrate Histology** **أنسجة لافقاريات وفقاريات**

(2 cr. h)	**Invertebrate histology** This course gives a theoretical and a detailed study of the histological organization of representive organs and tissues of selected invertebrates as Cnidaria, Annelida, Arthropoda, Mollusca and Echinodermata, and study of tissues using light microscopy, transmission electron microscopy and scanning electron microscopy. The relationship between structural changes and physiological changes during life cycle of organisms, histopathology with respect to tissue responses to infection and to damages by toxic agents. **Vertebrate histology** The course compares between the structure and function of cells, tissues and organs of vertebrate classes by means of light and electron microscopy.
Z C – 679 **(2 cr. h)**	**Histochemistry** **كيمياء أنسجه** The course aims to provide the student with a comprehensive insight of the use of histochemistry in understanding biological activities of cells and tissues under normal and physiologic conditions as well as their applications in pathology. It underlines the basic principles of techniques of enzyme histochemistry, immunohistochemistry, lectin histochemistry, molecular histochemical techniques and other techniques of current importance to researchers and clinicians.
Z C – 680 **(2 cr. h)**	**Human Genetics** **الوراثة البشـرية** The students are introduced to biochemical, molecular and genetic bases of human genetics in cell and disease. It also describes the human genome with reference to the human genome project. Moreover, the student should be aware of the genetic bases of cancer and gene therapy and ethical considerations in applying molecular techniques when dealing with human beings.

	6- M. Sc. Degree in Comparative Anatomy and Embryology (Z CA)
Z CA – 685 **(3 cr. h)**	**Comparative Anatomy of Nervous System, Cranial Nerves and Sense Organs** **التشريح المقارن للجهاز العصبى والأعصاب المخية وأعضاء الحس** **Nervous system** Introduction - Division of vertebrate nervous system - Histology of vertebrate nervous system - The brain: The structure and Ontogeny of the vertebrate – brain - Comparative anatomy of the vertebrate brain - Evolution of the vertebrate brain - Ventricles of the brain - Meninges of the brain - Grey matter and white matter of the spinal cord and the distribution of sensory and motor columns - Grey matter and white matter of the brain and the arrangement of sensory and motor nuclei - Peripheral nervous system - Spinal nerves - Autonomic nervous system. **Cranial nerves** Classification of the cranial nerves - Terminal nerve - Nerves of spinal senses and nerves of the lateral line - Branchial nerves - Eye-muscle nerves - The cranial nerves(V , VII , IX , X , XII) - Description of the nerves and their branches in Anamniota and Amniota - Analysis of the fibers carried by these nerves and their branches. **Sense organs** Structure and classification of sensory receptors and the places in which they

	are present - Sense of vision (Eye) - Development of the eye - Structure of the eye - Lens and accommodation(Ciliary body) - Accessory structures(eyelids, lacrimal gland) - Cavities of the eyeball - Sense of hearing and equilibrium - Development of the ear - Structure of the ear(Histology of the organs of the hearings and equilibrium) - Evolution of the cochlea – Olfactory sense: Olfactory structure - Histology of nasal mucosa - Jacobson's organ - Nasal glands - Sense of taste (Histology of taste buds and the organs in which they are distributed) - Lateral line organs - Simple sense organs.
Z CA – 686 (2 cr. h)	**Comparative Anatomy of Skeletal and Muscular Systems** **التشريح المقارن للجهاز الهيكلى والجهاز العضلى** **Skeletal system** Evolutionary classification of Chordata - An introduction to the anatomy of chordates, with special reference to the study of the skeletal system in various groups - A detailed study of the development of the skull of the snake *Eryx colubrinus* in several successive stages from the early stages of the development of the chondrocrainum till the fully formed chondrocranium followed by the formation of the osteocranium - The head region of *Bagrus bayad* (The study of the structure and function of the muscular system). **Muscular system** Types of muscular tissues: Smooth involuntary muscle: Origin, Structure and sites of the presence - Striated, involuntary, skeletal muscle: Origin , Structure and sites of the presence - Cardiac muscle: Origin and structure - Natural classification of muscles: Somatic: Axial: Trunk, tail and eyeball muscles - Appendicular muscles - Visceral: i- Branchiometric straiated muscle - Smooth(gut and the like) muscle - Morphology of the muscle(belly, origin and insertion) - Muscle terminology(extensor , flexor , adductor , abductor ...etc) - Eye muscles – Skin muscles - Electric organs - Innervations of muscles.
Z CA – 687 (2 cr. h)	**Molecular Taxonomy and Vertebrate Fauna** **التصنيف الجزيئى وفونا الفقاريات** Many errors in classification have been made because of the failure to recognize the inter-and intraspecific variations depending on the morphological differences. The significant application of biochemical characters in systematics had waited till the development of gel electrophoresis and the discovery that the genetic information is carried from generation to generation encoded in the nucleotides of the DNA. Then, biochemical systematics was given a renewed stimulus in the hope of resolving problems of speciation and systematics in population and species. The electrophoretic techniques were sufficiently refined to permit examination of a large number of different proteins in the same organisms. It has been found that these protein variations can be used systematically to distinguish clearly even closely related species. As the result of widespread use of electrophoretic techniques in systematics, considerable interest was directed by systematists to compare and to estimate degree of concordance between the morphological and biochemical characters. **Molecular taxonomy** Neo-Darwinism – Speciation - Anagenic speciation - Cladogenic speciation - Isolating mechanisms: Postmating isolating mechanism - Premating isolating mechanisms - Sources of variations: Mutations - Genetic drift – Inbreeding – Migration - Environmental variations - Natural selection: Stabilizing selection - Directional selection - Disruptive selection - Theories of classifications: Phenetic theory - Cladistic theory - Evolutionary theory - Isozymes and

	allozymes – Polymorphism - Systematic value of electrophoretic data – Examlpes - **Vertebrate fauna** Fishes of Egypt - Amphibian of Egypt - Reptiles: Lizards, Snakes, Crocodiles, Turtles and Tortoises - Birds known to occur in Egypt - Mammals of Egypt.
Z CA – 688 **(2 cr. h)**	**Developmental Biology and Electron Microscopy** **بيولوجيا تكوينية وميكروسكوب إلكترونى** **Developmental biology** Introduction: Definitions of comparative embryology, evolutionary embryology, descriptive embryology, medical embryology, experimental embryology and developmental embryology. Principles of Development: Stages of animal development , effect of environment on development, environment and sex determination, adaptation of embryos to their environment. Genome constancy: Evidences of genomic equivalence, transgenic animals, mammalian cloning, importance of cloning mammals, differential gene expression. RNA localization techniques: In situ hybridization, whole mount in situ hybridization, polymerase chain reaction (PCR), function of genes during development. Fertilization: Structure of gametes, recognition of egg and sperm, Blocking of polyspermy; fast and slow reactions. Mechanisms of Developments: Mechanisms of cleavage, gastrulation and neurulation. Embryonic induction during vertebrate development: Mesoderm and neural induction in Amphibia, induction of a secondary embryonic axis in birds, induction of the eye lens of vertebrates. Regeneration. **Electron microscopy: (from section cell biology)** Basic theory of microscopy: Basic principles of optics - Types of lens - Limits of magnification and useful magnification - Resolving power and its limiting factors - Transmission electron microscopy: General structure and physical basis - Image and contrast formation in microscopy - Resolving power in TEM - Lens defects - Theory of image formation in light and electron – microscopy - Preparation methods: Embedding and sectioning: Fixation – Buffers - Embedding media - Preparation of semi-thin and ultra-thin sections - Section staining and theory of contrast enhancement - Negative staining: Theoretical background and its applicability - Different specimen preparations and methods - Autoradiography: Theoretical background (radioactivity and radiation emitted, useful radiotracers, detection of radiation emitted in microscopy) - Preparation of radio-labeled specimens for light and electron microscopy - Interpretation of results.
Z CA – 689 **(2 cr. h)**	**Physiology of Excretion and Respiration** **فسيولوجيا الإخراج والتنفس** This course is intended to study how an animal cope with its environment concerning the respiratory ,excretory and circulatory systems. It includes structural and functional studies of the respiratory and excretory systems of aquatic and terrestrial vertebrates. **Respiratory system**

	The atmosphere: - Composition of dry atmosphere - Water vapor in air - Comparing water and air as respiratory medium - Respiration in water: Animals without specialized respiratory organs - Animals with respiratory organs. Origin of gills - Structure of gills - Ventilation of gills - Gas exchange and water flow(water pumping and ram ventilation) - Air-breathing in fishes - Lung in fishes - Swim-bladder - Examples of lung fishes - Respiration of tetrapods: Respiration in amphibian(Frogs) - Bucco-pharyngeal movement - Pulmonary ventilation - Cutaneous ventilation - Respiration of reptiles: Terrestrial and aquatic reptiles - Pulmonary ventilation - Cutaneous respiration in some forms of reptiles - Respiration of birds: Structure of respiratory system - Gas flow through the avian lung and mechanics of breathing - Arrangment of parabronchi with respect to blood capillaries, and the exchange of gases - Chemical transport of the respiratory gases - Respiration and metabolism - Problems of diving and high altitude. **Excretory system** Structures as related to function of various excretory organs of the different animal groups. Nitrogen excretion: Ammonotelic animals - Ureotelic animals - Uricotelic animals - Water and osmotic regulation: In aquatic environment (Marine, Fresh, Brackish) - In terrestrial environment.

6- Geology Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(G)	Diploma (500)	1- Ore Deposits and Mineral Exploration	(GO)
		2- Environmental Geology	(GE)
		3- Geological applications in Archaeological Site Restoration	(GGA)
		4- Geoinformatics in Earth and Environmental Sciences	(GGI)
		5- Petroleum Geology	(GP)
		6- Hydrogeology	(GH)
		7- Engineering Geology	(GEG)
	M.Sc. (600)	1- Structure Geology and Tectonics	(GS)
		2- Stratigraphy and Paleontology	(GSP)
		3- Environmental Geology	(GE)
		4- Petroleum Geology	(GP)
		5- Sedimentary and Sedimentation Geology	(GSG)
		6- Mineralogy, Petrology and Ore Deposites	(GM)
		7- Engineering Geology	(GEG)
		8- Geochemistry	(GG)
		9- Hydrogeology	(GH)
	Ph.D. (700)	1- Structure Geology and Tectonic	(GS)
		2- Stratigraphy and Paleontology	(GSP)
		3- Environmental Geology	(GE)
		4- Petroleum Geology	(GP)
		5- Sedimentary and Sedimentation Geology	(GSG)
		6- Mineralogy, Petrology and Ore Deposites	((GM)
		7- Engineering Geology	(GEG)
		8- Geochemistry	(GG)
		9- Hydrogeology	(GH)

1- Diploma in Ore Deposits and Mineral Exploration (GO)

Code	Course Number	Course Case	CR. Hours
(GO)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GO 501	Geology of Ore Deposits	2	1	2	2-3
	GO 502	Industrial Minerals & Rocks	2	1	2	2-3
	GO 503	Structural Controls of Ore Deposits	1	1	2	2-3
	GO 504	Mining & Quarrying Geology	1	1	2	2-3
Second	GO 505	Ore Mineralogy	2	1	2	2-3
	GO 506	Mineral Exploration	1	1	2	2-3
	GO 507	Ore Deposits of Egypt	1	1	2	2-3
	GO 508	Geochemical Exploration	2	1	2	2-3
		The Total Cr.h. Required	12	8		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	GO 509	Ore Dressing	1	1	2	2-3	
	GO 510	Geophysical Exploration	1	1	2	2-3	
	GO 511	Principles of Mineral Deposits	1	1	2	2-3	
	GO 512	Analytical Techniques in Geology	1	1	2	2-3	
Second	GO 513	Remote Sensing / GIS in Ore Deposits	1	1	2	2-3	
	GO 514	Environments Impact of Mining Operations	1	1	2	2-3	
	GO 515	Geostatistics	1	1	2	2-3	Also offered by Restoration
	GO 516	Introduction to Mineral Economics	1	1	2	2-3	
	GO 517	Special Topics	2	--	2	--	
		The Total Cr.h. Required	4				

2- Diploma in Environmental Geology (GE)

Code	Course Number	Course Case	CR. Hours
(GE)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GE 518	Environmental Characteristics of the Earth	1	1	2	2-3
	GE 519	Natural Resources	1	1	2	2-3
	GE 520	GIS Applications in Environment studies	2	1	2	2-3
	GE 521	Environmental Geochemistry	2	1	2	2-3
Second	GE 522	Human Impact & Biodiversity	1	1	2	2-3
	GE 523	Waste Disposal & Management	2	1	2	2-3
	GE 524	Natural Environmental Hazards	2	1	2	2-3
	GE 525	Legislation and Conventions	1	1	2	2-3
	The Total Cr.h. Required		12	8		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GE 526	Environmental Analytical Techniques	1	1	2	2-3
	GE 527	Medical Geology	1	1	2	2-3
Second	GE 528	Land Use Planning	1	1	2	2-3
	GE 529	Environmental Impact Assessment	1	1	2	2-3
	GE 530	Special Topics	2	--	2	--
	The Total Cr.h. Required		4			

3- Diploma in Geological Applications in Archaeological Site Restoration (GGA)

Code	Course Number	Course Case	CR. Hours
(GGA)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GGA 531	Geological Processes	1	1	2	2-3
	GGA 532	Physical & Geotechnical Properties of rocks and Monuments	1	1	2	2-3
	GGA 533	Building Materials & Monuments	2	1	2	2-3
	GGA 534	Field Geological Characteristics of Archaeological Sites	2	1	2	2-3
Second	GGA 535	Analytical Techniques in Archaeology	2	1	2	2-3
	GGA 536	Geoenvironmental Hazards	2	1	2	2-3
	GGA 537	Damage & Deterioration Phenomena	1	1	2	2-3
	GGA 538	Conservation & Restoration Methods and Materials	1	1	2	2-3
		The Total Cr.h. Required	12	8		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	GGA 539	Geophysical Exploration in Archaeology	1	1	2	2-3	
	GGA 540	Remote Sensing & GIS Application in Archaeology	1	1	2	2-3	Also offered by Engi-Geol.
Second	GGA 541	Geoarchaeological Applications	1	1	2	2-3	
	GGA 542	Special Topics	2	--	2	--	
	GO515	Geostatistics	1	1	2	2-3	Also offered by Ore.Depts.
		The Total Cr.h. Required	4				

4- Diploma in Geoinformatics in Earth and Environmental Sciences (GGI)

Code	Course Number	Course Case	CR. Hours
(GGI)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GGI 543	Principles of Remote Sensing	1	1	2	2-3
	GGI 544	Principles of GIS	1	1	2	2-3
	GGI 545	GIS Laboratory	2	1	2	2-3
	GGI 546	Geo-Information extraction	2	1	2	2-3
Second	GGI 547	Remote Sensing and GIS applications in Earth and Environmental Sciences	2	1	2	2-3
	GGI 548	Geo-spatial Data Modeling	1	1	2	2-3
	GGI 549	Geo-information and Risk Management	2	1	2	2-3
	GGI 550	Field and Spatial Techniques	1	1	2	2-3
		The Total Cr.h. Required	12	8		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GGI 551	Spatial information theory	1	1	2	2-3
	GGI 552	Introduction to Geo-Spatial Data Analysis- Theory and practice	1	1	2	2-3
	GGI 553	Geo-spatial Data Infrastructures Technical Design	1	1	2	2-3
Second	GGI 554	Data Mining and Knowledge Discovery	1	1	2	2-3
	GGI 555	Process modeling, programming and dissemination	1	1	2	2-3
	GGI 556	Visualization and dissemination of geospatial data	1	1	2	2-3
	GGI 557	Special Topics	2	--	2	--
		The Total Cr.h. Required	4			

5- Diploma in Petroleum Geology (GP)

Code	Course Number	Course Case	CR. Hours
(GP)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1). Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GP 558	Basic Petroleum Geology	2	1	2	2-3
	GP 559	Basis of Secondary Recovery methods for Petroleum Reservoirs and Reserve Evaluation.	2	1	2	2-3
	GP 560	Drilling Muds andTheir Parameters.	1	1	2	2-3
	GP 561	Remote Sensing and its Application in Petroleum exploration.	1	1	2	2-3
Second	GP 562	Egyptian Petroleum Provinces and their Petroleum Bearing Sections.	2	1	2	2-3
	GP 563	Natural Gases in Marine Sediments.	1	1	2	2-3
	GP 564	Geologic Control for Hydrocarbons.	2	1	2	2-3
	GP 565	Kerogen (oil) Shales and Organic Petrography.	1	1	2	2-3
		The Total Cr.h. Required	12	8		

Table (2). Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GP 566	Subsurface Mapping	1	1	2	2-3
	GP 567	Well log Analysis	1	1	2	2-3
	GP 568	Paleontological Applications in Exploration	1	1	2	2-3
Second	GP 569	Geochemistry of Oil Field Waters.	1	1	2	2-3
	GP 570	Petroleum Reservior Rock Types	1	1	2	2-3
	GP 571	Reservoirs Development and Treatment for Production	1	1	2	2-3
	GP 572	Special Topics	2	--	2	--
		The Total Cr.h. Required	4			

6- Diploma in Hydrogeology (GH)

Code	Course Number	Course Case	CR. Hours
(GH)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GH 573	Regional Groundwater Flow	2	1	2	2-3
	GH 574	Introduction to Aqueous Systems	2	1	2	2-3
	GH 575	Groundwater and the Environment	1	1	2	2-3
	GH 576	Principles of Well Drilling and Installation	1	1	2	2-3
Second	GH 577	Theory of Infiltration	2	1	2	2-3
	GH 578	Deviation from Equilibrium	2	1	2	2-3
	GH 579	Groundwater Modeling	1	1	2	2-3
	GH 580	Techniques in Water Analysis	1	1	2	2-3
		The Total Cr.h. Required	12	8		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GH 581	Source of Groundwater Contamination	1	1	2	2-3
	GH 582	Development of Groundwater Resource	1	1	2	2-3
Second	GH 583	Multifluid Contamination Problems	1	1	2	2-3
	GH 584	Mathematical Treatment of Land Subsidence	1	1	2	2-3
	GH 585	Special Topics	2	--	2	--
		The Total Cr.h. Required	4			

7- Diploma in Engineering Geology (GEG)

Code	Course Number	Course Case	CR. Hours
(GEG)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours	
			Th	Pr	Th	Pr
First	GEG 586	Engineering Geology	1	1	2	2-3
	GEG 587	Site Investigations	1	1	2	2-3
	GEG 588	Soil & Rock Mechanics Laboratory Techniques	2	1	2	2-3
	GEG 589	Special Studies	3	--	3	--
Second	GEG 590	Fundamentals of Earthquake in Engineering Geology	1	1	2	2-3
	GEG 591	Groundwater Engineering and Management	1	1	2	2-3
	GEG 592	Advanced Seminars in Engineering Geology	3	--	3	--
	GEG 593	Special Studies	3	--	3	--
	The Total Cr.h. Required		15	5		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	GGA540	Applied Remote Sensing and GIS in Archoeology	1	1	2	2-3	Also offered by Restoration
	GEG 594	Applied Geophysics in Engineering Geology	1	1	2	2-3	
Second	GEG 595	Earthworks Planning and Legal Aspects	1	1	2	2-3	
	GEG 596	Special Studies	2	--	2	--	
	The Total Cr.h. Required		4				

1- M. Sc. Degree in Structure Geology and Tectonics (GS)

Code	Course Number	Course Case	CR. Hours
(GS)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GS 601	Structural Geology	3	3	Also offered by Sediment. & Min-Pet & Ore Depos.
	GS 602	Rock Mechanics	2	2	
	GS 603	Geotectonic	2	2	
Second	GS 604	Petrofabrics	3	3	
	GS 605	Remote Sensing	2	2	
	GS 606	Geodynamics	2	2	
	The Total Cr.h. Required		14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GS 607	Analytical Techniques and Applications in Structural Geology	2	2
	GS 608	Sedimentary Basins	2	2
Second	GS 609	Subsurface Mapping	2	2
	GS 610	Introduction to Geographic Information Systems	2	2
	The Total Cr.h. Required		4	-

2- M. Sc. Degree in Stratigraphy and Paleontology (GSP)

Code	Course Number	Course Case	CR. Hours
(GSP)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GSP 611	Micropaleontology (1)	3	3	
	GSP 612	Litho- & Stable Isotope Stratigraphy	2	2	
	GSP 613	Macropaleontotogy (1)	2	2	
Second	GSP 614	Microfacies and Paleoecology	3	3	
	GSP 615	Applied Tools in Stratigraphy	2	2	
	GSP 616	Facies & Depositional Systems	2	2	Also offered by Sediment.
	The Total Cr.h. Required		14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GSP 617	Ichnofossils	2	2	
	GSP 618	Paleobiogeography	2	2	
	GSP 619	Palynology	2	2	
	GP 636	Petroleum Basins Analysis	2	2	Also offered by Petro.
Second	GSP 620	Vertebrate Paleontology (1)	2	2	
	GSP 621	Special Topics selected from:	-	-	
	GSP (621-a)	Calcareous Nannoplanktons	2	2	
	GSP (621-b)	Marine Geology I	2	2	
	GSP (621-c)	Selected Topics	2	2	
	The Total Cr.h. Required		4	-	

3- M. Sc. Degree in Environmental Earth Sciences (GE)

Code	Course Number	Course Case	CR. Hours
(GE)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GE 622	Environmental Geology	3	3	
	GE 623	Introduction to Remote Sensing & GIS of the Environment	2	2	
	GG 677	Environmental Geochemistry	2	2	Also offered by Geoch.
Second	GE 624	Environmental Isotope Geochemistry	3	3	
	GE 625	Medical Geology	2	2	
	GE 626	Environmental Pollution	2	2	
	The Total Cr.h. Required		14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GE 627	Contaminant Transport Modeling	2	2
	GE 628	Sediment Processes and Environment	2	2
	GE 629	Evaluation of Land & landscape Resources	2	2
Second	GE 630	Evaluating a Potential Sanitary Landfill Site	2	2
	GE 631	Information Systems for Resource Surveys & Development Planning	2	2
	GE 632	Independent Study	2	2
	The Total Cr.h. Required		4	-

4- M. Sc. Degree in Petroleum Geology (GP)

Code	Course Number	Course Case	CR. Hours
(GP)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GP 633	Petroleum Geology	3	3	
	GP 634	Advanced Reservoir Studies	3	3	
	GP 635	Structural and Stratigraphic Control of Hydrocarbon	2	2	
Second	GP 636	Petroleum Basin Analysis	2	2	Also offered by Stratg.
	GP 637	Source Rocks Evaluation	2	2	
	GG 682	Petroleum Geochemistry	2	2	Also offered by Geoch.
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GP 638	Petroleum provinces of Egypt	2	2
	GP 639	Natural gases	2	2
	GP 640	Petroleum Reservoir Rock Types	2	2
Second	GP 641	Oil Field Water	2	2
	GP 642	Geophysical Exploration for Petroleum	2	2
	GP 643	Petroleum Well Logging	2	2
		The Total Cr.h. Required	4	-

5- M. Sc. Degree in Sedimentary Geology and Sedimentation (GSG)

Code	Course Number	Course Case	CR. Hours
(GSG)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GSG 644	Sedimentary Petrology of Clastic rocks	3	3	
	GSG 645	Sedimentary Petrology of Non-Clastic Rocks	2	2	
	GSG 646	Advanced Stratigraphy (1)	2	2	
Second	GSG 647	Applied Techniques in Sedimentology	3	3	
	GSG 648	Geochemistry of Sedimentary Rocks (1)	2	2	
	GSP 616	Facies and Depositional Systems	2	2	Also offered by Stratig.
	The Total Cr.h. Required		14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GSG 649	Sedimentary Ore Deposits	2	2	
	GSG 650	Tectonics and Sedimentation	2	2	
	GS 601	Structural Geology	2	2	Also offered by Struct & Min. Petrol
Second	GSG 651	Isotope Geology	2	2	Also offered by Geoch, Min. Petrol
	GSG 652	Geological Applications of Computer and Statistical Methods	2	2	
	GSG 653	Special Topic: i.e (Marine Geology, Quaternary Geology, Volcaniclastics, Paleoecology, Bioinfluences in Sedimentology, Remote Sensing and GIS Application…etc)	2	2	
	The Total Cr.h. Required		4	-	

6- M. Sc. Degree in Mineralogy, Petrology and Ore Deposits (GM)

Code	Course Number	Course Case	CR. Hours
(GM)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GM 654	Petrology of Igneous & Metamorphic Rocks	3	3	
	GM 655	Advanced Mineralogy	2	2	
	GG 674	Advanced Geochemistry	2	2	Also offered by Geoch
Second	GM 656	Genesis of Ore Deposits	3	3	
	GM 657	Ore Petrology	2	2	
	GM 658	Environmental Mineralogy	2	2	
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GM 659	Advanced Sedimentary Petrology	2	2	Also offered by Geoch
	GM 660	Clay Mineralogy	2	2	
	GM 661	Remote Sensing & GIS	2	2	Also offered by Engn.
	GSG651	Isotope Geology	2	2	Also offered by Geoch.& Sediment
	GS601	Structural Geology	2	2	Also offered by Struct.& Sediment
Second	GM 662	Industrial Minerals	2	2	
	GM 663	Mineral Economics	2	2	
	GM 664	Selected Topics from :	-	-	
	GM (664-a)	Gemology	2	2	
	GM (664-b)	Volcanology	2	2	
	GM (664-c)	Analytical Techniques	2	2	Also offered by Geoch
	GM (664-d)	Mining Geology	2	2	
		The Total Cr.h. Required	4	-	

7- M. Sc. Degree in Engineering Geology (GEG)

Code	Course Number	Course Case	CR. Hours
(GEG)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GEG 665	Soil Mechanics in Engineering Practices	2	2
	GEG 666	Rock Mechanics in Engineering Practices	2	2
	GEG 667	Soil and Rock Mechanics, Laboratory	3	3
Second	GEG 668	Engineering Geology Practice	3	3
	GEG 669	Physical and Chemical Properties of Soils	2	2
	GEG 670	Special Studies	2	2
	The Total Cr.h. Required		14	-

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GM 661	Remote Sensing and GIS	2	2	Also offered by Min&petr.
	GEG 671	Topics in Soil Mechanics	2	2	
Second	GEG 672	Engineering Geology of Soft Sediments	2	2	
	GEG 673	Special Studies	2	2	
	The Total Cr.h. Required		4	-	

8- M. Sc. Degree in Geochemistry (GG)

Code	Course Number	Course Case	CR. Hours
(GG)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GG 674	Advanced Geochemistry	2	2	Also offered by Min&pet.
	GG 675	Exploration Geochemistry	3	3	
	GG 676	Hydrogeochemisty	2	2	Also offered by Hydrog.
Second	GG 677	Environmental Geochemistry	2	2	Also offered by Envirn.
	GG 678	Organic Geochemistry	3	3	
	GSG 651	Isotope Geology	2	2	Also offered by Sedmt Min-Pert .
		The Total Cr.h. Required	14	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GG 679	Geochemistry of Ores (1)	2	2	
	GG 680	Crystal Chemistry	2	2	
	GG 681	Geostatistics	2	2	
Second	GG 682	Petroleum Geochemistry	2	2	Also offered by Petroleum
	GG 683	Advanced Igneous Petrology(1)	2	2	
	GM 659	Advanced Sedimentary Petrology	2	2	Also ♀ offered by Min- Pet.
	GH(664-c)	Analytical Techniques	2	2	Also offered by Minrol-Pet.
		The Total Cr.h. Required	4	-	

9- Master Degree in Hydrogeology (GH)

Code	Course Number	Course Case	CR. Hours
(GH)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GH 684	Principles of Hydrogeology	3	3
	GH 685	Groundwater Geology	2	2
	GH 686	Groundwater Modeling	2	2
Second	GH 687	Contaminant Hydrogeology	3	3
	GH 688	Techniques in Water Analysis	2	2
	GH 689	Environmental Aqueous Geochemistry	2	2
		The Total Cr.h. Required	14	-

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GH 690	Field Techniques in Hydrogeology	2	2	
	GH 691	Isotopic and Trace Element Geochemistry	2	2	
	GH 692	Role of Fluids in Geologic Processes	2	2	
	GH 693	Watershed Analysis	2	2	
Second	GH 694	Drainage Basin Analysis	2	2	
	GH 695	Sedimentary Geochemistry	2	2	
	GH 696	Groundwater Management	2	2	
	GG 676	Hydrogeochemistry	2	2	Also offered by Geochm.
		The Total Cr.h. Required	4	-	

1-Ph.D. Degree in Structural Geology and Tectonics (GS)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GS)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GS 701	Advanced Structural Geology	2	2
	GS 702	Advanced Geotectonics	2	2
	GS 703	Remote Sensing	2	2
	GS 704	Advanced Geographic Information Systems	2	2
	GS 705	Basin Analysis for Oil and Gas	2	2
Second	GS 706	Advanced Seismic, structural and Stratigraphic Interpretation and 3D Modeling	2	2
	GS 707	Geohazards	2	2
	GS 708	Petrophysics	2	2
	GS 709	Geostatistics	2	2
	GS 710	Basin Mapping	2	2
	The Total Cr.h. Required		16	

2- Ph.D. Degree in Stratigraphy and Paleontology (GSP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GSP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GSP 711	Micropaleontology II	2	2
	GSP 712	Advanced Paleoecology	2	2
	GSP 713	Macropaleontology II	2	2
	GSP 714	Advanced Stratigraphy (1)	2	2
	GSP 715	Applications in Biostratigraphy	2	2
	GSP 716	Sedimentary Petrology	2	2
Second	GSP 717	Palynofacies & Paleoenvironmental Interpretation	2	2
	GSP 718	Mass Extinction & Evolution	2	2
	GSP 719	Marine Geology II	2	2
	GSP720	Vertebrates Paleontology II	2	2
	GSP 721	Special Topics	2	2
		The Total Cr.h. Required	16	

3- Ph.D. Degree in Environmental Earth Sciences (GE)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GE)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GE 722	Aqueous Environmental Geochemistry	2	2
	GE 723	Modern Analytical Methods in Geosciences	2	2
	GE 724	Environmental Aspects of Mine Wastes	2	2
	GE 725	Field Sampling Methods for Remedial Investigation	2	2
	GE 726	Environmental Impacts Analysis of Water Resources Systems	2	2
	GE 727	Natural Hazards and Environmental Geophysics	2	2
Second	GE 728	Groundwater Geochemistry and the Environment	2	2
	GE 729	Problems of Waste Disposal and Recycling	2	2
	GE 730	Environmental Geochemistry of Potentially Toxic Metals	2	2
	GE 731	Quantitative Methods in Environmental Studies	2	2
	GE 732	Medical Geology	2	2
	GE 733	Environmental Geology Seminar	2	2
		The Total Cr.h. Required	16	

4- Ph.D. Degree in Petroleum Geology (GP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GP)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GP 734	Progress in Petroleum Geology (I)	2	2
	GP 736	Petroleum Geology of Egypt (I)	2	2
	GP 738	Petroleum Geology of the Arabian Basin (I)	2	2
	GP 740	Global Distribution of Petroleum Deposits (their formation and occurrence) (I)	2	2
	GP 742	Quantitative and Qualitative Analysis of Well Logging	2	2
Second	GP 735	Progress in Petroleum Geology (2)	2	2
	GP 737	Petroleum Geology of Egypt (2)	2	2
	GP 739	Petroleum Geology of the Arabian Basin (2)	2	2
	GP 741	Global Distribution of Petroleum Deposits (their formation and occurrence) (2)	2	2
	GP 743	Seismic and Potential Field Interpretation of Oil Field areas	2	2
		The Total Cr.h. Required	16	

5- Ph.D. Degree in Sedimentary Geology (GPSG)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GSG)	The candidate studies (8) courses from table (2)	Elective	16
	Ph.D. thesis	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GSG 744	Sandstones and Conglomerates	2	2
	GSG 745	Mudstones and Shale	2	2
	GSG 746	Carbonates and Evaporites	2	2
	GSG 747	Siliceous Rocks and Phosphorites	2	2
	GSG 748	Diagenesis	2	2
	GSG 749	Advanced Paleoecology	2	2
Second	GSG 750	Karst Processes and Products	2	2
	GSG 751	Basin Analysis	2	2
	GSG 752	Geochemistry of Sedimentary Rocks (2)	2	2
	GSG 753	Advanced Stratigraphy (2)	2	2
	GSG 754	Regional Tectonics and Sedimentation	2	2
	GSG 755	Special Topics: i.e. (Applied Geomorphology, Pedology, Geology and Urbanization, …etc)	2	2
		The Total Cr.h. Required	16	

6- Ph.D. Degree in Mineralogy, Petrology and Ore Deposits (GM)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GM)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GM 756	Advanced Igneous & Metamorphic Petrology	2	2	
	GM757	Advanced Mineralogy	2	2	
	GM 758	Advanced Sedimentary Petrology	2	2	Also offered by Geoch.
	GM 759	Advanced Clay Mineralogy	2	2	
	GM 760	Radiogenic and Stable Isotope Geology	2	2	
	GM 761	Advanced Remote Sensing & GIS	2	2	
	GG 780	Advanced Geochemistry	2	2	Also offered by Geoch.
Second	GM 762	Mineral Economics	2	2	
	GM 763	Advanced Ore Geology	2	2	
	GM 764	Exploration Techniques	2	2	
	GM 765	Selected Topics	2	2	
	GM 766	Analytical Techniques in Geosciences	2	2	
	GM 767	Mining Geology	2	2	
	GM 768	Industrial Minerals and Rocks	2	2	
	GM 769	Ore Microscopy	2	2	
	The Total Cr.h. Required		16		

