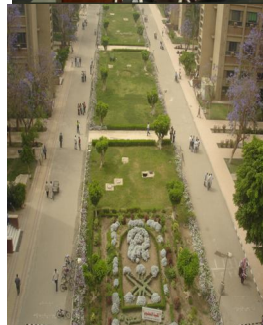# Faculty of Science
Internal Bylaw of Graduate Studies

"Program Curricula and Course Contents"

2016

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4- Geology Department

5- Botany and Microbiology Department

Courses' Contents

1- Mathematics Department

Mathematics Programs

Notice	Programs	Code	Degree
	1- Applied Statistics	M500	Professional Diploma
	2- Bioinformatics		
	1- Pure Mathematics	M600	M.Sc.
	2- Applied Mathematics		
	3- Mathematical Statistics		
	4- Computer Science		
	5- Scientific Computing		
	1- Pure Mathematics	M700	Ph.D.
	2- Applied Mathematics		
	3- Mathematical Statistics		
	4- Computer Science		
	5- Scientific Computing		

Postgraduate Mathematics Diploma

• Professional Diploma in Applied Statistics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	M500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	M 501	Calculus and Numerical Computations	3	-	3	**Compulsory**
	MS501	Descriptive Statistics with Statistical Software	2	2	3	
	MS503	Statistical Methods I	3	-	3	
	MS505	Statistical Computing	2	2	3	**Elective (select one)**
	MS507	Regression and Linear Models	2	2	3	
	MS509	Medical Statistics	3	-	3	
	MS511	Operations Research	3	-	3	
	MS513	Statistical Quality Control	3	-	3	
Second Semester	M 502	Linear Algebra with Applications	3	-	3	**Compulsory**
	MS502	Statistical Methods II	3	-	3	
	MS504	Biostatistics with Statistical Software	2	2	3	
	MS506	Decision Making and Forecasting	3	-	3	**Elective (select one)**
	MS508	Analysis of Variance and Design of Experiments	2	2	3	
	MS510	Time Series Analysis	3	-	3	
	MS512	Demography	3	-	3	
	MS514	Special Course in Statistics	3	-	3	

Postgraduate Computer Science Diploma

• Professional Diploma in Bioinformatics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	MC500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	MC521	Mathematical Biology	2	-	2	**Compulsory**
	MC523	Computation Biology Techniques	2	2	2	
	MC525	Bioinformatics (1)	2	2	3	
	MC527	Web Programming	2	2	3	**Elective (select one)**
	MC529	Biological Database	2	2	3	
	MC531	Python and Linux for Bioinformatics	2	2	3	
Second Semester	MC522	Introduction to Systems Biology	2	2	3	**Compulsory**
	MC524	Analyzing Next Generation Sequencing Data	2	2	3	
	MC526	Applied Statistics for Bioinformatics using R	2	2	3	
	MC528	Metabolic Engineering	2	2	3	**Elective (select one)**
	MC530	Computational Intelligence	2	2	3	
	MC532	Biological Data Mining	2	2	3	

M.Sc. Mathematics Programs

1- M.Sc. Degree in Pure Mathematics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	M600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48		Total credit hours	

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	M601	Linear Algebra **I**	3	-	3	**Compulsory**
	M603	Numerical Analysis **I**	3	-	3	
	M605	Functional Analysis	3	-	3	
	M607	Calculus of Variations	3	-	3	**Elective (select one)**
	M609	Differential Geometry **I**	3	-	3	
	M611	Fuzzy Mathematics	3	-	3	
	M613	Special Functions	3	-	3	
	M615	Special Course	3	-	3	
Second Semester	M602	Topology **I**	3	-	3	**Compulsory**
	M604	Partial Differential Equations **I**	3	-	3	
	M606	Discrete Mathematics	3	-	3	
	M608	Topics in Analysis **I**	3	-	3	**Elective (select one)**
	M610	Dynamical Systems **I**	3	-	3	
	M612	Operations Research **I**	3	-	3	
	M614	Selected Topics Related to Pure Mathematics	3	-	3	
	MC600	Practical (Computer)	3	-	3	

M.Sc. Degree in Applied Mathematics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	M600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	M603	Numerical Analysis **I**	3	-	3	**Compulsory**
	M617	Fluid Mechanics **I**	3	-	3	
	M619	Mathematical methods **I**	3	-	3	
	M621	Mechanics of Continuous media **I**	3	-	3	**Elective (select one)**
	M623	Elasticity theory **I**	3	-	3	
	M625	Electrodynamics **I**	3	-	3	
	M627	Statistical Mechanics **I**	3	-	3	
	M629	Special course	3	-	3	
Second Semester	M616	Advanced Quantum mechanics **I**	3	-	3	**Compulsory**
	MC618	Computational method in applied mathematics **I**	3	-	3	
	M620	Electromagnetic theory **I**	3	-	3	
	M622	Quantum electrodynamics **I**	3	-	3	**Elective (select one)**
	M624	Quantum Optics **I**	3	-	3	
	M626	Mathematical Modeling	3	-	3	
	M628	Selected Topics Related to Applied Mathematics	3	-	3	
	MC600	Practical curse (Computer)	3	-	3	

M.Sc. Degree in Mathematical Statistics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	M600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	MS601	Mathematical Statistics I	3	-	3	**Compulsory**
	MS603	Order Statistics	3	-	3	
	M601	Linear Algebra I	3	-	3	
	MS605	Sampling Theory	3	-	3	**Elective (select one)**
	MS607	Nonparametric Statistics	3	-	3	
	MS609	Regression Analysis	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	MS611	Special Coerce	3	-	3	
Second Semester	MS602	Mathematical Statistics II	3	-	3	**Compulsory**
	MS604	Bayesian Statistics	3	-	3	
	MS606	Computational Statistics	3	-	3	
	MS608	Stochastic Processes	3	-	3	**Elective (select one)**
	M612	Operations Research I	3	-	3	
	MS610	Queuing Theory	3	-	3	
	MS612	Selected Topics related to Mathematical Statistics	3	-	3	
	MC600	Practical (Computer)	3	-	3	

M.Sc. Degree in Computer Science

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	M600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	MC601	Computational Intelligence	3	-	3	**Compulsory**
	M601	Linear Algebra I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	MC603	Advanced Algorithms	3	-	3	**Elective (select one)**
	MC605	Network Security	3	-	3	
	MC607	Advanced Theory of Computation	3	-	3	
	MC609	Scientific Information Visualization	3	-	3	
	MC611	Special Course	3	-	3	
Second Semester	MC602	High – Performance Computing	3	-	3	**Compulsory**
	MS606	Computational Statistics	3	-	3	
	M606	Discrete Mathematics	3	-	3	
	M612	Operations Research I	3	-	3	**Elective (select one)**
	M626	Mathematical Modeling	3	-	3	
	MC604	Advanced Image Processing	3	-	3	
	MC606	Selected Topics related to Computer Science	3	-	3	
	MC600	Practical (Computer)	3	-	3	

M.Sc. Degree in Scientific Computing

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	M600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	MC601	Computational Intelligence	3	-	3	**Compulsory**
	M601	Linear Algebra I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	MC603	Advanced Algorithms	3	-	3	**Elective (select one)**
	MC607	Advanced Theory of Computation	3	-	3	
	MC609	Scientific Information Visualization	3	-	3	
	MC613	Introduction to Finite Element Methods	3	-	3	
	MC615	Special Course	3	-	3	
Second Semester	MC602	High – Performance Computing	3	-	3	**Compulsory**
	MS606	Computational Statistics	3	-	3	
	M606	Discrete Mathematics	3	-	3	
	M612	Operations Research I	3	-	3	**Elective (select one)**
	M626	Mathematical Modeling	3	-	3	
	MC608	Computational Fluid Dynamics	3	-	3	
	MC610	Selected Topics related to Scientific Computing	3	-	3	
	MC600	Practical (Computer)	3	-	3	

Ph.D. Mathematics Program

• **Ph.D. Degree in Pure Mathematics**

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	M700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Complex analysis	M701
	3	-	3	General Relativity	M702
	3	-	3	Number theory	M703
	3	-	3	Algebraic geometry	M704
	3	-	3	Operation Research II	M705
	3	-	3	Numerical analysis II	M706
	3	-	3	Dynamical systems II	M707
	3	-	3	Partial Differential Equations II	M708
	3	-	3	Lie algebra	M709
	3	-	3	Harmonic analysis	M710
	3	-	3	Optimization theory	M711
	3	-	3	Riemannian geometry	M712
	3	-	3	Topology II	M713
	3	-	3	Differential Equations	M714
	3	-	3	Numerical Linear Algebra	M715
	3	-	3	Information geometry	M716
	3	-	3	Topics in Analysis II	M717
	3	-	3	Integral Equations	M718
	3	-	3	Selected Topics related to Mathematical Logic	M719
	3	-	3	Differential Geometry II	M720
	3	-	3	Special Course I	M721

• <u>Ph.D Degree in Applied Mathematics</u>

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	M700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Numerical analysis **II**	M706
	3	-	3	Integral Equations	M718
	3	-	3	Fluid Mechanics **II**	M722
	3	-	3	Advanced Quantum mechanics **II**	M723
	3	-	3	Mathematical methods **II**	M724
	3	-	3	Elasticity theory **II**	M725
	3	-	3	Computational method in applied Mathematics **II**	M726
	3	-	3	Electrodynamics **II**	M727
	3	-	3	Statistical Mechanics **II**	M728
	3	-	3	Nonlinear Dynamical Systems	M729
	3	-	3	Electromagnetic theory **II**	M730
	3	-	3	Quantum electrodynamics **II**	M731
	3	-	3	Theory of Relativistic Quantum Mechanics	M732
	3	-	3	Special Course **II**	M733
	3	-	3	Selected Topics related to Applied Mathematical	M734

Ph.D. Degree in Mathematical Statistics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	M700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Advanced Probability	MS701
	3	-	3	Multivariate Statistical Analysis	MS702
	3	-	3	Time Series Analysis	MS703
	3	-	3	Stochastic Differential equation	MS704
	3	-	3	Fuzzy probability and Statistics	MS705
	3	-	3	Nonlinear Regression Analysis	MS706
	3	-	3	Advanced Biostatistics	MS707
	3	-	3	Experimental Design	MS708
	3	-	3	Reliability and Life testing	MS709
	3	-	3	Special Course	MS710
	3	-	3	Operation Research II	M705
	3	-	3	Optimization theory	M711
	3	-	3	Integral Equations	M718
	3	-	3	Selected Topics related to Mathematical Statics	MS711

• **Ph.D Degree in Computer Science**

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	M700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Numerical Analysis **II**	M706
	3	-	3	Advanced Computational Geometry	MC701
	3	-	3	Information Geometry	M716
	3	-	3	Advanced Probability	MS701
	3	-	3	Multivariate Statistical Analysis	MS702
	3	-	3	Fuzzy probability and Statistics	MS705
	3	-	3	Nonlinear Regression Analysis	MS706
	3	-	3	Nonlinear Optimization	MC702
	3	-	3	Computational Complexity Theory	MC703
	3	-	3	Distributed and Parallel Computing	MC704
	3	-	3	Data Mining and Knowledge Discovery	MC705
	3	-	3	Advanced Artificial Intelligence	MC706
	3	-	3	Advanced Cryptoghy	MC707
	3	-	3	Software Reliability Engineering	MC708
	3	-	3	Information Theory	MC709
	3	-	3	Advanced Biostatistics	MS707
	3	-	3	Special Course I	MC710
	3	-	3	Selected Topics related to Computer Science	MC718

• Ph. D Degree in Scientific Computing

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	M700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Numerical Analysis II	M 706
	3	-	3	Integral Equations	M 718
	3	-	3	Advanced Computational Geometry	MC 701
	3	-	3	Data Mining and Knowledge Discovery	MC 705
	3	-	3	Parallel Computations for large-scale problems	MC 711
	3	-	3	Computational Biology	MC 712
	3	-	3	Numerical Methods for Time-Dependent Partial Differential Equations	MC 713
	3	-	3	Nonlinear Optimization	MC 702
	3	-	3	Quantum Computing	MC 714
	3	-	3	Distributed and Parallel Computing	MC 704
	3	-	3	Bioinformatics and Genomics	MC 715
	3	-	3	Computational Methods for Finance	MC 716
	3	-	3	Special Course II	MC 717
	3	-	3	Selected Topics related to Scientific Computing	MC709

2- Physics Department

Physics Programs

Notice	Programs	Code	Degree
	1- Medical Physics	**P500**	**Diploma**
	1- Solid State Physics		
	2- Nanomaterials		
	3- Nuclear Physics		
	4- Radiation Physics	**P600**	**M.Sc.**
	5- Plasma Physics		
	6- Laser Physics		
	7- Theoretical Physics		
	8- Medical Physics		
	1- Solid State Physics		
	2- Nanomaterials		
	3- Nuclear Physics		
	4- Radiation Physics	**P700**	**Ph.D.**
	5- Plasma Physics		
	6- Laser Physics		
	7- Theoretical Physics		

Postgraduate Physics Diploma

• Diploma in Medical Physics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P500
6	Elective	2 Courses (1 Course/Semester)	
6	Project	Project	
30	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	MD501	Basic Human Anatomy and Physiology	3	-	3	**Compulsory**
	P503	Principles of Medical Imaging	3	-	3	
	P505	Introduction to Nuclear Medicine	3	-	3	
	P507	Radiation Therapy	3	-	3	**Elective (select one)**
	P509	Medical Accelerators	3	-	3	
	P511	Radiation Physics and Protection	3	-	3	
Second Semester	MD502	Medical Training	3	-	3	**Compulsory**
	P504	Fundamentals of Radiological Sciences	3	-	3	
	P506	Computation and Image Processing	3	-	3	
	P508	Selected Topics Related to Medical Physics	3	-	3	**Elective (select one)**
	P510	Clinical Dosimetry Measurements	3	-	3	

M.Sc. Physics Programs

• M.Sc. Degree in Solid State Physics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	**Compulsory**
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P605	Advanced Electronics	3	-	3	**Elective (select one)**
	P607	Magnetic Resonance	3	-	3	
	P609	Methods of Experimental Solid State Physics	3	-	3	
	P611	Physics of Metals and Alloys	3	-	3	
	P613	Semiconductor Properties and Applications	3	-	3	
Second Semester	P602	Condensed Matter Physics	3	-	3	**Compulsory**
	P604	Crystal Structure	3	-	3	
	P606	Statistical Physics	3	-	3	
	P608	Selected Topics Related to Solid state Physics	3	-	3	**Elective (select one)**
	P610	Thermal Analysis	3	-	3	
	P612	Thin Films and Technological Applications	3	-	3	
	P614	Introduction of Nanomaterials	3	-	3	

• **M.Sc. Degree in Nanomaterials**

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	**Compulsory**
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P607	Magnetic Resonance	3	-	3	**Elective (select one)**
	P609	Methods of Experimental Solid State Physics	3	-	3	
	P615	Semiconductor Devices	3	-	3	
	P617	Quantum dots	3	-	3	
	C601	Organic Chemistry for Physicist	3	-	3	
Second Semester	P606	Statistical Physics	3	-	3	**Compulsory**
	P614	Introduction of Nanomaterials	3	-	3	
	P616	Synthesis and Characterizations of Nanomaterials	3	-	3	
	P602	Condensed Matter Physics	3	-	3	**Elective (select one)**
	P608	Selected Topics Related to Nanomaterials	3	-	3	
	P612	Thin Films and Technological Applications	3	-	3	
	P618	Nanocomposites	3	-	3	
	C602	Inorganic Chemistry for Physicist	3	-	3	

M.Sc. Degree in Nuclear Physics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	**Compulsory**
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P619	Accelerators and Reactors Physics	3	-	3	**Elective (select one)**
	P621	Methods of Experimental Nuclear Physics	3	-	3	
	P623	Elementary Particles	3	-	3	
	P625	Methods of Mathematical Physics	3	-	3	
Second Semester	P606	Statistical Physics	3	-	3	**Compulsory**
	P620	Nuclear Structure I	3	-	3	
	P622	Nuclear Reactions I	3	-	3	
	P608	Selected Topics Related to Nuclear Physics	3	-	3	**Elective (select one)**
	P624	Physics of Nuclear Medicine & Instrumentations	3	-	3	
	P626	Quantum Field Theory	3	-	3	
	P628	Radiation Physics	3	-	3	
	M626	Mathematical Modeling	3	-	3	

- ## M.Sc. Degree in Radiation Physics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	Compulsory
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P607	Magnetic Resonance	3	-	3	Elective (select one)
	P619	Accelerators and Reactors Physics	3	-	3	
	P621	Methods of Experimental Nuclear Physics	3	-	3	
	P625	Methods of Mathematical Physics	3	-	3	
Second Semester	P606	Statistical Physics	3	-	3	Compulsory
	P628	Radiation Physics	3	-	3	
	P630	Neutron Physics I	3	-	3	
	P608	Selected Topics Related to Radiation Physics	3	-	3	Elective (select one)
	P620	Nuclear Structure I	3	-	3	
	P622	Nuclear Reactions I	3	-	3	
	P624	Physics of Nuclear Medicine & Instrumentations	3	-	3	
	M626	Mathematical Modeling	3	-	3	

• <u>M.Sc. Degree in Plasma Physics</u>

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	**Compulsory**
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P607	Magnetic Resonance	3	-	3	**Elective (select one)**
	P613	Semiconductor Properties and Applications	3	-	3	
	P625	Methods of Mathematical Physics	3	-	3	
	P627	Physical Electronics	3	-	3	
Second Semester	P606	Statistical Physics	3	-	3	**Compulsory**
	P632	Plasma Physics	3	-	3	
	P634	Physics of Corona Discharge	3	-	3	
	P608	Selected Topics Related to Plasma Physics	3	-	3	**Elective (select one)**
	P636	Methods of Experimental Plasma Physics	3	-	3	
	P638	Gas Discharge	3	-	3	
	P640	Plasma Physics Applications	3	-	3	
	M626	Mathematical Modeling	3	-	3	

- ## **M.Sc. Degree in Laser Physics**

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	P600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	**Compulsory**
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P607	Magnetic Resonance	3	-	3	**Elective (select one)**
	P613	Semiconductor Properties and Applications	3	-	3	
	P625	Methods of Mathematical Physics	3	-	3	
Second Semester	P606	Statistical Physics	3	-	3	**Compulsory**
	P642	Laser Physics and Quantum Electronics	3	-	3	
	P644	Laser Applications	3	-	3	
	P608	Selected Topics Related to Laser Physics	3	-	3	**Elective (select one)**
	P646	Methods of Experimental Laser Physics	3	-	3	
	P648	Laser Physics and Technology	3	-	3	
	M626	Mathematical Modeling	3	-	3	

M.Sc. Degree in Theoretical Physics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	P600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	P601	Electromagnetic Theory I	3	-	3	**Compulsory**
	P603	Quantum Mechanics I	3	-	3	
	M603	Numerical Analysis I	3	-	3	
	P625	Methods of Mathematical Physics	3	-	3	**Elective (select one)**
	P629	High temperature – High pressure Physics	3	-	3	
	P631	Shock waves and detonation	3	-	3	
	P633	Equation of state	3	-	3	
Second Semester	P606	Statistical Physics	3	-	3	**Compulsory**
	P608	Selected Topics Related to Theoretical Physics	3	-	3	
	P650	Computational Physics	3	-	3	
	P604	Crystal Structure	3	-	3	**Elective (select one)**
	P620	Nuclear Structure I	3	-	3	
	P622	Nuclear Reactions I	3	-	3	
	P652	Dense Fluids Physics	3	-	3	
	M604	Partial Differential Equations I	3	-	3	

• M.Sc. Degree in Medical Physics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	P600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

	Course Code	Course Title	L	T/P	C	Course Type
First Semester	MD601	Human Anatomy and Physiology	3	-	3	**Compulsory**
	P635	Nuclear Medicine	3	-	3	
	P637	Radiation Detection and Measurements	3	-	3	
	P619	Accelerators and Reactors Physics	3	-	3	**Elective (select one)**
	P639	Experimental Methods in Radiation Detection	3	-	3	
	P641	Applications of Laser in Medicine	3		3	
Second Semester	P654	Medical Imaging	3	-	3	**Compulsory**
	P656	Radiobiology and Radiotherapy	3	-	3	
	P658	Biostatistics and Computer Simulation	3	-	3	
	P606	Selected Topics	3	-	3	**Elective (select one)**
	P660	Radiation Dosimetry	3	-	3	
	P662	Radiation Protection	3		3	

Ph.D. Physics Programs

- ## Ph.D. Degree in Solid State Physics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Solid State Physics	P701
	3	-	3	Advanced Condensed Matter Physics	P702
	3	-	3	Electromagnetic Theory II	P703
	3	-	3	Quantum Mechanics II	P704
	3	-	3	Molecular Spectroscopy	P705
	3	-	3	Applied Magnetic Materials	P706
	3	-	3	Ceramic Materials	P707
	3	-	3	Advanced Functional Materials	P708
	3	-	3	Numerical Analysis II	M706

• Ph.D. Degree in Nanomaterials

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Nanomterials	P701
	3	-	3	Advanced Condensed Mater Physics	P702
	3	-	3	Applied Magnetic Materials	P706
	3	-	3	Ceramic materials	P707
	3	-	3	Advanced Functional Materials	P708
	3	-	3	Advanced Fine Particle Engineering	P709
	3	-	3	Advanced Semiconductor Devices	P710
	3	-	3	Biological Science	B701

• Ph.D. Degree in Nuclear Physics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Nuclear Physics	P701
	3	-	3	Quantum Mechanics II	P704
	3	-	3	Nuclear Structure II	P711
	3	-	3	Nuclear Reactions II	P712
	3	-	3	Accelerators and Reactors Physics II	P713
	3	-	3	Elementary Particle Physics II	P714
	3	-	3	Numerical Analysis II	M706

Ph.D. Degree in Radiation Physics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Rediation Physics	P701
	3	-	3	Quantum Mechanics II	P704
	3	-	3	Accelerators and Reactors Physics II	P713
	3	-	3	Radiation Physics II	P715
	3	-	3	Neutron Physics II	P716
	3	-	3	Numerical Analysis II	M706

• Ph.D. Degree in Plasma Physics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Plasma Physics	P701
	3	-	3	Electromagnetic Theory II	P703
	3	-	3	Quantum Mechanics II	P704
	3	-	3	Molecular Spectroscopy	P705
	3	-	3	Methods of Experimental Plasma Physics II	P717
	3	-	3	Plasma Physics II	P718
	3	-	3	Fusion Energy Technology	P719
	3	-	3	Numerical Analysis II	M706

• Ph.D. Degree in Laser Physics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Laser Physics	P701
	3	-	3	Advanced Condensed Matter Physics	P702
	3	-	3	Electromagnetic Theory II	P703
	3	-	3	Quantum Mechanics II	P704
	3	-	3	Molecular Spectroscopy	P705
	3	-	3	Methods of Experimental Laser Physics II	P720
	3	-	3	Magnetic Resonance II	P721
	3	-	3	Laser Applications II	P722
	3	-	3	Numerical Analysis II	M706

• Ph.D. Degree in Theoretical Physics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	P700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Selected Topics Related to Theoretical Physics	P701
	3	-	3	Advanced Condensed Matter Physics	P702
	3	-	3	Electromagnetic Theory II	P703
	3	-	3	Quantum Mechanics II	P704
	3	-	3	Nuclear Structure II	P711
	3	-	3	Nuclear Reactions II	P712
	3	-	3	Magnetic Resonance II	P721
	3	-	3	Numerical Analysis II	M706
	3	-	3	Differential Equations II	M708

3- Chemistry Department

Chemistry Programs

Notice	Programs	Code	Degree
	• **Professional Diploma in Biochemistry**	**C500**	**Diploma**
	• **Professional Diploma in Quality Control**		
	• **Professional Diploma in Applied Forensic Chemistry**		
	• **Professional Diploma in Applied Organic Chemistry**		
	• **Professional Diploma in Environmental Analytical Chemistry**		
	• **Analytical Chemistry**	**C600**	**M.Sc.**
	• **Inorganic Chemistry**		
	• **Organic Chemistry**		
	• **Physical Chemistry**		
	• **Biochemistry**		
	• **Analytical Chemistry**	**C700**	**Ph.D.**
	• **Inorganic Chemistry**		
	• **Physical Chemistry**		
	• **Organic Chemistry**		
	• **Biochemistry**		

Diploma Chemistry Programs

1- Professional Diploma in Biochemistry

Course Code	Number of Courses	Course Type	Credit Hours
C500	10 Courses (5 Courses/Semester)	Compulsory	18
	3 Courses	Elective	6
	Project	Compulsory	6
	Total credit hours		30

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	2	-	2	Food chemistry analysis	C501	**First Semester**
	2	-	2	Endocrinology	C503	
	2	-	2	Biological fluids	MD503	
	2	-	2	Biostatistics with Statistical Software	MS504	
	1	3	-	Practical Biochemistry I	C505	
Elective (select one)	2	-	2	Physiological Biochemistry	MD505	
	2	-	2	Microbiology and immunochemistry	MD507	
	2	-	2	Human Nutrition	MD509	
Compulsory	2	-	2	Analytical Biochemistry	C502	**Second Semester**
	2	-	2	Enzymology	Z502	
	2	-	2	Biotechnology	B518	
	2	-	2	Medical biomarkers	MD504	
	1	3	-	Practical biochemistry II	C506	
Elective (select two)	2	-	2	Advanced Molecular Biology	B520	
	2	-	2	Bioinformatics	MC525	
	2	-	2	Intoxification of biological systems	MD506	
	2	-	2	Environmental health community	MD508	

• **Professtional Diploma in Quality Control**

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	C500
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Measurement and Testing Techniques	C511	**First Semester**
	3	-	3	Customer Satisfaction and Quality Assurance	C513	
	3	2	2	Statistical Quality Control and Sampling	C515	
Elective (select one)	3	-	3	Advanced Probability and Statistics	C517	
	3	-	3	Human Factors in Quality Assurance	C519	
	3	-	3	Reliability	C521	
	3	-	3	Good Manufacturing Practices	C523	
	3	-	3	Quality Assurance for the Service Delivery Process	C525	
Compulsory	3	-	3	Quality Function Management and TQM	C512	**Second Semester**
	3	-	3	Advanced Experimental Design	C514	
	3	2	2	ISO 9000 and the Audit Function	C516	
Elective (select one)	3	-	3	Software Reliability	C518	
	3	-	3	Biomedical Quality Control Methods	C520	
	3	-	3	Statistical Quality Control for Service Professionals	C522	
	3	-	3	Six Sigma Principles and Applications	C524	

• __Professional Diploma in Applied Forensic Chemistry__

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	C500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30		Total credit hours	

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Principles of Forensic Science	MD501	**First Semester**
	3	2	2	Modern Analytical Techniques	C531	
	3	-	3	Environmental Forensics 1	C533	
Elective (select one)	3	-	3	Applied Statistics for Data Analysis	C535	
	3	-	3	Forensic Analysis of DNA	C537	
	3	2	2	Spectral Analysis and Applied Spectroscopy	C539	
	3	-	3	Forensic Medicine	MD503	
	3	2	2	Medicinal Chemistry of Drugs of Abuse	C541	
Compulsory	3	-	3	General Toxicology	MD502	**Second Semester**
	3	-	3	Forensic Chemistry	C532	
	3	-	3	Biochemical Analysis	C534	
Elective (select one)	3	3	--	Laboratory QA/QC	C536	
	3	-	3	Organic and Food Analyses	C538	
	3	2	2	Histochemistry	MD501	
	3	-	3	Environmental Forensics 2	C540	
	3	-	3	Special Topics in Forensic Science	C542	