7- Ph.D. Degree In Engineering Geology (GEG)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GEG)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	GEG 770	Earth Structures	2	2
	GEG 771	Soil Dynamics	2	2
	GEG 772	Highway Materials	2	2
	GEG 773	Rock Fragmentation	2	2
	GEG 774	Special Studies (I)	2	2
Second	GEG 775	Topics in Rock Mechanics	2	2
	GEG 776	Environmental Geology for Engineering	2	2
	GEG 777	Geotechnical Instrumentation	2	2
	GEG 778	Engineering Geology Case Histories	2	2
	GEG 779	Special Studies (2)	2	2
		The Total Cr.h. Required	16	

8- Ph.D. Degree in Geochemistry (GG)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GG)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GG 780	Advanced Geochemistry	2	2	Also offered by Min. Petr.
	GG 781	Advanced Exploration Geochemistry	2	2	
	GG 782	Advanced Hydrogeochemisty	2	2	Also offered by Hydro.
	GG 783	Geochemistry of Sedimentary Rocks	2	2	
	GG 784	Advanced Crystal Chemistry	2	2	
Second	GG 785	Isotope Geochemistry	2	2	
	GG 786	Advanced Environmental Geochemistry	2	2	
	GG 787	Geochemical Techniques	2	2	
	GG 788	Geochemistry of Hydrothermal Ore Deposits	2	2	
	GM 758	Advanced Sedimentary Petrology	2	2	Also offered by Min. Petr.
		The Total Cr.h. Required	16		

9- Ph.D. Degree in Hydrogeology (GH)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GH)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GH 789	Applied Hydrogeology	2	2	
	GH 790	Soil Physics and Groundwater	2	2	
	GH 791	Surface and Near-surface Hydrologic Response	2	2	
	GH 792	Field Techniques in Hydrogeology	2	2	
	GH 793	Hydraulic and Tracer Tests for Groundwater Resource Evaluation	2	2	
	GH 794	Advanced Watershed Analysis	2	2	
Second	GH 795	Applied Chemical Hydrogeology	2	2	
	GH 796	Groundwater Management, modeling, and Remediation	2	2	
	GH 797	Environmental Geochemistry	2	2	
	GH 798	Role of Fluids in Geologic Processes	2	2	
	GG 782	Advanced Hydrogeochemistry	2	2	Also offered by Geochm.
		The Total Cr.h. Required	16		

B- Course contents for Diploma

Code No.	Course name and contents
	1- Diploma in Ore Deposits and Mineral Exploration (G O)
G O – 501 **(3 cr. h)** **2h Th + 1 Pr**	**Geology of Ore Deposits** **جيولوجية رواسب الخامات** Definition of ore, geologic setting of : magmatic ore deposits, hydrothermal ore deposits, ores in sediments, stratabound and stratiform ore deposits, volcano-sedimentary ore deposits, metamorphic ore deposits. Geologic setting of famous World examples. **Practical Course** Field study / Research project. Two field trips, Eastern Desert / Sinai – Western Desert.
G O – 502 **(3 cr. h)** **2h Th + 1 Pr**	**Industrial Minerals and Rocks** **المعادن والصخور المستخدمة في الصناعة** The most important minerals (non-metallics) and rocks that satisfy the requirements for different industrial applications. Gemstones, minerals for agriculture and chemical industry, clays for construction, pigments, abrasives, refractories, ornamental stones, evaporites, limestones, aggregates for constructions, cement and plaster. **Practical Course** Laboratory studies for mineral exploration, properties and uses.
G O – 503 **(2 cr. h)** **1h Th + 1 Pr**	**Structural Controls of Ore Deposits** **التحكم التركيبي في تكوين الخامات** Patterns of distribution of ore deposits, continental growth rates, crustal evolution and metallogenesis, metallogeny through time, plate tectonics and ore deposits, ores in folded structures, ores in faulted structures, migration of ore-bearing fluids. **Practical Course** Field study - Research project.
G O – 504 **(2 cr. h)** **1h Th + 1 Pr**	**Mining and Quarrying Geology** **جيولوجيا المناجم والمحاجر** Earth and rock excavation; subsidence and ground control; exploration, development and exploration of mineral deposits by surface and underground mining including quarrying ore and industrial mineral deposits; tunneling; shaft sinking; mine ventilation, and illumination; mine drainage; mine haulage and hoisting; mine examination, valuation and cost of mining operation; mine administration, organization and finance; mining laws; mine safety and welfare. **Practical Course** Research project - Field study for surface and subsurface metallurgical regions – applied maps and mining operation.
G O – 505 **(3 cr. h)** **2h Th + 1 Pr**	**Ore Mineralogy** **معادن الخامات** Identification and characterization of the opaque minerals and their textures. Ore microscope, physical and optical properties of ore minerals, Textures and intergrowths, mineral assemblages in igneous, sedimentary and metamorphic environments, mineral processing. **Practical Course** Applied study on samples for local and international ores – Laboratorial /microscopic.
G O – 506 **(2 cr. h)** **1h Th + 1 Pr**	**Mineral Exploration** **طرق استكشاف التمعدنات** Factors governing the choice of exploration areas, Ore grades, size of mineral Deposits, Regional mapping, Geochemical and geophysical surveys, drilling and exploratory mining.

	Practical Course Research project - Field study for chemical geophysical exploration - Use of standard sections and physical maps.
G O – 507 **(2 cr. h)** **1h Th + 1 Pr**	**Ore Deposits of Egypt** **رواسب الخامات في مصر** Classification of mineral deposits in Egypt, ore deposits in mafic-ultramafic assemblages, mineral deposits in felsic association, stratiform volcanogenic massive sulphide deposits and related talc, precious and base metal vein–type deposits, stratabound deposits in sedimentary rocks, ores of sedimentary nature, mineral deposits in metamorphic association, metallogenic map of Egypt. **Practical Course** Research project - Field study (Eastern Desert – Sinai – Western Desert).
G O – 508 **(3 cr. h)** **2h Th + 1 Pr**	**Geochemical Exploration طريقة الأستكشاف الجيوكيميائي** The course will simulates the principle tasks of exploration geochemistry and prepares the participant for the planning and interpretation of orientation and major geochemical surveys. The course draws upon fundamental geologic knowledge, teaches basic geochemistry and shows how to apply both to the practice of exploration. In this way it bridges the gap between theory and practice. During the simulation the trainee covers the four main stages in exploration geochemistry. They will: Investigate how target and pathfinder elements move about in the exploration area, Select the best sampling and analytical techniques during an orientation survey, Plan and carry out the main survey cost-effectively, and Interpret the survey results and make clear recommendations for further exploration. **Practical Course** Research project - Field application for collecting samples from metallurgical regions - Analysis of samples by different analysis methods - Drawing of Exploration maps and Deducing results.
G O – 509 **(2 cr. h)** **1h Th + 1 Pr**	**Ore Dressing** **استخلاص الخامات** Modern quantitative techniques for mineral processing operations, flotation, gravity separation, magnetic separation, crushing, grinding, size classification and mineral liberation, laboratory experiments to establish models and parameters for grinding and flotation cells. **Practical Course** Research project - Field study for the raising efficiency of different ores labs (Institute of Metal Researches – Tibbeen).
G O – 510 **(2 cr. h)** **1h Th + 1 Pr**	**Geophysical Exploration** **الاستكشاف الجيوفيزيائي** The Principles and Limitations of Geophysical Exploration Methods. Geophysical Data Processing. Elements of Seismic Surveying. Seismic Reflection Surveying. Seismic Refraction Surveying. Gravity Surveying. Magnetic Surveying. Electrical Surveying. Electromagnetic Surveying. Radiometric Surveying. Geophysical Borehole Logging. **Practical Course** Research project - Applied field study and geophysical measurements – analysis of data and deducing results.
G O – 511 **(2 cr. h)** **1h Th + 1 Pr**	**Principles of Mineral Deposits** **أساسيات الخامات المعدنية** Mineral resources, ore-forming processes: igneous ores, magmatic -hydrothermal ores, hydrothermal ores, sedimentary ores, surficial and supergene ores. **Practical Course** Field study for regions of different ores - Analysis of ores by using different

	laboratory methods (chemical – microscopic and other different methods).
G O – 512 **(2 cr. h)** **1h Th + 1 Pr**	**Analytical Techniques in Geology** **طرق التحاليل في الجيولوجيا** Sampling what?, representative samples, Sampling plan, Preparation of samples for particular analysis. Pre-analysis studies, Analytical techniques including: wet chemical analysis, AA, XRF, ICP. Qualitative and quantitative analyses, Microscale analysis including; EDX, EPMA, IPMA. Limitation of Mineral identification by XRD. **Practical Course** Methods of preparing and selecting resembling samples and performing pre-analysis studies - Using different analytical methods which include chemical analysis, AA, XRF, ICP - Performing quantitative and qualitative analyses - Applying different analyses such as EDX, EPMA, IPMA - Determination of mineral by using XRD.
G O – 513 **(2 cr. h)** **1h Th + 1 Pr**	**Remote Sensing and Geographic Information Systems (GIS) Applications in Ore Deposits** **تطبيق الاستشعار عن بعد ونظم المعلومات الجغرافية في رواسب الخامات** Application of airborne and satellite remote sensing for understanding the surface of the earth. Focus on interpretation of images obtained by passive and active imaging systems using electromagnetic radiation, especially visible, infra-red, and radar. Introduces students to the fundamentals of spatial data management and GIS technology as applied to the mapping, display, and analysis of mining data. Topics covered include fundamental concepts, definitions, organization of databases and GIS; data integration and conversion; spatial and non-spatial query, analysis, display and reporting. **Practical Course** Applying remote sensing by using airborne and satellite methods - Employing electromagnetic radiation, especially visible, infra-red, and radar for interpretation of images obtained by passive and active imaging systems - Mapping, display, and analysis of mining data which introduces to the fundamentals of spatial data management and GIS technology - Different methods for organization of databases and GIS - Utilizing methods of data analysis, display and reporting.
G O – 514 **(2 cr. h)** **1h Th + 1 Pr**	**Environmental Impacts of Mining Operations** **التأثير البيئي للعمليات المنجمية** Types of mining operation, Assessment of quantities of mining waste generated, Mining waste types and characteristics, Environmental Impacts associated with: mine site construction, mine site operation, mine site closure and abandoned mines. Substances from mining with land contamination potential, Mining-waste management practices, Pollution Prevention and Control, Monitoring and Reporting, Mine Closure and Restoration Plan, Case studies. **Practical Course** Field study of different mining operations, quantities of waste generated and properties - Field study of environmental impacts due to mine operation, closure, waste-produced and methods of control, monitoring and reporting.
G O – 515 **(2 cr. h)** **1h Th + 1 Pr**	**Geostatiatics** **الإحصاء الجيولوجي** Statistical techniques with important applications in Earth science. Topics include robust statistics, exploratory data analysis, surface modeling and contouring, Kriging, analysis of point patterns and directional data. Factor, cluster and time series analysis may also be considered. Emphasis will be on application and theoretical understanding. This course explores concepts and

	methods in visualization, exploration and modeling of point pattern, spatially continuous data and area data. **Practical Course** Study of statistical techniques which include robust statistics, exploratory data analysis - Performing surface modeling and contouring - Analysis of point patterns and directional data with important applications in Earth science - Using analysis of factor, cluster and time series - Employing methods in visualization, exploration and modeling of point pattern, spatially continuous data and area data.
G O – 516 **(2 cr. h)** **1h Th + 1 Pr**	**Introduction to Mineral Economics** **مقدمة في اقتصاديات المعادن** Minerals and their importance, historical development of a society and the impact of minerals on technology, culture and society, mineral availability (supply vs demand): a. demand patterns, b. Resources measurement and c. Recycling. Economic Importance of Minerals; a. In Developed Nations, b. Developing Nations, c. Global political systems. Role of minerals in: a. National security, b. Energy, c. Public policy decisions (self-sufficiency & stockpiling). **Practical Course** Field study of regions of mineral and ores availability and their importance and uses and applying methods of self-sufficiency & stockpiling - Using different methods of analysis for ores either chemically or microscopically or any other methods of analysis.
G O – 517 **(2 cr. h)**	**Special Topics** **موضوعات مختارة**

	2- Diploma in Environmental Geology (G E)
G E – 518 **(2 cr. h)** **1h Th + 1 Pr**	**Environmental Characteristics of the Earth** **الخصائص البيئية للأرض** History of the Earth, Plate Tectonics, Earthquakes & Vulcanicity, Geological Surface Processes, Mass wasting factors and controlling. **Practical Course** Field trips to different area which display geological surface processes, mass wasting - Field study of the different geological structures and the regions affected by intensive earthquakes & vulcanicity.
G E – 519 **(2 cr. h)** **1h Th + 1 Pr**	**Natural Resources** **الموارد الطبيعية** Water, Soil, Mineral & Rocks – their uses, supply and management, Energy resources. **Practical Course** Field study for the different kinds of soils and also water, energy resources - Utilizing all analytical methods and laboratory facilities in studying rocks and minerals.
G E – 520 **(3 cr. h)** **2h Th + 1 Pr**	**GIS applications in Environment Studies** **تطبيقات نظم المعلومات الجغرافيه فى الدراسات البيئيه** Remote Sensing techniques, Introduction to GIS with special emphasis on environmental problems. **Practical Course** Specify training hours on the different kinds of remote sensing techniques - Applying GIS techniques on environmental problems.
G E – 521 **(3 cr. h)** **2h Th + 1 Pr**	**Environmental Geochemistry** **جيوكيمياء البيئه** Application of quantitative methods of thermodynamic and physicochemical

	analysis to the study of the distribution and movement of chemical elements in surface and near-surface geological environments. Emphasis on practical approaches to environmental geochemistry. **Practical Course** Laboratory studies of the distribution and movement of chemical elements - Applying practical methodology to environmental geochemistry - Utilizing thermodynamic and physicochemical quantitative analysis.
G E – 522 **(2 cr. h)** **1h Th + 1 Pr**	**Human Impact & Biodiversity** **الآثار البيئيه لأنشطه الانسان والتنوع الحيوى** Impacts of the human population and urbanization, Impacts of water uses - industrial versus agricultural use as well as industrial, mining and oil activities on the land and marine e.g. coral reef pollution - ecosystems and biodiversity. **Practical Course** Field study of the impacts of the human population and urbanization and the impacts of the use of water in industry against agriculture - Field study of the impacts of oil industry and mining activities on the land and marine e.g. coral reef pollution.
G E – 523 **(3 cr. h)** **2h Th + 1 Pr**	**Waste Disposal & Management** **طرق التخلص من النفايات وإدارتها** Solid wastes, Municipal waste, Landfill site characteristics, Liquid waste, Sewage treatment, Radioactive waste, Industrial and agricultural wastes. Management and policy and its application in waste disposal processes, Case Study in computer modeling and resource management. **Practical Course** Field study to sites which display industrial, agricultural, solid, liquid wastes - Application of computer systems on modeling and resource management - Field study to Landfill sites and municipal, sewage, radioactive wastes and different ways of treatment and disposal processes.
G E – 524 **(3 cr. h)** **2h Th + 1 Pr**	**Natural Environmental Hazards** **المخاطر البيئيه الطبيعيه** Introduction to the environmental hazards, Earthquake-related hazards- their reduction and awareness, Hazards related to volcanoes with some case histories, Effects of development on flood hazards and their reduction by controlling dams and watershed analysis and land use mapping. **Practical Course** Field trips to the areas which display the effect of earthquakes and volcanoes - Field study to dams sites which prevent flood hazards on economy and development.
G E – 525 **(2 cr. h)** **1h Th + 1 Pr**	**Environmental Legislation and National Conventions** **لقوانين البيئيه والاتفاقات الدوليه الخاصة بالبيئه** Resource Law, Law of sea, Limits of Pollution and its control, Laws relating to geological hazards, National Environmental Policy Act (Examples), Egyptian Law for the Environmental Protection, Basel convention and some other international environmental conventions as examples. **Laboratory training hours.**
G E – 526 **(2 cr. h)** **1h Th + 1 Pr**	**Environmental Analytical Techniques** **طرق التحاليل البيئيه** General Laboratory procedures and techniques- including safety procedures, chemical analyses, interpretation and presentation of data, Scientific report writing with case studies on water, soil, rock and air samples. **Practical Course** Using chemical analysis and displaying results - Application of laboratory safety procedures - Training on ways of writing scientific reports.

G E – 527 **(2 cr. h)** **1h Th + 1 Pr**	**Medical Geology** **الجيولوجيا الطبية** The scope of this Course is to share the most recent information on the relationship between toxic metal ions, trace elements, and their impact on the environmental and public health issues. **Practical Course** Application of laboratory studies on toxic metal ions, trace elements, and their impact on public health and on plants, animals and environment in general.
G E – 528 **(2 cr. h)** **1h Th + 1 Pr**	**Land Use Planning** **تخطيط استخدام الأراضى** Requirements for land use planning, Land-Use options, Maps as a planning tool, Site evaluation, Case histories, Some Egyptian application. **Practical Course** Laboratory training hours on using maps and land use planning requirements - Application of site evaluation elements in Egyptian case studies.
G E – 529 **(2 cr. h)** **1h Th + 1 Pr**	**Environmental Impact Assessment** **تقييم الأثر البيئى** Classification of Human activities and projects, Importance of EIA studies, Case studies for environmental profile, project description, environmental legislation, predicted environmental impacts, Mitigation measures and monitoring plan for oil activities, cement industry and land fills as examples. **Practical Course** Field study on applications of projects activities, cement and oil industry, and mitigation measures and building healthy landfills - Applied studies to evaluation of environmental effects - environmental legislation - predicted environmental impacts - Field study to sites affected by human activities.
G E – 530 **(2 cr. h)**	**Special Topics** **موضوعات مختاره**

	3- Diploma in Geological Applications in Archaeological Site Restoration (G GA)
G GA – 531 **(2 cr. h)** **1h Th + 1 Pr**	**Geological Processes** **العمليات الجيولوجية** Internal Processes and surface processes of the Earth e.g. plate tectonics. Earthquakes, flooding, wind and climatic processes. **Practical Course** Field trips to areas of flooding, earthquakes and volcanoes which display tectonic movements and exhibit the surfaces and monuments affected.
G GA – 532 **(2 cr. h)** **1h Th + 1 Pr**	**Physical & Geotechnical Properties of Rocks and Monuments** **الخصائص الفيزيائية والجيوتقنية للصخور والآثار** Principle of engineering geology, petrophysical and mechanical properties of the rocks and monuments, rock durability, case studies, methods for detecting the geotechnical properties of rocks and monuments. **Practical Course** Laboratory training and applying techniques on rocks for detecting their geotechnical, mechanical, petrophysical properties and durability in monuments case studies.
G GA – 533 **(3 cr. h)** **2h Th + 1 Pr**	**Building Materials & Monuments** **مواد البناء والآثار** Types of rocks and minerals, Petrographic identification and chemical properties of igneous, sedimentary and metamorphic rocks and their textures. **Practical Course** Laboratory hours for studying minerals & different rock types: igneous,

	sedimentary and metamorphic and their textures, also petrographic and chemical properties.
G GA – 534 **(3 cr. h)** **2h Th + 1 Pr**	**Field Geological Characteristics of Archaeological Sites** **الخصائص الجيولوجية الحقلية للمواقع الأثرية** Principles of field geology, Application of remote sensing and GIS techniques, Geomorphological and geological mapping, Fracturing analysis, Classification of rock types in archaeological sites, Field measurements and sampling, Geological evolution of archaeological sites. **Practical Course** Application of field measurements, different ways of sampling and principles of field geology - Training hours on geomorphological and geological mapping - Field trips for studying ways of classification of rock types, geological evolution of archaeological sites and fracturing analysis - Application of remote sensing and GIS techniques.
G GA – 535 **(3 cr. h)** **2h Th + 1 Pr**	**Analytical Techniques in Archaeology** **طرق التحاليل فى الآثار** General laboratory procedures and techniques, Selection of samples for different analytical techniques, Analyzing - interpreting and presenting data and scientific report writing for different analytical techniques in Archaeology e.g. structure ultrasonic technique, hydrochemical analysis, magnetic susceptibility, XRD, XRF, SEM-EDX, DTA, IR for mineral, rock and mortar as well as other non-destructive techniques. **Practical Course** Training on selection of samples for different analytical techniques and application of general laboratory procedures and techniques - Laboratory hours for application of using magnetic susceptibility, XRD, XRF, SEM-EDX, DTA, hydrochemical analysis - Utilizing the analysis using electronic microscope, IR, structure ultrasonic technique and other non-destructive techniques - Training on how to write a scientific report, analyze, interpret and present data for different analytical techniques.
G GA – 536 **(3 cr. h)** **2h Th + 1 Pr**	**Geoenvironmental Hazards** **المخاطر الجيوبيئية** Introduction to the environmental hazards groundwater, Earthquake and flood hazards and their impacts on archaeological sites, Mitigation measure and monitoring plans. **Practical Course** Field trips to sites that display environmental hazards and impacts of earthquakes, flood, groundwater on archaeological sites and to study the monitoring plans and mitigation measure.
G GA – 537 **(2 cr. h)** **1h Th + 1 Pr**	**Damage & Deterioration Phenomena** **مظاهر تدهور وتلف الآثار** Geological and mechanical factors influencing archaeological sites, Types of mass movements, Chemical factors of deterioration and damage, other factors. Case studies: e.g. Salinization, Karstification process and Land slides. **Practical Course** Field trips to study geological and mechanical factors and chemical factors of deterioration and damage influencing certain archaeological sites. Field study to Case studies on Salinization, Karstification process and Land slides and studying types and ways of mass movements.
G GA – 538 **(2 cr. h)** **1h Th + 1 Pr**	**Conservation & Restoration Methods and Materials** **الطرق والمواد المستخدمة فى حفظ الآثار وترميمها** Types of restoration and materials to increase rock durability against the environmental hazards, General classification of the Egyptian archaeological

	sites and monuments as applied case studies of restoration methods. **Practical Course** Field study to archaeological sites and types of restoration & materials and general classification of the Egyptian archaeological sites & monuments.
G GA – 539 **(2 cr. h)** **1h Th + 1 Pr**	**Geophysical Exploration in Archaeology** **طرق الاستكشاف الجيوفيزيائية للبحث عن الآثار** GPR, Seismic, Magnetic and other methods. **Practical Course** Training hours on using seismic, magnetic, GPR and other methods.
G GA – 540 **(2 cr. h)** **1h Th + 1 Pr**	**Remote Sensing & GIS Application in Archaeology** **تطبيقات طرق الاستشعار عن بعد ونظم المعلومات الجغرافية للآثار** Application of airborne and satellite remote sensing for understanding the surface of the earth. Focus on interpretation of images obtained by passive and active imaging systems using electromagnetic radiation, especially visible, infra-red, and radar. Introduces students to the fundamentals of spatial data management and GIS technology as applied to the mapping, display, and analysis of mining data. Topics covered include fundamental concepts, definitions, organization of databases and GIS; data integration and conversion; spacial and non-spatial query, analysis, display and reporting. **Practical Course** Training hours on the different applications of airborne and satellite remote sensing with interpretation of images obtained by passive and active imaging systems using electromagnetic radiation, especially visible, infra-red, and radar - Training on the fundamentals of GIS technology and data display, organization, integration, reporting and using computer programs.
G GA – 541 **(2 cr. h)** **1h Th + 1 Pr**	**Geoarchaeological Applications** **تطبيقات أثرية جيولوجية** Case Studies and Case histories. **Practical Course** Field trips.
G GA – 542 **(2 cr. h)**	**Special Topics** **موضوعات مختارة**

	4- Diploma in Geoinformatics in Earth and Environmental Sciences (G GI)
G GI – 543 **(2 cr. h)** **1h Th + 1 Pr**	**Principles of Remote Sensing (RS)** أساسيات الاستشعار عن بعد Explain the principles and use of the vocabulary of RS. Explain the main digital image processing procedures. Describe the common methods of image analysis. Apply appropriate RS methods for problem solving. Understand the capabilities, uses and limitations of RS in their field of application. **Practical Course** Training on use of vocabulary of remote sensing and understand the uses and limitations of remote sensing in their field of application and pertaining methods for problem solving - Laboratory hours on the use of the main digital image processing procedures and describing the common methods of image analysis.
G GI – 544 **(2 cr. h)** **1h Th + 1 Pr**	**Principles of GIS** **أساسيات نظم المعلومات الجغرافية** Explain the principal data models for spatial and non-spatial data used in GIS databases; the main components of a GIS and their functions; the relationship between spatial data and coordinate systems; the main spatial data analysis functions; Apply appropriate GIS methods for problem solving.

	Practical Course Laboratory hour on application of the principal data models for spatial and non-spatial data used in GIS databases. Training hour on the main components and functions of GIS and applying appropriate GIS methods for problem solving and studying the relationship between spatial data and coordinate systems.
G GI – 545 **(3 cr. h)** **2h Th + 1 Pr**	**GIS Laboratory** **الدراسات المعملية لنظم المعلومات الجغرافية** This GIS Lab course is directed to providing an in-depth experience with the use of a particular GIS software package, including ArcInfo, ArcView, ArcGIS, IDRISI and GRASS. The course involves developing familiarity with a specific GIS software instance; its interface, data management, analysis functions, and output generation. Prerequisites include Computing and Introduction to GIS or their equivalent. **Practical Course** Laboratory hour on using GIS software package including ArcInfo, ArcView, ArcGIS, IDRISI and GRASS - Laboratory hour on data management, analysis functions, output generation, computing, introduction to GIS or their equivalent.
G GI – 546 **(3 cr. h)** **2h Th + 1 Pr**	**Geo-Information Extraction** **استخلاص المعلومات الجيولوجية** Explain concepts and techniques used in attempts to automate geo-information extraction from images and laser scanner data. Explain capabilities and limitations of current spatial information extraction approaches. Describe trends in research and development of spatial data acquisition technology. **Practical Course** Laboratory hour for explaining the methods of geo-information extraction from images and laser scanner data with explaining of capabilities and limitations of current spatial information extraction approaches and describing trends in research and development technology.
G GI – 547 **(3 cr. h)** **2h Th + 1 Pr**	**Remote Sensing and GIS applications in Earth and Environmental Sciences** **تطبيقات الاستشعار عن بعد ونظم المعلومات الجغرافية فى علوم الأرض والبيئة** The overall objective of this course is to be able to use remote sensing and GIS concepts in: Mineral Exploration. Petroleum and Ground water exploration. Environmental studies and Geological Engineering. Global Monitoring. **Practical Course** Laboratory hour for practical usage of remote sensing and GIS concepts in: mineral exploration, petroleum and ground water exploration, environmental studies and geological engineering, global monitoring by performing field projects.
G GI – 548 **(2 cr. h)** **1h Th + 1 Pr**	**Geo-spatial Data Modeling** **عمل نماذج البيانات الجيولوجيا فى البعدين** Derive and analyze basic user requirements. Apply the basic concepts of conceptual data modeling in spatial data infrastructure (SDI) context. Perform basic conceptual data modeling in the spatial domain: spatial modeling (fields versus objects, features, etc.). Explain the fundamental concepts of object-orientation and to apply them in a geo information modeling process. **Practical Course** Lab. hour for practicing on the applications of the basic concepts of conceptual data modeling in spatial data infrastructure (SDI) context
G GI – 549 **(3 cr. h)**	**Geo-information and Risk Management** **المعلومات الجيولوجية وادارة المخاطر** This course aims to explore the theoretical aspects of risk analysis. It will allow

2h Th + 1 Pr	student to develop understanding of the major elements of risk analysis: risk assessment, risk perception, risk evaluation, risk management, and risk communication. **Practical Course** Lab. hour for practical experience about major elements of risk analysis: risk assessment, risk perception, risk evaluation, risk management, and risk communication.
G GI – 550 **(2 cr. h)** **1h Th + 1 Pr**	**Field and Spatial Techniques** **الطرق الحقلية والتقنيات ذات البعدين** This field-based subject introduces the basic techniques used to collect and interpret field data. Concepts include determination of location (using maps, global positioning systems, basic surveying), methods of drilling and augering, section measuring, and drill-hole logging. Field interpretations will consider flow regime concepts; styles and mechanisms of sedimentary deposits; sedimentary structures; analysis of palaeocurrents; and sedimentary environments. **Laboratory Training.**
G GI – 551 **(2 cr. h)** **1h Th + 1 Pr**	**Spatial Information Theory** **نظرية المعلومات ذات البعدين** Have a good understanding how to deal with time series in the geospatial data handling process. Understand all characteristics of topology and its role in the geospatial data handling process. Being able to deal with uncertainty during the geospatial data handling process. **Practical Course** Lab. hour for understanding how to deal with time series in the geospatial data handling process.
G GI – 552 **(2 cr. h)** **1h Th + 1 Pr**	**Introduction to Geo-Spatial Data Analysis- Theory and Practice** **مقدمة فى تحليل البيانات الجيولوجية ذات البعدين – النظرية والتطبيق** The goal of this course is to provide an overview of an introduction to the range of statistical techniques used in the analysis of spatial (geographic) data. Concepts and descriptive statistics. **Laboratory Training.**
G GI – 553 **(2 cr. h)** **1h Th + 1 Pr**	**Geo-spatial Data Infrastructures Technical Design** **التصميمات التقنية للبيانات الجيولوجية ذات البعدين** Explain the principal phases of (GI) engineering processes and be able to plan software integration, customization and development projects. Describe basic software architectures (monolithic, client/server, service oriented) and be able to assess their usability in a SDI context. Describe international GI-related standardization efforts to be able to efficiently design and implement interoperable SDI nodes. Explain fundamental web technologies to be able to customize and deploy Internet GIS components. Customize standards-based web services to setup core SDI nodes. **Laboratory Training.**
G GI – 554 **(2 cr. h)** **1h Th + 1 Pr**	**Data Mining and Knowledge Discovery** **بيانات منجمية واكتشاف المعلومات** Introduction to Data Mining and Knowledge Discovery, Data Bases and Warehouses, Data Structures, Exploratory Data Analysis Techniques, Association Rules, Artificial Neural Networks, Tree Based Methods, Clustering and Classification Methods, Regression Methods, Over fitting and Inferential Issues, Use of Data Mining packages. **Laboratory Training.**

G GI – 555 **(2 cr. h)** **1h Th + 1 Pr**	**Process Modeling, Programming and Dissemination** **عملية النمذجة والبرمجة والنشر** Have a general understanding of analytical models (process models, prediction models, binary models, weighted models etc). Identify required analyses and specify these analyses in a geo-processing model design. Create models to automate the geo-processing tasks using a visual environment to design the geo-processing work flow. **Laboratory Training.**
G GI – 556 **(2 cr. h)** **1h Th + 1 Pr**	**Visualization and Dissemination of Geospatial Data** **المرئيات ونشر البيانات الجغرافية ذات البعدين** Understand the role of visualization in geospatial data handling. Understand and explain the principles of visualization design in relation to map use issues. Apply cartographic design principles to different kinds of visualizations of geospatial data. Understand and explain the concept of scale and the relation between scale distortions and characteristics of map projection systems. Distinguish dissemination methods and environments and explain their role in geospatial data provision for different kinds of use and users. **Laboratory Training.**
G GI – 557 **(2 cr. h)**	**Special Topics** **موضوعات متخصصة**