Professional Diploma in Applied Organic Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	9 Courses	
6	Elective	3 Courses	C500
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	2	-	2	Spectroscopic analysis	C551	**First Semester**
	2	-	2	Textile and fibers	C553	
	2	-	2	Polymers	C555	
	2	-	2	Statistics	C557	
	2	-	2	Drug synthesis	C559	
Elective (select one)	2	-	2	Industrial inorganic chemistry	C561	
	2	-	2	Environmental organic chemistry	C563	
Compulsory	2	-	2	Chromatographic Techniques	C552	**Second Semester**
	2	-	2	Dyes and pigments	C554	
	2	-	2	Petroleum and petrochemicals	C556	
	2	6	-	Practical applied chemistry	C558	
Elective (select two)	2	-	2	Review article	C560	
	2	-	2	Food analysis	C562	
	2	-	2	Synthetic organic chemistry	C564	
	2	-	2	Nanomaterials and applications	C566	

Professional Diploma in Environmental Analytical Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	C500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30		Total credit hours	

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Fundamentals of Environmental Chemistry	C571	**First Semester**
	3	-	3	Pollution and its Control	C573	
	3	-	3	Environmental Chemistry of Selected Xenobiotics and Heavy Metals.	C575	
Elective (select one)	3	-	3	Executive Development Skills	Mang501	
	3	2	2	Chemometrics	M533	
	3	3	2	Quality Assurance/ Quality Control Principles	C577	
	3	2	2	Water Analysis	C579	
	3	2	2	Fuel Analysis	C581	
Compulsory	3	3	2	Instrumental Methods of Analysis	C572	**Second Semester**
	3	-	3	Problem and Activity-Orientated Environmental Analysis	C574	
	3	6	-	Laboratory Work, Environmental Analysis 1 & 2	C576	
Elective (select one)	3	-	3	Oral and Written Communication	Mang502	
	3	-	3	Cement Analysis	C578	
	3	-	3	Fertilizer Analysis	C580	

M.Sc. Chemistry Programs

• M.Sc. Degree in Analytical Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	C600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Analytical Separation Science	C601	**First Semester**
	3	-	3	Bioanalysis	C603	
	3	2	2	Chemometrics (I)	M605	
Elective (select one)	3	2	2	Thermal Analysis	C607	
	3	-	3	Quantum Chemistry	C609	
	3	-	3	Femtochemistry	C611	
Compulsory	3	2	2	Advanced Instrumental Analysis	C602	**Second Semester**
	3	2	2	Environmental Analysis (I)	C604	
	3	2	2	Nanochemistry- an Introduction and Potential Applications	C606	
Elective (select one)	3	-	3	Selected Topics related to Analytical Chemistry	C608	
	3	-	3	Bioinorganic Chemistry	C610	
	3	-	3	Biophysical Chemistry	C612	
	3	3	-	Laboratory Quality Control/ Assurance System	C614	

• **M.Sc. Degree in Inorganic Chemistry**

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	C600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Recent Applications of Organometallic Chemistry	C621	**First Semester**
	3	-	3	Structural Inorganic Chemistry and Crystal Structure	C623	
	3	2	2	Application of Spectroscopy in Inorganic Chemistry	C625	
Elective (select one)	3	-	3	Application of Group Theory in Chemistry and Spectroscopy	C627	
	3	2	1	Thermal Analysis	C629	
	3	-	3	Femtochemistry and Laser Spectra	C631	
Compulsory	3	-	3	Organic Stereochemistry	C622	**Second Semester**
	3	-	3	Kinetics and Mechanisms of Inorganic Reactions	C624	
	3	-	3	Magnetochemistry of Inorganic Compounds	C626	
Elective (select one)	3	-	3	Recent Methods and Advances in Calculating Stability Constants of Complexes	C628	
	3	-	3	Luminescence Spectra of Inorganic Compounds	C630	
	3	-	3	Selected Topics related to Inorganic Chemistry (1)	C632	

M.Sc.Degree in Organic Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	C600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	2	-	2	Advanced organic synthesis	C651	**First Semester**
	2	-	2	Advanced physical organic chemistry	C653	
	2	-	2	Dyes and textiles	C655	
	2	-	2	Advanced NMR spectroscopy	C657	
Elective (select two)	2	-	2	Polymers synthesis and characterization	C659	
	2	-	2	Advanced heterocyclic chemistry	C661	
	2	-	2	Green organic chemistry	C663	
	2	-	2	Computational organic chemistry	C665	
	2	-	2	Selected topics in analytical chemistry	C667	
	2	-	2	Organic electrochemistry	C669	
Compulsory	2	-	2	Spectroscopic analysis	C652	**Second Semester**
	2	-	2	Advanced stereochemistry	C654	
	2	-	2	Selected topics in organic chemistry	C656	
	2	-	2	Organometallics in organic synthesis	C658	
	2	-	2	Statistics	C660	
Elective (select one)	2	-	2	Chromatographic analysis	C662	
	2	-	2	Biocatalysis and enzymes in organic synthesis	C664	
	2	-	2	Molecular Photochemistry	C666	
	2	-	2	Selected topics in inorganic chemistry	C668	

M.Sc. Degree in Physical Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	C600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Advanced Electrochemistry I	C651	**First Semester**
	3	-	3	Surface Chemistry	C653	
	3	-	3	Statistical and Computer Science	C655	
Elective (select one)	3	-	3	Theories and mechanisms of catalytic reactions	C657	
	3	2	1	The modern Aspect of Polarography and Voltammetry	C659	
	3	-	3	Nuclear and Radiochemistry	C661	
	3	-	3	Application of Group Theory in Chemistry and Spectroscopy	C663	
	3	-	3	Quantum Chemistry	C665	
Compulsory	3	-	3	Theoretical Chemistry	C652	**Second Semester**
	3	-	3	Solid State Chemistry	C654	
	3	2	2	Crystal structure analysis	C656	
Elective (select one)	3	-	3	The modern Aspect of Colloidal Chemistry	C658	
	3	-	3	Advanced Chemical Kinetics	C660	
	3	-	3	The Phase Diagrams for Solutions of Materials and Alloys	C662	
	3	-	3	Thermal and surface analysis	C664	
	3	-	3	Selected Topics related to Physical chemistry I	C666	

M.Sc. Degree in Biochemistry

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	C600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	2	-	2	Bioenergetics &the metabolism of carbohydrate and lipids	C671	**First Semester**
	2	-	2	Biochemistry of extracellular & intracellular communication	C673	
	2	-	2	Structures &function of proteins and enzymes	C675	
	2	-	2	Biocatalysts and enzymes in organic synthesis	C677	
	2	-	2	Macromolecular Recognition	C679	
Elective (select one)	2	-	2	Xenobiotics metabolism	C681	
	2	-	2	Physiology	MD683	
Compulsory	2	-	2	Instrumental chemical analysis	C672	**Second Semester**
	2	-	2	amino &Metabolism of proteins acids	C674	
	2	-	2	Molecular biology & cancer biology	MD676	
	2	-	2	Chemistry of natural products	C678	
Elective (select two)	2	-	2	Green organic chemistry	C680	
	2	-	2	Histology	MD682	
	2	-	2	Selected topics in biochemistry	C684	

Ph.D. Chemistry Programs

• Ph.D Degree in Analytical Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	C700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Quality Management in Analytical Chemistry	C701
	3	-	3	Chemometrics (II)	M702
	3	-	3	Environmental Analytical Chemistry (II)	C703
	3	-	3	Selected Topics in Analytical Chemistry (2)	C704
	3	-	3	Laboratory Safety	C705
	3	-	3	Analytical Chemistry lab	C706
	3	-	3	Bioanalytical Chemistry and Chemical Sensors	C707
	3	-	3	Advanced Analytical Chemistry	C708
	3	-	3	Pharmaceutical & Toxicological Analysis	C709
	3	-	3	Selected Topics related to Analytical Chemistry	C710

• Ph.D. Degree in Inorganic Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	C700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Supramolecular Coordination Compounds	C720
	3	-	3	Photochemical Reactions of Inorganic Compounds	C721
	3	-	3	Stereochemistry of Coordination Compounds	C722
	3	-	3	Bioinorganic Chemistry	C723
	3	-	3	Application of Polarography and Cyclic Voltammetry to Inorganic Compounds	C724
	3	-	3	Selected Topics related to Inorganic Chemistry (2)	C725

• Ph.D. Degree in Physical Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	C700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Advanced Electrochemistry II	C730
	3	-	3	Concepts of Modern Catalysis	C731
	3	-	3	Advanced Kinetics for Modern Chemical Reactions and their Theories	C732
	3	-	3	Thermodynamics for Multi-Compound Reactions in Solution	C733
	3	-	3	Advanced Nuclear Chemistry	C734
	3	-	3	Nanostructured Materials; Preparation, Characterization and Application	C735
	3	-	3	Statistical Thermodynamics	C736
	3	-	3	Mass Transfer in Electrochemistry	C737
	3	-	3	Femtochemistry and Laser Spectroscopy	C738
	3	-	3	Selected Topics in Physical Chemistry II	C739

• Ph.D. Degree in Organic Chemistry

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	C700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select Three courses each semester)	2	-	2	Asymmetric synthesis	C750
	2	-	2	Toxins and medicinal chemistry	C751
	2	-	2	Supramolecular chemistry	C752
	2	-	2	Homogeneous and heterogeneous catalysis	C753
	2	-	2	Selected topics in organic reaction mechanisms	C754
	2	-	2	Modern physical organic chemistry	C755
	2	-	2	Advanced natural products chemistry	C756
	2	-	2	Environmental organic chemistry	C757
	2	-	2	Advanced biochemistry	C758
	2	-	2	Photochemistry and Chemistry of Organic Laser	C759

• Ph.D. Degree in Biochemistry

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	
4	Compulsory	Seminars	C700
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select Three courses each semester)	2	-	2	Drug drug interaction	C761
	2	-	2	Drug delivery	C762
	2	-	2	Nano biotechnology	C763
	2	-	2	Genetic engineering	C764
	2	-	2	Immunology	C765
	2	-	2	Selected topics biochemistry	C766
	2	-	2	Microbial ecology	C767
	2	-	2	. Drug Synthesis and Design	C768
	2	-	2	3D reconstruction of macromolecules using single particle electron microscopy.	C769

4- Geology Department

GeologyPrograms

Notice	Programs	Code	Degree
	1- Applied Geophysics 2- Petroleum Geology& Hydrogeology 3- Economic Ores& Minerals	G500	**Diploma**
	4-Medical Geology 5-Applied Environmental Geosciences		**Professional Diploma**
	1- Applied Geophysics	G600	**M.Sc.**
	2- Petroleum Geology		
	3- Stratigraphy& Paleontology		
	4- Sedimentary Geology		
	5- Structural Geology		
	6- Hydrogeology		
	7- Igneous& Metamorphic Rocks		
	8- Ores & Economic Geology		
	1- Applied Geophysics	G700	**Ph.D.**
	2- Petroleum Geology		
	3- Stratigraphy & Paleontology		
	4- Sedimentary Geology		
	5- Structural Geology		
	6- Hydrogeology		
	7- Igneous & Metamorphic Rocks		
	8- Ores & Economic Geology		

Postgraduate Geology Diploma

• -Diploma in Applied Geophysics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Geodynamics	G501	**First Semester**
	3	2	2	Seismic Prospecting	G503	
	3	2	2	Digital Data Processing	G505	
Elective (select one)	3	2	2	Earthquake Seismology	G507	
	3	2	2	Special Topics in Geophysics	G509	
Compulsory	3	2	2	Electric and Electromagnetic Prospecting	G502	**Second Semester**
	3	2	2	Gravity and Magnetic Prospecting	G504	
	3	2	2	Well logging and Petrophysics	G506	
Elective (select one)	3	2	2	Telluric and Magnetotellric Methods	G508	
	3	2	2	Radioactive& Geothermal Methods	G510	

• <u>Diploma in Petroleum Geology & Hydrogeology</u>

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Petroleum Geology-2	G511	**First Semester**
	3	2	2	Groundwater Hydrology	G513	
	3	2	2	Well Hydraulics	G515	
Elective (select one)	3	2	2	Sequence Stratigraphy-2	G517	
	3	2	2	Advanced Structure Geology	G519	
Compulsory	3	2	2	Well logging and Petrophysics	G506	**Second Semester**
	3	2	2	Petroleum Reservoirs (Siliciclastic, Carbonate and Fracture)	G512	
	3	2	2	Advanced Hydrochemistry	G514	
Elective (select one)	3	-	3	Groundwater Aquifer Systems in Egypt	G516	
	3	2	2	Sedimentary Rocks and Sedimentary Environments	G518	

• <u>Diploma in Economic Ores & Minerals</u>

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Ore Genesis	G521	**First Semester**
	3	2	2	Mineral Processing	G523	
	3	-	3	Advanced Mineral Deposits of Egypt	G525	
Elective (select one)	3	-	3	Mineral Economics	G527	
	3	2	2	Digital Data Processing	G505	
Compulsory	3	2	2	Advanced Ore Mineralogy and Ore Microscopy	G520	**Second Semester**
	3	2	2	Exploration of Mineral Deposits	G522	
	3	2	2	Special course	G524	
Elective (select one)	3	2	2	Advanced Geostatistics	G526	
	3	2	2	Structural Geology for Economic Geologists	G528	

Professional Diploma

• Professional Diploma in Medical Geology

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G500
6	Elective	2 Courses (1 Course/Semester)	
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Air Pollution and Health	G529	**First Semester**
	3	2	2	Environmental Metallotoxicology	Md531	
	3	2	2	Water and Health	Md533	
Elective (select one)	3	2	2	Inorganic geochemistry Techniques	G535	
	3	2	2	GIS	G537	
Compulsory	3	2	2	Environmental Geochemistry	G528	**Second Semester**
	3	2	2	Soil and Health	Md530	
	3	2	2	Minerals and Health of Human and Animal	Md532	
Elective (select one)	3	2	2	Waste Disposal and Pollution	G534	
	3	2	2	Geological Impact on Nutrition	G536	

• **Professional Diploma in Applied Environmental Geosciences**

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	G500
6	Compulsory	Project	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Applied Geochemistry	G539	**First Semester**
	3	2	2	Remote Sensing & Image Processing.	G541	
	3	2	2	Soil Mechanics and Stabilization Techniques.	G543	
Elective (select one)	3	2	2	Information Technology	G545	
	3	2	2	Hydrogeology	G547	
Compulsory	3	2	2	Geographic Information Systems(GIS)	G540	**Second Semester**
	3	2	2	Applied Sedimentology & Quaternary Geology.	G542	
	3	2	2	Environmental Geosciences	G544	
Elective (select one)	3	2	2	Applications of GIS & Remote Sensing in Environmental Geosciences	G546	
	3	2	2	Environmental Impact and Risk Assessment	G548	

M.Sc. Geology Programs

• M.Sc. Degree in Applied Geophysics

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	3	Earthquake Seismology	G601	**First Semester**
	3	2	3	Electric and Electromagnetic Prospecting	G603	
	3	-	3	Geodynamics2	G605	
Elective (select one)	3	-	3	Marine Geophysics	G607	
	3	2	3	Seismic Stratigraphy	G609	
Compulsory	3	2	3	Gravity and Magnetic Prospecting	G602	**Second Semester**
	3	2	3	Seismic Prospecting	G604	
	3	-	3	Inverse Theory and Inversion Concepts	G606	
Elective (select one)	3	2	3	Data Analysis Techniques in Geophysics	G608	
	3	2	3	Well logging and Petrophysics2	G610	
	3	2	3	Selected Topics related to Applied Geophysics	G611	

• M.Sc. Degree in Petroleum Geology

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Petroleum System2	G613	**First Semester**
	3	2	2	Advanced Sequence Stratigraphy and Sedimentary Basin Development	G615	
	3	2	2	Formation Evaluation	G617	
Elective (select one)	3	-	3	Siliciclastic Reservoir Rocks	G619	
	3	-	3	Environmental Sedimentology	G621	
Compulsory	3	2	2	Well logging and Petrophysics2	G610	**Second Semester**
	3	2	2	Petroleum Geochemistry	G612	
	3	2	2	Geophysical Exploration	G614	
Elective (select one)	3	-	3	Carbonate Reservoir Rocks	G616	
	3	-	3	The Phanerozoic Eon of Egypt	G618	
	3	-	3	Advanced Sedimentology	G620	
	3	-	3	Selected Topics related to Petroleum Geology	G622	

• __M.Sc. Degree in Stratigraphy& Paleontology__

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Applied Stratigraphy	G623	**First Semester**
	3	-	3	Advanced Vertebrate Paleontology	G625	
	3	-	3	Advanced Invertebrate Paleontology	G629	
Elective (select one)	3	-	3	Advanced Sequence Stratigraphy and Sedimentary Basin Development	G615	
	3	-	3	Remote Sensing and Image Processing	G627	
Compulsory	3	-	3	The Phanerozoic Eon of Egypt	G618	**Second Semester**
	3	-	3	Applied Micropaleontology	G624	
	3	-	3	Origin and Evolution of Earth	G626	
Elective (select one)	3	-	3	Advanced Plant Fossils	G628	
	3	-	3	Paleogeography & Paleoclimatology	G630	
	3	-	3	Selected Topics related to Stratigraphy & Paleontology	G632	

• <u>M.Sc. Degree in Sedimentary Geology</u>

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Advanced Sedimentology	G631	**First Semester**
	3	-	3	Applied Stratigraphy	G623	
	3	-	3	Advanced Sequence Stratigraphy and Sedimentary Basin Development	G 615	
Elective (select one)	3	-	3	Quaternary Sedimentology	G635	
	3	-	3	Clay Mineralogy	G637	
Compulsory	3	-	3	Advanced Geochemistry of Sedimentary Rocks	G644	**Second Semester**
	3	-	3	Sedimentary Basin Analysis	G636	
	3	-	3	Advanced Geotectonic	G638	
Elective (select one)	3	-	3	Environmental Sedimentology	G640	
	3	-	3	Advanced Depositional Systems	G642	
	3	-	3	Selected Topics related to Sedimentary Geology	G646	

• M.Sc. Degree in Structural Geology

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	G600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Remote Sensing and Image Processing	G627	**First Semester**
	3	-	3	Advanced Structural Analysis	G639	
	3	2	2	Applied Structural Geology (Case Study)	G641	
Elective (select one)	3	2	2	Petrofabric Analysis	G643	
	3	-	3	Global Tectonics	G645	
	3	-	3	Tectonic Evolution of the Arabian-Nubian Shield	G647	
Compulsory	3	-	3	Advanced Structural Geology and Tectonics	G634	**Second Semester**
	3	-	3	Tectonic Provinces of Egypt	G648	
	3	2	2	Geographic Information Systems and Production of Geologic Maps and Cross Sections	G650	
Elective (select one)	3	-	3	Morphotectonics and Analytical Geomorphology	G652	
	3	2	2	Engineering Geology	G654	
	3	2	2	Selected Topics related to Structural Geology	G656	

• <u>M.Sc. Degree in Hydrogeology</u>

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	G600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Groundwater Modeling	G649	**First Semester**
	3	2	2	Water Quality Modeling	G651	
	3	2	2	Hydrogeophysics	G653	
Elective (select one)	3	2	2	Field Hydrogeology	G655	
	3		3	Coastal Aquifers and Saltwater Intrusion	G657	
	3	-	3	Water Resources in Arid Environments	G659	
Compulsory	3	2	2	Surface Water/Groundwater Interaction	G658	**Second Semester**
	3	2	2	Applications of GIS in Water Resources	G660	
	3	2	2	Evaluation of Groundwater Resources	G662	
Elective (select one)	3	-	3	Karst and Fractured Aquifers	G664	
	3	2	2	Aqueous Geochemistry and Groundwater Contamination	G666	
	3	-	3	Selected Topics related to Hydrogeology	G668	

M.Sc. Degree in Igneous & Metamorphic Rocks

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48		Total credit hours	

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Petrology of Metamorphic Rocks	G661	**First Semester**
	3	-	3	General Characteristics of Metamorphic Terrains	G663	
	3	2	2	Basement Tectonic of Egypt	G665	
Elective (select one)	3	2	2	High-Grade Metamorphism and Anatexis	G 667	
	3	2	2	Alkaline Rocks	G669	
Compulsory	3	2	2	Petrology of Igneous Rocks2	G670	**Second Semester**
	3	-	3	Advanced Geochemistry	G672	
	3	2	2	Advanced Mineralogy	G674	
Elective (select one)	3	-	3	Igneous Petrogenesis and Plate Tectonics	G676	
	3	-	3	Petrology of Mantel	G678	
	3	-	3	Selected Topics related to Igneous& Metamorphic Rocks	G680	

• **M.Sc. Degree in Ores & Economic Geology**

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	G600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Minerals Deposit & Plate Tectonic	G671	**First Semester**
	3	-	3	Mineral Deposits in African Belt	G673	
	3	2	2	Geochemistry Of Mineral Deposits	G675	
Elective (select one)	3	2	2	Mining Geology and Resource Estimation	G677	
	3	2	2	Applications of Industrial Minerals and Rocks	G679	
Compulsory	3	-	3	Advanced Ore Petrology	G682	**Second Semester**
	3	2	2	Fluid Inclusions: Techniques and Applications	G684	
	3	2	2	Exploration Geochemistry	G686	
Elective (select one)	3	-	3	Prospecting of Mineral Deposits	G688	
	3	-	3	Advanced Ore Deposits	G690	
	3	-	3	Selected Topics related to Ore & Economic Geology	G692	

Ph.D. Geology Programs

• Ph.D. Degree in Applied Geophysics

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	G700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	2	2	Electric and Electromagnetic Prospecting -3	G701
	3	2	2	Well Logging and Petrophysics -3	G702
	3	2	2	Gravity and Magnetic Prospecting -3	G703
	3	2	2	Seismic Exploration -3	G704
	3	2	2	Shallow Geophysical Exploration and Applications	G705
	3	2	2	Seismic Hazard and Geophysical Site Investigations	G706
	3	2	2	Advanced Sequence Stratigraphy	G707
	3		3	East African Rift and Geology of Nile Basin	G708
	3	2	2	Selected Topics related to Applied Geophysics	G709

• **Ph.D. Degree in Petroleum Geology**

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	G700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	2	2	Seismic Exploration -3	G704
	3	-	3	East African Rift and Geology of NileBasin	G708
	3	2	2	Advanced Sequence Stratigraphy	G707
	3	2	2	Petroleum System-2	G710
	3	2	2	Advanced Geophysical Hydrocarbon Exploration	G711
	3	2	2	Petroleum Geochemistry	G712
	3	2	2	Advanced Sedimentary Basin Analysis	G713
	3	2	2	Modern Applications of Remote Sensing Techniques to Geologic Problems	G714
	3	-	3	Selected Topics related to Petroleum Geology	G715

• Ph.D. Degree in Stratigraphy & Paleontology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	
4	Compulsory	Seminars	G700
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	-	3	Advanced Sequence Stratigraphy	G707
	3	-	3	East African Rift and Geology of NileBasin	G708
	3	-	3	Global Stratigraphic Correlation	G716
	3	-	3	Micropalaeontology in the Petroleum Exploration	G717
	3	-	3	Geological Time Scale & the World Type Geologic	G718
	3	-	3	Phanerozoic Mass Extinctions	G719
	3	-	3	Advanced Quaternary and Environmental Geology	G720
	3	-	3	Stratigraphy of Africa	G721
	3	-	3	Selected Topics related to Stratigraphy & Paleontology	G722

• Ph.D. Degree in Sedimentary Geology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	
4	Compulsory	Seminars	G700
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	-	3	Advanced Sequence Stratigraphy	G707
	3	-	3	East African Rift and Geology of Nile Basin	G708
	3	-	3	Advanced Sedimentary Basin Analysis	G713
	3	-	3	Modern Applications of Remote Sensing Techniques to Geologic Problems	G714
	3	-	3	Advanced Quaternary and Environmental Geology	G720
	3	-	3	Stratigraphy of Africa	G721
	3	-	3	Advanced Geochemistry of Sediments and Sedimentary Rocks	G723
	3	-	3	Selected Topics related to Sedimentary Geology	G724

• Ph.D. Degree in Structural Geology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	G700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	-	3	East African Rift and Geology of Nile Basin	G708
	3	2	2	Modern Applications of Remote Sensing Techniques to Geologic Problems	G714
	3	-	3	Modern Concepts in Structural Geology and Tectonics	G725
	3	-	3	Geodynamics and Neo-tectonics	G726
	3	2	2	Quantitative Geomorphology	G727
	3	-	3	Tectonic Framework of the Middle East	G728
	3	-	3	Tectonics of Sedimentary Basins	G729
	3	-	3	Tectonic Setting of the Mediterranean Basins	G730
	3	2	2	Selected Topics related to Structural Geology	G731

• Ph.D. Degree in Hydrogeology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	G700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	-	3	Advanced Sedimentary Basin Analysis	G713
	3	2	2	Modern Applications of Remote Sensing Techniques to Geologic Problems	G714
	3	-	3	Advanced Quaternary and Environmental Geology	G720
	3	-	3	Integrated Water Resources Management	G732
	3	-	3	Socio- Hydrogeology	G733
	3	-	3	Integrated Watershed Management	G734
	3	-	3	Isotope Hydrogeology	G735
	3	-	3	Environmental Impact Assessment	G736
	3	-	3	Selected Topics related to Hydrogeology	G737

• Ph.D. Degree in Igneous & Metamorphic Rocks

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	
4	Compulsory	Seminars	G700
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	-	3	Modern Applications of Remote Sensing Techniques to Geologic Problems	G714
	3	-	3	Stratigraphy of Africa	G721
	3	-	3	Micro Tectonics	G738
	3	-	3	Modern and Ancient Volcanic Successions	G739
	3	-	3	Metamorphic Mineral Reaction &Equilibra	G740
	3	-	3	Metamorphism and Tectonics	G741
	3	-	3	The Evolving Continents	G742
	3	-	3	Isotope Geology	G743
	3	-	3	Selected Topics related to Igneous & Metamorphic Rocks	G744

• Ph.D. Degree in Ores & Economic Geology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	G700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select one)	3	-	3	Modern Applications of Remote Sensing Techniques to Geologic Problems	G714
	3	-	3	Stratigraphy of Africa	G721
	3	2	2	Hydrothermal Alteration	G745
	3	-	3	Isotope Geochemistry for Economic Geologists	G746
	3	-	3	Applications in Industrial Minerals &Rocks Applications in Industrial Minerals &Rocks	G747
	3	-	3	Fluids in Earth Crust	G748
	3	-	3	Mineral Hazards to Human Health	G749
	3	-	3	Advanced Mineral Exploration	G750
	3	-	3	Selected Topics related to Ore & Minerals Economic	G751

5- Botany and Microbiology Department

Botany and Microbiology Programs

Programs	Code	Degree
• **Professional Diploma in Applied Microbiology**	**B500**	**Diploma**
• **Plant Physiology**	**B600**	**M.Sc.**
• **Plant Ecology**		
• **Taxonomy of Flowering Plants and Flora of Egypt**		
• **Microbiology**		
• **Plant Physiology**	**B700**	**Ph.D.**
• **Plant Ecology**		
• **Taxonomy of Flowering Plants and Flora of Egypt**		
• **Microbiology**		