	5- Diploma in Petroleum Geology (G P)
G P – 558 **(3 cr. h)** **2h Th + 1 Pr**	**Basic Petroleum Geology** **أساسيات جيولوجيا البترول** Introduction to petroleum geology – History of petroleum exploration in Egypt and Arabia – Origin of petroleum: Inorganic theory (abiogenic) views and inorganic chemical reactions – Organic theory (Biogenic): Nature and type of the organic source material, Transformation of the organic matter into hydrocarbons – surface and subsurface occurrences of hydrocarbons and their types and classification including the autochtonous and the allochtonous types – The petroleum reservoir traps: the petroleum reservoir as a storage unit and its elements, a concise approach on the petroleum reservoir as an active geochemical unit (Metwalli's Theory and concept, 1970 and 2000) – Concepts of the petroleum migration and accumulation: primary migration and concepts – secondary migration and its role in petroleum maturation – The geochemical characteristics of petroleum (crude oil and hydrocarbon gases and their types). **Laboratory Training.**
G P – 559 **(3 cr. h)** **2h Th + 1 Pr**	**Basis of Secondary Recovery Methods for Petroleum Reservoir and Reserve Evaluation** **اساسيات الانتاج الثانوى للخزانات البترولية وتقييم الخزانات** Introduction on the types of petroleum Reservoirs rock types – Oil and gas reservoirs drives – occurrences of oil, gas and water in oil and gas reservoirs – Physical Properties of reservoir fluids under formation conditions – What is mint by secondary recovery: water infection method and its petroleum of infection, gas infection method and the characteristics of its application – Oil recovery under different drives – Fundamental principles of infection of a working agent into a reservoir: lithologic characteristics; and tectonic characteristics of the infection in an oil field area; curve oil characteristics – Market behavior and secondary recovery application; when we use secondary

	recovery techniques – Other secondary recovery methods and its economic visibility taking into consideration the petroleum market fortunes – Reserve evaluation of crude oil and gas fields: geologic criteria for reserve evaluation – reserve evaluation of an oil fields area; with an example – reserve evaluation of a gas field, with an example – categorization of petroleum fields according to their exploration and exploitation. **Laboratory Training.**
G P – 560 **(2 cr. h)** **1h Th + 1 Pr**	**Drilling Muds and Their Parameters** **طفلات الحفر ونوعيات استخدامها** What is meant by a drilling mud and its characteristics and composition – types of drilling mud and its successful application taking into consideration the lithologic characteristics of the petroleum, bearing section – Drilling mud parameters – Mud-gas critting (Methane, H_2S and CO_2), and Mud-gas logs and their detection of over pressures – Flow-line mud weight, gas kicks, flow line temperature, hole fill-up and mud flow rate – The significance and importance of drilling mud in drilling a petroleum well. **Practical Course** Practical course and field trips for the mud logging companies.
G P – 561 **(2 cr. h)** **1h Th + 1 Pr**	**Remote Sensing and its Application in Petroleum Exploration** **الاستشعار عن بعد وتطبيقه فى التنقيب عن البترول** Introduction on the uses of remote sensing techniques in geology – geologic information extraction and integration in exploration – application of remote sensing in petroleum exploration – geologic analysis of naturally fractured reservoirs – faulting, fault sealing and fault flow in hydrocarbons reservoirs – geologic risk and uncertainty in oil exploration – open discussion using published works on the aim of the subject and course given. **Practical Course** Lab. hour for studying the uses of remote sensing techniques in geology – geologic information extraction and integration in exploration – application of remote sensing in petroleum exploration.
G P – 562 **(3 cr. h)** **2h Th + 1 Pr**	**Egyptian Petroleum Province and their petroleum-bearing sections** **المديريات البترولية المصرية والقطاعات الحاملة للبترول** The gulf of Suez province: generalized lithostratigraphic petroleum-bearing section (source, reservoir, and sealing horizons), a lithostratigraphic petroleum-bearing section of the northern part of the gulf (pay-zones, source and seal), fields examples (on-share and off-shore), a lithostratigraphic petroleum-bearing section in the central part of the gulf (pay-zones, source and seal), fields examples (onshore and offshore) – a lithostratigraphic petroleum-bearing section in the southern part of the gulf (pay-zones, source and seal), fields examples (onshore and offshore – correlation of the gulf of Suez producing parts – evaluation of the reservoirs and seals in the gulf of Suez petroleum province – cycles of petroleum generation, migration and accumulation, in the gulf of Suez petroleum province – The Western Desert petroleum province: a generalized lithostratigraphic petroleum-bearing section (source, reservoir and seal), the main stratigraphic petroleum horizons in the Western Desert with field examples, cycles of petroleum generation, migration and accumulation; and the problem of the source-reservoir relations – The Nile Delta petroleum province: a generalized lithostratigraphic petroleum-bearing section in the onshore and offshore areas (source, reservoir and seal), with fields examples, the penetrated main stratigraphic petroleum horizons and their vertical and lateral facies change, the correlation of the hydrocarbon-bearing horizons in the

	Nile Delta area with that of the gulf of Suez and the Northern Western Desert, the petroleum of the source – reservoir relations in the Nile Delta petroleum province. **Laboratory Training.**
G P – 563 **(2 cr. h)** **1h Th + 1 Pr**	**Natural Gases in Marine Sediments** **الغازات الطبيعية فى الرواسب البحرية** Introduction to the industrial and natural gases and their uses – Natural gases (organic and inorganic) in nature and in the earth and their origin and significance to the petroleum geologist – The nature and distribution of gases in marine sediments (estuarine environments, soil, swamps and lakes) in deeper water sediments especially methane and several other volatile homologs, taking into consideration, the continental margin sediments – The gas producing bacteria in deep sea sediments and the nature of the gas in the abyssal sediments – Nature, origin and content of gases in marine sediments during early diagenesis from biogenic degradation of organic matter – gas diffusing upward from depth as a result probably of the thermocatalytic cracking of more complex organic compounds; and gas produced by submarine volcanic or geothermal processes (probably submarine volcanism) – Physical state of gases in sediments – Biogenic gas production in the Ocean – Thermogenic gas production in marine sediments and depth distribution in sediment – Inorganic and Organic hydrocarbon gas and its association in sediments (shallow and deep marine) – The economic importance and the uses of these gases in domestic and industrial purposes. **Laboratory Training.**
G P – 564 **(3 cr. h)** **2h Th + 1 Pr**	**The Geologic Control for Hydrocarbons** **التحكم الجيولوجى للهيدروكربونات** Tectonic (structural) control: lithologic responses to tectonic controls, the lithologic associations resulted from the tectonic framework, the tectonic intensity and the nature of the depositional environment – The basement tectonics and its result on the development of the tectonic models for hydrocarbons – The tectonic behavior of an area and its control on the distribution of sedimentary environments through a control of the strand line – Sedimentary associations on the stable and unstable shelves – Intracratonic basin sediments and its relation to the unstable shelves – Sedimentary facies and associations of the rifted and orogenic basins and their control on the petroleum deposit – Stratigraphic control and regional sedimentary – stratigraphic analysis: areal lithofacies maps and their use in the areal representation of sedimentary rock characteristics of a stratigraphic interval – Bases of regional stratigraphic analysis as an echo of contemporaneous tectonic activity which affects also the environments of deposition which make the stratigraphic field of a sedimentary basin geometries – Cyclicity in the stratigraphic record and its impact on the lithofacies and stratigraphic control of hydrocarbons. **Laboratory Training.**
G P – 565 **(2 cr. h)** **1h Th + 1 Pr**	**Kerogen (oil) Shales and Organic Petrography** **الطفلة الكيروجينية (البترولية) والبتروجرافيا العضوية** Introduction to oil shales: Definition, origin of oil shale, types of oil shale, potential resources, recovery methods, biochemical recovery method – Geological setting of oil-shale deposits and world prospects: introduction and lithology, environment of deposition, age and world distribution, geologic settings favorable for prospecting – The origin and formation of oil shale: introduction and likely source materials in kerogen formation, the formation of

	oil shale, torbanites: their nature and origin, tasmanite and its nature – Mineralogy of oil shale: general characteristics of oil shales, authigenic minerals, chemical separation and characterization of kerogen from oil shale, isolation of kerogen, oil-shale classification and constitution – Organic components of oil shales – Microscopic constituents of kerogen – Oil shales distribution and their occurrences in Egypt. **Laboratory Training.**
G P – 566 **(2 cr. h)** **1h Th + 1 Pr**	**Subsurface Mapping** **خرائط تحت سطحية** Introduction to subsurface mapping – The preparation of contour maps – Types of contour maps (topographic maps, structure maps, isopach maps, and some lithofacies maps) the data required in these maps – General contouring rules – The preparation of cross sections, subsurface panel diagrams and faulting contour maps – Paleogeologic and paleogeographic maps and their differences and aim – Geophysical and geochemical maps – Map evaluation. **Practical Course** Lab. hour for studying the preparation of contour maps – types of contour maps (topographic maps, structure maps, isopach maps, and some lithofacies maps) the data required in these maps – general contouring rules – the preparation of cross sections, subsurface panel diagrams and faulting contour maps.
G P – 567 **(2 cr. h)** **1h Th + 1 Pr**	**Well log Analysis** **تسجيلات آبار** Introduction of the ultimate aim of well logging – Types of well logs – Acquisition of data logs – The well log interpretation of data – Statement of the log – interpretation problem in terms of Bore-hole conditions. **Practical Course** Lab. hour for practical problems.
G P – 568 **(2 cr. h)** **1h Th + 1 Pr**	**Paleontological Applications in Exploration** **تطبيقات علم الحفريات فى التنقيب** Macrofossils and their interpretation in the reconstruction of the basin of deposition and its strand line – Microfossils and their use in the zonation of the pay-zones and their facies of deposition. **Laboratory Training.**
G P – 569 **(2 cr. h)** **1h Th + 1 Pr**	**Geochemistry of Oil Field Water** **جيوكيمياء المياة المصاحبة للبترول** Introduction to the occurrence of crude oil and saline waters – Hydraulic currents and buoyancy – Chemical characteristics of oil field waters – Sampling subsurface oil field waters and considerations in selecting sampling sites – Drill-stem test and its tools – Analysis of oil field waters for some physical properties and inorganic chemical constituents and reporting the analytical results – Interpretations of chemical analysis of oil field waters – Organic constituents in saline waters – Origin of oil field waters. **Laboratory Training.**
G P – 570 **(2 cr. h)** **1h Th + 1 Pr**	**Petroleum Reservoir Rock-Types** **انواع صخور الخزانات البترولية** Introduction to depositional systems – Clastic reservoirs rocks types: quartoze sediments, greywacke sediments, arkase sediments porosity and permeability in clastic rock-types – Carbonate reservoir rock types: introduction to the types of carbonates, fluid distribution in carbonates, reservoir rocks with carbonate type porosity – Shale reservoirs and their development – Evaporites (rock salt, anhydrite or gypsum and impure anhydrite formation – Igneous and metamorphic reservoir rock-types. **Laboratory Training.**

G P – 571 **(2 cr. h)** **1h Th + 1 Pr**	**Reservoirs Development and Treatment for Production** **تنمية معالجة الخزانات للانتاج** Introduction to the petroleum reservoir rock types and their petrophysical characteristics – Porosity and permeability (reservoir capacity in-short) in clastic rock type – Petrophysical relations between porosity and permeability – Carbonate reservoirs rock types and their preparation for production of their contained hydrocarbon fluids – Acidization of reservoir rock types and its precaution before production if necessary to the permeability of the pay-zone – Treatment of wells with hydrochloric acid – Reagents used in acidizing wells – Thermal acidizing of wells – Hydraulic formation fracturing – Reservoir exploitation control. **Laboratory Training.**
G P – 572 **(2 cr. h)**	**Special Topics** **موضوعات متخصصة**

	6- Diploma in Hydrogeology (G H)
G H – 573 **(3 cr. h)** **2h Th + 1 Pr**	**Regional Groundwater Flow** التدفق الاقليمى للمياه الجوفية Recharge, discharge, water divide, effect of topography, effect of geology, quantitative interpretation of regional flow system. **Practical course** Volume of water by rain fall - Porosity and permeability measurements - Flow net construction and prediction - Input and out put estimation of recharge.
G H – 574 **(3 cr. h)** **2h Th + 1 Pr**	**Introduction to Aqueous Systems** **مقدمة للأنظمة المائية** Equilibrium versus kinetic reactions, Description of reactions, reaction rate equilibrium models, activity models. **Practical course** Volume of water by rain fall - Porosity and permeability measurements - Rock water interaction - Rainfall chemistry.
G H – 575 **(2 cr. h)** **1h Th + 1 Pr**	**Groundwater and the Environment** **المياه الجوفية والبيئة** Non reactive constituents in homogeneous and heterogeneous systems, transport of reactive systems in porous and fractured rocks, Dispersive adsorption, land disposal of solid waste sewage disposal on land agricultural activity, petroleum leakage and spills, disposal of radioactive waste, dry well disposal and liquid wastes. **Practical course** Rainfall volume on the earth - Groundwater chemistry - Groundwater pollution - Impact of anthropogenic sources on groundwater quality.
G H – 576 **(2 cr. h)** **1h Th + 1 Pr**	**Principles of Well Drilling and Installation** **أسس حفر الآبار وتركيباتها** Fundamentals of borehole measurements. Petrophysical considerations. Wellbore environment. Qualitative log evaluation methods. Interpretation and analysis of formation properties. **Practical course** Geophysical exploration for groundwater - Well design and construction techniques - Development and step test analysis - Constant test analysis.
G H – 577 **(3 cr. h)** **2h Th + 1 Pr**	**Theory of Infiltration** **نظرية الترشيح** Overland and subsurface storm flow, base flow recession & bank storage, ground water level fluctuation.

	Practical course Volume of water by rainfall - Porosity and permeability measurements - Infiltration measurements - Infiltration application.
G H – 578 **(3 cr. h)** **2h Th + 1 Pr**	**Deviation from Equilibrium** **الانحراف عن الاتزان** Kinetic reactions, organic compounds as source of pollution, ground water composition, describing chemical data. **Practical course** Rainfall volume on Earth - Pumping tests precautions - Log-log type curve matching - Semi-log plots - Advantages and disadvantages of pumping tests.
G H – 579 **(2 cr. h)** **1h Th + 1 Pr**	**Groundwater Modeling** **نمذجة المياه الجوفية** Analysis and synthesis of hydrology problems. Conceptual modeling process, parameter estimation, model validation, and model prediction. Mathematical models for steady and transient flow and transport. Applications to well hydraulics, water supply, regional flow, recharge and infiltration, subsidence, sea water intrusion, surface water/groundwater interaction, groundwater pollution, and geotechnical problems. Case studies. **Practical Course** Selected programs principles - Saturation index estimation - Partial pressure of Co_2 determination - Grid representation of the aquifer system - Prediction of future hydrogeological conditions of the aquifer system with pumping - Remediation procedures of contaminated aquifer.
G H – 580 **(2 cr. h)** **1h Th + 1 Pr**	**Techniques in Water Analysis** **تقنيات تحاليل المياه** This course is an introduction to chemical analytical techniques applied to hydrogeology. The emphasis of the course is on the application of the technique, rather than on description of the basic principles. More emphasis will be on the quantification of the techniques. **Practical course** Water sampling protocols - Insitu measurements - Titration procedures for major ions - Flame photometer techniques - Inductive couples plasma AAS - Atomic absorption spectrophotometer.
G H – 581 **(2 cr. h)** **1h Th + 1 Pr**	**Source of Groundwater Contamination** **مصادر تلوث المياه الجوفية** Radioactive, trace metals, materials, inorganic, organic and biological contaminants, solute plumes, fractured and karst systems. **Practical course** Water sampling protocols - Rock water interaction - Groundwater flow and contaminant plume configuration - Sorption – desorption processes - Industrial, agricultural, and sanitary wastewaters impact on groundwater quality.
G H – 582 **(2 cr. h)** **1h Th + 1 Pr**	**Development of Ground Water Resource** **تنمية مصادر المياه الجوفية** Artificial recharge and conjunctives use, simulation of aquifer response to pumping, numerical simulation, finite difference and finite elements, use of numerical methods. **Practical course** Rainfall volume on the Earth - Input and output estimation of recharge water - Step test analysis - Constant test analysis - Surface and groundwater interactions - Porosity and permeability, and pumping procedures.
G H – 583 **(2 cr. h)** **1h Th + 1 Pr**	**Multifluid Contamination Problems** **مشكلات الملوثات متعددة المصادر السائلة** Relative permeability, design of sampling networks, sampling methods, indirect methods of detecting contamination, remediation.

	Practical course Water sampling protocols - Rock water interaction - Groundwater flow and contaminant plume configuration - Sorption-desorption processes - Industrial, agricultural, and sanitary wastewaters impact on groundwater quality.
G H – 584 **(2 cr. h)** **1h Th + 1 Pr**	**Mathematical Treatment of Land Subsidence** **المعالجة الرياضية لهبوط سطح الأرض** Time rate of subsidence, sea water intrusions, upcoming of the interface, simulation of optimization concepts in management schemes. **Practical course** Land subsidence sources - Enhancement of land subsidence - Treatment procedures of land subsidence.
G H – 585 **(2 cr. h)**	**Special Topics** **موضوعات متخصصة**

	7- Diploma in Engineering Geology (G EG)
G EG – 586 **(2 cr. h)** **1h Th + 1 Pr**	**Engineering Geology** **الجيولوجيا الهندسية** Rocks as a material, Symmetry concepts and strength anisotropy of some rocks, Rock material and Rock mass classifications, Stability of soil slopes, Rock slope stability, Ground improvement, Water resources, Reservoirs and dams,…etc, The engineering geological report. **Laboratory Training.**
G EG – 587 **(2 cr. h)** **1h Th + 1 Pr**	**Site Investigations** **فحص المواقع** Preliminary investigations, Aerial photographs, Terrain evaluation for highway projects, Geological exploration techniques, Site exploration, Mining subsidence, Site investigation reports. **Laboratory Training.**
G EG – 588 **(3 cr. h)** **2h Th + 1 Pr**	**Soil and Rock Mechanics Laboratory Techniques** **التقنيات المعملية لميكانيكا التربة والصخور** Grain size analysis. Atterberg limits. Visual classification of soils. Specific gravity. Bulk density, void ratio and porosity determinations. Constant and failing head permeability tests. Compaction and California Bearing Ratio tests. Unconfined compression, direct shear, and consolidation tests. Absorption and slake durability tests. Point load, uniaxial and triaxial testing of rock. Determination of dynamic elastic constants of rock materials. **Laboratory Training.**
G EG – 589 **(3 cr. h)** **2h Th + 1 Pr**	**Special Studies** **دراسات متخصصة** A comprehensive investigation on a topic of geological engineering interest in a selected field of specialization. **Laboratory Training.**
G EG – 590 **(2 cr. h)** **1h Th + 1 Pr**	**Fundamentals of Earthquake in Engineering Geology** **أساسيات الزلازل في الهندسة الجيولوجية** Mechanics, intensity and magnitude of earthquakes, Global seismic patterns, Influence of ground conditions on earthquake ground motion, earthquake resistant designing of structure. **Laboratory Training.**
G EG – 591 **(2 cr. h)**	**Groundwater Engineering and Management** **هندسة المياه الجوفية وأدارتها** Types of subsurface water, Groundwater flow, Seepage forces, drainage and

1h Th + 1 Pr	drain wells, Permeability tests-rocks, Permeability tests-soils, Economic exploitation of groundwater, Ownership of groundwater and permitted abstractions, Groundwater exploration, Regional investigations, Simulation of groundwater regimes, Well losses, Improving aquifer yield, Groundwater quality. **Laboratory Training.**
G EG – 592 **(3 cr. h)**	**Advanced Seminar in Engineering Geology** **حلقة مناقشة في الهندسة الجيولوجية** Seminar on topics of current interest in Engineering Geology.
G EG – 593 **(3 cr. h)**	**Special Studies** **دراسات متخصصة** A comprehensive investigation on a topic of engineering geological interest in a selected field of specialization.
G EG – 594 **(2 cr. h)** **1h Th + 1 Pr**	**Applied Geophysics in Engineering Geology** **تطبيقات الجيوفيزياء فى الهندسة الجيولوحية** Application of geophysical methods to engineering problems, Principles of field techniques and instrumentation of the seismic refraction, electrical resistivity, induced polarization, well logging and magnetic methods, Interpretation of field data. **Practical course: Applied Trainings.**
G EG – 595 **(2 cr. h)** **1h Th + 1 Pr**	**Earthworks Planning & Legal Aspects** **تصميم الأعمال الأرضية والاعتبارات القانونية** Organizing of projects. Job planning and scheduling. Critical path analysis. Construction methods and specifications. Coat analysis. Contract documents and bid procedures. **Practical course: Applied Trainings.**
G EG – 596 **(2 cr. h)**	**Special Studies** **دراسات متخصصة** A comprehensive investigation on a topic of engineering geological interest in a selected field of specialization.

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Structural Geology and Tectonics (G S)
GS – 601 **(3 cr. h)**	**Structural Geology** **جيولوجيا تركيبية** The course treats geometry and location of the most common deformational structures like folds, faults/shear zones and fractures and their relationship to strain and stress (forces) in the earth crust. Examples include structural elements and development of tectonic regimes. Emphasis is placed on methodology, in particular in relation to thesis work in structural geology and tectonics, as well as their application in practical geology (engineering geology, hydrogeology, petroleum geology etc.). Review of the main structural features, Minor structures, lineation, cleavage & folds. Detection of multiple structures.
GS – 602 **(2 cr. h)**	**Rock Mechanics** **ميكانيكة الصخور** Elastic, viscoelastic and plastic behavior of rock, crack phenomena and mechanisms of rock fracture, finite element solutions, dynamic rock mechanics, engineering and geological applications.
GS – 603 **(2 cr. h)**	**Geotectonics** **جيوتكتونية** Examination of current ideas and their development as global tectonic theories. Plate tectonic controls on orogeny, orogenic belts, magmatism, sedimentation, and metallogeny of major geologic region and the tectonic implications for economic and petroleum geology is to be addressed.

	Review of the main structures in continents and oceans, Structures in Africa and Europe.
GS – 604 **(3 cr. h)**	**Petrofabrics** **النسيج الصخرى** Study of the different types of microtextures of tectonites and its relation to tectonic phases. Universal stage techniques and its implication in mineralogy and structural geology.
GS – 605 **(2 cr. h)**	**Remote Sensing** **الاستشعار عن بعد** This course will provide a thorough introduction to basic scientific principles involved in remote sensing, and some of the applications to studies of the land surface. This shall include examining the basic physics of electromagnetic radiation and the complex interactions of radiation with the surface and atmosphere (i.e. spectral signatures). The theoretical background laid out in the beginning of the course will provide the tools for examining the remote sensing applications in different parts of the electromagnetic spectrum. The applications will include uses of satellite remote sensing data in areas such as hydrology, geology, and ecology with a particular focus on arid regions.
GS – 606 **(2 cr. h)**	**Geodynamics** **جيوديناميكا** This advanced geodynamics class discusses analytical and numerical models and applies them to quantitatively investigate and interpret geological processes in the solid Earth. The quantitative skills to be learned are useful for all Earth scientists, but the focus of the class is on tectonophysics and mantle convection problems. Key continuum mechanics concepts are discussed by means of worked example problems such as cooling of magma bodies and oceanic plates, Stokes flow, post-glacial rebound, and mantle convection. We briefly review the fundamentals, but give more room to quantitative analysis and numerical solutions. An intro geodynamics class such as GEOL534 is recommended, but not required, preparation.
GS – 607 **(2 cr. h)**	**Analytical Techniques and Applications in Structural Geology** **الطرق التحليلية والتطبيقية للتراكيب الجيولوجية** Structural methods used in the analysis of deformed rocks, statistical treatment of data, sections, polydeformation, low to high metamorphic grade terrains, migmatites and gneisses, granite tectonics and fabrics, mylonites.
GS – 608 **(2 cr. h)**	**Sedimentary Basins** **أحواض ترسيبية** Architecture and evolution of sedimentary basins in relation to plate-tectonic setting and crustal properties. Sequence stratigraphy: sequence models and sequence forcing mechanisms tectonism, eustasy, and climate change. The global-cycle-chart controversy. World-wide review of basins in the context of plate tectonics.
GS – 609 **(2 cr. h)**	**Subsurface Mapping** **التخريط التحت سطحى** Systematic and accurate acquisition, evaluation, and interpretation of subsurface data as applied in the search for oil and mineral deposits.
GS – 610 **(2 cr. h)**	**Introduction to Geographic Information Systems** **مقدمة فى نظم المعلومات الجغرافية** Map properties, map design, remote sensing, GPS, and the growth and development of geographic information. The use computers and other tools related to Geographic Information Systems (GIS).

	2- M. Sc. Degree in Stratigraphy and Paleontology (G SP)
G SP – 611 **(3 cr. h)**	**Micropaleontology I** **الأحافير الدقيقة (١)** Systematic research into foraminifers and ostracods, their ecology, stratigraphy, evolution and classification, microscopic investigation to study the morphological features of foraminifers and ostracods, larger forminifera and their significance in biostratigraphy, establishment of biozonation using foraminifers and ostracods, uses of foraminifers and ostracods in the paleoecological interpretations.
G SP – 612 **(2 cr. h)**	**Litho- & Stable Isotope Stratigraphy الطباقية الصخرية والطباقية للنظائر المستقرة** The international code of stratigraphy, establishing the sequence events, interpreting the stratigraphical record, correlation by stable isotope events, measurements of isotopic ratios, oxygen isotope stratigraphy, carbon isotope and circulation patterns, catastrophic chemical events, sulfur and strontium isotopes, geologic applications of the isotopic techniques.
G SP – 613 **(2 cr. h)**	**Macropaleontology I** **الاحافير الكبيرة (١)** Species concept (species as a unit), taxonomic hierarchy, mechanism of evolution, taphonomy (taphonomic processes and applications), biochemistry (skeletal minerals and isotope techniques), trace fossils (ichnology and ichnofacies), uses of statistical methods in paleontology, fossils as sedimentary rocks builders.
G SP – 614 **(3 cr. h)**	**Microfacies and Paleoecology** **السحنات الدقيقة و البيئات القديمة** Definition and objectives of paleoecology, petrographic studies of a number of stratigraphic sequences, identification of their faunal content and interpretation of the paleoenvironmental conditions that prevailed during sedimentation; adaptive functional morphology, ecosystems and communities in paleoecology.
G SP – 615 **(2 cr. h)**	**Applied Tools in Stratigraphy** **تطبيقات فى علم الطبقات** Erecting sequence framework, importance of unconformities, facies cycles, stratigraphic architecture (seismic method), assessing regional and global changes in sea level, the four basic types of stratigraphic cycle, the basic sequence model, depositional systems and systems tracts, sequence boundaries, sequence concepts, chronostratigraphy and correlation, magnetostraigraphy and chemostratigraphy.
G SP – 616 **(2 cr. h)**	**Facies & Depositional Systems** **السحنات و أنظمة الترسيب** Updated definitions of the terms facies and depositional systems and their sequential processes in geology. Factors controlling depositional systems in the different sedimentary rock types. Basics of defining the different depositional systems (applied cases about Egyptian sedimentary column). Lab exercises in studied economic potential resources applying facies variations in different depositional systems.
G SP – 617 **(2 cr. h)**	**Ichnofossils** **بصمة الاحافير** Definitions and Ichnofacies concepts, ethological classification, recognition and description of different ichnogenera, relation of ichnofacies to substrate, ichnological application to sequence stratigraphy, ichnological recognition of various environments.
G SP – 618 **(2 cr. h)**	**Paleobiogeography** **الجغرافيا الحيوية القديمة** Concepts, factors controlling geographic distribution of species: depth-evolution, temperature, and other environmental parameters; island biogeography, defining provincial boundaries, modern provinces, ancient

	biotic provinces, endemic and cosmopolitan faunal distribution, and Cretaceous paleobiogeography: a case study from north Sinai, Egypt.
G SP – 619 **(2 cr. h)**	**Palynology** **حبوب اللقاح والأبواغ** Introduction, nomenclature and taxonomy; palynological techniques, processing and microscopy; dinofagellates, acritachs, spores and pollen grains, chitinozoa and conodonts (history of study, life cycle, morphology and major morphologic groups, taxonomy, stratighraphic ranges and distribution, evolution, biogeography and paleoecology, applications of fossil groups).
G SP – 620 **(2 cr. h)**	**Vertebrate Paleontology I** **الاحافير الفقارية (١)** Ancestry of vertebrates, why animals acquired skeletons?, bird's eye view of fishes, eurypterid influence of vertebrate history, cartilaginous and bony fishes, the first land vertebrates, the origin of tetrapods, varied reptilian groups, the grand father of birds, introduction to Mammals.
G SP – 621a **(2 cr. h)**	**Calcareous Nannoplankton** **الهائمات الجيرية المجهرية الدقيقة** Definitions, biology of the organism, paleoecology, major morphologic groups, evolutionary trends (Discoasters), biostratigraphy and geologic distribution.
G SP – 621b **(2 cr. h)**	**Marine Geology I** **جيولوجيا البحار (١)** History and origin of seas and oceans, bottom relief features and their nomenclatures, sampling methods, origin and kinds of sediments of the sea floor and their distribution by currents an the continental slope; selected examples from northern shores of Egypt, their accretion, erosion, and beach protective measures (Nile Delta).
G SP – 621c **(2 cr. h)**	**Special Topics** **مقرر خاص** Senior standing in stratigraphy and paleontology or consent of instructor, includes: Biostratigraphy - Mesozoic & Cenozoic Stratigraphy - Paleobiology - Comparative Anatomy of Vertebrates.

	3- M. Sc. Degree in Environmental Geology (G E)
G E – 622 **(3 cr. h)**	**Environmental Geology جيولوجيا البيئة** Applied geology for some of the interactions between man and the geologic environment with emphasis on geologic hazards (earthquakes, volcanoes, landslides, and flooding). This course focuses on global processes. Earth system and global change mechanisms are studied to understand both natural processes at the origin of global change and how human action influences these processes. It is also focuses on the nature of earthquakes and volcanoes, emphasizing how society evaluates and confronts the dangers posed by these natural phenomena.
G E – 623 **(2 cr. h)**	**Introduction to Remote Sensing and GIS and the Environment** **مقدمة فى علم الاستشعار عن بعد ونظم المعلومات الجغرافية والبيئة** This course will explore the acquisition, analysis and visualization of remotely sensed data. Single band, multi-spectral and hyper-spectral data sets will be used to discuss such concepts as image statistics, radiometric and geometric corrections, spatial filtering and special transformations like the Normalized Difference Vegetation Index. Supervised and Unsupervised classification schemes will be discussed as will change detection. This

	course will also introduce you to the fundamental concepts underlying computerized geographic information systems (GIS).
G E – 624 **(3 cr. h)**	**Environmental Isotope Geochemistry** **جيوكيمياء النظائر البيئية** Isotope geochemistry is the study of small, but quite measurable differences in the abundance of various stable and natural radioactive elements in geological materials. The resulting tools are challenging in their use, but can provide unique information of great use in environmental studies.
G E – 625 **(2 cr. h)**	**Medical geology** **الجيولوجيا الطبية** The scope of this Course is to share the most recent information on the relationship between toxic metal ions, trace elements, and their impact on the environmental and public health issues.
G E – 626 **(2 cr. h)**	**Environmental Pollution** **الملوثات البيئية** This unit examines the problems of coastal pollution ranging from oil spills to effluent discharges. The legal aspects will be discussed and followed by typical causes and solutions. Case studies will be included.
G E – 627 **(2 cr. h)**	**Contaminant Transport Modeling** **نماذج انتقالِ الملوثِات** Flow systems, mass transport in the vadose and saturated zones; advection and dispersion; transformation, retardation and attenuation of solutes; Low temperature geochemical processes and kinetics of chemical reactions; contaminant modeling using finite difference-finite element methods.
G E – 628 **(2 cr. h)**	**Sediment Processes and Environments** **العمليات الترسيبية والبيئة** Introduces important sediment properties and processes, including size distributions, initial motion, bed load and suspended load transport, bed forms, erosion and deposition, flocculation, sedimentary structures, and animal sediment interactions. Several depositional settings are investigated, including coastal, wetland, and fluvial environments.
G E – 629 **(2 cr. h)**	**Evaluation of Land & Landscape Resources** **تقييم موارد الأرض ومسطحاتها** The aim of the course is to examine methods of evaluation and techniques for the assessment of land and landscape resources; to allow opportunities for their application to selected planning issues.
G E – 630 **(2 cr. h)**	**Evaluating a Potential Sanitary Landfill Site** **تقييم مواقع الدفن الصحى للنفايات** The learning objectives of this course are to understand the environmental, technical and social factors that should be considered when evaluating potential sanitary landfill sites and to be able to develop a procedure for evaluating potential sanitary landfill sites.
G E – 631 **(2 cr. h)**	**Information Systems for Resource Surveys and Development Planning** **نظم المعلومات لمسح ولتنمية وتخطيط الموارد** Resource surveys require the collection of different types of data pertaining to soils, geology, vegetation patterns, drainage conditions, topography and land use. In addition, socio-economic data on transport networks and settlement distributions must be incorporated.
G E – 632 **(2 cr. h)**	**Independent Study** **دراسات مستقلة** This course will be decided per student need especially in his/her research area.

	4- M. Sc. Degree in Petroleum Geology (G P)
G P – 633	**Petroleum Geology** **جيولوجيا البترول**

(3 cr. h)	What is mint by petroleum geology?, and the principles of petroleum geology – History of petroleum exploration in the world – Origin of petroleum: Introduction to the occurrences of hydrocarbons in the earth and satellites, a review on the origin of petroleum, the chemical complexity of crude oil, its fluid, migratory nature, and the innumerable geological factors which presented a considerable challenge to the investigator, occurrence of hydrocarbons in recent sediments, oil and organic matter in source rocks of petroleum, geologic and geochemical aspects of the origin of petroleum – Theories of the migration of petroleum, and the migration differentiation concepts – The petroleum reservoir: the petroleum reservoir elements and its storage character, the petroleum reservoir as an active geochemical unit – The chemical composition of petroleum (crude oil and hydrocarbon gases and their types).
G P – 634 **(3 cr. h)**	**Advanced Reservoir Studies** **دراسات متقدمة للخزانات** What is meant by petroleum reservoir? And the rules for petroleum production from the different reservoir rock types – The petroleum reservoir traps and its dimensions and configuration – The petroleum reservoir in the logic of plate tectonic theory – The petroleum reservoir as an active storage and geochemical unit – The reservoir fluids drives and precautions, and oil recovery under different drives – Secondary recovery of petroleum reservoir and methods of infection – Geologic methods for petroleum reserve evaluation.
G P – 635 **(2 cr. h)**	**Structural and Stratigraphic Control of Hydrocarbons** **التحكم التركيبى والطبقى فى الهيدروكربونات** The tectonic setting of the prospective areas and its structural control on the distribution of hydrocarbons – The sedimentologic responses for the hydrocarbons occurrences and their behavior on the tectonic models of hydrocarbons – Stratigraphic control, and its cyclicity and impact on the lithofacies control of petroleum occurrence – Stratigraphic controls on the development and distribution of fluid hydrocarbon – pressure compartments.
G P – 636 **(2 cr. h)**	**Petroleum Basin Analysis** **تحليل أحواض البترول** Types of petroleum basins in the logic of plate tectonics – Evolution of petroleum basins from the standpoint of petroleum generation and accumulation; and quantitative appraisal of hydrocarbon potential – Petroleum generation and accumulation in basin evolution – Petroleum system in space and time.
G P – 637 **(2 cr. h)**	**Source Rocks Evaluation** **تقييم صخور المصدر** Mother and source rocks and their geological and geochemical criteria – Direct criteria for source rock recognition: bitumenological analysis, indirect criteria for source rock recognition and the data required – Analytical techniques and interpretation of the analyzed data.
G P – 638 **(2 cr. h)**	**Petroleum Provinces of Egypt** **المديريات البترولية فى مصر** Gulf of Suez petroleum province and its hydrocarbon bearing section – Western desert petroleum provinces and its hydrocarbon-bearing section – Nile Delta petroleum province and its hydrocarbon-bearing section – Comparison and correlation of the petroleum-bearing sections in Egypt and their source rocks and cycles of petroleum generation, migration and accumulation.