Postgraduate Botany and Microbiology Diploma

- ## Professional Diploma in Applied Microbiology

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	B500
6	Elective	2 Courses (1 Course/Semester)	
6	Project	Thesis	
30	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	-	3	Virology and Immunology	B501	First Semester
	3	2	2	Yeasts systematics	B503	
	3	2	2	Medical microbiology	B505	
Elective (select one)	3	-	3	Biofuels and Renewable Energy	B507	
	3	-	3	Aquatic Hyphomycetes	B509	
	3	-	3	Environmental Microbiology	B511	
	3	-	3	Microbial Toxins	B513	
				Medical Biochemistry	MD515	
Compulsory	3	2	2	Applied Phycology	B502	Second Semester
	3	2	2	Microbiological Analyses	B504	
	3	-	3	Selected Topic in Microbiology	B506	
Elective (select one)	3	2	2	Microbial Bioremediation	B508	
	3	-	3	Food Microbiology	B510	
	3	2	2	Applied Bacteriology	B512	
	3	2	2	Biosafety and Biocontrol	B514	
	3	2	2	Selected Topics in Parasitology	Z 664	

M.Sc. Botany Programs

• Master Degree of Science in Plant Physiology

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	B600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48		Total credit hours	

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Molecular Physiology	B601	**First Semester**
	3	2	2	Mineral Nutrition	B603	
	3	-	3	Plant Water Relations	B605	
Elective (select one)	3	2	2	Environmental Pollution	B607	
	3	2	2	Plant Biotechnology	B609	
	3	2	2	Soil Microbiology	B627	
Compulsory	3	2	2	Physiology and Plant Biochemistry	B602	**Second Semester**
	3	2	2	Plant Hormones	B604	
	3	2	2	Selected Topics related to Plant Physiology	B606	
Elective (select one)	3	2	2	Physiology of Salt Tolerance	B608	
	3	2	2	Enzymology	B610	
	3	2	2	Biostatistics	M640	

• __M.Sc. Degree in Plant Ecology__

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	
6	Elective	2 Courses (1 Course/Semester)	B600
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Mineral Nutrition	B603	**First Semester**
	3	-	3	Plant Water Relations	B605	
	3	2	2	Environmental Pollution	B607	
Elective (select one)	3	-	3	Ecology of Halophytes	B611	
	3	-	3	Ecology of Mediterranean Region	B613	
	3	-	3	Biology of Seeds Dispersal and Germination	B615	
Compulsory	3	2	2	Environmental Soil Chemistry	B612	**Second Semester**
	3	-	3	Phytogeography and Natural Ecosystems	B614	
	3	2	2	Selected Topics related to Plant Ecology	B616	
Elective (select one)	3	2	2	Microenvironment of Plants	B618	
	3	2	2	Phytosociology and Functional groups	B620	
	3	2	2	Biostatistics	M640	

• M.Sc. Degree in Taxonomy of Flowering Plants and Flora of Egypt

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	B600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Principles of Plant Taxonomy	B617	**First Semester**
	3	2	2	Cytotaxonomy	B619	
	3	2	2	Comparative Plant Morphology	B621	
Elective (select one)	3	2	2	Ecology of Mediterranean Region	B613	
	3	2	2	Taxonomy of Aquatic Plants	B623	
	3	-	3	Botanical Gardens and Herbaria	B625	
Compulsory	3	2	2	Advanced Palynology	B622	**Second Semester**
	3	2	2	Chemotaxonomy	B624	
	3	2	2	Selected Topics related to Plant Taxonomy	B626	
Elective (select one)	3	-	3	Phytogeography and Natural Ecosystems	B614	
	3	2	2	Medicinal Plants	B628	
	3	2	2	Fossil Plants	B630	

• M.Sc. Degree in Microbiology

Credit Hours	Course Type	Number of Courses	Course Code
18	Compulsory	6 Courses (3 Courses/Semester)	B600
6	Elective	2 Courses (1 Course/Semester)	
2	Compulsory	Seminars	
22	Compulsory	Thesis	
48		Total credit hours	

Course Type	Hours/Week			Course Title	Course Code	
	C	T/P	L			
Compulsory	3	2	2	Soil Microbiology	B627	**First Semester**
	3	2	2	Microbial Secondary Metabolites	B629	
	3	2	2	Microbial Enzymes	B631	
Elective (select one)	3	2	2	Advanced Virology	B633	
	3	2	2	Advanced Bacteriology	B635	
	3	2	2	Advanced Mycology	B637	
	3	2	2	Advanced Algae	B639	
Compulsory	3	2	2	Aquatic Microbiology	B632	**Second Semester**
	3	2	2	Microbial Biotechnology	B634	
	3	2	2	Selected Topics related to Microbiology	B636	
Elective (select one)	3	2	2	Host Parasite Relationship	B638	
	3	2	2	Industrial Microbiology	B640	
	3	2	2	Physiology of Bacteria	B642	
	3	2	2	Microbial Pollution	B644	

Ph.D. Botany Programs

• Ph.D. Degree in Plant Physiology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	B700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Growth Regulators	B701
	3	-	3	Plant Metabolism Regulation	B702
	3	2	2	Bioinformatics	B703
	3	-	3	Plant Signals	B704
	3	2	2	Secondary Metabolites	B705
	3	-	3	Environmental Stresses	B706
	3	-	3	Mechanisms Associated With Environmental Stress Tolerance in Plants	B707
	3	2	2	Plant Tissue Culture	B708
	3	2	2	Genetic and Molecular Biology	B709
	3	2	2	Selected Topics related to Plant Physiology	B710

• Ph.D. Degree in Plant Ecology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	B700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	-	3	Phytotechnology	B711
	3	-	3	Ecology of Xerophytes	B712
	3	2	2	Vegetation Analysis	B713
	3	2	2	Ecology of Aquatic Plants	B714
	3	2	2	Botanical Maps	B715
	3	-	3	Physiological Plant Ecology	B716
	3	-	3	Evolutionary Ecology	B717
	3	2	2	Selected Topics related to Plant Ecology	B718

• Ph.D. Degree in Taxonomy of Flowering Plants and Flora of Egypt

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	B700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	2	2	Botanical Maps	B715
	3	2	2	Molecular Systematic	B719
	3	2	2	Flora of Egypt in Relation to Neighbouring regions	B720
	3	2	2	Paleobotany	B721
	3	2	2	Numerical Taxonomy	B722
	3	2	2	Plant Nomenclature	B723
	3	2	2	Modern trends in Plant Identification	B724
	3	2	2	Selected Topics related to Plant Taxonomy	B725

• Ph.D. Degree in Microbiology

Credit Hours	Course Type	Number of Courses	Course Code
12	Elective	4 Courses (2 Course/Semester)	B700
4	Compulsory	Seminars	
44	Compulsory	Thesis	
60	Total credit hours		

Course Type	Hours/Week			Course Title	Course Code
	C	T/P	L		
Elective (select two courses each semester)	3	2	2	Actinomycetes	B726
	3	2	2	Algal Toxins	B727
	3	2	2	Ecophysiology of Aquatic Fungi	B728
	3	2	2	Bacterial Biotechnology	B729
	3	2	2	Biochemistry and Physiology of the Plant Pathogenic Viruses	B730
	3	-	3	Bioremediation of Environmental Pollutants	B731
	3	2	2	Biosensors and Their Biological Functions	B732
	3	2	2	Cyanobacteria	B733
	3	2	2	Freshwater Algae	B734
	3	2	2	Fungal Biotechnology	B735
	3	2	2	Fungal Enzymes	B736
	3	2	2	Medical Mycology	B737
	3	2	2	Industrial Mycology	B738
	3	2	2	Lichens	B739
	3	2	2	Marine and Fresh Water Bacteria	B740
	3	2	2	Marine Phytoplankton	B741
	3	2	2	Microbial Biotransformations	B742
	3	-	3	Microbial Genetics	B743
	3	2	2	Mycorrhizae	B744
	3	2	2	Mycotoxins	B745
	3	2	2	Nitrogen Fixing Prokaryotes	B746
	3	2	2	Seaweeds	B747
	3	2	2	Seed-Borne Fungi	B748
	3	2	2	Serological Techniques and Plant Viruses	B749
	3	-	3	Viroids	B750
	3	-	3	Plant Viruses and the Environment	B751
	3	2	2	Selected Topics related to Microbiology	B752

6- Zoology and Entomology Department

Zoology and Entomology Department
M.Sc. and Ph. D. programs
<u>1 .Zoology Programs</u>

Notice	Programs	Code	Degree
	1- Cell Biology		
	2- Histology and Histochemistry		
	3- Invertebrates		
	4- Parasitology	Z600	M.Sc.
	5- Physiology		
	6- Fish Biology		
	7- Comparative anatomy and Embryology		
	1- Cell Biology		
	2- Histology and Histochemistry		
	3- Invertebrates		
	4- Parasitology	Z700	Ph.D.
	5- Physiology		
	6- Fish Biology		
	7- Comparative Anatomy and Embryology		

2- Entomology Programs

Notice	Programs	Code	Degree
	1. Entomology	E600	M.Sc.
	1. Entomology		
	2. Insect Molecular Biology	E700	Ph.D
	3. Economic and Applied Entomology		

<u>M.Sc. Degree in Zoology</u>

1- M.Sc. Degree in Zoology (Cell Biology)

Course Code	Number of Courses	Course Type	Credit Hours
Z600	6 Courses (3 Courses/Semester)	Compulsory	18
	2 Courses (1 Course/Semester)	Elective	6
	Seminars	Compulsory	2
	Thesis	Compulsory	22
Total credit hours			48

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	Z 601	Cell biology	3	-	3	Compulsory
	Z 603	Molecular biology	3	-	3	
	Z 605	Practical Cell Biology	2	2	3	
	Z 607	Cellular traffic and endocytosis	3	-	3	Elective (select one)
	Z 609	Tumor biology	3	-	3	
	Z 611	Signal transduction	3	-	3	
Second Semester	Z 602	Histology	3	-	3	Compulsory
	Z 604	Histochemistry	3	-	3	
	ZM 606	Biostatistics	3	-	3	
	Z 608	Stem cell	3	-	3	Elective (select one)
	Z 610	Special course	3	-	3	
	Z 612	Selected topics in cell biology	3	-	3	

2. M.Sc. Degree in Zoology (Histology and Histochemistry)

Course Code	Number of Courses		Course Type	Credit Hours
Z600	6 Courses (3 Courses/Semester)		Compulsory	18
	2 Courses (1 Course/Semester)		Elective	6
	Seminars		Compulsory	2
	Thesis		Compulsory	22
Total credit hours				48

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	Z 601	Cell biology	3	-	3	Compulsory
	Z 613	Histochemistry and micro techniques	2	2	3	
	Z 615	Special course	3	-	3	
	Z 617	Immunology(1)	3	-	3	Elective (select one)
	ZM 606	Biostatistics	3	-	3	
	Z 619	Pathology	3	-	3	
	Z 621	Genetic and Molecular Biology	3	-	3	
Second Semester	Z 602	Histology	3	-	3	Compulsory
	Z 614	Physiology	3	-	3	
	Z 616	Basic Toxicology	3	-	3	
	Z 618	Aquatic Pollution (1)	3	-	3	Elective (select one)
	Z 620	Biochemistry	3	-	3	
	Z 622	Endocrinology	3	-	3	
	Z 624	Special course	3	-	3	
	Z 626	Selected Topics	3	-	3	

3. M.Sc. Degree in Zoology (Invertebrates)

Course Code	Number of Courses	Course Type	Credit Hours
Z600	6 Courses (3 Courses/Semester)	Compulsory	18
	2 Courses (1 Course/Semester)	Elective	6
	Seminars	Compulsory	2
	Thesis	Compulsory	22
Total credit hours			48

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	Z 623	Invertebrate structure and function	3	-	3	Compulsory
	Z 602	Histology	3	-	3	
	Z 625	Animal Ecology	3	-	3	
	Z 627	Fresh water ecology	3	-	3	Elective (select one)
	Z 629	Ecophysiology	3	-	3	
	Z 631	Special course related to Invertebrate	3	-	3	
	Z 603	Molecular biology	3	-	3	
Second Semester	Z 628	Principles of systematic zoology	3	-	3	Compulsory
	ZM 606	Biostatistics.	3	-	3	
	Z 630	Practical Invertebrates	2	2	3	
	Z 632	Biology of Mollusca	3	-	3	Elective (select one)
	Z 634	Immunology of invertebrates	3	-	3	
	Z 636	Soil ecology	3	-	3	
	Z 638	Invertebrate Relationships	3	-	3	
	Z 640	Selected Topics related to Invertebrates	3	-	3	

4. M.Sc. Degree in Zoology (Parasitology)

Course Code	Number of Courses	Course Type	Credit Hours
Z600	6 Courses (3 Courses/Semester)	Compulsory	18
	2 Courses (1 Course/Semester)	Elective	6
	Seminars	Compulsory	2
	Thesis	Compulsory	22
Total credit hours			48

	Course Code	Course Title	Hours/Week			Course Type
			L	**T/P**	**C**	
First Semester	Z 633	Parasitic Protozoa	3	-	3	**Compulsory**
	Z 635	Histo-Pathology	3	-	3	
	ZM 606	Biostatistics	3	-	3	
	Z 613	Histochemistry and microtechniques	3	-	3	**Elective (select one)**
	Z 637	Parasites of fishes	3	-	3	
	Z 639	Biochemistry	3	-	3	
	Z 641	Special course related to Parasitology	3	-	3	
Second Semester	Z 642	Parasitic helminthes	3	-	3	**Compulsory**
	Z 602	Histology	3	-	3	
	Z 644	Intermediate hosts and biological vectors	2	2	3	
	Z 646	Immunology	3	-	3	**Elective (select one)**
	Z 648	Practical and research project in Parasitology	2	2	3	
	Z 650	Selected Topics in Parasitology	3	-	3	

5. M.Sc. Degree in Zoology (Physiology)

Course Code	Number of Courses		Course Type	Credit Hours
Z600	6 Courses (3 Courses/Semester)		Compulsory	18
	2 Courses (1 Course/Semester)		Elective	6
	Seminars		Compulsory	2
	Thesis		Compulsory	22
Total credit hours				48

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	Z 643	Comparative physiology	3	-	3	Compulsory
	Z 645	Physiological Biochemistry	3	-	3	
	ZM 606	Biostatistics	3	-	3	
	Z 647	Nutrition and metabolism	3	-	3	Elective (select one)
	Z 649	Immunohistochemistry	3	-	3	
	Z 651	Pharmacology	3	-	3	
	Z 653	Comparative Reproduction	3	-	3	
Second Semester	Z 652	Selected topics in physiology	3	-	3	Compulsory
	Z 654	Lab and research project in physiology	2	2	3	
	Z 656	Cell physiology	3	-	3	
	Z 658	Pathology	3	-	3	Elective (select one)
	Z 660	Biotechnology	3	-	3	
	Z 662	Environmental physiology	3	-	3	
	Z 664	Selected Topics related to physiology	3	-	3	

6. M.Sc. Degree in Zoology (Fish Biology)

Course Code	Number of Courses	Course Type	Credit Hours
Z600	**6 Courses (3 Courses/Semester)**	Compulsory	**18**
	2 Courses (1 Course/Semester)	Elective	**6**
	Seminars	Compulsory	**2**
	Thesis	Compulsory	**22**
Total credit hours			**48**

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	Z 655	Limnology	3	-	3	**Compulsory**
	Z 657	Fish Ecology	3	-	3	
	Z 659	Fish physiology	3	-	3	
	Z 661	Special course in Fish Biology	3	-	3	**Elective (select one)**
	Z 663	Electron microscopic Technique	3	-	3	
	Z 603	Molecular biology	3	-	3	
Second Semester	Z 666	Aquaculture	2	2	3	**Compulsory**
	Z 668	Fish population dynamics	3	-	3	
	ZM 606	Biostatistics	3	-	3	
	Z 670	Cryo preservation	3	-	3	**Elective (select one)**
	Z 672	Fish Biodiversity	3	-	3	
	Z 674	Fisheries managements	3	-	3	
	Z 676	Fish Taxonomy	3	-	3	
	Z 678	Selected Topics in Fish Biology	3	-	3	

7. M.Sc. Degree in Zoology (Comparative Anatomy and Embryology)

Course Code	Number of Courses	Course Type	Credit Hours
Z600	6 Courses (3 Courses/Semester)	Compulsory	18
	2 Courses (1 Course/Semester)	Elective	6
	Seminars	Compulsory	2
	Thesis	Compulsory	22
Total credit hours			48

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	Z 665	Comparative anatomy of nervous system (Cranial nerves and sensory organs)	3	-	3	Compulsory
	Z 667	Molecular taxonomy and Vertebrate fauna	3	-	3	
	Z 669	Experimentation and Data analysis	2	2	3	
	Z 671	Development of Vertebrate body	3	-	3	Elective (select one)
	Z 673	Advanced Histology and Histochemistry	3	-	3	
	Z 675	Molecular Biology	3	-	3	
	Z 677	Special course related to the thesis				
Second Semester	Z 680	Biology of Regeneration	3	-	3	Compulsory
	Z 682	Isolating Mechanism and Speciation	3	-	3	
	Z 684	Developmental Biology and Electron Microscopy	3	-	3	
	Z 686	Comparative Physiology	3	-	3	Elective (select one)
	Z 688	Special course related to the thesis	3	-	3	
	Z 690	Selected Topics related to Comparative anatomy and Embryology	3	-	3	
			3	-	3	

1- Ph.D. Degree in Zoology (Cell Biology)

Course Code	Number of Courses	Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			**60**

Course Code	Course Title	Hours/Week			Course Type
		L	**T/P**	**C**	
Z701	Advanced Cell Biology	3	-	3	
Z702	Advanced histology	3	-	3	
Z703	Advanced Molecular Biology	3	-	3	
Z704	Advanced Signal transduction	3	-	3	
Z705	Advanced cellular traffic and endocytosis	3	-	3	Elective (select two courses each semester)
Z706	Advanced Stem cell	3	-	3	
Z707	Advanced Tumor Biology	3	-	3	
Z708	Molecular and cellular Immunology	3	-	3	
M708	Mathematical and statistical Packages	3	-	3	
Z709	Selected Topics in cell biology	3	-	3	

2- Ph.D. Degree in Zoology (Histology and Histochemistry)

Course Code	Number of Courses	Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			**60**

Course Code	Course Title	Hours/Week			Course Type
		L	T/P	C	
Z701	**Advanced Cell biology**	3	-	3	
Z702	**Advanced Histology**	3	-	3	
Z710	**Histochemistry**	3	-	3	
Z711	**Biochemical toxicology**	3	-	3	
Z712	**Immunology (2)**	3	-	3	**Elective (select two courses each semester)**
Z713	**Aquatic pollution(2)**	3	-	3	
Z714	**Genetic Engineering**	3	-	3	
Z715	**Microbiology**	3	-	3	
M708	**Mathematical and statistical Packages**	3	-	3	
Z716	**Selected Topics related to histology and Histochemistry**	3	-	3	

3- Ph.D. Degree in Zoology (Invertebrates)

Course Code	Number of Courses	Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			60

Course Code	Course Title	Hours/Week			Course Type
		L	T/P	C	
Z717	Invertebrate Haematology	3	-	3	Elective (select two courses each semester)
Z718	Nanobiology	3	-	3	
Z719	Aquatic pollution	3	-	3	
Z720	Soil Biology	3	-	3	
Z721	Invertebrate biodiversity and conservation	3	-	3	
Z722	Aquatic Ecotoxicology and terrestrial ecotoxicology	3	-	3	
Z723	Biology of Hirudinea	3	-	3	
Z724	Biology of Crustacea	3	-	3	
Z725	Invertebrate taxonomy	3	-	3	
M708	Mathematical and statistical Packages	3	-	3	
Z726	Ecophysiology	3	-	3	
Z727	Special course related to Invertebrates	3	-	3	
Z728	Selected Topics	3	-	3	

4- Ph.D. Degree in Zoology (Parasitology)

Course Code	Number of Courses	Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			**60**

Course Code	Course Title	Hours/Week			Course Type
		L	**T/P**	**C**	
Z729	**Advanced Parasitology**	3	-	3	**Elective (select two courses each semester)**
Z730	**Ultrastructure of histopathology**	3	-	3	
Z702	**Advanced Molecular biology**	3	-	3	
Z731	**Special course in Parasitology**	3	-	3	
Z732	**Special topics in parasitology**	3	-	3	
Z733	**Haematology**	3	-	3	
Z734	**Ecotoxicology**	3	-	3	
Z735	**Seminars and research project related to Parasitology**	3	-	3	
M708	**Mathematical and statistical Packages**	3	-	3	

5- Ph.D. Degree in Zoology (Physiology)

Course Code	Number of Courses		Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)		Elective	12
	Seminars		Compulsory	4
	Thesis		Compulsory	44
Total credit hours				**60**

Course Code	Course Title	Hours/Week			Course Type
		L	**T/P**	**C**	
Z736	**Neurophysiology**	3	-	3	
Z737	**Immuno-regulation and cell signaling**	3	-	3	
Z738	**Molecular Genetics**	3	-	3	
Z739	**Special Topics in physiology**	3	-	3	
Z740	**Cell cycle control and cancer**	3	-	3	
Z741	**Advanced Stem cell**	3	-	3	
Z742	**Applied Immunology**	3	-	3	**Elective (select two courses each semester)**
Z743	**Dysfunction of some organs**	3	-	3	
Z744	**Molecular Endocrinology**	3	-	3	
Z745	**Reproduction and infertility problems**	3	-	3	
Z746	**Molecular Hematology**	3	-	3	
Z747	**Seminar and research project related to Physiology**	3	-	3	
Z748	**Selected Topics in Physiology**	3	-	3	
Z 707	**Molecular and cellular Immunology**	3	-	3	
M708	**Mathematical and statistical Packages**	3	-	3	

6- Ph.D. Degree in Zoology (Fish Biology)

Course Code	Number of Courses	Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			60

Course Code	Course Title	Hours/Week			Course Type
		L	T/P	C	
Z749	**Fish biogeography**	3	-	3	
Z750	**Aquatic Ecosystem**	3	-	3	
Z751	**Fish hatchery managements**	3	-	3	
Z752	**Aquatic toxicology**	3	-	3	
Z753	**Fish Embryology**	3	-	3	
Z754	**Bioinformatics**	3	-	3	**Elective (select two courses each semester)**
Z755	**Nano Technology**	3	-	3	
Z756	**Fish Reproduction**	3	-	3	
Z757	**Fish food and Feeding Biology**	3	-	3	
Z710	**Histochemistry**	3	-	3	
Z758	**Selected Topics in fish biology**	3	-	3	
M708	**Mathematical and statistical Packages**	3	-	3	

7- Ph.D. Degree in Zoology (Comparative anatomy and Embryology)

Course Code	Number of Courses	Course Type	Credit Hours
Z700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			60

Course Code	Course Title	Hours/Week			Course Type
		L	T/P	C	
Z759	Experimental embryology	3	-	3	Elective (select two courses each semester)
Z760	Functional anatomy of vertebrates	3	-	3	
Z702	Advanced Molecular Biology	3	-	3	
Z761	Vertebrate physiology	3	-	3	
Z762	Genetic Engineering	3	-	3	
Z763	Advanced Developmental Biology	3	-	3	
Z764	Practical and research project	3	-	3	
ZP708	Biomechanics	3	-	3	
Z765	Selected Topics related to the thesis	3	-	3	
Z766	Special course related to Comparative anatomy and Embryology)	3	-	3	

2. Entomology Programs

1. M.Sc. in Entomology

Course Code	Number of Courses	Course Type	Credit Hours
E600	6 Courses (3 Courses/Semester)	Compulsory	18
	2 Courses (1 Course/Semester)	Elective	6
	Seminars	Compulsory	2
	Thesis	Compulsory	22
Total credit hours			48

	Course Code	Course Title	Hours/Week			Course Type
			L	T/P	C	
First Semester	E601	Insect Comparative Anatomy	3	-	3	Compulsory
	E603	Insect Taxonomy and ecology	3	-	3	
	E605	Selected Topics	3	-	3	
	E607	Medical Entomology	3	-	3	Elective (select one)
	E609	Insect toxicology				
	E611	Microtechnique	3	-	3	
	E613	Social Insects	3	-	3	
	E615	Insect Immunity	3	-	3	
Second Semester	E602	Insect physiology and behavior	3	-	3	Compulsory
	E604	Insect control	3	-	3	
	EM606	Biostatistics	3	-	3	
	E610	Molecular Biology	3	-	3	Elective (select one)
	E616	Histology and histochemistry	3	-	3	
	E612	Practical Entomology	3	-	3	
	E614	Chemical ecology	3	-	3	
	E616	Selected Topics	3	-	3	

Ph.D. Entomology Program

1- Ph.D. Degree in Entomology (Insect Physiology)

Course Code	Number of Courses	Course Type	Credit Hours
E700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			**60**

Course Code	Course Title	Hours/Week			Course Type
		L	T/P	C	
E701	Advanced Insect Physiology	3	-	3	Elective (select two courses each semester)
E702	Advanced Insect Behavior	3	-	3	
E703	Insect Endocrinology	3	-	3	
E704	Insect Sensory Physiology	3	-	3	
E705	Forensic Entomology	3	-	3	
E706	Histology and Histochemistry	3	-	3	
E707	Advanced Insect Control	3	-	3	
E708	Biochemistry	3	-	3	
E709	Selected Topics	3	-	3	

2- Ph.D. Degree in Insect Molecular Biology

Course Code	Number of Courses	Course Type	Credit Hours
E700	4 Courses (2 Courses/Semester)	Elective	12

		Compulsory	4
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			**60**

Course Code	Course Title	Hours/Week			Course Type
		L	**T/P**	**C**	
E701	**Forensic Entomology**	3	-	3	
E711	**Insect Behavior 2**	3	-	3	
E702	**Insect Endocrinology**	3	-	3	
E713	**Insect Sensory Physiology**	3	-	3	
E714	**Insect Control**	3	-	3	**Elective (select two courses each semester)**
E715	**Histology and Histochemistry**	3	-	3	
E716	**Molecular Biology 2**	3	-	3	
E717	**Genetic Engineering**	3	-	3	
E718	**Insect Molecular Systematics**	3	-	3	
E719	**Cell Biology**	3	-	3	
E720	**Insect Physiology 2**	3	-	3	
E721	**Selected Topics**	3	-	3	

3-Ph.D. Degree in Economic and Applied Entomology

Course Code	Number of Courses	Course Type	Credit Hours
E700	4 Courses (2 Courses/Semester)	Elective	12
	Seminars	Compulsory	4
	Thesis	Compulsory	44
Total credit hours			**60**

Course Code	Course Title	Hours/Week			Course Type
		L	T/P	C	
E722	Forensic Entomology	3	-	3	Elective (select two courses each semester)
E723	Insect molecular systematic	3	-	3	
E724	Advanced Insect Behavior	3	-	3	
E725	Economic Entomology	3	-	3	
E726	Advanced Insect Control	3	-	3	
E727	Histology and Histochemistry	3	-	3	
E728	Aquatic Insects	3	-	3	
E729	Advanced Chemical ecology	3	-	3	
E730	Apiculture and Bee Keeping	3	-	3	
E731	Acarology	3	-	3	
E732	Advanced Insect Physiology	3	-	3	
E733	Selected Topics	3	-	3	

Courses' Contents

Mathematics Programs
• Professional Diploma in Applied Statistics

M501 Calculus and Numerical Computations

The concept of limits, the concept of continuity, the techniques of differentiation, various application of derivations, the integration as the reverse of differentiation. Approximate numbers; rounding off, significant figures, digits, errors of approximation. Finite differences, interpolation, Newton's Gregory formula for forward and backward interpolation. Divided difference formulae Inverse interpolation, numerical solution in one unknown – iterative methods. Numerical differentiation: Newton's backward, forward and Lagrange's interpolation. Numerical integration: Trapezoidal rule, Simpson's one third rule. Summation of series – Euler Meclaurin formula. Stirling's approximation of factorials (without proof)

M502 Linear Algebra with Applications

Matrices and their algebra, determinants, solutions of systems of linear equation using matrices and numerical methods, the basic concepts and manipulations of vectors and their application to engineering problems, Eigen values and Eigen vectors. Elementary number theory and Counting

MS501 Descriptive Statistics with Statistical Software

Meaning of Statistics. Primary and secondary data. Collection of data and scrutiny of data, Frequency and non–frequency data. Tabular and diagrammatic representation of non – frequency data (line diagram. Ratio chart, bar diagram, pictograph and pie diagram). Tabular representation of frequency data: Frequency, relative frequency, cumulative frequency and frequency density. Column diagram, frequency polygon, histogram and cumulative frequency diagram. Central tendency and dispersion. Measures of central tendency: mean, median and mode. Measures of dispersion: range, mean deviation and standard deviation, coefficient of variation and coefficient of concentration. Moments and quantiles, skewness and kurtosis of a frequency distribution. Bivariate data, scatter diagram, concept of correlation and correlation coefficient. Simple regression by least-squares method: its relationship with simple correlation. Correlation ratio. Rank correlation: Spearman's and Kendall's coefficients. Theory of attributes. Multivariate data, multiple regression by least squares method (up to two independent variables), multiple and partial correlation coefficients. Use of appropriate statistical softwares.