G P – 639 **(2 cr. h)**	**Natural Gases** **الغازات الطبيعية** Natural gases in the atmosphere and satellites and their origin – Natural gases in the lithosphere and their origin – Natural gases in marine sediments – Natural gases (inorganic and organic) in rapture, and in the earth; their origin and significance to the petroleum geologist.
G P – 640 **(2 cr. h)**	**Petroleum Reservoir Rock Types** **أنواع صخور الخزانات البترولية** Argillaceous and fine grained sediments and their fracturing and significance in the creation of abnormal formation pressures – Carbonate reservoir rock types and their petrophysical properties and reservoir capacity – Fine grained and coarse grained clastic reservoirs and their bulk volume in relation to the pore-volume and reservoir capacity.
G P – 641 **(2 cr. h)**	**Oil Field Waters** **المياه المصاحبة للبترول** Sampling subsurface oil field waters: drill-stem test, tabulation of sample description – Analysis of oil field waters from some physical properties and inorganic chemical constituents – Interpretation of chemical analysis of oil field waters – Significance of some inorganic constituents and physical properties of oil field waters – organic constituents in saline waters – Origin of oil field waters – Classification of oil field waters, application of the classification systems and their representation by diagrams geochemical maps and figures.
G P – 642 **(2 cr. h)**	**Geophysical Exploration for Petroleum** **التنقيب الجيوفيزيقى للبترول** Introduction of geophysical methods in petroleum exploration – Basic principles of geophysical methods – Applications of geophysical methods in petroleum exploration – Interpretation of geophysical data – 2D and 3D seismic sections and seismic and potential interpretation of the field area – Applications of seismic and potential methods in hydrocarbons exploration (seismic, gravity and magnetic methods).
G P – 643 **(2 cr. h)**	**Petroleum Well logging** **تسجيلات الآبار البترولية** Introduction of the ultimate aim of well logging – Types of well logs – Acquisition of data logs – The well log interpretation of data – Determination of the petrophysical characteristics of the petroleum-bearing rocks – Statement of the log – interpretation problem in terms of bore-hole interpretation.

	5- M. Sc. Degree in Sedimentary and Sedimentation Geology (G SG)
G SG – 644 **(3 cr. h)**	**Sedimentary Petrology of Clastic Rocks** **علم الصخور الفتاتية** Lab, field characteristics and different types of clastic sedimentary rocks, origins and effects of physical and chemical characteristics. Detailed petrographic, textures relations and mineralogy of clastic rocks with emphasis on their size taxonomy. Interpretation of depositional environments.
G SG – 645 **(2 cr. h)**	**Sedimentary Petrology of Non-Clastic Rocks** **علم الصخور غير الفتاتية** Lab, field characteristics and different types of non-clastic sedimentary rocks, origins and effects of physical and chemical characteristics. Detailed petrographic, texture relations and mineralogy with emphasis on bio-influence on solubility products (facies predominance and size).
G SG – 646 **(2 cr. h)**	**Advanced Stratigraphy (1)** **علم الطبقات المتقدم (١)** Principles and techniques of stratigraphic analysis with emphasis on interpreting the stratigraphic record to aid in reconstruction of environment

	of deposition and paleogeography. Course will revolve around a field problem and include application of methods from physical stratigraphy, biostratigraphy, sequence stratigraphy and sedimentary petrology to solve the problem.
G SG – 647 **(3 cr. h)**	**Applied Techniques in Sedimentology Geology** **تطبيقات التقنيات فى علم الرسوبيات** Collection and analysis of field data, Grain size and mineral analyses of sediments and interpretation. Microscopical techniques of slice, slides, stains and peels. Cathodoluminescence microscopy, XRD Technique, scanning electron microscopy, XRF, atomic absorption and other geochemical analysis of sedimentary rocks.
G SG – 648 **(2 cr. h)**	**Geochemistry of Sedimentary Rocks (1)** **جيوكيمياء الصخور الرسوبية (١)** Controls on the composition of natural waters and the role of fluid-rock interactions in the geochemical evolution of sedimentary rocks, the ocean, the atmosphere and major geochemical cycles. Abundance and migration of elements in the earth: chemical processes in the evolution of the earth and its crust including geochemistry of organic compounds. Classic low-temperature aqueous geochemistry and the concepts of mass-balancing, open and closed systems.
G SG – 649 **(2 cr. h)**	**رواسب الخامات الرسوبيةSedimentary Ore Deposits** This course investigates the types and main processes of the formation of stratiform and stratabound ore deposits. The course includes a discussion of phosphorites, ironstones, manganese, coal, fluorite, barite deposits,…etc. The course concerns with the residual (laterite, bauxite and kaolinite deposits) and supergene (weathering related ore deposits) processes. Topics include banded iron formation (BIF), volcanogenic massive sulphide deposits (VMS), exhalative volcaniclastic fluorite and barite deposits. World examples of stratiform and stratabound ore deposits.
G SG – 650 **(2 cr. h)**	**Tectonics and Sedimentation** **التكتونية والترسيب** This course covers the interplay of sedimentation, geotechnical properties, hydrogeology and deformation along continental margins. Also, it focus on convergent plate boundaries and structural architecture affecting patterns of sedimentation and the relation between sediment composition and the behavior of specific structural elements. Emphasis on active systems where modern technology can be used to image 3-D architecture in detail, sample and monitor in situ properties, and capture important events in real time.
G SG – 651 **(2 cr. h)**	**جيولوجيا النظائرIsotope Geology** This course covers the principles of nuclear chemistry, radioactive decay, isotopic fractionation processes, radiometric dating techniques and stable isotopic studies. Radiometric techniques are introduced by a discussion of atoms and isotopes before particular systems and techniques (such as K-Ar, Ar-Ar, Rb-Sr and U) are covered. Another topic is stable isotope systematics and application of O, C and S isotopes to geologic investigations.
G SG – 652 **(2 cr. h)**	**Geological Applications of Computer and Statistical Methods** **التطبيقات الجيولوجية للحاسوب والإحصاء** An elementary background in computers is recommended. Introduction to statistical theory, computer programming, and the use of computer based statistical and graphical packages as applied to problem solving in the geological sciences.

G SG – 653 **(2 cr. h)**	**Special Topic** **مقرر خاص** Investigation of selected topics in geology i.e. (Marine Geology, Quaternary Geology, Volcaniclastics, Paleoecology, Bioinfluence, Remote Sensing and GIS Application…etc).

	6- M. Sc. Degree in Mineralogy, Petrology and Ore Deposits (G M)
G M – 654 **(3 cr. h)**	**Petrology of Igneous & Metamorphic Rocks** **علم الصخور النارية المتحولة** Introduction to the observation and interpretation of igneous and metamorphic rocks in outcrop, hand sample, and thin sections. Processes of melting, solidification and migration of magmas; solid state recrystallizaton and pressure-temperature histories. Heat flow and regional crustal dynamics.
G M – 655 **(2 cr. h)**	**Advanced Mineralogy** **علم المعادن المتقدم** Fundamental and applied aspects of mineral science, with emphasis on internal structure of minerals including crystallinity, bonding effects. Features a survey of techniques used in mineral spectroscopy such as electron diffraction and imaging and magnetic resonance.
G M – 656 **(3 cr. h)**	**Genesis of Ore Deposits** **أصل تكوين رواسب الخامات** Ore-forming processes, magma differentiation, hydrothermal systems, sedimentation and metamorphism. Identification, textures, structures, associations, and sequence of mineral deposition with problem-solving philosophy.
G M – 657 **(2 cr. h)**	**Ore Petrology** **علم الصخور المتمعدنة** Essentials of reflected light microscopy; mineralogy, textural relationships, paragenesis, phase chemistry, and origin of major ore minerals; detailed study of selected ore bodies. Application of ore microscopy in mineral technology. Fluid inclusion studies. Geothermometry and geobarometry of ore assemblages. Study of phase diagrams related to ore assemblages and construction of stability diagrams. Introduction to stable isotopic studies of ores.
G M – 658 **(2 cr. h)**	**Environmental Mineralogy** **علم المعادن والبيئة** Mineralogy of natural dust in the troposphere and hydrosphere. Asbestos, zeolites, silica, and radon. Clay minerals and their application in remediation. Overview of some radioactive waste forms.
G M – 659 **(2 cr. h)**	**Advanced Sedimentary Petrology** **علم الصخور الرسوبية المتقدم** Texture, composition and structure of sediments and sedimentary rocks. Origin, diagenesis and classification of conglomerate, sandstone, shale, limestone, dolomite, chert, phosphorites, evaporites and iron bearing sediments. Provenance and palaeocurrent. Environment and facies, characteristics of various non-marine, transitional and marine environments. Sedimentation and tectonics. Basin classification and their description, a brief idea about basin analysis.
G M – 660 **(2 cr. h)**	**Clay Mineralogy** **علم معادن الطين** The study of clay minerals and colloids and the application of their physical and chemical properties to various geologic, agricultural, and environmental problems. Special emphasis is given to ion exchange and sorption problems involving clays under various conditions. Techniques of semi-quantitative analysis of clay minerals and the alteration of their

	chemical physical properties are emphasized.
G M – 661 **(2 cr. h)**	**Remote Sensing & GIS** **الاستشعار عن بعد ونظم المعلومات الجغرافية** Application of airborne and satellite remote sensing for understanding the surface of the earth. Focus on interpretation of images obtained by passive and active imaging systems using electromagnetic radiation, especially visible, infra-red, and radar. Introduces students to the fundamentals of spatial data management and GIS technology as applied to the mapping, display, and analysis of mining data. Topics covered include fundamental concepts, definitions, organization of databases and GIS; data integration and conversion; spatial and non-spatial query, analysis, display and reporting. Principles and techniques of spatial data collection, handling, analysis and visualization. Application of GIS technology in land use and in urban site selection.
G M – 662 **(2 cr. h)**	**Industrial Minerals** **المعادن المستخدمة في الصناعة** A detailed examination of the main industrial rocks and minerals, including construction raw materials, their geology and technology, and to put this in context with the market requirements. To understand the worldwide distribution and geological setting of industrial rocks and minerals. To acquire knowledge of the major types of industrial rocks and minerals and construction raw materials. To be able to relate their geology, mineralogy and technical properties to their uses.
G M – 663 **(2 cr. h)**	**Mineral Economics** **اقتصاديات المعادن** Feasibility study for mineral deposits, geological and other factors controlling ore quality in mineral economics.
G M – 664a **(2 cr. h)**	**Gemology** **علم الأحجار الكريمة** Minerals and gem minerals natural, synthetic and substitutes. Brief history of gemology and gem market. Origin and occurrence of gems. Physical and chemical properties of gems. Crystallography. Optical properties. Inclusions and flaws. Instrumentation refractometer, spectroscope, specific gravity determination, polaroscope, dichroscope, microscope. Synthesis of gems. Imitative, composite and treated gems. Gem enhancement. Gem cutting and polishing. Description of gems.
G M – 664b **(2 cr. h)**	**Volcanology** **علم البراكين** Characteristics and mechanisms of volcanic systems, volcanism in various continental and marine (including submarine) tectonic settings. Laboratory to include field and laboratory examination of volcanic rocks and structures, models of volcanic processes.
G M – 664c **(2 cr. h)**	**Analytical Techniques** **التقنيات التحليلية** Sampling of different media, methods of sample preparation for analysis, precisions, choosing adequate technique, petrographical and mineralogical analytical techniques: X-ray diffraction, differential thermal analysis, scanning electron microscopy, probe microanalyser and other relevant methods, destructive and non-distractive geochemical analytical techniques.
G M – 664d **(2 cr. h)**	**Mining Geology** **جيولوجيا المناجم** Earth and rock excavation; subsidence and ground control; exploration, development and exploration of mineral deposits by surface and underground mining including tunneling; shaft sinking; mine ventilation, and illumination; mine drainage; mine haulage and hoisting; mine examination, valuation and cost of mining operation**.**

	7- M. Sc. Degree in Engineering Geology (G EG)
G EG – 665 **(2 cr. h)**	**Soil Mechanics in Engineering Practices** **ميكانيكا التربة في الممارسات الهندسية** Scope of soil engineering. Origin, formation and structure of soils. Principle of effective stress. Volume change characteristics and strength behavior of soils. Practice aspects of plastic equilibrium in soils. Practical aspects of plastic equilibrium in soils. Foundations for structures: footings, piles, and piers. Soil stabilization.
G EG – 666 **(2 cr. h)**	**Rock Mechanics in Engineering Practices** **ميكانيكا الصخور في الممارسات الهندسية** Geological consideration. Mechanical properties of rock. In situ tests on rock masses. The measurement of stress and strain in rock masses. Design of structures in rock with emphasis on stability of slopes and underground excavations. Rock blasting. Methods of improving the properties of rock masses.
G EG – 667 **(3 cr. h)**	**Soil and Rock Mechanics Laboratory** **معمل ميكانيكا التربة وميكانيكا الصخور** Grain size analysis. Atterberg limits. Visual classification of soils. Specific gravity. Bulk density, void ratio and porosity determinations. Constant and failing head permeability tests. Compaction and California Bearing Ratio tests. Unconfined compression, direct shear, and consolidation tests. Absorption and slake durability tests. Point load, uniaxial and triaxial testing of rock. Determination of dynamic elastic constants of rock materials.
G EG – 668 **(3 cr. h)**	**Engineering Geology Practice** **التطبيقات العملية للجيولوجيا الهندسية** A review of subsurface exploration techniques. Geological processes including grouting, drainage, rock bolting and anchorage. Engineering geological investigations for building materials, foundations of buildings, roads and railways, tunnels and underground power plants, hydraulic structures, and regional planning. The engineering geological report.
G EG – 669 **(2 cr. h)**	**Physical and Chemical Properties of Soils** **الخواص الطبيعية والكيميائية للتربة** Soil composition and structure. Exchange capacity of soils. Clay colloidal chemistry. Relation between soil composition and engineering characteristics including consistency, strength, stabilization, consolidation and swelling.
G EG – 670 **(2 cr. h)**	**Special Studies** **دراسات خاصة** A comprehensive investigation on a topic of engineering geological interest in a selected field of specialization.
G EG – 671 **(2 cr. h)**	**Topics in Soil Mechanics** **موضوعات في ميكانيكية التربة** Stress, deformation and strength characteristics of soils. Foundations of buildings in clay and sand. Deep excavation and tunneling in soft ground.
G EG – 672 **(2 cr. h)**	**Engineering Geology of Soft Sediments** **الجيولوجية الهندسية للصخور الرخوة** Clay minerals and their identification. Review of soil-forming processes. Sedimentary environments. Influence of geological factors on engineering properties of residual and transported soils. Case studies.
G EG – 673 **(2 cr. h)**	**Special Studies** **دراسات متخصصة** A comprehensive investigation on a topic of engineering geological interest in a selected field of specialization.

	8- M. Sc. Degree in Geochemistry (G C)
G C – 674 **(2 cr. h)**	**Advanced Geochemistry (I)** **الجيوكيمياء المتقدمة (١)** Distribution of elements in earth, modern advances in geochemistry of igneous and metamorphic rocks, geochemical constrains on plate tectonics and ophiolites, physico-chemical controls on sedimentation, geochemical controls on diagenesis and weathering, geochemistry and applications of the rare earth elements, platinum metals, isovalents and common elements groups.
G C – 675 **(3 cr. h)**	**Exploration Geochemistry** **التنقيب الجيوكيميائي** Exploration media, sample types, sampling intervals, analytical techniques, data display, statistical treatments, orientation survey, primary and secondary dispersions, prospecting in arid and semi-arid environments, hydro-geochemical explorations, isotopes in prospecting, geochemical map, geochemical atlas, geochemical exploration in stream sediments of Egypt, case studies; Eastern Desert and Sinai.
G C – 676 **(2 cr. h)**	**Hydrogeochemistry** **جيوكيمياء المياه** Groundwater chemistry, origin of groundwater, chemical development of meteoric water. Groundwater in arid areas, connate and saline waters, how safe is the water, bottled waters, groundwater temperature.
G C – 677 **(2 cr. h)**	**Environmental Geochemistry (I)** **الجيوكيمياء البيئية (١)** Geochemistry of ecosystems, role of environmental geochemistry, sources, origin, mobility and dispersion of toxic elements, environmental media and samples, analytical techniques and reproducibility, statistical treatment of data, bioavailability, bioaccumulation, biomagnification, symptoms of impact on health, antagonistic / synergistic effects, Maximum contaminant levels (MCLs) of toxic metals, speciation, remediation and alleviation of metal, decision making for environmental sustainability.
G C – 678 **(3 cr. h)**	**Organic Geochemistry** **الجيوكيمياء العضوية** Composition, origin and distribution of organic matter in the geological environment; the carbon cycle; terminology and structure of organic molecules; metamorphism of organic materials; formation and composition of coal, oil, natural gas; organic geochemistry of the oceans; role of organics in ore formation; organic compounds in natural waters; a biogenic organic compounds in magmatic rocks and fluids.
G C – 679 **(2 cr. h)**	**Geochemistry of Ores (I)** **جيوكيمياء الخامات (١)** Ore-forming processes, magma differentiation, hydrothermal systems, sedimentation and metamorphism, Geochemical classifications, endogenic and exogeneic processes, chemical weathering of ores, stability diagrams of minerals, physico-chemical controls, geochemistry in interpreting ore genesis, case studies from Egypt: geochemistry of gold mineralization, ilmenite, talc, black sands, phosphorites, radio-elements resources.
G C – 680 **(2 cr. h)**	**Crystal Chemistry** **الكيمياء البللورات** Topics in physics and chemistry of minerals are covered, particularly crystal structure control on chemical substitution and order-disorder phenomena. Methods of mineral identification and characterization by x-ray powder diffraction and other techniques. Topics in crystal chemistry of major rock-forming mineral groups, specifically reactions, transformations, deformations, and geothermometry and geobarometry based on inter- and

	intracrystalline element distributions in these major mineral groups.
G C – 681 **(2 cr. h)**	**Geostatistics** **الإحصاء الجيولوجي** This course provides a brief introduction to the theory of regionalized variables, and the associated techniques for estimation and simulation of spatially correlated quantities. Parameters such as porosity and permeability may be better mapped and predicted using geostatistical theory (kriging) than via conventional methods because the former explicitly accounts for the nature of the spatial variability of the parameter (as expressed in the semivariogram). Development geologists and reservoir engineers are making increasing use of these techniques to build more accurate reservoir models.
G C – 682 **(2 cr. h)**	**Petroleum Geochemistry** **جيوكيمياء البترول** Geochemistry of petroleum formation, influence of host rock on mineral content of petroleum, petroleum composition, characteristics and stability of petroleum fractions, identification of source fields and petroleum using geochemical methods, and geochemical techniques used in petroleum exploration.
G C – 683 **(2 cr. h)**	**Advanced Igneous Petrology (I)** **علم الصخور النارية المتقدم (١)** Mode of occurrence, texture and structure, mineralogical and chemical classification; chemical conditions governing solid-liquid equilibrium. Crystallization paths of binary and ternary systems. Magmatic differentiation, assimilation and partial melting. Global consanguineous associations, petrogenesis of acid, intermediate, basic, ultrabasic groups, anorthosites, charnockites, alkaline rocks and carbonatites with Indian case histories.

	9- M. Sc. Degree in Hydrogeology (G H)
G H – 684 **(3 cr. h)**	**Principles of Hydrogeology** **أساسيات الهيدروجيولوجي** Aquifers, Monitoring wells, groundwater flow. Well hydraulics and aquifer tests, groundwater quality and solute transport, and managing groundwater pollution.
G H – 685 **(2 cr. h)**	**Groundwater Geology** **جيولوجيا المياه الجوفية** Lithology, stratigraphy, and structures. Fluvial, Aeolian, and glacial deposits. Sedimentary, igneous, and metamorphic rocks.
G H – 686 **(2 cr. h)**	**Groundwater Modeling** **نماذج المياه الجوفية** Groundwater flow equations, porosity, permeability, conceptualizing groundwater systems. Solute transport and governing equations, diffusion, advection, dispersion, aquifer boundary, numerical solution techniques. Multicomponent diffusion and reaction transport. Case study processing Mudflow Window and AquaChem programs.
G H – 687 **(3 cr. h)**	**Contaminant Hydrogeology** **الملوثات وجيولوجيا المياه** Physical and chemical processes governing the transport of solutes in groundwater; application of hydrogeologic and geochemical theory and practice to the protection of aquifers from contamination; problem sets and group projects. Prediction models of contaminant behavior controlled by equilibrium and kinetics. Modern methods of contaminant transport simulation and optimal aquifer remediation. Introductory computer programming.
G H – 688 **(2 cr. h)**	**Techniques in Water Analysis** **الوسائل المستخدمة فى تحاليل المياه** Protocol of water collection. In situ measurements, different equipments in

	chemical analysis.
G H – 689 **(2 cr. h)**	**Environmental Aqueous Geochemistry** **جيوكيمياء البيئة المائية** Application of quantitative chemical principles to the study of natural waters. Includes equilibrium computations, weathering and digenetic processes, precipitation of chemical sediment, and pollution of natural waters.
G H – 690 **(2 cr. h)**	**Field Techniques in Hydrogeology** **التقنيات الحقلية للهيدرولوجيا** Extensive analysis and interpretation of data gathered during the field session, complete exercises and prepare a written report.
G H – 691 **(2 cr. h)**	**Isotopic and Trace Element Geochemistry** **جيوكيمياء النظائر والعناصر الشحيحة** Discussion on theories for natural isotopic and element variations and their application to the solution of geologic and cosmologic problems.
G H – 692 **(2 cr. h)**	**Role of Fluids in Geologic Processes** **دور السوائل فى العمليات الجيولوجية** Principles governing geologic processes in which fluids (groundwater) play an important role. Regional flow of groundwater, movement and entrapment of petroleum, development of anomalous fluid pressures, and role of fluid in tectonic movements, hydraulic fracturing as a measure of in-situ stress, transport of chemical constituents by groundwater, flow in fractured rocks and transport of heat by groundwater.
G H – 693 **(2 cr. h)**	**Watershed Analysis** **تحليل خط تقسيم المياه** Quantitative methods of data collection and analysis of drainage, basin evolution models, with emphasis on human interaction.
G H – 694 **(2 cr. h)**	**Drainage Basin Analysis** **تحليل أحواض مجارى المياه** Principles, basin characterization, basin analysis. Remote sensing and GIS methods for basin analysis.
G H – 695 **(2 cr. h)**	**Sedimentary Geochemistry** **جيوكيمياء الرسوبيات** Carbonate chemistry, chemical weathering, geochemistry of clay minerals, adsorption/ desorption reactions. Uranium, iron, and sulfur geochemistry.
G H – 696 **(2 cr. h)**	**Groundwater Management** **ادارة المياه الجوفية** Aspects of groundwater management in Germany, groundwater recharge and pollution control. Numerical approaches in groundwater management, impact of land use change on groundwater quality, groundwater management and legislation in China, groundwater management in rural areas of Tamil Nadu. Rainfall harvesting and conservation, biomass nutrient recycling.

7- Astronomy & Meteorology Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(A)	Qualifying Program	Qualifying Program in Astronomy and Meteorology	(AQ)
	Diploma (500)	1- Space Dynamics	(ASD)
		2- Space Physics	(ASP)
		3- Meteorology	(AMT)
		4- Air Pollution	(AA)
	M.Sc. (600)	1- Space Physics	(AS P)
		2- Space Dynamics	(ASD)
		3- Meteorology	(AMT)
		4- Mathematical Astronomy	(AM)
		5- Astrophysics	(A AP)
	Ph.D. (700)	1- Space Sciences	(AS)
		2- Meteorology	(AMT)
		3- Mathematical Astronomy	(AM)
		4- Astrophysics	(A AP)

Qualifying Program In Astronomy and Meteorology (AQ)

Code	Course Number	Course Case	CR. Hours
(AQ)	The candidate studies (7) courses / semester from table (1)	Compulsory	28
	The Total Cr.h. Required		28

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	AQ 1	Astrophysics (1)	2	2
	AQ 3	Spherical Astronomy (1)	2	2
	AQ 5	Celestial Mechanics (1)	2	2
	AQ 7	General Astronomy (1)	2	2
	AQ 9	Stellar Structure and Dynamics	2	2
	AQ 10	Solar Physics	2	2
	AQ 11	Astronomical Calculations and Lab (1)	2	2
Second	AQ 2	Astrophysics (2)	2	2
	AQ 4	Spherical Astronomy (2)	2	2
	AQ 6	Celestial Mechanics (2)	2	2
	AQ 8	General Astronomy (2)	2	2
	AQ 12	Astronomical Calculations and Lab (2)	2	2
	AQ 13	Galactic Structure	2	2
	AQ 14	Planetary Physics	2	2
		The Total Cr.h. Required	28	

1&2- Diploma in Space Science{Space Physics (ASP), Space Dynamics (ASD)}

Code	Course Number	Course Case	CR. Hours
(AS)	The candidate studies (8) courses in table (1)	Compulsory	16
	The candidate chooses (2) course / semester from table (2) or (3)	Elective	8
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AS 501	Space Physics (1)	2	2	Offered by Space Physics & Space Dynamics
	AS 503	Space Dynamics (1)	2	2	
	AS 505	Theory of Artificial Satellite Motion	2	2	
	AS 506	Space Mission Analysis and Design(1) – practical	2	4	
Second	AS 502	Space Physics (2)	2	2	
	AS 504	Space Dynamics (2)	2	2	
	AS 507	Space Mission Analysis and Design(2) – practical	2	4	
	AS 508	Space Environment(1)	2	2	
		The Total Cr.h. Required	16	-	

Table (2) Elective Courses for space Dynamics

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ASD 509	Celestial Mechanics (1)	2	2	Also offered by Sp. Phys.
	ASD 511	Theory of Orbits	2	2	
	ASD 512	Remote Sensing	2	2	Also offered by Sp. Phys.
	ASD 513	Astronomical and Ballistic Missiles	2	2	
	ASD 514	Dynamical Systems	2	2	
	ASD 515	Attitude Dynamics	2	2	
Second	ASD 516	Plasma in Space	2	2	Also offered by Sp. Phys.
	ASD 517	Space Chemistry	2	2	
	ASD 518	Satellite Geodesy	2	2	
	ASD 519	Optimal Space Trajectories	2	2	
	ASD 520	Space Environment (2)	2	2	
	ASD 510	Celestial Mechanics(2)	2	2	Also offered by Sp. Phys.
		The Total Cr.h. Required	8	-	

Table (3) Elective Courses for Space Physics

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ASD 509	Celestial Mechanics (1)	2	2	Also offered by Sp. Dyn.
	ASP 521	Stability Theory	2	2	
	ASP 522	Astrophysics of Solar System	2	2	
	ASP 523	Special Topics	2	2	
	ASP 524	Solar Physics	2	2	
Second	ASP 525	Theory of Relativity	2	2	
	ASD 516	Plasma in Space	2	2	Also offered by Sp. Dyn.
	ASD 512	Remote Sensing	2	2	
	ASD510	Celestial Mechanics (2)	2	2	
		The Total Cr.h. Required	8	-	

Note:- the code No. of the branch: from 501 to 529
From 526 to 529 are codes No. for adding new courses

3- Diploma in Meteorology (AMT)

Code	Course Number	Course Case	CR. Hours
(AMT)	The candidate studies (8) courses in table (1)	Compulsory	16
	The candidate chooses (2) courses / semester from table (2)	Elective	8
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	AMT 530	Dynamical Meteorology (1)	2	2
	AMT 532	Physical Meteorology (1)	2	2
	AMT 534	Synoptic (1)	2	2
	AMT 536	Applications on Atmospheric Physics and Dynamics (1) (Practical)	2	4
Second	AMT 531	Dynamical Meteorology(2)	2	2
	AMT 533	Physical Meteorology (2)	2	2
	AMT 535	Synoptic (2)	2	2
	AMT 537	Applications on Atmospheric Physics and Dynamics (2) (Practical)	2	4
		The Total Cr.h. Required	16	-

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	AMT 538	Climatology and Climatic Change	2	2
	AMT 539	Radiation and Satellite Meteorology	2	2
	AMT 540	Energy and Environment	2	2
	AMT 541	Tropical Meteorology	2	2
Second	AMT 542	Selected Topics in Meteorology	2	2
	AMT 543	Physics of the Upper Atmosphere	2	2
	AMT 544	Numerical Weather Prediction	2	2
		The Total Cr.h. Required	8	-

Note:- the code No. of the branch: from 530 to 549
From 545to 549 are codes No. for adding new courses

4- Diploma in Air Pollution (AA)

Code	Course Number	Course Case	CR. Hours
(AA)	The candidate studies (4) courses in table (1)	Compulsory	16
	The candidate chooses (2) courses / semester from table (2)	Elective	8
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	AA 550	Physics of the Atmosphere	4	3
	AA 551	Introduction to Atmospheric Dynamics	4	3
Second	AA 552	Air Pollution Dispersion	2 Th 2 Pr	2 Th 2-3 Pr
	AA 553	Chemistry of the Atmosphere	4	3
		The Total Cr.h. Required	16	-

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	AA 554	Clean Energy	2	2
	AA 555	Monitoring From Satellites	2	2
	AA 556	Special Course(1)	2	2
	AA 557	Air Pollution Measurements and Control	2	2
Second	AA 558	Reuse and Recycle of Solid Wastes	2	2
	AA 559	Energy and Environment	2	2
	AA 560	Special Course (2)	2	2
	AA 561	Environmental Impact Assessment	2	2
		The Total Cr.h. Required	8	-

Note:- the code No. of the branch: from 550 to 569
From 562to 569 are codes No. for adding new courses

1&2- M. Sc. Degree in Space Sciences {Space Physics (ASP), Space Dynamics (ASD)}

Code	Course Number	Course Case	CR. Hours
(AS)	The candidate studies (4) courses in table (1)	Compulsory	8
	The candidate chooses (5) courses from table (2) or (3)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AS 601	Space Craft Attitude Dynamics	2	2	Offered by Space Physics & Dynamics
	AS 602	Artificial Satellite Theory	2	2	
Second	AS 603	Modeling of the Space Environment (1)	2	2	
	AS 604	Space Mission Analysis and Design (1)	2	2	
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses for Space Dynamics

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ASD 605	Perturbation Theory	2	2	
	ASD 606	Sensor Theory	2	2	Also offered by Sp. Phys.
	ASD 607	Relativistic Celestial Mechanics(1)	2	2	Also offered by Math. Astron.
	ASD 609	Space Communication	2	2	
	ASD 610	Space Mission Analysis and Design (2)	2	2	Also offered by Sp. Phys.
	ASD 611	Astronautics	2	2	
Second	ASD 608	Relativistic Celestial Mechanics(2)	2	2	
	ASD 612	Dynamical Systems	2	2	Also offered by Math. Astron.
	ASD 613	Optimal Trajectories	2	2	
	ASD 614	Stability in Celestial Mechanics	2	2	Also offered by Sp. Phys. & Math. Astron.
	ASD 615	Special Course	2	2	
	ASP 616	Attitude Dynamics	2	2	Also offered by Sp. Phys.
		The Total Cr.h. Required	10	-	

Table (3) Elective Courses for Space Physics

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ASP 617	Ionospheric Physics	2	2	
	ASP 618	Space Plasma (1)	2	2	
	ASP 620	Space Radiation(1)	2	2	
	ASD 606	Sensor Theory	2	2	Also offered by Sp. Dyn.
	ASD 610	Space Mission Analysis and Design (2)	2	4	Also offered by Sp. Dyn.
Second	ASP 622	Advanced Solar Physics	2	2	
	ASP 619	Space Plasma (2)	2	2	
	ASP 621	Space Radiation (2)	2	2	
	ASP 623	The Sun – Earth Connection	2	2	
	ASP 624	Special Course	2	2	
	ASD 614	Stability in Celestial Mechanics	2	2	Also offered by Sp. Dyn. & Math. Astron.
		The Total Cr.h. Required	10	-	

Note:- the code No. of the branch: from 601 to 629
From 625 to 629 are codes No. for adding new courses

3- M. Sc. Degree in Meteorology (AMT)

Code	Course Number	Course Case	CR. Hours
(AMT)	The candidate studies (4) courses in table (1)	Compulsory	8
	The candidate chooses (5) courses from table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	AMT 630	Physics of Clouds and Precipitation	2	2
	AMT 631	Physics of Air Sea Boundary Layer	2	2
Second	AMT 632	Advanced Atmospheric Dynamics	2	2
	AMT 633	Synoptic Meteorology in the Tropics	2	2
		The Total Cr.h. Required	8	-

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AMT 634	Climatological Analysis	2	2	
	AMT 635	Advanced Synoptic Analysis	2	2	
	AMT 636	Structure of Atmospheric Systems	2	2	
	AMT 637	Atmospheric Dispersion and Air Pollution	2	2	
Second	AMT 638	Radiative Transfere	2	2	
	AMT 639	Numerical Modeling in Meteorology	2	2	
	AMT 640	Atmospheric Turbulence	2	2	
	AMT 641	Large Scale Atmospheric Circulation	2	2	
	AMT 642	Selected Topics	2	2	
		The Total Cr.h. Required	10	-	

Note:- the code No. of the branch: from 630 to 649
From 643to 649 are codes No. for adding new courses

4- M. Sc. Degree in Mathematical Astronomy (AM)

Code	Course Number	Course Case	CR. Hours
(AM)	The candidate studies (4) courses in table (1)	Compulsory	8
	The candidate chooses (5) courses from table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AM 650	Space Dynamics (1)	2	2	
	AM 652	Mathematical Methods	2	2	Also offered by Astroph.
Second	AM 651	Space Dynamics (2)	2	2	
	AAP 670	Advanced Astrophysics(1)	2	2	Also offered by Astroph.
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AM 653	Celestial Mechanics	2	2	
	AM 654	Relativity and Cosmology	2	2	
	AM 655	Cosmic Magnetic Fields (1)	2	2	
	AM 657	Selected Topics	2	2	
	AM 658	Theory of Orbits (1)	2	2	
	ASD 612	Dynamical Systems	2	2	Also offered by Sp.Dyn.
	ASD 614	Stability in Celestial Mechanics (1)	2	2	Also offered by Sp. Phys. & Sp. Dyn.
Second	AM 656	Cosmic Magnetic Fields (2)	2	2	
	AM 659	Theory of Orbits (2)	2	2	
	AM 660	Field Theories	2	2	
	AM 661	Gravitational Radiation and Collapse	2	2	
	AM 662	Special Courses	2	2	
	ASD 607	Relativistic Celestial Mechanics(1)	2	2	Also offered by Sp. Dyn.
		The Total Cr.h. Required	10	-	

Note:- the code No. of the branch: from 650 to 669
From 663to 669 are codes No. for adding new courses

5- M. Sc. Degree in Astrophysics (AAP)

Code	Course Number	Course Case	CR. Hours
(AAP)	The candidates studies (4) courses in table (1)	Compulsory	8
	The candidates chooses (5) courses from table (2)	Elective	10
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AAP 670	Advanced Astrophysics(1)	2	2	Also offered by Math.
	AM 652	Mathematical Methods	2	2	Also offered by Math.
Second	AAP 671	Astrochemistry	2	2	
	AAP 672	Advanced Planetary Physics	2	2	
		The Total Cr.h. Required	8	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AAP 673	Stellar Dynamics	2	2	
	AAP 674	Experimental Astronomy	2	2	
	AAP 675	Stellar Astrophysics	2	2	
	AAP 676	Galactic Physics	2	2	
	AAP 677	Special Course	2	2	
	AAP 678	Extra Galactic System	2	2	
Second	AAP 679	Space Physics	2	2	
	AAP 680	Astrometry Techniques	2	2	
	AAP 681	Radio Astronomy	2	2	
	AAP 682	Statistical Astronomy	2	2	
	AAP 683	Special Course	2	2	
	AAP 684	Advanced Astrophysics(2)	2	2	
		The Total Cr.h. Required	10	-	

Note:- the code No. of the branch: from 670 to 689
From 685to 689 are codes No. for adding new courses

1- Ph. D. Degree in Space Sciences (AS)

Table (1)

Code	Course Number	Course Case	CR. Hours
(AS)	The candidate chooses (4) courses / semester from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AS 701	Periodic Orbits	2	2	
	AS 702	Stability Theory	2	2	
	AS 703	Radiative Transfer (1)	2	2	Also offered by Astorph.
	AS 705	Attitude Dynamics and Control	2	2	
	AS 706	Satellite Geodesy	2	2	
	AS 707	Motion Near to the Manifolds of Equilibrium	2	2	
	AS 708	Optimal Space Trajectories	2	2	
	AM 750	Mathematical Methods (1)	2	2	Also offered by Math. Astron.
Second	AS 704	Radiative Transfer (2)	2	2	Also offered by Astorph.
	AS 709	Advanced Space Physics	2	2	
	AS 710	Space Radiation and Materials	2	2	
	AS 711	Modeling of Space Environment	2	2	
	AS 712	Selected Topics	2	2	
	AM 751	Mathematical Methods(2)	2	2	Also offered by Math. Astron.
	AAP 766	Advanced Planetary Physics(1)	2	2	Also offered by Astorph.
	AAP 772	Advanced Solar Physics(1)	2	2	Also offered by Astorph.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 701 to 719
From 713 to 719 are codes No. for adding new courses

2- Ph. D. Degree in Meteorology (AMT)

Table (1)

Code	Course Number	Course Case	CR. Hours
(AMT)	The candidate chooses (4) courses / semester from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AMT 720	Meteorological Prediction (1)	2	2	
	AMT 722	Structure of the Upper Atmosphere (1)	2	2	
	AMT 724	Atmospheric Technology	2	2	
	AMT 726	Atmospheric Chemistry(1)	2	2	
	AMT 728	Dynamics of Moist Convective Systems (1)	2	2	
	AMT 730	Statistical Weather Prediction(1)	2	2	
	AMT 732	Physical and Chemical Processes in the Upper Atmosphere(1)	2	2	
	AMT 734	Selected Topics in Meteorology (1)	2	2	
Second	AMT 721	Meteorological Prediction(2)	2	2	
	AMT 723	Structure of the Upper Atmosphere(2)	2	2	
	AMT 725	Atmospheric Technology(2)	2	2	
	AMT 727	Atmospheric Chemistry(2)	2	2	
	AMT 729	Dynamics of Moist Convective Systems(2)	2	2	
	AMT 731	Statistical Weather Prediction(2)	2	2	
	AMT 733	Physical and Chemical processes in the Upper Atmosphere(2)	2	2	
	AMT 735	Selected Topics in Meteorology(2)	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 720 to 739
From 736 to 739 are codes No. for adding new courses

3- Ph. D. Degree in Mathematical Astronomy (AM)

Table (1)

Code	Course Number	Course Case	CR. Hours
(AM)	The candidate chooses (4) courses / semester from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AM 740	Field Theory(1)	2	2	
	AM 742	Galactic Dynamics(1)	2	2	
	AM 744	Chaotic Dynamics (1)			
	AM 746	Cosmology (1)	2	2	
	AM 748	Planetary Theory (1)	2	2	
	AM 750	Mathematical Methods (1)	2	2	Also offered by Sp. Science..
	AM 752	Magneto Hydrodynamics(1)	2	2	
	AM 754	The 3-body Problem(1)	2	2	
Second	AM 741	Field Theory(2)	2	2	
	AM 743	Galactic Dynamics(2)			
	AM 745	Chaotic Dynamics(2)	2	2	
	AM 747	Cosmology(2)	2	2	
	AM 749	Planetary Theory(2)	2	2	
	AM 751	Mathematical Methods(2)	2	2	Also offered by Sp. Science..
	AM 753	Magneto Hydrodynamics(2)	2	2	
	AM 755	The 3-body Problem(2)	2	2	
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 740 to 759
From 756 to 759 are codes No. for adding new courses

4- Ph. D. Degree in Ph.D. Degree In Astrophysics (AAP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(AAP)	The candidate chooses (4) courses / semester from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	AAP 760	Interstellar Matter (1)	2	2	
	AAP 762	Galactic Structure (1)	2	2	
	AAP 764	Super Massive Objects (1)	2	2	
	AAP 766	Advanced Planetary Physics (1)	2	2	Also offered by Sp. Science..
	AAP 768	Mathematical Methods in Astrophysics (1)	2	2	
	AAP 770	Selected Topics (1)	2	2	
	AAP 772	Advanced Solar Physics (1)	2	2	Also offered by Sp. Science..
	AS 703	Radiative Trausfere (1)	2	2	
Second	AAP 761	Interstellar Matter (2)	2	2	
	AAP 763	Galactic Structure	2	2	
	AAP 765	Super Massive Objects (2)	2	2	
	AAP 767	Advanced Planetary Physics (2)	2	2	
	AAP 769	Mathematical Methods in Astrophysics (2)	2	2	
	AAP 771	Selected Topics (2)	2	2	
	AAP 773	Advanced Solar Physics (2)	2	2	
	AS 704	Radiative Transfer (2)	2	2	Also offered by Sp. Science..
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 760 to 779
From 774 to 779 are codes No. for adding new courses

B- Course contents for Qualifying program in Astronomy and Meteorology (A Q)

Code No.	Course name and contents
A Q – 1 & 2 (2 cr. h/ Semester)	**Astrophysics (1 & 2)** **فلك فيزيائي (١ ، ٢)** Historical introduction, light, stellar: distances, motions, magnitude - analyzing starlight, H-R diagram, stellar properties: luminosity, radii and densities, stellar masses, stellar spectra, telescopes - eclipse – binary stars – parallax – astronomical measurements – planetary phenomena.
A Q – 3 (2 cr. h.)	**Spherical Astronomy (1)** **فلك كروي (١)** Basics of spherical astronomy - Celestial coordinates – Time - spherical triangle – orbital and solar motions- reflection in the atmosphere – binary stars
A Q – 4 (2 cr. h.)	**Spherical Astronomy (2)** **فلك كروي (٢)** Three body problem - perturbations – the dynamics of oscillations - Motion of the Moon – Seasonal variations**.**
A Q – 5 (2 cr. h.)	**Celestial Mechanics (1)** **ميكانيكا سماوية (١)** Two body problem – functions of elliptical motion – celestial coordinates – classical mechanics.
A Q – 6 (2 cr. h.)	**Celestial Mechanics (2)** **ميكانيكا سماوية (٢)** Classical mechanics – theory of Hamilton and Jacobi – lunar motion – perturbation theory.
A Q – 7 (2 cr. h.)	**General Astronomy (1)** **فلك عام (١)** Historical astronomy – Earth and celestial spheres – principles of time – radiation and spectrum – solar system – astronomical phenomena**.**
A Q – 8 (2 cr. h.)	**General Astronomy (2)** **فلك عام (٢)** Planetary atmospheres – the sun – stars – star clusters- galaxies – the universe - the Big Bang.
A Q – 9 (2 cr. h.)	**Stellar Structure and Dynamics** **تركيب وديناميكا النجوم** Star formation – nuclear reactions in stars – stellar evolution – giants – planetary nebulae - White dwarfs – variable stars – star clusters**.**
A Q – 10 (2 cr. h.)	**Solar Physics** **فيزياء شمسية** solar physics: physical properties – layers – interior – activities – solar wind – solar magnetic field – radiative transfer
A Q – 11 (2 cr. h.)	**Astronomical Calculations and Lab (1)** **حسابات ومعمل فلك (١)** Calculations: sunrise and sunset – beginning of Arabic month – prayer times – eclipse and occultation
A Q – 12 (2 cr. h.)	**Astronomical Calculations and Lab (2)** **حسابات ومعمل فلك (٢)** Observations: - telescope- solar and stellar observations – stellar spectra
A Q – 13 (2 cr. h.)	**Galactic Structure** **تركيب المجرات** The milky way – types of galaxies – star clusters – galactic interactions – ISM in galaxies- quasars – galactic clusters - the Universe
A Q – 14 (2 cr. h.)	**Planetary Physics** **فيزياء الكواكب** planetary physics: general – origin and evolution – atmospheric models – internal structure – rings – satellites – asteroids and comets.

C- Course contents for Diploma

Code No.	Course name and contents
	1 & 2- Diploma in Space sciences [Space Physics (A SP) and Space Dynamics (A SD)
A S – 501 **(2 cr. h)**	**Space Physics (1) فيزياء الفضاء (١)** Terrestrial atmosphere – Internal structure – Magnetosphere – Ionosphere – Solar-Terrestrial interactions- Plasma physics – Space systems.
A S – 502 **(2 cr. h)**	**Space Pphysics (2) فيزياء الفضاء (٢)** Magnetosphere physics & structure – Plasma observations – Ionosphere layers – Space weather – Space environment components.
A S – 503 **(2 cr. h)**	**Space Dynamics (1) ديناميكا الفضاء (١)** Principles of spherical astronomy and time systems – Equations of motion – Planetary system – Earth/Moon system – Solar system.
A S – 504 **(2 cr. h)**	**Space Dynamics (2) ديناميكا الفضاء (٢)** Relativistic equations of motion – Two body problem – Three body problem – Perturbation theory- Special topics.
A S – 505 **(2 cr. h)**	**Theory of Satellite Motion نظرية حركة الأقمار الصناعية** Forces influencing satellite motion – Effect of earth's shape – Solar radiation pressure – Air drag – Gravitational effects – Critical inclination effects – Special topics.
A S – 506 **(2 cr. h)** **(Practical)**	**Space Mission Analysis and Design (1) معمل تحليل وتصميم رحلات الفضـاء (١)** Introduction – Principles- Space segment – Launch section – Orbital latitude strategy and adjustment – Lifetime – Communication base – Mission processes – Special topics.
A S – 507 **(2 cr. h)** **(Practical)**	**Space Mission Analysis and Design (2) معمل تحليل وتصميم رحلات الفضـاء (٢)** Mission analysis - Space environment – Orbital – Magnetic field – Systems.
A S – 508 **(2 cr. h)**	**Space Environment (1) البيئة الفضائية (١)** Introduction - Space weather – Earth's magnetosphere – advances in the ionosphere – Asteroids and space debris – Satellites: anomalous, contamination, Surface charging – Solar activities – Radiation effects – Special topics .
A SD – 509 **(2 cr. h)**	**Celestial Mechanics (1) ميكانيكا سماوية (١)** Expansion in elliptic orbits – Hamiltonian mechanics – Hamilton-Jacobin theory – Action-Angle variables.
A SD – 510 **(2 cr. h)**	**Celestial Mechanics (2) ميكانيكا سماوية (٢)** Lunar theory – the disturbing function – Secular perturbation– special topics.
A SD – 511 **(2 cr. h)**	**Theory of Orbits نظرية المدارات** Periodic and quasi-periodic motions – Adiabatic variations – Periodical solutions and resonance - Resonance – Poincre surfaces for conics. KAM theory - Nonuniformaties - Special topics.
ASD – 512 **(2cr.h)**	**Remote Sensing الاستشعار من بعد** Ranging systems – Scattering techniques – Platforms (Aircrafts, Satellites, Orbits, and Coverage) – Data processing.- Special topics.
ASD – 513 **(2 cr h)**	**Astronomical Ballistic Missiles الملاحة الفضائية والمقذوفات البالستية** Rocket dynamics – Transfer orbits - Relative motion and maneuwers – Perturbation and station - keeping – Orbit systems – Coverage and constellation design - Orbit computation – Satellite phenomena – Solar soils and gravity

	assisttrajectories – Special topics.
A SD – 514 **(2 cr. h)**	**Dynamical Systems** **النظم الديناميكية** Phase space analysis –Diffeomorphisms and flow - Stability – Bifurcations - Area preserving maps – Special topics .
A SD – 515 **(2 cr. h)**	**Attitude Dynamics** **ديناميكا الهيئــة** Attitude kinematics – Attitude dynamics – Spacecraft tarques – Gravitational stabilization - Space stabilization in orbits.
A SD – 516 **(2 cr. h)**	**Plasma Physics** **البلازما فى الفضاء** Plasma motion – plasma in electro-magnetic fields – ionization – wave propagation – shock waves –solar plasma- solar wind interaction with magnetosphere – Special topics.
ASD – 517 **(2 cr. H)**	**Space Chemistry** **كيمياء الفضاء** The earth's atmosphere – Atmospheric chemistry – Ionospheric chemistry – Plasma in the magnetosphere – Gases immeted from A. S. – Solar radiation effects on materials in space – Electromagnetic radiation – Solid substances – Solar radiation – Brightness – Aurora Solar wind and magnetic field – A.S. (Charges – Erosion – Interactions) – Radiation belts.
A SD – 518 **(2 cr. h)**	**Satellite Geodesy** **جيوديسيا الأقمار الصناعية** Coordinate systems – Itroduction - Systems of satellite observations –Statistics and data analysis- Computation of the gravitational field parameters from satellite observation –-Integrated approach - Special topics.
A SD – 519 **(2 cr. h)**	**Optimal Space Trajectories** **المدارات المثلي** Modeling of propulsion systems – Parametric optimization – The Continsous - Pontryiagin maximum principle – Optimal transfer in gravitational fields – Optimal orbit corrections – Time free and restricted orbital transfer – Interplanetary rendezvous – Special topics.
A SD – 520 **(2 cr. h)**	**Space Environment (2)** **البيئة الفضائية (٢)** Parameters affecting space environments – Corpuscular radiation – The radiation belt – e.m.radiation – Solid particle effects – The solar wind – High energetic particles – The magnetosphere – Hazardous effects : atmospheric – Plasma – Contaminations.
A SP – 521 **(2 cr. h)**	**Stability Theory** **نظرية الاستقرار** Essential principles and definitions – Functions of linear variables –Phase space analysis - Direct Lyiapanoff method – Energy method –Methods of mathematical approximations – Application of stability in celestial mechanics – Rigid body dynamics and its applications – Special topics.
A SP – 522 **(2 cr. h)**	**Astrophysics of Solar System** **الفيزياء الفلكية للمجموعة الشمسية** Introduction to solar physics – Solar-terrestrial interactions – Earth's atmosphere – Ionospheric layers – Magnetosphere –Planetary physics : Internal structure –Atmospheres –Magnetic fields – Rings – Satellites – Asteroids – Comets.
A SP – 523 **(2 cr. h)**	**Special Topics** **موضوعات مختارة**
A SP – 524 **(2 cr. h)**	**Solar Physics** **الفيزياء الشمسية** Attitude kinematics – Attitude dynamics – Spacecraft tarques – Gravitational stabilization - Space stabilization in orbits.
A SP – 525 **(2 cr. h)**	**Theory of Relativity** **نظرية النسبية** Tensor algebra-Riemannian space and Foundations of Riemannian geometry-Einstein field equations-The Schwarzschild solution-Classical tests-The Schwarzschild singularity -Gravitational collapse and black holes-The

	Schwarzschild solution in other coordinate systems-The Kerr solution -Other solutions.

	3- Diploma in Meteorology (A MT)
A MT – 530 **(2 cr. h)**	**Dynamical Meteorology (1)** **ديناميكا الجو (١)** Fundamental equations, Coordinate systems, Balanced and unbalanced flow, Wind, Atmospheric waves.
A MT – 531 **(2 cr. h)**	**Dynamical Meteorology (2)** **ديناميكا الجو (٢)** Circulation, Vorticity, Divergence, Atmospheric models, Vorticity equation, Bortropic and baroclinic waves.
A MT – 532 **(2 cr. h)**	**Physical Meteorology (1)** **فيزياء الجو (١)** Atmospheric structure and composition, Dry and moist air, Humidity, Atmospheric stability, Radiation physics.
A MT – 533 **(2 cr. h)**	**Physical Meteorology (2)** **فيزياء الجو (٢)** Cloud physics, Rainfall and hail formation, Cloud seeding , Cloud decay and growth.
A MT – 534 **(2 cr. h)**	**Synoptic (1)** **سينوبتك (١)** Kinematic analysis, air masses, fronts and surfaces of discontinoity, weather conditions.
A MT – 535 **(2 cr. h)**	**Synoptic (2)** **سينوبتك (٢)** Motion of pressure system, get streams, prognostic of weather charts maximum wind and tropopuse charts.
A MT – 536 **(2 cr. h)**	**Applications on Atmospheric Physics and Dynamics (1)** **معمل تطبيقات الفيزياء وديناميكا الغلاف الجوي (١)** **Practical Course** Exercises in physical and dynamical problems.
A MT – 537 **(2 cr. h)**	**Applications on Atmospheric Physics and Dynamics (2)** **معمل تطبيقات الفيزياء وديناميكا الغلاف الجوي (٢)** **Practical Course** Wind calculations, stability analysis, wave analysis, islobaric wind vertical wind estimate.
A MT – 538 **(2 cr. h)**	**Climatology and Climatic Change** **مناخ وتغيرات مناخية** Climate elements, climate classes, concept of climate change, climate models.
A MT – 539 **(2 cr. h)**	**Radiation and Satellite Meteorology** **الإشعاع والأقمار الصناعية** Short wave radiation, radiation on slopes, models for estimating solar radiation, long wave radiation, radiation models, motion and type of satellites.
A MT – 540 **(2 cr. h)**	**Energy and Environment** **الطاقة والبيئة** Population growth, growth rate, energy resources, environmental regulations, energy index.
A MT – 541 **(2 cr. h)**	**Tropical Meteorology** **أرصاد مدارية** Equation of motion at low latitudes, wind of the equator, tropical storms condensation at low latitude.
A MT – 542 **(2 cr. h)**	**Selected Topics In Meteorology** **مقرر مختار فى الأرصاد الجوية**
A MT – 543 **(2 cr. h)**	**Physics of the Upper Atmosphere** **فزياء طبقات الجو العليا** Structure of upper atmosphere, E and F regions, ionospheric physics, Quasibinal oscillation, electron density profite.

A MT – 544 **(2 cr. h)**	**Numerical Weather Prediction** **التنبؤات العددية للطقس** Basic of NWP, time integration, initial boundaries, model stability short rang models, model energy and evaluations.

	4- Diploma in Air Pollution (A A)
A A – 550 **(4 cr. h)**	**Physics of the Atmosphere** **فيزيـــاء الغـــلاف الجـــوي** Composition, vertical struclure, dry and moist air, stability, radiation budget.
A A – 551 **(4 cr. h)**	**Introduction to Atmospheric Dynamics** **مقدمة لديناميكا الجـو** Basic equations, wind, circulation, wave propagation, vorticily equation.
A A – 552 **(4 cr. h)**	**Air Pollution Dispersion** **انتشـــار ملوثات الهـــواء** 3D dispersion equation, pollution transport, air pollution parameterization, stake emission , muttisources emission. **Practical Course** Computer aids, dispersion models, Chimney characteristics, point and area sources.
A A – 553 **(4 cr. h)**	**Chemistry of the Atmosphere** **كيميـــاء الغـــلاف الجـــوي** Chemical reactions, chemistry models, chemical composition, ozone air pollution, acid Precipitation.
A A – 554 **(2 cr. h)**	**Clean Energy** **الطاقـــة النظيفـــة** Wind distribution, Webiual distribution, wind power, radiation estimate, radiation on slopes, model for estimating solar energy.
A A – 555 **(2 cr. h)**	**Monitoring From Satellites** **أرصاد الأقمار الصناعيـة** Radiation, motion of satellite, satellite output, satellite images, air pollution from space.
A A – 556 **(2 cr. h)**	**Special Course (1)** **مقرر خاص (١)** New subject, in air pollution.
A A – 557 **(2 cr. h)**	**Air Pollution Measurements and Control** **قياسات تلوث الهواء والتحكم فيها** Air quality, measurments of TSP, gases emissions, suspended dust, analysis of TSP, reduction of emissions.
A A – 558 **(2 cr. h)**	**Reuse and Recycle of Solid Waste** **إعادة اســتخدام وتدوير المخلفات الصلبـــة** Properties of solid waste – Collection system – Disposal primary landfill design and operation – Medical waste – Chemical waste – Treatment and disposal of waste.
A A – 559 **(2 cr. h)**	**Energy and Environment** **الطاقة والبيئة** New energy resources – Uses of clean energy – population growth – growth rate – energy impacts on environment.
A A – 560 **(2 cr. h)**	**Special Course (2)** **مقرر خاص (٢)** New issues in air pollution, small project.
A A – 561 **(2 cr. h)**	**Environmental Impact Assessments** **تقييم الأثر البيئـــي** Clean, black projects, social impact, air quality impacts, project evaluation, case study.

D- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1 & 2- M. Sc. degree in Space Sciences [Space Physics (A SP) – Space Dynamics (A SD)]
A S – 601 (2 cr. h)	**Spacecraft Attitude Dynamics** **ديناميكا هيئة ســـفن الفضـــاء** Attitude dynamics and kinematics – kinematics and dynamics of no spinning – In space & environment.
A S – 602 (2 cr. h)	**Artificial Satellite Theory** **نظرية حركة الأقمار الصناعية** Numerical integration of orbits – Observability (rising and setting, visibility zone Shadow, brightness) – The critical inclination – Resonant orbits - Intermediaries – Frozen orbits – Special topics .
A S – 603 (2 cr. h)	**Modeling the Space Environment** **نمذجة البيئة الفضائية** Modeling: contaminations, solid particles, radiation, magnetic field, gravity.
A S – 604 (2 cr. h)	**Space Mission Analysis and Design (1)** **تحليل وتصميم رحلات الفضاء (١)** Introduction – Principles- Space segment – Launch section – Orbit strategy and adjustment - Lifetime – Communication base – Mission processes – Special topics.
A S – 605 (2 cr. h)	**Perturbation Theory** **طرق الإقـلاق** Straightforward expansion method, Lindsdt-Poincare, Renormalization procedure, Averaging principle, Canonical perturbations, Lie method and Lie series.
A S – 606 (2 cr. h)	**Sensor Theory** **نظرية المستشعرات** Sims sensors – Horizon sensors – Magnetometers – Star sensors gyroscopes - Momentum and reaction wheels – Magnetic coils – Gas jets – On board computers – Data transmission and processing – Data validation and adjustment – Special topics .
A S D – 607, 608 (2 cr. h / semester)	**Relativistic Celestial Mechanics (1) & (2)** **ميكانيكا سماوية نسـبوية (١)، (٢)** PN app. - Equations of motion of solar system – Natural and artificial bodies in the PN app. – Reference frames and astrometric measurements - The 4PN effects near to the earth in A.S. motion - Spin motion – Time systems – Special topics. .
A S D – 609 (2 cr. h)	**Space Communications** **اتصالات الفضـاء** Geostationary sat. –.Station keeping – C.I. sat. – Constellations and its design – Coverage types – GPS sat. – Mutual observability – Umbra and penumbra regions - Special topics.
A S D – 610 (2 cr. h)	**Space Mission Analysis and Design (2)** **تحليل وتصميم رحلات الفضاء (٢)** The process – characterization – evaluation – requirements – definition – geometry – orbit and constellation design – environmental considerations.
A S D – 611 (2 cr. h)	**Astronautics** **الملاحة الفضائية** Orbital systems (types, windows, tracks) – coverage and cnstellation design – reentry and landing – particular topics (solar sails, planet assisted trajectories, tethers) – space debris.
A S D – 612 (2 cr. h)	**Dynamical Systems** **النظم الديناميكيــة** Periodic solutions - Stability theory – Perturbation theory – Averaging – Relaxation oscillations – Bifurcation theory – Chaos-Hamiltonian systems .

A S D – 613 **(2 cr. h)**	**Optimal Space Trajectories** **المدارات المثلي** Introductory - Modeling and optimization of population systems – Functional optimization – Optimal transfere in a central G.F. – Optimal corrections - Time free orbital transferees – Time fixed orbital and rendezvous -Interplanetary rendezvous.
A S D – 614 **(2 cr. h)**	**Stability in Celestial Mechanics** **الاستقرار في الميكانيكا السماوية** Definitions of stability (Yaupon), applications. Hamiltonian stability, Periodic orbit, Poi care map, KAM Theory.
A S D – 615 **(2 cr. h)**	**Special Course** **مقرر خاص**
A S D – 616 **(2 cr. h)**	**Dynamic Attitude** **ديناميكا الهيئة** Single and dial biased stabilization – Attitude maneuvers in space – Momentum biased attitude stabilization – Reaction thruster attitude control – Special topics.
A S P – 617 **(2 cr. h)**	**Ionospheric Physics** **فيزياء الأيونوسفير** Photochemistry –layers of the ionosphere – chemistry of the ionosphere – electron density – ionospheric disturbances.
A S P – 618 **(2 cr. h)**	**Space Plasma (1)** **بلازما الفضاء (١)** Plasma in: Ionosphere, Radiation belts, Plasma sheet, Magneto tail – Special topics.
A S P – 619 **(2 cr. h)**	**Space Plasma (2)** **بلازما الفضاء (٢)** Physics of plasma – Plasma waves – Interactions – Space damage by plasma – Special topics.
A S P – 620 **(2 cr. h)**	**Space Radiation (1)** **الأشعة في الفضاء (١)** Types of space radiations – Sources of radiations – Radiation effects – radiation flux- LET – Radiation damage effects – Special topics.
A S P – 621 **(2 cr. h)**	**Space Radiation (2)** **الأشعة في الفضاء (٢)** Modeling: radiation dose effects - Physics of radiation effect - Special topics..
A S P – 622 **(2 cr. h)**	**Advanced Solar Physics (1)** **فيزياء شمسية متقدمة (١)** Solar wind – CME – Solar e. m. radiation – Solar activities - Solar flares – IP shocks- - High-Energy Particles: Acceleration Mechanisms, Space Weather – Special topics.
A S P – 623 **(2 cr. h)**	**The Sun-Earth Connections** **تأثيرات شمس-أرضية** The Earth's magnetic influence - Geomagnetic storms and terrestrial auroras - Danger blowing in the wind - The varying sun and its effect on the earth's atmosphere - The sun's role in warming and cooling Earth - Open topics.
A S P – 624 **(2 cr. h)**	**Special Course** **مقرر خاص**

	3- M. Sc. Degree in Meteorology (A MT)
A MT – 630 **(2 cr. h)**	**Physics of Cloud and Precipitation** **فيزياء السحب والهطول** Convection, Moist and dry convection, Large scale condensation, Cloud impacts, Cloud chemistry and formation.
A MT – 631 **(2 cr. h)**	**Physics of Air Sea Boundary Layer** **فيزياء الطبقة الحدية للهواء الملامس لسطح البحر** Diurnal variation of ABL, Tropical thermal circulation mechanism of vegetation- Climate feedback, Coupling to monsoon system coupling of musicales circulation.

A MT – 632 **(2 cr. h)**	**Advanced Atmospheric Dynamics** **ديناميكا الغلاف الجوى المتقدمة** Circulation at Mid. latitude, Trod wind analysis, Second order stability, Coupled models for atmospheric dynamics, Multi voluble dynamics, Filtration of noise.
A MT – 633 **(2 cr. h)**	**Synoptic Meteorology in the Tropics** **سينوبتك المدارى** Motion around equator, N-S motion, Trod wind inversion, Low latitude dynamics, Theory of motion transfer.
A MT – 634 **(2 cr. h)**	**Climatological Analysis** **تحليل مناخ** Climate models, Time scale analysis, Time sears analysis, Stochastic model analysis.
A MT – 635 **(2 cr. h)**	**Advanced Synoptic Analysis** **تحاليل متقدمة فى السينوتيك** Oscillation of pressure system, Mediterranean weather, Interaction between troposphere and stratosphere.
A MT – 636 **(2 cr. h)**	**Structure of Atmospheric System** **تركيب نظم الغلاف الجوى** Review of climatic fluctuations, Scale analysis of large-scale motion, Stability analysis, General circulation.
A MT – 637 **(2 cr. h)**	**Atmospheric Dispersion and Air Pollution** **التشتت والتلوث الجوى** Dispersion, Stack models, Emission from sources, Stability of flow, Puff models.
A MT – 638 **(2 cr. h)**	**Radiative Transfer** **الانتقال الاشعاعى** Theory of radiative transfer, Single scattering albedo absorption, Refractive index, Theory of heating and cooling in the atmosphere.
A MT – 639 **(2 cr. h)**	**Numerical Modeling in Meteorology** **نماذج عددية للأرصاد الجوية** Recent limited area models, Efficiency of integration and time schemes, Model stability, Model performance case studies.
A MT – 640 **(2 cr. h)**	**Atmospheric Turbulences** **اضطرابات الخلاف الجوى** Turbulent flow, Beckman spiral, high level turbulence, Reduction of turbulence, Global turbulence variability.
A MT – 641 **(2 cr. h)**	**Large Scale Atmospheric Circulation** **الدورة العامة للرياح** Midlatilude tropospheric varcability, El Nino sour Tehran Oscillation-Stratospheric variability, Stratosphere troposphere coupling, long term circulation models.
A MT – 642 **(2 cr. h)**	**Selected Topics** **موضوعات مختارة**

	4- M. Sc. Degree in Mathematical Astronomy (A M)
A M – 650 **& 651** **(2 cr. h)**	**Space Dynamics (1), (2)** **ديناميكا الفضـاء (١) ، (٢)** The geopotential – Extraterresterial gravitation – Nonconservative forces – The main problem of A.S. theory – The problem of three bodies – Lunar and interplanetary trajectors – Solar sails – The N body problem – Special topics.
A M – 652 **(2 cr. h)**	**Mathematical Methods** **طرق رياضية** Boundary layer problem (Linear and nonlinear) – Elliptic integrals and functions – Hamiltonian systems – Pertens in Hamiltonian systems – The method of van Zeipel – Lie series and transforms - Resonance phenomena - Special topics.
A M – 653 **(2 cr. h)**	**Celestial Mechanics** **ميكانيكا سـماوية** Tides and rotation – Spin – Orbit coupling - The disturibing function – Planetary oblateness – Seculer pertus. And the effect of control mass Resonant perturbations - Special topics.