MS502 Statistical Methods II

Statistic and parameter. Random sampling from a distribution. Sampling distribution of a statistic and its standard error under random sampling. Sampling distributions of the sample sum in sampling from a binomial and Poisson distribution. Sampling distribution of sample mean and sample variance in sampling from a univariate normal distribution. Definitions of chi-square, t and F statistics and their probability density functions and basic properties (without derivations). Point and interval estimation. Intuitive considerations underlying the principles of unbiasedness, minimum variance and consistency. Basic principles of hypothesis testing: test, critical region, type I error and type II error, level of significance and power of a test. Tests for a single mean, for the equality of two means, for a single variance and for the equality of two variances, for the significance of correlation coefficient (under normal population models).

MS503 Statistical Methods I

The concepts of Probability, Concepts of Random Variable, Probability distribution, Distribution Function, Expected Value, Variance and Higher Moments. Probability generating function, moment generating function and cumulant. Basic discrete and continuous distributions. Concepts of independence, jointly distributed random variables and conditional distributions, use of generating functions. Central limit theorem and its application.

MS504 Biostatistics with Statistical Software

Explain the scope and uses of statistics in biology and medicine, State types and sources of biological and medical data, various types of variability associated with bio-medical data, e.g. response and reactions to drugs, vital statistical indices, the standardized rates, the meaning of genetics, the simple Mendelian ratio, the fundamental principles of bioassay, the relative potency, simple assays, direct and parallel lines. Use of appropriate statistical softwares.

MS505 Statistical Computing

Simulation techniques for various probability models - Different resampling plans. - Nonlinear regression and generalized linear models with applications - Cluster analysis and other multivariate applications - Smoothing and function estimation - EM algorithm, single and multiple imputation - Markov Chain Monte Carlo techniques. Use of appropriate statistical softwares.

MS506 Decision Making and Forecasting

Basic Concepts of Forecasting and Decision Making. Qualitative Methods of Forecasting (Delphi, Subjective Probabilities, Market Research). Quantitative Techniques of Forecasting and Regression Model. Quantitative Techniques of Forecasting and other Casual Models. (Econometric, Input-Output, Leading Indicator). Quantitative Techniques of Forecasting Time Series Model. (Trend Projection). Quantitative Techniques of Forecasting Time Series Model. (Smoothing and Decomposition). Quantitative Techniques of Forecasting and Box Jenkins Model. Selection of Right Forecasting Methods. Decision Making and Quantitative Tools. Decision Making and Qualitative Tools. Steps in Decision Making. Inventory management and introduction, inventory control, costs in inventory problems, Techniques of Inv. Control and with selective control (ABC analysis, Usage rate and criticality). Techniques of inv. Control and with known demand and E.O.Q with uniform demand, prod. Runs of unequal length, with finite rate of replenishment, Problem of E.O.Q with shortage. Techniques inv. Control and with uncertain demand and buffer stock computation, stochastic problems and uniform demand. Techniques inv. Control and with price discounts. Financial Applications and Computation of net present value, future value and internal rate of return, converting effective interest rate to nominal rate, computing compound interest, accumulated value, discount, annuities etc. Break even analysis, Standard / Marginal Costing.

MS507 Regression and Linear Models

Simple linear regression, Multiple linear regression, Regression diagnostics, Transformation of variable, Analysis of collinear data, Logistic regression, Stepwise regression, ONE WAY ANOVA, TWO WAY ANOVA, Multiway ANOVA and Nested Analysis, Comparison of individual means, Analysis of covariance, One Way Random effect model, Two way Mixed Model. Use of appropriate statistical softwares.

MS508 Analysis of Variance and Design of Experiments

Analysis of variance: Analysis of data for a one-way classification: fixed effects and random-effects models. Analysis of data for a two way classification with the same number of observations per cell: main effects and interaction effects for fixed-effects model only and estimation of error variance. Design of Experiment: Controlled experiments. Basic principles of designs: randomization, replication and local control. Description and method of analysis of experiments conducted according to a completely randomized, a randomized block and a latin square design. Factorial experiments: 22 and 23 experiments. Confounding: complete and partial. Use of appropriate statistical softwares.

MS509 Medical Statistics

Phase I, II and III Clinical Trials, Randomization, Blinding and Placebos, Sample size calculation, Comparing more than two treatments, Causality, Non-compliance and Intent-to-treat, Survival analysis in Phase III clinical trials, Early stopping of clinical trials, Multiplicity and interim analysis, Parallel and Crossover designs, Binary Response data, Categorical Data Analysis, Comparing Methods of measurements, Meta-analysis, Repeated measures analysis.

MS510 Time Series Analysis

Exploratory Analysis of Time Series: Graphical display, classical decomposition model – trend, seasonal and cyclical components, Stationary Stochastic Time Series: Weak and strong stationarity; AR, MA and ARMA models; Box-Jenkin's correlogram analysis – ACF and PACF; diagnostic tests. Non-Stationary Time Series: ARIMA model; deterministic and stochastic trends; unit root tests – DF and ADF tests. Forecasting based on ARIMA/ARMA model. Introductory VAR Analysis.

MS511 Operations Research

Nature of OR problems and applications in different areas. The LP problem, its formulation, graphic solution of two variable problems. Transportation and assignment problems. Deterministic inventory models – ABC analysis and inventory management. Queuing theory – single server waiting time model.

MS512 Demography

Scope and importance of demography. Data sources and their limitations. Population census, Vital registration, Population register, Demographic and Health surveys, other sources. Evaluation and adjustment of census and survey data on age-sex distribution - Growth of Human Population: Rate of natural increase; Arithmetic, Geometric and Exponential growths.

International statistical classification of diseases, injuries and causes of death - Measures based on diseases (i.e., morbidity), death (i.e, mortality) and birth (i.e., fertility) statistics including measures such as Gross and Net reproduction rates, Mean length of generation, and Census measures of fertility - Life Tables: definition, simple construction and applications. Concept of Migration.

MS513 Statistical Quality Control

Concept, measurement and control of quality. Seven tools of Quality Control. Control charts – Concepts of control charts, R, p, np, and c charts. Interpretation of control charts. Acceptance sampling – inspection by attributes, OC curve, producer's and consumer's risks, AQL, LTPD, AOI, AOQL, IQL, single and double sampling plans.

• __Professional Diploma in Bioinformatics__

MC521 Mathematical Biology
Part 1) Mathematics
(i) Computational methods in (i) optimization, (ii) Solving class of differential equations
Part 2) Biologigy
i) Molecular biology of prokaryotic and eukaryotic cells and their viruses. ii) Mechanisms of DNA replication, transcription, translation. Structure of genes and chromosomes. Regulation of gene expression, DNA methylation, and MicroRNA. iii) Biochemistry: metabolism of carbohydrates: lipids, proteins, nucleic acids, and amino acids, Glycolytic pathway, TCA cycle Electron transport and oxidative phosphorylation

MC522 Introduction to Systems Biology
Applications of omics technology: genomics, transcriptomics, proteomics, metabolomics to systems biology. Sytems Bilogy cycle, Reconstruction of metabolic networks. Analyzing of large genome-scale metabolic models (GEM). Integration omics data with GEM. Application of systems biology: microbial systems biology and systems medicine.

MC523 Computation Biology Techniques
Introduction to programming with Matlab, algorithms, dynamic programming, graph theory, probability, Bayesian Network, and hidden Markov models.

MC524 Analyzing Next Generation Sequencing Data
Genome browser, genome mapping, An Analyzing of RNA-Seq, DNA-methylation, proteomics.

MC525 Bioinformatics
i) The NCBI public sequence database, searching in PubMed, sequence retrieval. ii) Comparing Genes, Proteins, and Genomes. iii) Genome Assembly. iii) Gene finding. iv) Protein-Protein Interaction.

MC526 Applied Statistics for Bioinformatics using R
Introduction to R package, Basics of statistical inference, p-values and confidence intervals, statistical modeling, multiple testing, factor analysis, empirical Bayes. Bioconductor package.

MC527 Web Programming
HTML 5.0, Javascript, client-server application and web-service

MC528 Metabolic Engineering
Principles of enzyme function and kinetics, stoichiometry and energetics of metabolism, regulation of metabolic pathway, metabolic control analysis, application of thermodynamics and systems biology in metabolic engineering,

MC529 Biological Database
Fundamentals of relational database design and its application to biological information. Introduction to SQL, XML schema, ontologies, SBML, database curation.

MC530 Computational Intelligence
Introduction to Neural Network, Genetic Algorithms, genetic programming,

MC531 Python and Linux for Bioinformatics
i) Linux command lines, how software works on Linux and how to use it, Linux tools for bioinformatics.
ii) Introduction to Python, Organizing Data, files, error handles, classes, regular expression and Biopython.

MC532 Biological Data Mining
Introduction to data mining methods: association rules, classification and clustering. Application of these methods to omics data. Text mining for biological data. eQTL Analysis, Analyzing biological networks

• <u>M.Sc. Degree in Pure Mathematics</u>

M601 Linear Algebra I

The course contains: Inner product spaces - Schawrz and triangular inequalities -Orthogonality - Gram-Schmidt - Matrix norms - Linear least squares - Sparse matrices - Positive definite - symmetric matrices and Cholesky's algorithm-Quadratic forms - Linear differential equations with constant coefficients -Schur normal form - QR factorization of matrices.

M602 Topology I

Topological spaces – Bases and sub-bases - Finite product spaces – Continuous maps – Homeomorphisms – Hausdorff spaces – compactness and connectedness – Separation axioms – Countability axioms.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems, boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra, discretizations, convergence, stability, error propagation, finite differences, finite elements, finite volumes, method of lines, conjugates gradient methods, multigrid methods.

M604 Partial Differential Equations I

The topics of this course are: Non-linear PDE of elliptic hyperbolic and parabolic types and their applications - Backlund transformation and soliton theory.

M605 Functional Analysis

Banach spaces - Hahn-Banach theorem - Banach-Steinhaus theorem - open mapping and closed graph theorems – Duality - weak topologies - reflexive and separable spaces -Bounded and unbounded operators - Closed operators – Adjoint – Spectrum - Compact self-adjoint operators and their spectral theory -Fredholm theory – Index -Spectral analysis of specific operators.

M606 Discrete Mathematics

Mathematical logic – sets – functions –relations – trees – Counting - Mathematical induction – Graphs and planar graphs – Trees and cut-sets – Finite state Machines – Analysis of Algorithms – Boolean Algebras and Logic Circuits – Possets and Lattices – Elements of coding theory.

M607 Calculus of Variations

The optimal path problem – The Euler-Language equation – In n-dimensions –The parametric approach – Corner conditions – Strong external – Constraints – Sufficiency tests – The calculus of variations in practice.

M608 Topics in Analysis I

Metric spaces – The Riemann – Stielties Integral – Sequence and series of functions – Weierstrass approximations theorem – Stone-weierstrass theorem – Power series – Radius of convergence – Real power series – Order of summation.

M609 Differential Geometry I

The topics of this course are: Differentiable manifolds and embedding theorems, tangent bundle, vector fields and differential 1-forms, Riemannian metrics and connections, Geodesics, Exponential map, jacobi fields, and Comparison Theorems.

M610 Dynamical Systems I

Introduction - Equilibrium – Solutions - Periodic and Quasi-periodic Solutions - Stability Analysis - Introduction to perturbation Theory - Relaxation Oscillations - Bifurcation Theory - Chaos.

M611 Fuzzy Mathematics

Fuzzy set - Fuzzy numbers and their algebra – logic - Fuzzy logic calculations of linguistic variables. Minkovski distance between triangular fuzzy numbers.

M612 Operation Research I

Linear Programming (L.P): Basic concepts - Graphical method - simplex method. The two phases method, Duality of LP - Wolfe Decomposition - Transportation problemInteger programming (I.P): Graphical Representation - Gomory's Cutting plane method.numerative techniques - Bola's AlgorithmDynamic programming (D.P): Basic D.P structure - Multistage Decision Processes - Computational Procedure in D.P - LP as a case of D.P.