A M – 654 **(2 cr. h)**	**Relativity and Cosmology** **نسبية وعلم الكون** PPN approximation – PN approx . – Gravitational waves – Black holes Gravitational lenses – The early universe – The inflationary universe – Matter in the universe – Formation of galaxies – Special topics.
A M – 655 & 656 **(2 cr. h / semester)**	**Cosmic Magnetic Fields (1) & (2)** **المجالات المغناطيسية في الكون (١) ، (٢)** Observations – Dynamo theory – Magnetic fields in the solar system and in the stars and galaxies – Magnetic fields in neutron stars and in pulsars – Special topics..
A M – 657 **(2 cr. h)**	**Selected Topics** **موضوعات مختارة**
A M – 658 & 659 **(2 cr. h / semester)**	**Theory of Orbits (1) & (2)** **نظرية المدارات (١) ، (٢)** Periodic and quasi-periodic motions – adiabatic variations – periodical solutions and resonance - Resonance – Poincre surfaces of section -. KAM theory - Nonuniformaties - Special topics. **Special Course:** to be determined
A M – 660 **(2 cr. h)**	**Field Theories** **نظرية المجال** Geometrical field Theories-Riemannian theories-Non- Riemannian theories-Quantum field theory -Quantum electrodynamics -Feynman diagrams-Renormalization-Path integrals -Gauge symmetries -The weak interaction -Non-Abelian gauge symmetries -Spontaneous symmetry breaking -The electroweak model -Quantum chromo dynamics -Quantum gravity -Kaluza-Klein models –Super symmetry.
A M – 661 **(2 cr. h)**	**Gravitational Radiation and Collapse** **الإشعاع والانهيار التثاقلي** Radiation from binary systems – Radiation from rotating masses – Radiation from collisions From non spherical collapse – Describtional gravitational collapse – Spherically symmetric gravitational collapse – Black holes – Structure of dwarf and superdwarf stars – Singularity – Particle creation – Special topics.
A M – 662 **(2 cr. h)**	**Special Course** **مقرر خاص** To be determined

	5- M. Sc. in Astrophysics (A A P)
A A P – 670 **(2 cr. h)**	**Advanced Astrophysics (1)** **فيزياء فلكية متقدمة (١)** Introduction – Radiation field – The equation of transfer – The equations of Statistical Equilibrium - Model Atmospheres.
A A P – 671 **(2 cr. h)**	**Astrochemistry** **كيمياء فلكية** Interstellar matter: observations – Cloud types - Spectra , Gas phase chemistry – Grain chemistry – Chemistry of shocked regions – Chemistry of PNe – Chemistry in HII regions – Chemistry in comets.
A A P – 672 **(2 cr. h)**	**Advanced Planetary Physics** **فيزياء الكواكب المتقدمة** Planetary properties – Planetary atmosphere: Thermal structure, Atmospheric composition, Cloud's photochemistry, Ionosphere, Atmospheric evolution – Interplanetary medium – Solar wind – Plasma – Magnetospheres of individual bodies – Waves in the magnetospheres.
A A P – 673 **(2 cr. h)**	**Stellar Dynamics** **ديناميكا نجمية** Binary systems - Star clusters – Galactic dynamics.
A A P – 674 **(2 cr. h)**	**Experimental Astronomy** **فلك تجريبي** Using telescopes, CCD–camera and spectrograph. - Observing the Sun -

	Observational techniques – Night observation – data Analysis.
A A P – 675 **(2 cr. h)**	**Stellar Astrophysics** **الفيزياء الفلكية للنجوم** Star formation – Nuclear reactions in stars – Stellar evolution – Giants – planetary nebulae - White dwarfs – Variable stars – Star clusters.
A A P – 676 **(2 cr. h)**	**Galactic Physics** **فيزياء المجرات** Galactic: Observations – Types – Structure – Distribution – Dynamics.
A A P – 677 **(2 cr. h)**	**Special Course** **موضوعات مختارة**
A A P – 678 **(2 cr. h)**	**Extra-Galactic Systems** **نظم المجرات الخارجية** Observation of galaxies, Properties of galaxies, Masses of galaxies, ISM in galaxies, The chemical evolution of galaxies, Galaxies in the universe, Galaxy interactions, Clusters and super clusters, Formation and evolution of galaxies, The early galaxies - Seyfert galaxies - Radio galaxies - Quasars – Interacting galaxies -Expansion of the universe - Radiation in the universe– Dark matter.
A A P – 679 **(2 cr. h)**	**Space Physics** **فيزياء الفضاء** Introduction to space weather – Earth's magnetic field - Physics of the upper polar atmosphere – Asteroids and space debris – Comets – Meteoroids – physics of the space near Earth - Modeling the upper atmosphere – Modeling: the Earth's magnetosphere and gravitational fields – Solar radiation and solar winds.
A A P – 680 **(2 cr. h)**	**Astrometry Techniques** **تقنيات القياسات الفلكية** Elements – Galactic system statistic – Stellar motion – Luminosity – Spectral type distribution – Stellar distribution – Galactic rotation.
A A P – 681 **(2 cr. h)**	**Radio Astronomy** **فلك راديوي** Introduction – Radio Telescopes – Signal detection and noise – Galactic continuum radiation – Interstellar matter – Galactic dynamics – Stars – Pulsars – Radio galaxies and Quasars - Cosmic microwaves – Gravitational lensing - X-ray astronomy – Gamma ray astronomy – UV and EUV astronomy – Optical and IR astronomy from space.
A A P – 682 **(2 cr. h)**	**Statistical Astronomy** **فلك إحصائي** Proper motion – Atrometry data – Dynamics of star clusters – Stability and homogeneity – Time of relaxation – Mean free path – Galactic rotation – Stellar systems.
A A P – 683 **(2 cr. h)**	**Special Course** **موضوعات مختارة** To be determined
A A P – 684 **(2 cr. h)**	**Advanced Astrophysics (2)** **فيزياء فلكية متقدمة (٢)** Introduction – The solar spectrum – LTE and non LTE line formation – Radiative transfer in moving Atmospheres – Stellar winds.

8- Entomology Department
A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(E)	Diploma (500)	1- Medical Insects	(EM)
		2- Insect Environmental Informatics	(EEI)
	M.Sc. (600)	1- Insect Ecology	(EE)
		2- Medical and Vetrinary insects	(EM)
		3- Insect control	(EC)
		4- Insect Physiology and Cell Biology	(EPC)
		5- Insect structure and Growth Biology	(ES)
		6- Insect Biochemistry and Molecular Sciences	(EB)
		7- Insect Taxonomy and Classification	(ET)
	Ph.D. (700)	1- Insect Ecology	(EE)
		2- Medical and Vetrinary insects	(EM)
		3- Insect control	(EC)
		4- Insect Physiology and Cell Biology	(EPC)
		5- Insect structure and Growth Biology	(ES)
		6- Insect Biochemistry and Molecular Sciences	(EB)
		7- Insect Taxonomy and Classification	(ET)

1- Diploma in Medical Insects (EM)

Code	Course Number	Course Case	CR. Hours
(EM)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	EM501	Morphology and Taxonomy of medically important insects	2	1	2	2-3	
	EM502	Diseases Transmitted by insects	2	1	2	2-3	
	EM503	Microtechniques (Practical Course)		2		4	
	EM504	Microbiology	1	1	2	2-3	
Second	EM505	Parasitology	2	1	2	2-3	
	EM506	Control of Medically important insects	2	1	2	2-3	
	EM507	Diagnosis and Treatment of Diseases Transmitted by Insect and Arthropods in the Tropics	1	1	2	2-3	
	EM508	Immunology	2		2		
		The Total Cr.h. Required	12	8			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	EM509	Epidemiology	1	1	2	2-3	
	EM510	Pathology	1	1	2	2-3	
Second	MS676	Biostatistics	2		2		From Ststist . Math.
	EM511	Data analysis	2		2		
		The Total Cr.h. Required	3	1			

Note:- the code No. of the branch: from 501 to 519
From 512to 519 are codes No. for adding new courses

2- Diploma in Insect Environmental Informatics (EEI)

Code	Course Number	Course Case	CR. Hours
(EEI)	The candidate studies (8) courses in table (1)	Compulsory	20
	The candidate chooses (1) course / semester from table (2)	Elective	4
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	EEI 520	Ecosystem	2	1	2	2-3	
	EEI 521	Population Dynamics	2		2		
	EEI 522	conservation Biology & Environmental Management	2	1	2	2-3	
	EEI 523	Evolution & Biodiversity	2		2		
Second	EEI 524	Community Ecology	2		2		
	EEI 525	Environmental Toxicology	2	1	2	2-3	
	EEI 526	Taxonomy & Morphology & Anatomy	2	1	2	2-3	
	EEI 527	Recent Trends In Insect Control	1	1	2	2-3	
		The Total Cr.h. Required	15	5			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Thr	Pr	Th	Pr	
First	EEI 528	Information Theory	2		2		
	EEI 529	General Ecology	1	1	2	2-3	
Second	EEI 530	Climatology	1	1	2	2-3	
	MS676	Biostatistics	2		2		From Ststist Math.
		The Total Cr.h. Required	4				

Note:- the code No. of the branch: from 520 to 539
From 531to 539 are codes No. for adding new courses

1- M. Sc. Degree in Insect Ecology (EE)

Code	Course Number	Course Case	CR. Hours
(EE)	The candidate study (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E 601	Fundamentals of Scientific Research	2	2		Also offered by all
	MS 676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	EE 610	Ecosystems and Community Ecology	2	2	Also offered by Control	
	EE 611	Population Dynamics & Bahavioral Ecology	3	3		
	EE 612	Insect Taxonomy and Classification	3	3		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	EE 613	Conservation Biology & Environmental Management	2	2	
	EE 614	Ecological Succession and Climatology	2	2	
Second	EE 615	Environmental Health	2	2	
	EE 616	Insect Morphology & Biodiversity	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 610 to 619
From 617 to 619 are codes No. for adding new courses

2- M. Sc. Degree in Medical and Veterinary Insects (EM)

Code	Course Number	Course Case	CR. Hours
(EM)	The candidate study (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E 601	Fundamentals of Scientific Research	2	2		Also offered by all gps
	MS676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	EM 620	Microbiology	2	2		
	EM 621	Parasitology	3	3		
	EM 622	Insects and some Arthropods of medical and veterinary importance	3	3		
		The Total Cr.h. Required	12	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	EM 623	Epidemiology and Molecular Biology	2	2	
	EM 624	Distribution of Infectious Diseases	2	2	
Second	EM 625	Arthropod-Vertebrate Pathogen Relationships	2	2	
	EE 615	Environmental Health	2	2	Also offered by Env. & Med.
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 620 to 629
From 626 to 629 are codes No. for adding new courses

3- M. Sc. Degree in Insect control (EC)

Code	Course Number	Course Case	CR. Hours
(EC)	The candidate study (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E 601	Fundamentals of Scientific Research	2	2		Also offered by all gps
	MS 676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	EC 630	Microbial Control	2	2		
	EC 631	Recent Trends in Insect Control	3	3		
	EC 632	Toxicology Insecticide, Metabolism and Resistance	3	3		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	EC 633	Integrated Pest Management	2	2	
	EC 634	Insect Control by Radiation	2	2	
Second	EE 610	Ecosystems and Community Ecology	2	2	Also offered byEnviron. & Med.
	EE 615	Environmental Health	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 630 to 639
From 635 to 639 are codes No. for adding new courses

4- M. Sc. Degree in Insect Physiology and Cell Biology (EPC)

Code	Course Number	Course Case	CR. Hours
(EPC)	The candidate study (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E 601	Fundamentals of Scientific Research	2	2		Also offered by all gps
	MS 676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	EPC 640	Integrated Performance In Insect Life	2	2		
	EPC 641	Insect Ethology	2	2		
	EPC 642	Physiology of Insect Development	2	2		
	EPC 643	Insect Endocrinology	2	2		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	EPC 644	Insect Immunology	2	2	
	EPC 645	Cytology and Radiation effects on the Cell	2	2	
Second	E B 664	Biochemical Genetics	2	2	Also offered by Biochm.
	E B 666	Biochemical and Physiological Ecology of Insects	2	2	
	EPC 646	Selected Topics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 640 to 649
From 647 to 649 are codes No. for adding new courses

5- M. Sc. Degree in Insect Structure and Growth Biology (ES)

Code	Course Number	Course Case	CR. Hours
(ES)	The candidate study (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E 601	Fundamentals of Scientific Research	2	2		Also offered byall
	M S 676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	ES 650	Ultrastructure of Insect Cells	2	2		
	ES 651	General Biology	3	3		
	EB 660	Insect Biochemistry	3	3	Also offered byBiochem.	
		The Total Cr.h. Required	12	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ES 652	Advanced Histological Techniques, Tissue Culture & Molecular Analysis	2	2	
	ES 653	Insect Morphology	2	2	
Second	ES 654	Embryonic Endocrinology	2	2	
	ES 655	Diapause & Photoperiodism	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 650 to 659
From 656 to 659 are codes No. for adding new courses

6- M. Sc. Degree in Insect Biochemistry and Molecular Sciences (EB)

Code	Course Number	Course Case	CR. Hours
(EB)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E 601	Fundamentals of Scientific Research	2	2		Also offered by all gps
	MS676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	EB 660	Insect Biochemistry	3	3	Also offered by Struct.	
	EB 661	Biochemical Toxicology of Insects	3	3		
	EB 662	Insect Nutrition Enzymes & Energy Metabolism	2	2		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	EB 663	Histochemistry of Ultrastructure of Insects	2	2	
	EB 664	Biochemical Genetics	2	2	Also offered by Physiol. & Cell Biol.
Second	EB 665	Insect Biotechnology	2	2	
	EB 666	Insect Environmental Biochemistry and Physiology			Also offered by Physiol. & Cell Biol.
	EB 667	Selected Topics	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 660 to 669
From 668 to 669 are codes No. for adding new courses

7- M. Sc. Degree in Insect Taxonomy and Classification (ET)

Code	Course Number	Course Case	CR. Hours
(ET)	The candidate studies (6) courses in table (1)	Compulsory	14
	The candidate chooses (1) course / semester from table (2)	Elective	4
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks	
First	E601	Fundamenals of Scientific Research	2	2		Also offered by all gps
	MS 676	Biostatistics	2	2	From Statist. Math.	
	CA 626	Instrumental Microanalysis	2	2	From analytical Chem.	
Second	ET 670	Theory and Practice of Taxonomy	3	3		
	ET 671	New Trends in Taxonomy	3	3		
	ET 672	Biodiversity	2	2		
		The Total Cr.h. Required	14	-		

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	ET 673	Insect Embryology and Metamorphosis	2	2	
	ET 674	Zoogeography	2	2	
Second	ET 675	Morphology and Ultrastructure of Insects	2	2	
	ET 676	Flora	2	2	
		The Total Cr.h. Required	4	-	

Note:- the code No. of the branch: from 670 to 679
From 677 to 679 are codes No. for adding new courses

1- Ph. D. Degree in Insect Ecology (EE)

Table (1)

Code	Course Number	Course Case	CR. Hours
(EE)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph. D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 702	Scientific Design & Data Analysis	2	2	
	E 703	Recent Trends In Entomology	2	2	Also offered by all gps
	EE 710	Selected Topics	2	2	
	EE 711	Advanced Medical Entomology	2	2	
Second	EE 712	Behavioral Ecology	2	2	
	EE 713	Insect Adaptations	2	2	
	EE 714	Biological Clocks	2	2	Also offered by Med. Cont. & Physiol.
	EE 715	Seminar	2	2	
	EE 716	Environmental Management	2	2	Also offered byMed. &Cont.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 710 to 719
From 717 to 719 are codes No. for adding new courses

2- Ph. D. Degree in Medical and Vetrinary Insects (EM)

Table (1)

Code	Course Number	Course Case	CR. Hours
(EM)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 702	Scientific Design & Data Analysis	2	2	
	E 703	Recent Trends in Entomology	2	2	Also offered by all gps
	EM720	Selected Topics	2	2	
	EM721	Advanced Medical Entomology	2	2	
Second	EM722	Forensic Entomology	2	2	
	EM723	Public Health Insects	2	2	
	EM724	Seminar	2	2	
	EE714	Biological Clocks	2	2	Also offered by Env., Cont. & Physiol.
	EE716	Environmental Management	2	2	Also offered by Env.& Cont.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 720 to 729
From 725 to 729 are codes No. for adding new courses

3- Ph. D. Degree in Insect Control (EC)

Table (1)

Code	Course Number	Course Case	CR. Hours
(EC)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 702	Scientific Design & Data Analysis	2	2	
	E 703	Recent Trends In Entomology	2	2	Also offered by all gps
	EC730	Selected Topics	2	2	
	EC731	Pest Management	2	2	
Second	EC732	Insect Growth Regulators	2	2	
	EC733	Chronotoxicology	2	2	
	EC734	Seminar	2	2	
	EE 714	Biological Clocks	2	2	Also offered by Med. & Environ.
	EE 716	Environmental Management	2	2	Also offered by Med. Environ. & Physiol.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 730 to 739
From 735 to 739 are codes No. for adding new courses

4- Ph. D. Degree in Insect Physiology and Cell Biology (EPC)

Table (1)

Code	Course Number	Course Case	CR. Hours
(EPC)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 702	Scientific Design & Data Analysis	2	2	
	E 703	Recent Trends in Entomology	2	2	Also offered by all gps
	EPC740	Selected Topics	2	2	
	EPC741	Cellular & Molecular Biology	2	2	Also offered by Struct.
Second	EPC742	Genetics and Genetic Engineering	2	2	Also offered by Struct.
	EPC743	Advanced Cell Biology	2	2	
	EPC744	Seminar	2	2	
	EE 714	Biological Clocks	2	2	Also offered by Med, Env. &Cont.
	ES 754	Insect Ultrastructure	2	2	Also offered by Struct. & Biochem.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 740 to 749
From 745 to 749 are codes No. for adding new courses

5- Ph. D. Degree in Insect Structure and Growth Biology (ES)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ES)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 702	Scientific Design & Data Analysis	2	2	
	E 703	Recent Trends in Entomology	2	2	Also offered by all gps
	ES 750	Selected Topics	2	2	
	EPC 741	Cellular & Molecular Biology	2	2	Also offered byPhysiol
Second	ES 751	Histological Techniques and Tissue Culture	2	2	Also offered by Biochem.
	ES 752	Seminar	2	2	
	ES 753	Insect Ultrastructure	2	2	Also offered by Physiol. & Biochem.
	EPC 742	Genetics and Genetic Engineering	2	2	Also offered by Physiol.
	EB 763	Molecular Analysis	2	2	Also offered by Biochem.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 750 to 759
From 754 to 759 are codes No. for adding new courses

6- Ph. D. Degree in Insect Biochemistry and Molecular Sciences (EB)

Table (1)

Code	Course Number	Course Case	CR. Hours
(EB)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 702	Scientific Design & Data Analysis	2	2	
	E 703	Recent Trends in Entomology	2	2	Also offered by all gps
	EB 760	Selected Topics	2	2	
	EB 761	Biotechnology	2	2	
Second	EB 762	Advanced Histochemistry	2	2	
	EB 763	Molecular Analysis	2	2	Also offered by Struct.
	EB 764	Seminar	2	2	
	ES 752	Histological Techniques and Tissue Culture	2	2	Also offered by Physiol & Struct.
	ES 754	Insect Ultrastructure	2	2	Also offered by Struct.
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 760 to 769
From 765 to 769 are codes No. for adding new courses

7- Ph. D. Degree in Insect Taxonomy (ET)

Table (1)

Code	Course Number	Course Case	CR. Hours
(ET)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	B&E 701	Advanced Molecular Biology	2	2	Also offered by Botany
	B&E 701	Scientific Design & Data Analysis	2	2	
	E703	Recent Trends in Entomology	2	2	Also offered by all gps
	ET 770	Phylogeny and Evolution	2	2	
	ET 771	Selected Topics	2	2	
Second	ET 772	Advanced Insect Taxonomy	2	2	
	ET 773	Microscopic Anatomy	2	2	
	ET 774	Behavioral Ecology	2	2	
	ET 775	Insect Physiology and Biochemistry	2	2	
	ET 776	Microtechnique In Taxonomy	2	2	
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 770 to 779
From 777 to 779 are codes No. for adding new courses

B- Course contents for Diploma

Code No.	Course name and contents
	1- Diploma in Medical Insects (E M)
E M - 501 (3 cr. h) (2 Th - 1 Pr)	**Morphology and Taxonomy of Medically Important Insects** **مورفولوجى وتصنيف الحشرات الطبية** Complete morphological description, taxonomic position and biological studies of arthropods and insect vectors of human and animal disease. **Practical Course** Description and drawing of specimens of medically important insects species of taxonomic keyed for the identification of insects of medical importance.
E M – 502 (3 cr. h) (2 Th - 1 Pr)	**Diseases Transmitted by Insects** **الأمراض التى تنقلها الحشرات** Nomination of the diseases and causative organisms transmitted by insects and arthropods to human and animals-Description of these diseases in both the insects and the hosts. **Practical Course:** Exhibition of films and slides to show these diseases.
E M – 503 (2 cr. h = Pr)	*Microtechnique (Practical Course)* *تقنيات دقيقة (مقرر عملى)* Dissection and colonization of insects and orthrophods (ticks and sites) of medical importance.
E M – 504 (2 cr. h) (1 Th - 1 Pr)	**Microbiology** **ميكروبيولوجي** Microbial world. General Microbiology - Classification of Microbes – Systematic Medical Microbiology - Clinical microbiology – Different methods used for studying and cultivat-ing of microorganisms – Laboratory diagnosis of microbial pathogens. **Practical Course** Differentiation between the different species of bacteria training for the culture of bacteria using different media.
E M – 505 (3 cr. h) (2 Th - 1 Pr)	**Parasitology** **علم الطفيليات** Parasites of human, and animals transmitted by insects and arthropots –Systematic position Biology – Laboratory diagnosis of different parasites transmitted by characteristics insects and arthropods. Practical Course Microscopical studies to differentiate between the different parasites causing diseases – presentation of slides projector for these parasites.
E M – 506 (3 cr. h) (2 Th - 1 Pr)	Control of Medically Important Insects مكافحة الحشرات ذات الاهمية الطبية Different means of control insects and arthropods. Different chemical compounds – ways applied for their use Practical Course Description of the different equipments used for insect control . Field application to control one of the most prevalent medical insect.
E M – 507 (2 cr. h) (1 Th - 1 Pr)	Diagnosis and Treatment of Diseases Transmitted by Insects and Arthropods in the Tropics تشخيص وعلاج الامراض المنقولة بواسطة الحشرات والمفصليات فى المدارات

	Overall description either externally or internally of the diseases and the simple ways to treat these diseases transmitted by the insects and arthropods in the tropics. Practical Course Uses of the different applied methods (microscopic ones) to describe the parasites.
E M – 508 **(2 cr. h)**	**Immunology** **علم المناعة** Defense mechanisms of the host-Barries at the portal of entry-Systems involved in immune defences-Nonspecific immune reactions of the body. Characteristics of antibodies structure, function classes-the nature of antivirus and the hosts response to them-the origin of diversity and specificity in the immune response**.**
E M – 509 **(2 cr. h)** **(1 Th - 1 Pr)**	**Epidemiology** **وبائيات** Introduction and Definition- Principles of general Epidemiology-Mechanism of transmission of the different diseases-Branches of epidemiological - Practical Epidemiology. **Practical Course** Studies of epidemiological characters analytical studies and experimental studies. Analytical studies of some epidemic diseases in Egypt and world wide.
E M – 510 **(2 cr. h)** **(1 Th - 1 Pr)**	**Pathology** **علم الباثولوجيا** Pathological effects of trapical climates: insects bites and stings, pathology of diesases transmitted by insects and afthropods of medical imprteuce-synpotoms. **Practical Course** Preparation of the specimens for clinical studies.
E M – 511 **(2 cr. h)**	**Data Analysis** **تحليل نتائج** Mathematical analyses of the data obtained through the biological experiments
M S – 676 **(2 cr. h)**	**Biostatics** **احصاء حيوى**rom M. Sc. in Statistical Mathematics

	2- Diploma in Environmental Informatics in Insects (E EI)
E EI – 520 **(3 cr. h)** **(2 Th - 1 Pr)**	**Ecosystems** **علم الأنظمة البيئية** Concept of the ecosystem - Characters of the ecosystem - Ecosystem theory - Ecosystem energetics - Ecosystem as an information system – Biogeo-chemical cycles - Environmental health and Environmental Enginering. **Practical Course** Primary Producers including zooplanktons and phyto-planktons trophio levels-Food chains-food webs-Laboratory training on the design of food webs and food chains.
E EI – 521 **(2 cr. h)**	**Population Dynamics** **ديناميكية الاهلات** Definitions of a population -Factors affecting populations - Life ables - Population modeling - Competetion and coexistence - Predation, Parasitism and herbivory.

E EI – 522 **(3 cr. h)** **(2 Th - 1 Pr)**	**Conservation Biology & Environmental Management** **حفظ الانواع وادارة الانظمة البيئية** Species concept - Speciation theories - Extinction - Management of Ecosystems - Protectorates (Design and management) - Conservation of natural resources (International Agreements) - Environmental impact assessment studies (Methods of study and report preparation). **Practical Course** Field studies on protected ecosystems including protectorate design, different types of ecosystems in Egypt including desert ecosystem. Wetland ecosystems. Agro-ecosystems and aquatic ecosystems.
E EI – 523 **(2 cr. h)**	**Evolution & Biodiversity** **تطور وتنوع حيوى** Darwinism - Modern theories in evolution - Evolution of insect taxa - Diversity (Gne mutation - Point mutation) - Effect of population size (bottle neck) - Natural selection and speciation.
E EI – 524 **(2 cr. h)**	**Community Ecology** **علم بيئة المجتمعات** Concept of community - Diversity Indices - Diversity Gradients - Stability - Migration - Biogeography - Behavior and Optimum foraging theory.
E EI – 525 **(3 cr. h)** **(2 Th - 1 Pr)**	**Environmental Toxicology** **علم السموم البيئية** Water Pollution (Sources - impacts - avoidance - Control) - Air Pollution (Sources - impacts - avoidance - Control) - Soil Pollution (Sources - impacts - avoidance - Control) - Biogeochemical cycls and biological accumulation - Enviormental impact assessment studies - Enviormental health and landscape ecology. **Practical Course** Environmental monitoring equipments, laboratory experiments on the toxicity of pesticides and herbicides on non target organisms- Site seeing of highly polluted localities in Egypt. Applications of chemical pesticides and herbicides in the field.
E EI – 526 **(3 cr. h)** **(2 Th - 1 Pr)**	**Taxonomy & Morphology & Anatomy** **تصنيف ومورفولوجيا وتشريح** Taxonomy and Scientific nomenclature - Insect orders and families - Toxonomic keys - General Morphology of insects (head - thorax - abdomen) - Modifications in different taxa - Internal Morphology and histology of body systems and organs. **Practical Course:** Insect orders Families of Agricultural and Medical significance-Families of Natural enemies (insect predators and Parasites). Insect morphology and Anatomy.
E EI – 527 **(2 cr. h)** **(1 Th - 1 Pr)**	**Recent Trends in Insect Control** **الاتجاهات الحديثة فى مكافحة الحشرات** Genetic Tactic of Insect Control - Photoinsecticides - Hormones & Phermones – ICR - Plant extracts **Practical Course** Making cultures of entomophagous pathogenic microorganisms (Bacteria and Fungi) and Nematods – Raising Insect prodators and parasites – Field studies on the applications of pathogen and other natural enemies.
E EI – 528 **(2 cr. h)**	**Information Theory** **نظرية المعلومات** Information theory - Bioinformatics (Concept and Application) - Enviromental Informatics - Applications of information theory in system ecology - Applications of information theory in Molocular biology and Genetics - Applications of information theory in Evolution.
E EI – 529 **(2 cr. h)**	**General Ecology** **علم البيئة العام**

(1 Th - 1 Pr)	Introduction (Origin and Concept of Ecology) - Evolutionary Ecology - Behavioral Ecology - Population Ecology - Community Ecology - Applied Ecology. **Practical Course** Ecological groups including Benthic animals surface dwellers wetland animals desert species….. etc Trophic relationsships e.g. Mutualism, commensalism predation parasitism ….etc Field studies on the seasonal changes in the populations of selected species
E EI – 530 **(2 cr. h)** **(1 Th - 1 Pr)**	**Climatology** **الطقس والارصاد** Climate and weather - Climate change: Greehouse effect - Agricultural Emissions - Water resousces and sea-level Rise - Regions at Risk. **Practical Course:** Study of Meteorological instruments e.g. Paragraphs thermographs ….etc and recent digital meteorological instruments Visits to meteorological stations weather maps
M S – 676 **(2 cr. h)**	**Biostatistics** **احصاء حيوى** From M. Sc. In Statistical Mathematics

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Insect Ecology (E E)
E – 601 **(2 cr. h)**	**Fundamentals of Scientific Research** **اساسيات بحث علمي** Choosing a research problem – Using the library – First steps in treating data – Writing the Paper – Making the paper interesting – Correcting the typewritten copy – Good form and Usage – Tables – Illustrations – Prepublication Review – Bibliography - Index
M S – 676 **(2 cr. h)**	**Biostatistics** **احصاء حيوى** From M. Sc. in Statistical Mathematics.
C A – 626 **(2 cr. h)**	**Instrumental Microanalysis** **أجهزة تحاليل دقيقة** From M. Sc. in Analytical Chemistry.
E E – 610 **(2 cr. h)**	**Ecosystems and Community Ecology** **أنظمة بيئية ومجتمعات حشرية** Concept of Ecosystem- Components of Ecosystems – Biogeochemical Cycles- Energy Flow and Trophic Levels- Concept of Community – structure of the community – Interactions in the community – Interrelationships in communities
E E – 611 **(3 cr. h)**	**Population Dynamics and Behavioral Ecology** **ديناميكية اهلات وسلوك حيوان** Concept of a population – colonization – population growth – key Factor analysis – Models and Modeling – Meaning of animal behavior – optimum Foraging theory – living in groups- Altruism – Evolution of animal behavior
E E – 612 **(3 cr. h)**	**Insect Taxonomy and Classification** **تصنيف وتقسيم الحشرات** Species Concept - Speciation - extinction - zoological nomenclature - biogeography - Insect evolution - higher classification of insets - scientific tools in insect classification
E E – 613 **(2 cr. h)**	**Conservation Biology and Environmental Management** **حفظ أنواع وادارة بيئة** Ecosystem theory – speciation- Extinction – protection of threatened species – theory and design of protected Ecosystems – Environmental engineering – landscape Ecology – Ecosystem management
E E – 614	**Ecological Succession and Climatology** **تتابع بيئى ومناخ**

(2 cr. h)	History of life on the earth- Theory of continental drift – Evolution theories – biogeography – Meaning of Ecological succession – Ecological succession in aquatic habitats – Ecological succession in terrestrial habitats – principles of climatology – change in earth climate.
E E – 615 **(2 cr. h)**	**Environmental Health** **صحة بيئة** Pollution – types of pollutants – impact of human activities on the environmental health – concepts of environmental health- Environmental Engineering – landscape engineering – Environmental Ethics – laws and regulation of Environmental protection.
E E – 616 **(2 cr. h)**	**Insect Morphology and Biodiversity** **مورفولوجيا وتنوع الحشرات** Polymorphism and morphological changes on the species level - Adaptation to seasonal changes - migration - diapause - Quiescence - Morphological adaptations for seasonal changes - Insect diversity in different habitats - biodiversity measurements

	2- M. Sc. Degree in Medical & veterinary Insect (E M)
E M – 620 **(2 cr. h)**	**Microbiology** **ميكروبيولوجى** Microbial world. Host-parasite relationships. General properties of viruses. Arthropod-borne viruses. Bacterial cell characteristics. Major groups of bacteria. Mycoplasma, spirochetes, and rickettsia. Fungi structures and groups. Infection and epidemiology of selected pathogens causing indigenous diseases in Egypt. Cultivation of microorganisms. Laboratory diagnosis of microbial pathogens.
E M – 621 **(3 cr. h)**	**Parasitology** **علم الطفيليات** Parasites of human, animals, plants, and insects. Characteristics, biology, infection, and epidemiology of parasitic protozoans, worms and insects, of common occurrence in Egypt. Protozoa: Rhizopodea, Telosporea, Toxoplasmea, and Ciliatea. Platyhelminthes: Trematoda, and Cestoidea. Nematoda: Aphasmidia, and Phasmidia. Parasitic insects. Laboratory diagnosis of parasitic infections.
E M – 622 **(3 cr. h)**	**Insects and Some Arthropods of Medical and Veterinary Importance** **الحشرات وبعض المفصليات ذات الاهمية الطبية والبيطرية** Role of Insects in the disease transmissions to human and animals – Mechanical transmission of diseases – Biological transmission of diseases (Propagative transmission – Cyclopropagative transmission – Cyclodevelop-mental transmission – Transiovarian. Transtidial transmission)
E M – 623 **(2 cr. h)**	**Epidemiology and Molecular Biology** **وبائيات وبيولوجيا جزيئية** Introduction and Definition – Some parasitological Terminology – Principles of general Epidemiology – Mechanism of transmission of the different diseases – Branches of Epidemiology – Epidemiological static's, Epidemiological dynamics and Epidemiological parameters – Practical Course Epidemiology. **Mutations:** Types of Gene Mutations. Causes of Mutations and DNA repair Mechanisms. Regulation of Gene Expression in Bacteria. Regulation of Gene Expression in Eukaryotes. Recombinant DNA. Generating Recombinant DNA. Isolating specific Recombinant clones. Analysing and using cloned Genes. Transformation in higher organisms. DNA sequencing. Reguirements for DNA sequencing. Steps of DNA sequencing.

E M – 624 **(2 cr. h)**	**Distribution of Infectious Diseases** **توزيع الأمراض المعدية** **World wide distributions of:** Insect vectors. Parasites. Infectious diseases - Annual reports of infectious diseases. World Health organization (WHO) and Center for Disease and control preventions (CDC).
E M – 625 **(2 cr. h)**	**Arthropod –Vertebrate Pathogen Relationships** **علاقة الحشرات بمسببات الأمراض** Role of the Body wall structures of the Arthropod and pathogens transmission – Role of The feeding Apparatus in the mechanical transmission of pathogens – Associated Aspects of the Digestive tract (Mid-gut) – Role of Insect peritrophic matrix. In the mechanical limitation of biological of pathogens – Life cycles of pathogens through Arthropod-vertebrate Hosts – Effect of climatic of behavionral ecology in the relationship among Arthropod-vertebrat and pathogens.

	3- M. Sc. Degree in Insect Control (E C)
E C – 630 **(2 cr. h)**	**Microbial Control** **المكافحة الميكروبية** Introduction; History: Biology and dynamics of pathogens - Epizootiology of insect pathogens – Bacterial pathogens of insects – Viral pathogens – Fungal pathogens – Nematodes – Population regulation theory end implications for microbial control – Augmentation of Pathogens and nematodes – Integration of microbial control into pest management system – Insect control with transgenic plants-expressing Bt-crystal proteins: expressing fungal chitinase protein - expressing fungal cholestrol oxidas proteins.
E C – 631 **(3 cr. h)**	**Recent Trends in Insect Control** **الاتجاهات الحديثة فى مكافحة الحشرات** Genetic Tactic of Insect Control – Photoinsecticides - Hormones & Phermones – IGR - Plant extracts.
E C – 632 **(3 cr. h)**	**Toxicology, Insecticide Metabolism and Resistance** **سمية وأيض المبيدات والمناعة** Major classes of insecticides, and other toxins and pollutants. Routes of the hazardous xenobiotics into, and fate in, living organisms and ecosystems. Metabolism and effect of hazardous xenobiotics on living organisms (Physiological effects. Biochemical effects. Interactive effects). Biomarkers. Effects of hazardous xenobiotics on populations and communities: Changes in population density. Evolution of resistance. Changes in communities and ecosystems. Biomarkers in populations. Basic techniques and procedures. Noninfectious diseases: Mechanical injuries. Injuries due to physical agents. Injuries due to poisons. Injuries due to parasitization or infestation by other insect or arthropod. Infectious dieases: Basic definitions and parameters.
E C – 633 **(2 cr. h)**	**Integrated Pest Management (Advanced Course)** **السيطرة المتكاملة على الآفات (مقرر متقدم)** The pest management concept – Ecological aspects of Pest management – Economics of pest management – Pest management theory and practice-Tactics of pest management – Insect pest management programs.
E C – 634 **(2 cr. h)**	**Insect Control by Radiation** **مكافحة الحشرات بالاشعاع** I- Radioisotopes and radiation in Entomology. A- Tagging insect with radioisotopes , 1- Population studies , 2- Biological control , 3- Insect transmission of plant diseases ,4- Insect physiology, 5- In biosynthesis , 6- Insecticidal control,

	B- Insect control by Irradiation, The use of radiation for insect control, A- DIRECT CONTROL, B- INDIRECT CONTROL (sterile-male- tecchique) * Requirements of the successful application of the sterile-male release technique for insect control, *Biological information needed in the sterile-male method of insect control, 1- Population density., 2- Distribution of a species., 3- Flight range, 4- Mating behaviour., (*Component of sterility , (A) Infecundity , (B) Inability to mate , (C) Sperm inactivation , (D) Dominant lethal mutation , (E) Aspermia, (*Type of sterility desired for insect control Programs , The applications , (A) Insects of medical importance, (B) Insects of Agricultural importance, (C) Household insects,(D) Stored -product insects , (* Considerations affecting the success of future field trials).

	4- M. Sc. Degree in Insect Physiology and Cell biology (E PC)
E PC – 640 (2 cr. h)	**Integrated Performance in Insect Life الاداء الوظيفى التكاملى فى حياة الحشرات** Performance of support and movement systems. Neuromuscular performance Coordination between maintenance systems: feeding, digestion, absorption, transport, ventilation, excretion, and reproduction. Water balance Physiological role of the different systems in homeostatic state of the insect life. Physiological adaptations in specialized modes of life: Parasitic life, aquatic environment…etc.
E PC – 641 (2 cr. h)	**Insect Ethology علم السلوك والتوجيه والطبائع فى الحشرات** Sensation to the environment, conduction, integration, and response. Orientation mechanisms. Kinesis. Taxes. Coordinated behavior. Insect-insect interactions. Semiochemical mediated behavior. Chemical modifying insect behavior. Allelopathy. Learning. Instincts. Posture and pattern. Feeding behavior. Feeding habits. Parasitism. Predatism. Host finding. Competition. Courtship and mating. Brood care and social life. Migration and dispersal. Latitude and altitude distribution. Behavioral photoperiodism. Circadian rhythms. Adult emergence and swarming. Photoperiodism and growth, diapause, and ecological adaptation.
E PC – 642 (2 cr. h)	**Physiology of Insect Development فسيولوجيا التطور والنمو فى الحشرات** Development of the central nervous system, sensilla, muscles, neuromusculature, heart, tracheal system, Malpighian tubules, fat cells, salivary and silk glands. Developmental mechanisms and differentiation: Determination (commitment to a type of differentiation). Differentiation: (building cell phenotype). Causes of differentiation. Molecular aspects of insect sex determination. Morphogenesis (organization of cells into functional units). Single- cell movements. Moving cells and extracellular substances. Cell population movements. Localized relative growth. Localized cell death. Deposition of extracellular matrix. Pattern formation and regulatory genes at work. Gene control systems affecting development. Gene regulation in imaginal disc development during metamorphosis. Genes involved in postembryonic cell proliferation.
E PC – 643 (2 cr. h)	**Insect Endocrinology علم الغدد الصم فى الحشرات** Mechanisms and mode of action of insect hormones. Role of ecdysteroids and juvenile hormones in embryonic development. Neuroendocrine regulation of ecdysis. Prothoracicotropic hormone. Edysteroid chemistry and biochemistry. Ecdysteroid agonists and antagonists. Edysteroid receptors. Juvenile hormones. Hormonal control of reproductive processes. Hormonal

	control of homeostasis. Circadian organization of the endocrine system. Hormonal control of diapause. Endocrine control of polyphenism. Programmed cell death. Structure and functional activity of neurohormones in : growth and development, reproduction, diuresis, metabolism, and muscle performance.
E PC – 644 (2 cr. h)	**Insect Immunology** **علم المناعة فى الحشرات** Introduction. Effective immune mechanisms. Cellular components, the haemocytes: haemocyte multiplication and origins (Haemopoiesis), haemocyte populations and functional aspects, ultrastructural characterization of haemocytes, haemocyte isolation and role in defense mechanism. Cell-mediated defense reaction: phagocytosis, nodule formation, encapsulation, wound healing. Cell-free immunity: coagulation of haemolymph, humoral encapsulation, melanization, bactericidal activity. Purification and partial characterization of innate and inducible humoral immunity: lectins, lysozymes, defensins, deptricins, attacins, cecropins etc. Phenoloxidase activating system and its role in cellular communication. Suppression of insect immune system. Genetic control of immunity in insect. Mechanism of immunity in insect vectors of parasites.
E PC – 645 (2 cr. h)	**Cytology and Radiation Effects on the Cell** **علم الخلية والتأثيرات الاشعاعية علي الخلية** Cells and organells. Membrane structure and function. Transport across membranes. Electrical signal transduction mechanism; messengers, and receptors. Extracellular structures, cell adhesion, and cell junctions. Intracellular compartments. Cytoskeletal system. Cellular movement: motility and contractility. Radiation effects on the molecular, and cell organelles levels. Malformations, mutations, aberrations, and effects on cell life. Effect on gamete- cells. Effects on tissue levels. Radio-protectives and sensitizers.
E PC – 646 (2 cr. h)	**Selected Topics** **مقررات مختارة**

	5- M. Sc. Degree in Insect Structure and Growth Biology (E S)
E S – 650 (2 cr. h)	**Ultrasructure of Insect Cells** **التركيب الدقيق لخلايا الحشرات** A complete description of architecture of insect cells: alimentary canal of different insects, excretion (Malpighian tubules-Rectal pads) - Tracheal cells - Fat body cells - Blood cells - Muscle cells - Nervous system cells - Reproductive system cells.
E S – 651 (3 cr. h)	**General Biology** **البيولوجيا العامة** Postembryonic Development, Metamorphosis - Maturity - Food Habits - Seasonal Cycles – Reproduction - The Role of Hormones - Physiological Effects on Hormonal Control**.**
E S – 652 (2 cr. h)	**Advanced Histological Techniques, Tissue Culture, and Molecular Analysis (Advanced Course)** **تحاليل جزيئية وزراعة وتقنيات أنسجة (مقرر متقدم)** Biological-specimen preparation: Cell lysis and extraction. Techniques for preparing biological material. Subcellular fractionation of cell components and organelles. Separation and purification of proteins, carbohydrates, and lipids. Centrifugation techniques: Separation methods in preparative ultracentrifuges. Applications of the analytical ultracentrifuge. Quantitative determination of biomolecules: Carbohydrates, amino acids, peptides,

	proteins, nucleotides, nucleic acids, and lipids. Electrophoretic techniques: Electrophoresis of proteins. Electrophoresis of nucleic acids. Chromatographic techniques: Low pressure column chromatography. High performance liquid chromatography. Ion-exchange chromatography. Exclusion (permeation) chromatography. Affinity chromatography. Gas-liquid chromatography. Thin-layer chromatography. Radioisotope techniques: Detection and measurement of radioactivity. Enzyme techniques: Enzyme assay techniques. Molecular biology techniques: Isolation of nucleic acids. Physical analysis of DNA. Enzymes used in genetic manipulation. Cloning vectors. Sequencing of DNA. Isolation of specific nucleic acid sequences (cDNA, gene libraries, colony hybridisation, PCR, oligonucleotide probes). Expression of genes. Histological techniques: Tissue preparation, mounting, cutting by ordinary, freezing and ultramicrotome. Staining, coating, and visualization of cells, chemical components, ulterastructure and organelles. Cell and tissue culture: Apparatus, sterility, and cleaning. Cell culture media. Microscopy of living cells. Basic cell culture technique and the maintenance of cell lines. Primary cultures and the establishment of cell lines. Specific cell types and their requirements. Uses of tissue and cell culture (In virology, biochemistry, immunology, parasitology and toxicology, physiology, and manufacture of biological substances).
E S – 653 **(2 cr. h)**	**Insect Morphology** **مورفولوجيا الحشرات** The head and its Appendages: Head - Neck - Antennae - Mouth parts - Head glands – The thorax and legs: Segmentation - Thorax - Legs – The Wings: Occurrence and structure of wings - Modifications of the wings - Wing coupling - Articulation of the wings with the thorax - Wing folding - Muscles associated with the wings – The Abdomen: Segmentation of the abdomen - Abdominal appendages - External reproductive organs of the mole - Female genitalia – The Integument: Epidermis and its derivatives - Cuticle – The Eyes: Structure of compound eyes - Dorsal ocelli - Stemmata.
E S – 654 **(2 cr. h)**	**Embryonic Endocrinology** **التطور الجنينى والجهاز الغددى** Introduction: history of investigations dealing with the endocrine aspects during insect embryonic development - Embryonic origin of endocrine centres – Ecdysteroids - Identification of Ecdysteroids - Fluctuations in Ecdysteriod Titres - Role of Edysteroids in Embryonic Development - Juvenile hormones - Identification of Juvenile hormones - Fluctuations in Juvenile hormone Titres - Role of Junvenile hormones in Embryonic Development - Effect of Juvenile hormone Excess - Effect of Juvenile hormone Deficiency - Juvenile hormone Biosynthesis in relation to corpora Allata - Juvenile hormone Metabolism During Embryogenesis – Neuro-hormones - Prothoracicotropic hormone - Bursicon - Insulin – like Peptides.
E S – 655 **(2 cr. h)**	**Diapause and Photoperiodism** **طور السكون والتعاقب الضوئى** Types of diapause - Diapause stages in insects (embryonic, larval and nymphal, pupal and adult eliapause) - Factors affecting diapause - Light effects and photoperiodism, (effect of day length) – Photophase – Scotophase - The principal type of reaction to daylenght – The long-day type of development – The short-day type of development – Light intensity and light quality – Physiology of Diapause.

	6- M. Sc. Degree in Insect Biochemistry (E B)
E B – 660 **(3 cr. h)**	**Insect Biochemistry** **الكيمياء الحيوية للحشرات** Molecular organization of the exoskeleton and body colors. Metabolism of chitin. Biochemistry of cuticular proteins, sclerotization, and the metamorphic genes. Molecular structure and characteristics of muscle biochemistry. Chemistry of hemolymph composition. Insect immuno-proteins. Biochemistry of biochromes. Biochemistry of defensive secretions. Biochemistry of digestion in midgut. Biochemistry of biomembranes. Transport of biomolecules and electrolytes across membranes. Intermediary metabolism in the fat body. Biosynthesis, storage, and mobilization of the insect macro-biomolecules. Functional role of different metabolites in the insect life. Biochemical changes during insect embryogenesis, metamorphosis, and maturation.
E B – 661 **(3 cr. h)**	**Biochemical Toxicology of Insects** **الكيمياء الحيوية للسموم الحشرية** Toxins and insecticides: nature and structural classes. Biochemistry of neurotransmission: Enzymes and transmitters. Inhibition by organophosphorus insecticides (Mode of action and mechanism. Phosphorylation of the enzyme). Inhibition by carbamate insecticides (Competitive inhibition). Ion transfer across membranes: Mechanisms. Inhibition by organochlorine insecticides. Ion channels: Mechanisms of transport in ion channels. Inhibition by pyrethroids. Metabolic inhibitors: Classes and mechanisms of action. Weak points in metabolism that can be attacked. Biochemical mode of action of novel insecticides. Insect resistance to insecticides: Excretion; role of cytochrome P_{450} in xenobiotic metabolism. Role of hydrolases, monooxygenases, transferases, and conjugation. Molecular biology of insecticide resistance.
E B – 662 **(2 cr. h)**	**Insects Nutrition, Enzymes, and Energy Metabolism** **التغذية والإنزيمات وأيض الطاقة فى الحشرات** Feeding, digestion, and absorption. Growth. Insect nutrients. Special requirements for insects. Enzyme classes and nomenclature. Enzyme kinetics. Regulatory strategies of enzymes. Enzyme purification, and assay in the insect tissue. Specialized metabolic pathways for insects. Metabolic stores. Hormonal control to insect metabolism. Metabolic pathways supporting the flight muscle activity. Energy demands for the flight muscle activity. Metabolic energy expenditure and its control by insect hormones.
E B – 663 **(2 cr. h)**	**Histochemistry and Ultrastructure of Insects** **كيمياء الأنسجة والتركيب الدقيق للحشرات** Ultrastructure of the cell organelles and components. Ultrastructure of the different insect tissues, organs, and systems. Chemical characterization, changes, and localization of substances in the cell and the intercellular matrix of tissues in relation to structural organization (Cytoplasmic inclusions and granules. Extracellular substances. Proteins and their amino acids. Lipids. Carbohydrates. Nucleoproteins and nucleis acids. Pigments. Inorganic sub-stances. Enzymes.). Cytochemistry. Immunocytochemistry. Autoradiography.
E B – 664 **(2 cr. h)**	**Biochemical Genetics** **الكيمياء الحيويةالوراثية** Structural basis of the genes. Organization of DNA in genomes. DNA packaging in chromatin and chromosomes. The nucleus. The cell cycle. DNA replication. Nuclear and cell division. Regulation of the cell cycle. Sexual reproduction. Meiosis. Segregation and assortment of alleles.

	Recombination and crossing over. Gene expression. The genetic code and transcription. Translation. Posttranslational processes. Regulation of gene expression. Genomic control. Transcriptional control. Posttranscriptional control. Variation and genetic linkage. Giant chromosomes and genes. Linkage groups and chromosomes. Sex determination. Sex linkage. Gene interactions. Incomplete dominance. Multiple alleles. Lethal genes. Gene complex. Epistasis. Polygenic inheritance. Variation and sources. Chromosomal mutations. Gene mutations.
E B – 665 **(2 cr. h)**	**Insect Biotechnology** **بيوتكنولوجى الحشرات** Basic methods of isolating, cloning, and characterizing nucleic acids and their products. Genome mapping techniques. Proteomics. Molecular genetics of populations and identification techniques (inter-simple sequence repat-polymerase chain reaction, ISSR –PCR. Primer pair-ISSR-PCR, PP-ISSR-PCR. Randomly amplified microsatellite polymorphisms, RAMP. Selective amplification of microsatellite polymorphic loci, SAMPL. Primer pair-random amplification of polymorphic DNA Polymerase chain reaction, PP-RAPD-PCR. Genetic variation of mitochondrial DNA, mt DNA and the nuclear ribosomal spacer, ITSI. Restriction fragment length polymorphism, RFLP. Random amplified polymorphic DNA, RAPD). Transgenesis and transformation techniques. Targeted transformation of insect genome. Specific recombination for the genetic manipulation of transgenic insects. Transgenic selection. Vectors. Applications (e.g. Molecular probes in diagnosis and epidemiology of insect-born diseases. Transgenesis in IPM).
E B – 666 **(2 cr. h)**	**Insect Environmental Biochemistry and Physiology** **الكيمياء الحيوية والفسيولوجيا البيئية للحشرات** Metabolic and enzyme adaptation to temperature. Temperature and insect development. Biochemistry and physiology of lethal temperature limits. Environmental aspects of insect dormancy. Respiratory water loss. Water and salt regulation. Colors and color changes. Environmental aspects of insect bioluminescence. Chemical signals in relation to biocommunications. Molecular determinants of activity and biosynthesis. Perception of semiochemicals. Insect-plant interactions. Applications in IPM.
E B – 667 **(2 cr. h)**	**Selectede Topics in Insect Biochemistry** **مقررات مختارة فى الكيمياء الحيوية للحشرات**

	7- M. Sc. degree in Insect Taxonomy and Classification (E T)
E T – 670 **(3 cr. h)**	**Theory and Practice of Taxonomy** **الأساسيات النظرية و العملية لعلم التصنيف** Introduction- Rise of Taxonomy- Keys and Identification- Nomenclature and Classification (International Commissions- International Code of Zoological Nomenclature)- Museums and their roles- The Future of Taxonomy.
E T – 671 **(3 cr. h)**	**New Trends in Taxonomy** **الاتجاهات الحديثة فى علم التصنيف** Cytotaxonomy- Chemotaxonomy- Immunotaxonomy- Nucleic acids, Proteins and taxonomy- Palaeotaxonomy- Embryological and immature stages approaches- Ecological and Behavioural approaches- Phylogenetic Analysis and Classification of fossil data.
E T – 672 **(2 cr. h)**	**Biodiversity** **التنوع الحيوى** Introduction to biodiversity - Origin and extinction of biodiversity – Monitoring, evaluating, and estimating biodiversity – Threats to biodiversity – Conserving biodiversity.
E T – 673	**Insect Embryology and Metamorphosis** **علم الاجنة والتحول فى الحشرات**

(2 cr. h)	**Embryology:** Introduction- Embryonic development of Orthoptera (Histogenesis-Organogenesis-Morphogenesis)-Comparative embryology of Hymenoptera, Diptera and Coleoptera **Metamorphosis:** Introduction- Evolution of insect metamorphosis- Types of postembryonic development- Physiology and role of hormones in the development of insects.
E T – 674 **(2 cr. h)**	**Zoogeography** **الجغرافيا الحيوانية** Introduction to zoogeography – History of zoogeography – Principles of zoogeography- Continental pattern and faunal regions – Island patterns – Life zones- Hybrid zones- Evolution of the geographical patterns, climate, and evolution – Community change- The past in the light of zoogeography .
E T – 675 **(2 cr. h)**	**Morphology and Ultrastructure** **التركيب الخارجى والدقيق للحشرات** Detailed study of the structure of the different body regions and its appendages, with special reference to all possible modifications that may occur to accommodate the different habitats- Study of different microscopic body structures (hairs, bristles and scales- different types of sensilla- types of gills in aquatic forms- types of spiracles…. etc.).
E T – 676 **(2 cr. h)**	**Flora** **الفلورا** Introduction and Historical review to the flora of Egypt – How to make a plant collection, procedures and case study – Plant nomenclature and identification – Herbaria and Botanical gardens, their role and function in conserving biodiversity – Plant species diversity in the flora of Egypt – Biogeographic zones of Egypt, an overview to their floristic diversity – Rare and threatened plant species, implementation to conservation.

9- Geophysics Department

A- Programs

Department Code	Degree Code	Specializations	Specialization Code
(GP)	Diploma (500)	1- Applied Geophysics	(GPA)
	M. Sc. (600)	1- Geophysics	(GPGP)
	Ph. D. (700)	1- Geophysics	(GPGP)

G PA) (Diploma In Applied Geophysics

Code	Course Number	Course Case	CR. Hours
(GPA)	The candidate studies (6) courses in table (1)	Compulsory	18
	The candidate chooses (1) course / semester from table (2)	Elective	6
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	GPA 501	Gravity and Magnetic Exploration	2	1	2	2-3	
	GPA 502	Well Logging Principles	2	1	2	2-3	
	GPA 503	Electric and Electromagnetic Exploration Methods	2	1	2	2-3	
Second	GPA 504	Seismic Exploration Methods	2	1	2	2-3	
	GPA 505	Geothermal and Radioactive exploration Methods	2	1	2	2-3	
	GPA 506	Principles of Seismology	2	1	2	2-3	
		The Total Cr.h. Required	12	6			

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours		Exam Hours		Remarks
			Th	Pr	Th	Pr	
First	GPA 507	Geology of Petroleum and Reservoir	2	1	2	2-3	
	GPA 508	Introduction to Palaeomagnetism	2	1	2	2-3	
Second	GPA 509	Remote-sensing and Tectonics	2	1	2	2-3	
	GPA 510	Rock Properties	2	1	2	2-3	
		The Total Cr.h. Required	4	2			

Note:- the code No. of the branch: from 501 to 519
From 511to 519 are codes No. for adding new courses

M. Sc. Degree in Geophysics (GPGP)

Code	Course Name	Course Case	CR. Hours
(GPGP)	The candidate studies (6) courses in table (1)	Compulsory	12
	The candidate chooses (1) course / semester from table (2)	Elective	6
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GPGP 601	Gravity and Magnetic Methods	2	2	
	GPGP 602	Seismic Reflection Methods	2	2	
	GPGP 603	Well Logging	2	2	
Second	GPGP 604	Seismic Refraction Methods	2	2	
	GPGP 605	Seismology	2	2	
	GPGP 606	Electrical and Electromagnetic Methods	2	2	
	The Total Cr.h. Required		12	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GPGP 607	Computer Applications in Geophysics	3	3	
	GPGP 608	Reservoir Simulation and Production	3	3	
Second	GPGP 609	Radioactive Methods	3	3	
	GPGP 610	Borehole Geophysics and Rock Properties	3	3	
	The Total Cr.h. Required		6	-	

Note:- the code No. of the branch: from 601 to 619
From 611 to 619 are codes No. for adding new courses

Ph.D. Degree in Geophysics (GPGP)

Table (1)

Code	Course Number	Course Case	CR. Hours
(GPGP)	The candidate chooses (8) courses from Table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	GPGP 701	Advanced Gravity Methods	2	2	
	GPGP 702	Advanced Magnetic Methods	2	2	
	GPGP 703	Advanced Electric Methods	2	2	
	GPGP 704	Advanced Electromagnetic Methods	2	2	
	GPGP 705	Advanced Seismic Refraction Methods	2	2	
	GPGP 706	Advanced Seismic Reflection Methods	2	2	
	GPGP 707	Advanced Well Logging	2	2	
	GPGP 708	Earthquake Engineering	2	2	
Second	GPGP 709	Advanced Radioactive Methods	2	2	
	GPGP 710	Reservoir Engineering	2	2	
	GPGP 711	Advanced Seismology	2	2	
	GPGP 712	Integrated Exploration	2	2	
	GPGP 713	Marine Geophysics	2	2	
	GPGP 714	Engineering and Environmental Geophysics	2	2	
	GPGP 715	Advanced Geotectonics	2	2	
	GPGP 716	Advanced Computer Applications in Geophysics	2	2	
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 701 to 719
From 717 to 719 are codes No. for adding new courses

B- Course contents for Diploma

Code No.	Course name and contents
	Diploma in Applied Geophysics
G PA - 501 **(3 cr. h)** **(2h Th + 1h Pr)**	**Gravity and Magnetic Exploration Methods** **طرق الاستكشاف التثاقلى والمغناطيسى** **Theoretical Contents:** Gravity and magnetic potentials - Normal gravitational field and the figure of the earth -Volume potential - First and second derivative of the volume potential -Instrumentation and gravity and magnetic field measurements - Surveying techniques - Reduction of gravity and magnetic data -Gravity and magnetic anomalies **Practical contents:** Computations of gravity and magnetic anomalies due to simple bodies- practical applications on gravity and magnetic corrections- construction of gravity and magnetic anomaly maps
G PA – 502 **(3 cr. h)** **(2h Th + 1h Pr)**	**Well logging Principles** **مبادىء تسجيلات الآبار** **Theoretical Contents:** Introduction - Basic relationships and some concepts of well log analysis - Classification of well logs: Types- Rock properties that affect logging measurements- borehole environment- invasion and resistivity profiles- basic information and fundamental equations needed in log interpretation - Logging tools and their types: Electrical-Radiation-Acoustics- nuclear - Usefulness of logging tools in determining petrophysical parameters: Rw-determination- porosity and permeability- water and hydrocarbon saturations - Case histories. **Practical contents:** Rw determination- Shale volume calculation-porosity, saturation and permeability estimation
G PA – 503 **(3 cr. h)** **(2h Th + 1h Pr)**	**Electrical and Electromagnetic Exploration Methods** **طرق الاستكشاف الكهربى والكهرومغناطيسى** **Electrical Methods** **Theoretical Contents:** Introduction and general definition - Outlining the different types of electrical methods with special emphasis on common Resistivity methods - Mathematical theory of current penetration through earth - Factors affecting the Resistivity of different types of rocks and their ranges - Relation between depth of penetration and surface spread of layouts (Types of Resistivity layouts)- Instrumentation - Field work and its related parameters (Types of Resistivity survey and errors in Resistivity measurements) - Apparent and true Resistivity (correction and smoothing techniques) - Qualitative and quantitative interpretation techniques. **Practical contents:** Examples and problems on how to quality and quantity interpret Resistivity data. **Electromagnetic Methods:** **Theoretical Contents:** Background and application - Type of EM systems - Principles of EM surveying - Factors affecting terrain conductivity - Airborne and Sea EM surveying - Borehole EM surveying - Continuous and Pulse-transient EM systems - Telluric and Magneto-Telluric methods . **Practical contents:** Applications and case histories
G PA – 504 **(3 cr. h)** **(2h Th + 1h Pr)**	**Seismic Exploration Methods** **طرق الاستكشاف السيزمى** **Theoretical Contents:** General introduction to seismic methods - Theory of elasticity - wave equation and its solution - Basic principles of seismic reflection method - Basic principles of seismic refraction method - Field

	techniques - Wave characteristics on field record - wave motion - Seismic velocity (Types-measurements-factors affecting) **Practical contents:** - Elastic modulii determination – cases of seismic reflection method – cases of seismic refraction method – picking first break of seismic sections – determination of seismic velocities.
G PA – 505 **(3 cr. h)** **(2h Th + 1h Pr)**	**Geothermal and Radioactive Exploration Methods** **طرق الاستكشاف الحرارى والاشعاعى** **Geothermal:** **Theoretical Contents:** Introduction - The earth's heat and internal temperatures - Observed heat flow (q) - Implications of the observed heat flow (q) - Heat flow provinces - Thermal models of the crust and upper mantle - Internal temperatures, convection cells and plate tectonics - Geothermal Exploration - General criteria for the sitting of deep exploration holes **Practical contents:** Geothermal Case histories world wide **Radiation methods:** **Theoretical Contents:** Review on principles, fundamentals and method of radioactivity - Data standardization: quick review - Data presentation and integration - Data analysis and interpretation - mapping natural sources of radiation - mapping man-made sources of radiation **Practical contents:** Measuring instruments and calibration – Ground reporting units – Radiometric mapping (Geologic) – Uranium exploration
G PA – 506 **(3 cr. h)** **(2h Th + 1h Pr)**	**Principles of Seismology** **مبادىء علم الزلازل** **Theoretical Contents:** Physics of the earth's interior, density and elastic constants - Earthquakes in history - Occurrence of earthquakes -- Plate tectonics - Volcanoes and Earthquake Prediction - Earthquake mechanism - Measuring earthquakes - Earthquake prediction –Tsunamis - Paleo-seismicity - Earthquake hazard analysis -Statistic distribution of earthquakes - Probabilistic seismic hazard analysis **Practical contents:** Determination of Earthquake Location – Determination of the magnitude of an earthquake – Estimation of Earthquake's energy.
G PA – 507 **(3 cr. h)** **(2h Th + 1h Pr)**	**Geology of Petroleum and Reservoir** **جيولوجيا بترول وخزانات** What is mint by petroleum geology?, and the principles of petroleum geology – History of petroleum exploration in the world – Origin of petroleum: Introduction to the occurrences of hydrocarbons in the earth and satellites, a review on the origin of petroleum, the chemical complexity of crude oil, its fluid, migratory nature, and the innumerable geological factors which presented a considerable challenge to the investigator, occurrence of hydrocarbons in recent sediments, oil and organic matter in source rocks of petroleum, geologic and geochemical aspects of the origin of petroleum – Theories of the migration of petroleum, and the migration differentiation concepts – The petroleum reservoir: the petroleum reservoir elements and its storage character, the petroleum reservoir as an active geochemical unit – The chemical composition of petroleum (crude oil and hydrocarbon gases and their types). What is meant by petroleum reservoir? And the rules for petroleum production from the different reservoir rock types – The petroleum reservoir traps and its dimensions and configuration – The petroleum reservoir in the logic of plate tectonic theory – The petroleum reservoir as an active storage and geochemical unit – The reservoir fluids drives and precautions, and oil

	recovery under different drives – Secondary recovery of petroleum reservoir and methods of infection – Geologic methods for petroleum reserve evaluation. **Laboratory Training.**
G PA – 508 **(3 cr. h)** **(2h Th + 1h Pr)**	**Introduction to Paleomagnetism** **مقدمة للمغناطيسية القديمة** **Theoretical Contents:** Common magnetic minerals - Introducing the Natural Remnant Magnetism (NMR) acquired by rocks - Magnetization of rocks and its physical analysis - Magnetic character of continents and oceans - Sampling and measurements - Statistical analysis - Application of paleomagnetism **Practical contents:** Sample measurements analysis for the calculation of the remnant magnetization
G PA – 509 **(3 cr. h)** **(2h Th + 1h Pr)**	**Remote-sensing and Tectonics** **استشعار عن بعد وتكتونية** **Remote sensing:** **Theoretical Contents:** Concepts of Remote sensing - Satellite sensors - Types of satellite images - Image corrections (Radiometric and Geometric) - Image processing (Enhancement, filtering band ratios, Fusion technique) - Image classifications (Unsupervised and supervised) - Applications of Remote sensing techniques **Practical contents:** Classification of remote sensing satellite – types of remote sensing images – elements of visual interpretations– Pre-processing and image enhancement– image transformation– image classification and analysis **Tectonics:** **Theoretical Contents:** Introduction: Historical background development of the theory - The plate tectonic theory: evidences of plate motion, sea floor spreading and types of plate boundaries, Mid oceanic ridge, subduction zone and transform faults - Global distribution of seismicity and volcanicity, types of earthquakes, seismic belts, volcanic chains, mantle convection - The deriving mechanism of plate tectonics and continental drift - Red sea – Gulf of Suez- Gulf of Aqaba rift system, origin of the red sea. **Practical contents:** Examples of Regional and Global Earthquake belts
G PA – 510 **(3 cr. h)** **(2h Th + 1h Pr)**	**Rock Properties** **خواص الصخور** **Theoretical Contents:** Introduction - Mineralogical and Petrographical principles of rock physics - Physical properties of rocks and factors determining them - Mechanical properties of rocks (Study of Elastic wave velocities) - Acoustics of rocks - Thermodynamics of rocks - Electromagnetic properties of rocks - Radiation properties of rocks - Radiation properties of rocks - Interrelation between properties and physical phenomena in rocks **Practical contents:** Practical determination of Formation Resistivity factor- elastic modulii- porosity and seismic velocity determination from acoustic logs- radioactive materials using Gamma-ray

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
GP GP - 601 **(2 cr. h)**	**Gravity and Magnetic Methods** **طرق تثاقلية ومغناطيسية** Regional residual separation techniques (Smoothing and graphical techniques, average profiling method, moving average methods, least-squares methods, Caracovin computation methods, optimum order regional determination, relaxation methods) - Transformation (second derivative methods, up and down word continuation methods, reduction to the pole methods) - Interpretation of gravity and magnetic data.
GP GP - 602 **(2 cr. h)**	**Seismic Reflection Methods** **طرق سيزمية انعكاسية** Seismic wave propagation - Seismic recording instruments - Seismic data acquisition on and in water covered areas - Enhancement of seismic reflection data in processing centers - Transformation of reflection times into geological structures - Geological interpretation of seismic reflection data.
GP GP - 603 **(2 cr. h)**	**Well Logging** **تسجيلات الآبار** Electrical resistivity of rocks - Radioactive properties of rocks - Acoustic properties of rocks - Quick-look interpretation: cross plots and overlays - Approaches for petrophysical parameters evaluation in shaly sands - Mixed lithology evaluation - Evaluation of gas-bearing formation - Integrated formation evaluation.
GP GP - 604 **(2 cr. h)**	**Seismic Refraction Methods** **طرق سيزمية انكسارية** Refraction versus reflection - Wave paths and time distance relations for horizontal layers - Dipping beds with discrete velocities - Refraction shooting across a fault - Refraction in a medium having continuous change of speed with depth - Delay times - Refraction operations in the field - Refraction records - Refraction analysis - Interpretation of refraction data.
GP GP - 605 **(2 cr. h)**	**Seismology** **علم الزلازل** History of seismology - Stress-strain theory - Seismic waves - Ray theory – Tomography - Surface waves -and dispersion – Earthquakes - Observational seismology - Seismic networks - Analysis of seismograms - Source theory - Source spectra - Earthquake prediction Seismotectonics – Tsunami.
GP GP – 606 **(2 cr. h)**	**Electrical and Electromagnetic Methods** **طرق كهربية وكهرومغناطيسية** **Electrical Methods:** General review - Parameters of resistivity acquisitions (Hydraulic, Engineering, and geotechnical) - Application of resistivity methods in Engineering, Environmental, resources evaluation, and archeology - Environmental applications of resistivity methods. **Electromagnetic Methods:** Description of EM fields - Amplitude and phase relations - Ellipse polarization - Natural inductance - Conductor response - Theory of measuring instruments - Ground and Airborne surveys - Measurements of polarization ellipse - Dip angle measurements - Measurements of phase components - Interpretation of the measured elements of electromagnetic fields.
GP GP – 607 **(3 cr. h)**	**Computer Applications in Geophysics** **تطبيقات حاسب فى الجيوفيزياء** Introduction to computer sciences - Computer languages - Routines and subroutines - Programming potential field data problems - Programming seismic field data problems.

GP GP – 608 **(3 cr. h)**	**Reservoir Simulation and Production** **انتاجية ومحاكاة الخزانات** Introduction to reservoir simulation - Types of reservoir simulation models - simplified approach to understanding reservoir simulation - Application of reservoir simulation - Difference between simulators - Steps in a reservoir simulation study - Data needed for a typical simulation study.
GP GP – 609 **(3 cr. h)**	**Radioactive Methods** **الطرق الاشعاعية** Review on Fundamentals and methods of radioactivity - Data standardization - Data presentation and integration - Data analysis and interpretation - Mapping natural sources of radiation - Mapping man-made sources of radiation.
GP GP – 610 **(3 cr. h)**	**Borehole Geophysics and rock properties** **جيوفيزياء الآبار وخواص الصخور** **Borehole Geophysics:** General introduction - Well logging instrumentation and their operational aspects - Formation evaluation principles - Well site hydrocarbon indicators - Well site interpretation examples - Resistivity, density, gravity, acoustic, dipmeter, and radiation logs principles - Uses of borehole geophysics and their applications. **Rock properties:** General introduction - Mineralogical and petrographysical principles of rock physics - Physical properties of rocks and factors affecting them - Mechanical properties of rocks - Acoustic properties of rocks - Thermodynamics of rocks - Electromagnetic properties of rocks - Radiation properties of rocks - Inter-relation between properties and physical phenomenon in rocks.

10- Biophysics Department

A- Programs

Department Code	Degree	Specializations	Specialization Code
(BP)	Diploma (500)	1- Health Biophysics	(BPH)
	M.Sc. (600)	1- Medical Biophysics	(BPM)
		2- Molecular Biophysics -	(BPMO)
		3- Environmental Biophysics	(BPE)
	Ph.D. (700)	1- Medical Biophysics	(BPM)
		2- Molecular Biophysics	(BPMO)
		3- Environmental Biophysics	(BPE)

1- Diploma in Health Biophysics (BPH)

Code	Course Number	Course Case	CR. Hours
(BPH)	The candidate studies (4) courses in table (1)	Compulsory	12
	The candidate chooses (1) course / semester from table (2)	Elective	6
	Health Biophysics Practical courses in table (3)	Compulsory	6
	The Total Cr.h. Required		24

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	BPH 501	Biophysics of Nuclear Medicine (1)	3	3
	BPH 503	Radiation Dosimetry	3	3
Second	BPH 502	Biophysics of Nuclear Medicine(2)	3	3
	BPH 504	Radiation Measurement Instrumentations	3	3
		The Total Cr.h. Required	12	-

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	BPH 505	General Biophysics (1)	3	3
	BPH 507	Ionizing Radiation Sources	3	3
Second	BPH 506	General Biophysics (2)	3	3
	BPH 508	Medical Radiation Protection and Diagnostic Uses of Radioisotopes	3	3
		The Total Cr.h. Required	6	-

Table (3) Practical Courses (Compulsory)

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	BPH 509	Health Biophysics (1)	3	3-4
Second	BPH 510	Health Biophysics (2)	3	3-4
		The Total Cr.h. Required	6	

Note:- the code No. of the branch: from 501 to 519
From 511 to 519 are codes No. for adding new courses

M. Sc. Degree in Medical Biophysics (BPM) 1-

Code	Course Number	Course Case	CR. Hours
(BPM)	The candidate studies (4) courses in table (1)	Compulsory	10
	The candidate chooses (2) courses / semester from table (2)	Elective	8
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 601	Biomathematics (1)	2	2	Also offered by all gps.
	BP 603	Molecular Biophysics	3	3	
Second	BP 602	Biomathematics (2)	2	2	
	BP 604	Membrane and Cell Biophysics	3	3	
		The Total Cr.h. Required	10	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	BPM 610	Biophysics of Ionizing Radiation Imaging	2	2
	BPM 611	Health Biophysics	2	2
	BPM 612	Technology of Ionizing Radiation Dosimetry	2	2
Second	BPM 613	Medical Radiation Protection	2	2
	BPM 614	Radiobiology	2	2
	BPM 615	Technology of Non-ionizing Radiation Dosimetry	2	2
		The Total Cr.h. Required	8	-

Note:- the code No. of the branch: from 610 to 629
From 616 to 629 are codes No. for adding new courses

2- M. Sc. Degree in Molecular Biophysics (BPMO)

Code	Course Number	Course Case	CR. Hours
(BPMO)	The candidate studies (4) courses in table (1)	Compulsory	10
	The candidate chooses (2) courses / semester from table (2)	Elective	8
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 601	Biomathematics (1)	2	2	Also offered by all gps.
	BP 603	Molecular Biophysics	3	3	
Second	BP 602	Biomathematics (2)	2	2	
	BP 604	Membrane and Cell Biophysics	3	3	
		The Total Cr.h. Required	10	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BPMO 630	Macromolecular Spectroscopy (1)	2	2	
	BPMO 632	Technology of Communication andControl	2	2	
	BPMO 633	Technology of Drug and Biomolecules Carriers System	2	2	
Second	BPMO 631	Macromolecular Spectroscopy (2)	2	2	
	BPMO 634	Bioenergetics	2	2	
	BPMO 635	Magnetic Properties of Biomolecules	2	2	
		The Total Cr.h. Required	8	-	

Note:- the code No. of the branch: from 630 to 649
From 636 to 649 are codes No. for adding new courses

3- M. Sc. Degree in Environmental Biophysics (BPE)

Code	Course Number	Course Case	CR. Hours
(BPE)	The candidate studies (4) courses in table (1)	Compulsory	10
	The candidate choose (2) courses / semester from table (2)	Elective	8
	M. Sc. thesis (Compulsory)	699	18
	The Total Cr.h. Required		36

Table (1) Compulsory Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 601	Biomathematics (1)	2	2	Also offered by all gps.
	BP 603	Molecular Biophysics	3	3	
Second	BP 602	Mathematics (2)	2	2	
	BP 604	Membrane andCell Biophysic	3	3	
		The Total Cr.h. Required	10	-	

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours
First	BPE 650	Advanced Plant Ecology	2	2
	BPE 651	Immunobiology	2	2
	BPE 652	Biophysics of low Frequency Non-ionizing Electromagnetic Fields	2	2
Second	BPE 653	Advanced Animal Ecology	2	2
	BPE 654	Environmental Pollution	2	2
	BPE 655	Biophysics of High Frequency Non-ionizing Electromagnetic Fields	2	2
		The Total Cr.h. Required	8	-

Note:- the code No. of the branch: from 650 to 669
From 656 to 669 are codes No. for adding new courses

1- Ph. D Degree in Medical Biophysics (BPM)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BPM)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 701	Computational Biophysics	2	2	Also offered by all gps.
	BP 702	Biophysical Measurements	2	2	
	BP 703	Molecular Biophysics	2	2	
	BPM 710	Electronphysiology	2	2	
	BPM 711	Medical Bioenergetics	2	2	
	BPM 712	Medical Biophysics	2	2	
Second	BPM 713	Radiation Biophysics	2	2	Also offered by Env.
	BPM 714	Biomaterials	2	2	Also offered by Env.
	BPM 715	Neurobiophysics	2	2	Also offered by Mol.
	BPM 716	Topographic Imaging	2	2	
	BPM 717	Brachytherapy Dosimetry	2	2	
	BPM 718	Electromagnetic Waves in Physical Therapy	2	2	
	BPM 719	Cellular Biophysics	2	2	Also offered by Mol.
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 710 to 729
From 720 to 729 are codes No. for adding new courses

2- Ph. D Degree in Molecular Biophysics (BPMO)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BPMO)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 701	Computational Biophysics	2	2	Also offered by all gps.
	BP 702	Biophysical Measurements	2	2	
	BP 703	Molecular Biophysics	2	2	
	BPMO 730	Molecular Spectroscopy	2	2	
	BPMO 731	Bioinformatics	2	2	
	BPMO 732	Membrane Biophysics	2	2	
Second	BPMO 733	X-ray Crystallograph	2	2	
	BPMO 734	Biotechnology	2	2	
	BPMO 735	Membrane Bioenergetics	2	2	
	BPMO 736	Molecular Motors	2	2	
	BPM 715	Neurobiophysics	2	2	Also offered by Med
	BPM 719	Cellular Biophysics	2	2	Also offered by Med
	The Total Cr.h. Required		16		

Note:- the code No. of the branch: from 730 to 749
From 737 to 749 are codes No. for adding new courses

3- Ph. D Degree in Environmental Biophysics (BPE)

Table (1)

Code	Course Number	Course Case	CR. Hours
(BPE)	The candidate chooses (8) courses from table (2)	Elective	16
	Ph.D. thesis (Compulsory)	799	44
	The Total Cr.h. Required		60

Table (2) Elective Courses

Semester	Course Code	Course Name	CR. Hours	Exam Hours	Remarks
First	BP 701	Computational Biophysics	2	2	Also offered by all gps.
	BP 702	Biophysical Measurements	2	2	
	BP 703	Molecular Biophysics	2	2	
	BPE 750	Environmental Biophysics	2	2	
	BPE 751	Analysis of Biosystems	2	2	
Second	BPE 752	Health Physics of Pollutants	2	2	
	BPE 753	Environmental Bioindicators	2	2	
	BPM 713	Radiation Biophysics	2	2	Also offered by Med
	BPM 714	Biomaterials	2	2	Also offered by Med
		The Total Cr.h. Required	16		

Note:- the code No. of the branch: from 750 to 769
From 754 to 769 are codes No. for adding new courses

B- Course contents for Diploma

Code No.	Course name and contents
	Diploma in Health Physics (BP H)
BP H – 501 (3 cr. h)	**Biophysics of Nuclear Medicine (I)** **بيوفيزياء الطب النووى (١)** Detection of high – energy radiation: Gas-filled detectors – Scintillation detectors- Solid state detectors - In–Vitro Radiation Detection: Well – type scintillation detectors – Liquid scintillation detectors.
BP H – 502 (3 cr. h)	**Biophysics of Nuclear Medicine (II)** **بيوفيزياء الطب النووى (٢)** In – Vivo Radiation Detection: Organ uptake and organ scanning – Collimation, Scattering and attenuation – Organ uptake probes – Organ imaging devices, Gamma Camera: Digital camera, multidetector camera, Performance parameters of gamma camera (spatial resolution, sensitivity, linearity and uniformity, quality control tests) - Tomographic imaging devices.
BP H – 503 (3 cr. h)	**Radiation Dosimetry** **قياس الجرعات الاشعاعيه** Quantities to describe a radiation beam – Energy transfer; Kerma and absorbed dose-Electronic equilibrium – The Bragg-Gray cavity – Determination of absorbed dose using an absolute ion chamber – Effects of temperature and pressure on ionization measurements – Exposure; The Roentgen – Standard air chamber – Practical ion chambers – Effective atomic number – Determination of absorbed dose in " Free Space "- Determination of absorbed dose in a phantom – Determination of absorbed dose at energies above 3 MeV – Absorbed dose in the neighborhood of an interface between different materials – Relation between energy fluence and exposure. Saturation in ion chambers – Calculations of efficiency of ion collection – Types of ion chambers – Thermoluminescent dosimetry (TLD) – Chemical dosimetry – Direct measurement of absorbed dose; the calorimeter. Sources of ionizing radiation – Occupational and nonoccupational exposure limits – ALARA – Calculations involving exposures and doses – Internal and external sources of radiation.
BP H – 504 (3 cr. h)	**Radiation measurement instrumentations** **اجهزة قياس اشعة** Particle counting instruments: Gas-filled counters - Ionization chamber counter - Proportional counter - Geiger counter - Quenching a Geiger counter - Resolving time - Measurement of resolving time - Scintillation counter - Nuclear spectroscopy - Cerenkov detector - Semiconductor detector - Dose-measuring Instruments: Pocket dosimeter - Film bandage - Thermoluminescent dosimeter - Ion current chamber - Neutron measurement: Detection reaction - Neutron counting with a proportional counter - Long counter - Proton recoil counter - Neutron Dosimetry: Fast neutrons: Hurst counter - Thermal and fast neutron dose-equivalent meter - Albedo neutron dosimeter.
BP H – 505 (3 cr. h)	**General Biophysics (I)** **بيوفيزياء عامة (١)** Biomechanics of bone - Viscoelasticity of biomatrials - Biophysics of vision - Biological structures: The structures of life: The cellular structure of life, organization, Membranes - The morpholog of cells: Cells types, Cytosketeton, Eukaryotic organelles - The biological macromolecules: Biopolymers, Proteins, Nucleic acid, Polys a ccharides, Lipids, Lipid bilayers – Menbranes: Membrane funoction, Membrane composition, Membrane proteins, Membrane structure - Cell evolution: Prokaryotic and organellar similarities, Endosymbiosis, Evolution of cells.

BP H – 506 (3 cr. h)	**General Biophysics (II)** **بيوفيزياء عامه (٢)** Biophysics of hearing - Ultrasound in medicine - Biophysics of nerves - Radioactive isotopes as tracers - Absorption spectrophotometry. Techniques using Mechanical and Electrical phenomena: Centrifugation and sedimentation - Some physics of centrifugation - Method of sedimentation Equilibrium - Method of sedimentation velocity - Density gradient sedimentation.
BP H – 507 (3 cr. h)	**Ionizing Radiation sources** **مصادر اشعة مؤينة** Production of X-rays - Orthovoltage and super voltage therapy - Van De Graff generator - Linear accelerator – Betatron – Microton – Cyclotron - Cobalt–60 –unit – Some nuclear reactions: Fission, fusion, neutron activation, transmutation - Radioisotope generators - Peaceful uses of radiation sources with emphasis on medical and industrial application.
BP H – 508 (3 cr. h)	**Medical Radiation Protection and Diagnostic uses of Radioisotopes** **وقايه اشعاعيه طبيه و استخدامات تشخيصية للنظائر المشعة** Units of measurement – Radiation weighting factors- Equivalent dose – Effective dose – Committed Equivalent dose – Committed Effective dose – Collective Equivalent dose – Collective Effective dose – Collective Effective dose commitment , objectives of radiation protection - Recommended dose limits for occupational workers and general public - External radiation hazard: Effect of time , distance , and shielding for γ - sources and neutron sources - Protective Barriers for x –ray machines - Internal radiation hazard: Routes of entry – The ALI – Control of the contaminated hazard . Routine control of contamination.
BPH 509 (3cr.h Pr) Practical	**Health Biophysics (1)** **فيزياء حيوية صحية عملى (١)** Radioactivity measurement of β-and γ-emitting radioactive isotopes using Geiger-Mueller detector. Study the characteristics of the G-M detector - Study the statistical nature of radioactive emanations - Detection of gamma rays and its absorption in different atomic-number elements. Shield design for γ - radiation protection. (using Pb or concrete) - Measurements of β-particles range from different sources in different media –Beta shield design – Beta backscattering - Study the use of Na I (Tl) scintillation detector for gamma rays of different energies- study the effect of PM high tension or amplifier gain on the energy spectrum of ^{137}Cs . Using different radioactive γ - sources of different energies, check the linear performance of the scintillation detector.
BPH 510 (3cr.h Pr) Practical	**Health Biophysics (2)** **فيزياء حيوية صحية عملى (٢)** Localization of gamma emitters in phantom materials using different focusing collimators - Study the effect of collimation length and aperture diameter on spatial resolution. Resolution measurement using two radioactive sources in phantom - Detection of massive charged particles (e-g. α - particles) using nuclear track etching detector. Study the characteristics of the track etching detector. Measurement of α - particle range in air - x-ray production - x-ray spectrum - x-ray filtration and absorption - Ionizing radiation protection considerations for broad photon beams - Radiation field monitoring using survey meters. Personnel dose measurement using personnel dosimeters - Neutron detection either through reaction with capper or gold or through the use of neutron rem – meter.

C- Course contents for M. Sc. Degree

Code No.	Course name and contents
	1- M. Sc. Degree in Medical Biophysics (BP M)
BP M - 601 (2 cr. h)	**Biomathematics (1)** **رياضة بيولوجية (١)** Monte Carlo simulation - Simulation of an experimental data to a Known model - Simulation of data for determining the decay constant of radioactive material and the linear attenuation coefficient of absorbing material - Simulation in biology - Boolean algebra and its application to design logic circuits - Binomial and Poisson's distributions and there applications in biology - Biophysical models.
BP M - 602 (2 cr. h)	**Biomathematics (2)** **رياضة بيولوجية (٢)** Fitting an experimental data to a linear model - Fitting an experimental data to a polynomial or a linear combination of functions - Numerical solution of linear equations: Gauss elimination method - Iteration method - Fitting an experimental data to a non- linear model - Newton- Raphson method for fitting an experimental data to a non- linear model - Steepest descent method for fitting an experimental data to a non-linear model - Simplex method for fitting an experimental data to a non- linear model - Genetic algorithm - Application of Genetic algorithm in optimization - Applications of Genetic algorithm in biology.
B PM - 603 (3 cr. h)	**Molecular Biophysics** **بيوفيزياء جزيئيه** X-Ray ANALYSIS And Molecular Structure: Production of x-rays - Diffraction of x-rays - The diffraction patterns of some protein fibers - The structure of globular proteins - Intramolecular and intermolecular forces: Strong and weak forces - The covalent bond - The Ionic bond – Resonance - Dipole – dipole interaction - The action of ionizing radiation on cellular constituents: The action of ionizing radiation - The measure of radiation – Dosimetry - Experimental results of bombarding large biological molecules - Size and shape of macromoleculae: Macromolecules as hydrodynamic Particles - Friction properties of macro molecules in solution - Macromolecular Diffusion - Fickls 1 st and 2 nd laws of Diffusion – Ultracentrifugation: The ultracentrifuge : The lamm Equation - Solving the Lamm Equation - Analysis of Sedimentation measurements.
BP M – 604 (3 cr. h)	**Membrane and cell Biophysics** **بيوفيزياء الخلية والاغشية** Liposomes as model membrane system; properties of liposomes; stability of liposomes. Liposome-cell interactions; serum-liposome interactions - Liposomal targeting; liposomes & biophysics; gene therapy; gene vectors - Cell membrane solubilization using detergents - Separation of biomembrane components - Membrane reconstitution and liposome encapsulation.
BP M - 610 (2 cr. h)	**Biophysics of Ionizing Radiation Imaging** **بيوفيزياء التصوير الاشعاعى المؤين** The image receptor: Phosphors and fluorescent screens – x- ray film – Digital radiography, quality control of recording media and image intensification systems - The radiological image: Image quality – contrast – scatter variation with photon energy- Grids – Resolution and unsharpness, Geometry of film , patient and x-ray source. Factors affecting radiological image - Special radiographic techniques – High voltage radiography – macroradiography – subtraction techniques - Diagnostic imaging with radioactive materials, Factors affecting the quality of radionuclide images -

	Quality standards ,assurance , and control - Tomographic imaging: Longitudinal tomography - Axial transmission tomography - Single photon emission computed tomography (SPECT) - Positron emission tomography.
B PM – 611 **(2 cr. h)**	**Health Biophysics** **بيوفيزياء صحية** Biological Effects of Radiation: Dose response characteristics: Direct action - Indirect action - Radiation effects: Acute effects - Blood changes - Hemopoietic syndrome - Gastrointestinal syndrome - Central nervous system syndrome - Other acute effects - Delayed effects: Cancer – Leukemia - Bone cancer - Lung cancer - Genetic effects - Hazards and toxicity - Life shortening – Cataracts - Risk estimates: BEIR III - Relative biological effectiveness (RBE) and Quality factor (QF): Dose equivalent : The sievert (and the Rem) - Radiation detectors: Particle-counting instruments: Gas-filled counter - Ionization chamber counter - Proportional counter - Geiger counter - Quenching a Geiger counter - Resolving time: Measurement of resolving time - Scintillation counters - Nuclear spectroscopy - Cerenkov detector - Semiconductor detector - Dose-measuring instruments: Pocket dosimeter - Film bandages - Thermoluminescent dosimeter - Ion current chamber - Neutron Measurements: Detection reaction - Neutron counting with a proportional counter - Long counter - Proton recoil counter - Neutron Dosimetry: Fast neutrons: Hurst counter - Thermal and fast neutron dose-equivalent meter - Albedo neutron dosimeter - External Radiation Protection: Basic principles - Techniques of external radiation protection – Time – Distance – Shielding.
BP M - 612 **(2 cr. h)**	**Technology of ionizing radiation dosimetry** **تكنولوجيا قياس الجرعات الاشعاعيه المؤينه** Quantities to describe a radiation beam – Energy transfer; Kerma and absorbed dose – Electronic equilibrium – The Bragg- Gray cavity – Determination of absorbed dose using an absolute ion chamber – Effects of temperature and pressure on ionization measurements – Exposure; The Roentgen – Standard air chamber – Practical ion chambers – Effective atomic number – Determination of absorbed dose in " Free Space"- Determination of absorbed dose in a phantom – Determination of absobed dose at energies above 3 MeV – Absorbed dose in the neighborhood of an interface between different materials – Relation between energy fluence and exposure. Saturation in ion chambers – Calculations of efficiency of ion collection – Types of ion chambers – Thermoluminescent dosimetry (TLD) – Chemical dosimetry – Direct measurement of absorbed dose; the calorimeter. Sources of ionizing radiation – Occupational and nonoccupational exposure limits- ALARA – Calculations involving exposures and doses – Internal and external sources of radiation.
BP M - 613 **(2 cr. h)**	**Medical Radiation Protection** **الوقايه الاشعاعيه الطبيه** Units of measurement – Radiation weighting factors- Equivalent dose – Effective dose – Committed Equivalent dose – Committed Effective dose – Collective Equivalent dose – Collective Effective dose – Collective Effective dose commitment , objectives of radiation protection - Recommended dose limits for occupational workers and general public - External radiation hazard: Effect of time , distance , and shielding for γ - sources and neutron sources - Protective Barriers for x –ray machines - Internal radiation hazard: Routes of entry – The ALI – Control of the

	contaminated hazard . Routine control of contamination.
BP M - 614 **(2 cr. h)**	**Radiobiology** **بيولوجيا اشعاعيه** Ionizing and nonionizing radiation: Ionizing radiation: Basic biologic interactions of radiation: Linear energy transfer (LET), relative biological effect (RBE) and target theory - Radiation effects on DNA - Radiation effects on Chromosomes - Radiation effects on other cellular constituents - Effects of fast neutrons on biological tissues - Chemical radioprotectors and antioxidants - Radiation shielding for Gamma rays, electrons and neutrons - Nonionizing radiation: Types of nonionizing radiation - Electromagnetic radiation and its distribution - Biological effects of EMF on biological systems and different organs of the body - Calculation of the specific absorption rate for the different waves - Radiation shielding for the different waves.
BP M - 615 **(2 cr. h)**	**Technology of non- ionizing radiation dosimetry** **تكنولوجيا قياس الجرعات الاشعاعية غير المؤينة** Radiation monitoring for ELF – EMFs, Field meter types, detection, magnetic field meters – international limits and doses, Biological effects - Radio Frequency and micro waves field inteusity meters, Protection guide and standards ,safety limits - Ultra violet radiation, detectors, biological effects on skin and eye, safety limits and precausions - Laser radiation, detectors, units of measurements, Biologcal effects, eye and skin dama-ges, protection guides and standards - Regularity requirements safety measurements, power and energy - Radiation shielding against; ELF – EMF, Magnetic fields, Radiofrequency, Ultraviolet, Laser radiation.

	2- M. Sc. Degree in Molecular Biophysics (BP MO)
BP MO - 630 **(2 cr. h)**	**Macromolecular Spectroscopy (1)** **أطياف الجزيئات الكبيرة (١)** Introduction to FTIR: Terms and Definitions - A Brief History of FTIR - The Advantages and Limitations of FTIR - Proper Use of Spectral Manipulations: Introduction - Spectral Subtraction - Baseline Correction – Smoothing.
BP MO - 631 **(2 cr. h)**	**Macromolecular Spectroscopy (2)** **اطياف الجزيئات الكبيرة (٢)** Choosing the Right Sampling Technique: Transmission Techniques: Transmission Spectra of Solids - KBr Pellets – Mulls - Cast Films - Heat and Pressure Films - Transmission Spectra of Liquids: Capillary Thin Films - Sealed Liquid Cells - Transmission Spectra of Gases - Reflectance Techniques: Diffuse Reflectance (DRIFTS) - Quantitative DRIFTS - Attenuated Total Reflectance(ATR) - Specular Reflectance - Photoacoustic Spectroscopy (PAS) - PAS Applications Quantitative Analysis: Introduction - Beer's Law - Single- Component Analyses - Different Standard Methods: External Standards - Internal Standards.
BP MO – 632 **(2 cr. h)**	**Technology of communication and control** **تكنولوجيا الاتصال والتحكم** Introduction - Structure and Function of the Nervous System - Biophysics of Neurons: Membrane Potential - Chemical – to- Electrical transduction - Signal Summation - Action Potential - Electrical – to Chemical Transduction - Biophysics of ionic channels: Types of ionic channels - Methods of measuring channels activity - Neuronal Systems: Overview -

	Sensory Systems - Neural Networks - Volume transmission - Learning and Memory - Instrumentation for measuring bioelectric activity from the neurons: Extracellular recordings - Intracellular recordings - Signal conditioning – Transducers - Noise in measurements - Methods of Data Analysis.
BP MO – 633 **(2 cr. h)**	**Technology of drug and biomolecules carriers system** **تكنولوجيا حاملات العقاقير الطبية والجزيئات البيولوجية** General techniques of liposomes preparations - Liposome characterization, size distribution, storage stability and leakage rate - Tailoring the bilayer membrane of liposomes – stealth liposomes - Interaction of lipid membranes with blood cells and proteins - Immuno liposome Targeting - Target – sensitive liposomes as rug carriers.
BP MO - 634 **(2 cr. h)**	**Bioenergetics** **طاقات حيوية** Membrane structure and storage of free energy – Chemiosmosis - Components and pathways for electron transport and proton translocation - Utilization of electrochemical ion gradients - Bioenergetics of the archaea - Energetics of methanogenesis - Energetics of respiration: Light-driven energetics - Proton transport in archaeal rhodopsins - Secondray energy converters - Light control of plant development - Photosystem I and II – Phytochrome.
BP MO – 635 **(2 cr. h)**	**Magnetic Properties of Biomolcules** **الخصائص المغناطيسية للجزيئات البيولوجية** Influence of magnetic fields on living cells - Magnetic field detection by animals - Growth in magnetic fields (magnetotropism) - Magnetic orientation of macromolecules systems - Diamagnetic and paramagnetic anisotropy of macromolecules - Magnetic Bireferengence - Polyelectric solutions under high magnetic fields - Membrane and micelles under steady magnetic fields: Organized biological molecules - Outer segments of retinal rods - Systems containing chloroplasts - Other biological particles.

	3- M. Sc. Degree in Environmental Biophysics (BP E)
BP E – 650 **(2 cr. h)**	**Advanced plant Ecology** **علم بيئة نباتية متقدم** Plant Ecology: The biophysical world - Traditional and modern approaches and concepts of plant ecoloqy - Ecosystem structure and function - Environmental changes and stress and life of plants with special reference to cosmic radiations and microwaves - Biogeochemical cycles - Interactions between plants and environment -mathematical and theoretical modelling of plant populations and ecosystem dynamics in natural and stressed systems - Applications of ecological knowledge in biophysical research and studies.
BP E – 651 **(2 cr. h)**	**Immunobiology** **مناعة بيولوجية** The course tends to acquaint the student with the basic and advanced topics in relation to the immune system. As immunology is a highly progressive field of science, it is of vital importance to give a general idea of its various aspects. The basis of immunology(innate and acquired immunity) - Molecules which recognize antigen (immunoglobulins, major histocompatibility complex MHC, T-cell receptor) - Production of effectors (B-cell activation, T-cell activation) – Hypersensitivity – Transplantation - Autoimmune diseases.
BP E - 652 **(2 cr. h)**	**Biophysics Of Low Frequency - Nonionizing Electromagnetic Fields** **بيوفيزياء المجالات الكهرومغناطسية الغير مؤينة منخفضة التردد** Electromagnetic waves, definition, classification according to their energies

	(wavelengths), sources. Environmental impact - Interactions of electromagnetic waves with biological systems, resonance interaction mechanisms, radiation hazards, safety limits - Transmission of electromagnetic waves, types of antenna, fields - Doses from mobile transmission antenna, safety limits, Radiation fields from broadcasting antennas, safety limits, Electromagnetic fields from power lines, magnetic components - Radiation effects on alive systems , safety limits and criteria - Absorption of non – ionizing radiation, radiation shielding.
BP E - 653 **(2 cr. h)**	**Advanced Animal Ecology** **علم بيئة حيوان متقدم** Ecological communication (Stimuli and communication: Sign stimuli (Key features) - Diverse sensory capacities - Acoustic behavior in vertebrates and invertebrates - Communication by language signals - Communicator signals during orientation and migration of birds, fishes, and insects - Communication by light signals (bioluminescence) – Echolocation – Colouration – Chemoreception - Neuroethology: Neural bases of behavior - Determinants of behavior - Physiology of communication: Acoustic behavior - Learning in animals - Human consciousness and behavior - Learning and memory in human - Behavioral Endocrinology: Reproductive behavior - Homeostasis and behavior - Biological rhythms - Memory and learning – Migration – Hibernation.
BP E – 654 **(2 cr. h)**	**Environmental pollution** **تلوث بيئه** Pollution in the modern world - Air pollution - Health effect of major air pollutants - Air pollutant concentration models: fixed box models - diffusion models - Pollution creation and decay in the atmosphere - Ozone - Oxides of carbon , nitrogen and sulphur and their effects on the environment - Acid rain - Climate change - Organic pollutants - Heavy metals - Inorganic pollutants - Toxicity and risk assessment of environmental pollutants.
BP E – 655 **(2 cr. h)**	**Biophysics Of High frequency Nonionizing Electromagnetic Fields** **بيوفيزياء المجالات الكهرومغناطسية الغير مؤينة عالية التردد** Laser physics, generation of laser, types, radiation doses, interaction of laser with matter. Biological interaction of laser, detectors, uses of laser in medicine and biology - Dosimetry of non – ionizing radiation , international limits, safety rules, shielding, detectors - General uses of non- ionizing electromagnetic radiation in medicine and biology.