M613 Special Functions

This course study special functions and focus on: Gamma functions - Beta functions - Other functions defined by integrals - Bessel functions - Modified Bessel functions - Legendre polynomials - Hermite and Laguere polynomials - Chebyshev and Jacobi polynomials - Hypergeometric functions - Generalized Hypergeometric functions.

M614 Selected Topics Related to Pure Mathematics

Topics of this course will be selected by Mathematics Department to meet new directions in pure mathematics.

M615 Special Course I

Topics of this course will be selected by Mathematics Department to meet new directions in pure mathematics.

MC600 Practical (Computer)

Topics of this course will be selected by Mathematics Department in Computer Science.

• <u>M.Sc. Degree in Applied Mathematics</u>

M616 Advanced Quantum Mechanics I

The development of quantum mechanics - Wave packets and time-dependent Schrödinger equation – Simple solutions of Schrödinger equation – Vector spaces and linear operators: Dirac notations (Vector representation of states - Linear operators - Eigenvalues and eigenvectors, Relationship between kets and wave functions - Observables - Commutability and compatibility) – The linear harmonic oscillator – The Schrödinger and Heisenberg pictures – Angular momentum and spin – Motion in a magnetic field – Interaction matter – Relativistic theory.

M617 Fluid Mechanics I

Two and three dimensional motion – Rotational and irrotational motion – Viscous flow – Flow through porous medium – Theory of potential field – Water waves – Boundary Layer theory – Shallow water equations – Turbulent boundary layers.

MC618 Computational Method in Applied Mathematics I

Conservation Equations – Boundary – Layer Equations - Uncoupled laminar Boundary Layers – Uncoupled laminar Duct flow – Numerical Methods for parabolic and Elliptic Equations – Numerical Methods for Model Hyperbolic Equations.

M619 Mathematical Methods I

Topics of this course include: Orthogonal functions – Legender functions – Legender differential equation, Legender polynomials – Hermite polynomials – Laguerre polynomials - Sturm-Liouville systems – Bessel Functions – Applications to physical problems Partial differential equations – Integral equations – Integro-differential equations – Differential-Difference equations.

M620 Electromagnetic Theory I

Basic laws of electromagnetic fields and wave operations - Diffraction method (kirshof – kotler) - Radiation of electromagnetic waves - Plaue waves - Spread of electromagnetic waves in gyro tropic medium.

M621 Mechanics of Continuous Media I

Topics of this course include: Tensor analysis – Energy and entropy – Fundamental basic equations – Applications in elasticity – Elastic bodies – Viscous elastic bodies.

M622 Quantum Electrodynamics I

Free classical fields – Quantum free fields – Interacted fields – Scattering matrix.

M623 Elasticity Theory I

Elastic bodies - Analysis of strain – Analysis of stress – Stress-strain relation – Treatments of some problems in dynamics of elastic medium – Solutions of N-S equation in spherical and cylindrical coordinates – Oblate spheroidal elastic bodies.

M624 Quantum Optics I

Topics of this course include: Basic quantum Mechanics – Algebra of the Exponential Operator – Representations of some Lie-Algebra – The Electromagnetic field atom – Field interaction - Hamiltonian two-level atom and optical Bloch equation.

M625 Electrodynamics I

Topics of this course include: System of conductors – Continuous distribution – The basic equations of electromagnetic field in material media – Dielectrics of magnetism – Electrostatic stress & energy magnetism.

M626 Mathematical Modeling

The main goal of this course is to learn how to make a creative use of some mathematical tools, such as difference equations, ordinary and partial differential equations and numerical analysis, to build a mathematical description of some physical problems. The course topics includes: Introduction to Modeling -Qualitative Modeling with Functions - Modeling with Dimensional Analysis - Modeling with Difference Equations - Modeling with Ordinary Differential Equations - Empirical Modeling with Data Fitting - Modeling with Partial Differential Equations.

M627 Statistical Mechanics I

System of interacting Particles – Crystals - Kinetic theory of gases and other systems - Method of correlation functions – Kinetic properties of solids – Quantum statistics (B.E and F.D perfect gases) – Internal Partition Function.

M628 Selected Topics Related to Applied Mathematics

Topics of this course will be selected by Mathematics Department to meet new directions in applied mathematics.

M629 Special Course

Topics of this course will be selected by Mathematics Department to meet new directions in applied mathematics.

• M.Sc. Degree in Mathematical Statistics

MS601 Mathematical Statistics I

Sampling distributions - Exponential families - completeness. Sufficiency – factorization - likelihood ratio - minimax principle. Point estimation. Lehmann-Scheffe and Cramer-Rao theorems. Interval estimation.

MS602 Mathematical Statistics II

Testing hypotheses: parametric methods. Neyman-Pearson lemma. Uniformly most powerful tests. Unbiased tests. Locally optimal tests. Large sample theory, asymptotically best procedures. Linear models, analysis of variance.

MS603 Order Statistics

Basic Distribution theory - expected values and moments - Discrete Order Statistics - Order Statistics for Some Specific Distributions - Moment Relations - Bounds and Applications - Characterizations using Order Statistics - Asymptotic theory.

MS604 Bayesian Statistics

Basic Concepts - Utility and Loss - Statistical Decision theory - Prior Information and Subjective Probability - Bayesian Statistical Inference and Decision Making - Approximate Bayes methods - Posterior approximation with the Gibbs sampler - Numerical Computations in Bayesian Analysis.

MS605 Sampling Theory

Simple random sampling - Sampling for proportions - Estimation of sample size - Sampling with varying probabilities - Sampling: stratified – systematic -cluster -double -sequential and incomplete.

MS606 Computational Statistics

Modern methods of computational statistics and their application to both practical problems and research -Methods of random variate generation -simulation of random vectors -Topics include Monte Carlo simulation – bootstrapping- numerical optimization in statistics -the MCMC techniques

MS607 Nonparametric Statistics

Order Statistics - Quartiles and Converges - Tests of Randomness - Tests of Goodness of Fit - One Sample and Paired Sample Procedure - The General two Sample Problems.

MS608 Stochastic Processes

Basic concepts of stochastic processes - Markov processes (discrete and continuous parameters) - Random walks - Poisson processes - Birth and death processes - Renewal processes and basic limit theorems - Discrete time martingales - stopping times - optional sampling theorem - Applications from theories of stochastic epidemics - survival analysis and others.

MS609 Regression Analysis

Least Square estimation: Gauss-Markoff Setup - Normal equations and least square Method of estimation - properties of estimator - variance of estimator - Estimation of variance - Linear Regression: Simple linear regression model - least square estimation of parameters - Hypothesis testing of slope and intercept - co-efficient of determination - Multiple Regression: Model - estimation of model parameters - test for significance of regression - regression co-efficient, co-efficient of determination - use of anova. Polynomial and logistic regression: Models and method of estimation - logistic regression-binary-model and estimates.

MS610 Queueing Theory

Queueing Systems: General Concepts - Birth and Death Queueing systems - The Simple M/M/1 Queue - the M/M/1/k model - the M/M/∞ model - Non-Birth and Death Queueing Systems

MS611 Special Course

Topics of this course will be selected by Mathematics Department to meet new directions in mathematical statistics.

MS612 Selected Topics Related to Mathematical Statistics

Topics of this course will be selected by Mathematics Department to meet new directions in mathematical statistics.

M.Sc. Degree in Computer Science

MC601 Computational Intelligence

Computational Intelligence is used as an umbrella term for different approaches that deliver enhanced performance and applicability. It encompasses artificial neural nets, evolutionary algorithms, and fuzzy logic. This course gives a thorough introduction into all three aspects of computational intelligence from the perspective of computer science. It focuses on theoretical aspects as well as typical application scenarios.

MC602 High-Performance Computing

Introduction to high-performance computing: History and importance of computational science – Overview of application areas – Review of required skills

High-performance computing: Processor architectures – Memory systems for high performance – Input/output devices – Pipelining – Parallel languages and architectures – Parallel algorithm design and analysis – Applications studied and implemented on parallel machines.

MC603 Advanced Algorithms

Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms - and explores a variety of applications.

The topics that the course covers include hashing - bloom filters – scheduling - network design - online load balancing - algorithms in machine learning - boosting (in the context of learning) - Markov chains and the MCMC method - byzantine agreement - internet algorithms, and nearest neighbor algorithms.

MC604 Advanced Image Processing

Recall of Linear Algebra - Multidimensional Signal Processing - Human Visual System - Image Representation: pyramids and wavelets - Random signals - Image Modeling - Image Sensor Models - Noise Models - Image Denoising - Image Restoration - Image Compression - Video Modeling and Compression - Digital Data Hiding.

MC605 Network Security

Basic concepts and techniques in information security and management such as risks and vulnerabilities - applied cryptography - authentication, access control - multilevel security - multilateral security - network attacks and defense - intrusion detection - physical security - copyright protection - privacy mechanisms, security management - system assurance and evaluation - and information warfare. Coverage of high-level concepts such as confidentiality – integrity - and availability applied to hardware – software - and data.

MC606 Selected Topics Related to Computed Science

Topics of this course will be selected by Mathematics Department to meet new directions in Computer Science.

MC607 Advanced Theory of Computation

This course includes: Algorithms, computability – decidability – enumerability - formal replacements and Church's thesis - Turing machines - primitive recursive functions - u-recursive functions - undecidable predicates.

MC609 Scientific Information Visualization

Study of computer visualization principles – techniques - and tools used for explaining and understanding information - includes visualization algorithms – techniques - and applications.

MC611 Special Course

Topics of this course will be selected by Mathematics Department to meet new directions in Computer Science.

• __M.Sc. Degree in Scientific Computing__

MC608 Computational Fluid Dynamics

The course is an elementary introduction to computational fluid dynamics. The emphasis is on the basics of conservation laws, and on high-Reynolds number laminar flows. Both compressible and incompressible flows will be treated. Potential flow and the Kutta condition, quasi-1D flow of a perfect gas through a nozzle, and boundary layer flow over a flat plate are the examples treated in the computer labs. They illustrate such flow phenomena as shocks and boundary layers

MC610 Selected Topics Related to Scientific Computing

Topics of this course will be selected by Mathematics Department to meet new directions in Computer Science.

MC613 Introduction Finite Element Methods

Discretization and the Direct Stiffness Method - Formulation of Finite Element - Computer Implementation of the Finite Element Method

MC615 Special Course

Topics of this course will be selected by Mathematics Department to meet new directions in Computer Science.

• Ph.D. Degree in Pure Mathematics

M701 Complex Analysis

The topics of this course are: Quaternionic and bicomplex algebra – Elementary bicomplex functions – Differentiation of bicomplex functions – Bicomplex integration – Bicomplex harmonic Analysis. Function of two complex variables – function of two complex matrices – functions of two linear operators - The fundamental theorem of algebra - the argument principle - calculus of residues - Fourier transform - the Gamma and Zeta functions - product expansions - Schwarz principle of reflection and Schwarz-Christoffel transformation - elliptic functions - conformal mapping and univalent functions - maximum principle and Schwarz's lemma - the Riemann mapping theorem.

M702 General Relativity

Riemannian and Pseudo Riemannian Spaces - Lorentz Space - Space time Space - Space like manifold time like manifold - light like manifold Einstein Field equations.

M703 Number Theory

Congruences – Primes – the Riemann zeta function. Quadratic reciprocity – the arithmetic of quadratic fields – class groups.Introduction to elliptic curves.

M704 Algebraic Geometry

Projective spaces – Bezout's theorem – plane conics – curves and their genus – affine varieties – Hilbert bases theorem – irreducible algebraic sets – zariski topology – coordinate ring and polynomial maps - Applications in quadratic surfaces – singularity dimension.

M705 Operation Research II

Classical optimization techniques (COT): Single variable optimization - Multivariable optimization with no constraints - Multivariable optimization with constraints (equality and inequality) - Single variable optimization technique(SVO):Unimodel functions - Elimination method - Fibonacci method Golden section method - Quadratic interpolation method, cubic interpolation method.Unconstrained optimization techniques: Random search method - Steepest descent method - Conjugate Gradient method - variablemetric method. Constrained optimization techniques: Methods of feasible direction - Lagrange multiplier method - Penalty function methods - Kuhn- Tucker conditions.

M706 Numerical Analysis II

Different numerical methods for large problems with different time scales. Spectral methods – wavelets - multiple methods - preconditioned conjugate gradient methods - multigrid methods.

M707 Dynamical Systems II

Introduction - Hamiltonian Systems - Control of Chaos and Bifurcation - Tools to Analyze Motions - Chaotic Systems - Dynamics in State Space - The Theory of Complexity.

M708 Partial Differential Equations II

Basic constant-coefficient linear examples: Laplace's equation, the heat equation, and the wave equation, analyzed from many viewpoints including solution formulas - maximum principles - and energy inequalities. Key nonlinear examples such as scalar conservation laws - Hamilton-jacobi equations - and semilinear elliptic equations - analyzed using appropriate tools including the method of characteristics - variational principles - and viscosity solutions. Simple numerical schemes: finite differences and finite elements. Important PDE form mathematical physics - including the Euler and Navier-Stokes equations for incompressible flow.

M709 Lie Groups

Manifold - Continuous group of transformations - infinitesimal generators -Lie bracket- Lie Algebra - Applications in Kinematic of Robotics and Solution Theory of differential equations.

M710 Harmonic Analysis

The Fourier transform on L^1 - Tempered distributions – The Fourier transform on L^2 – Interpolation of Operators – The Hardy Little wood maximal function – singular Integrals – Little wood – Paly theory – Fractional integration – Singular multipliers – Inverse problems.(Global uniqueness).

M711 Optimization Theory

Introduction- classical optimization techniques- Linear programming- Non Linear programming- geometric programming- Dynamic programming

M712 Riemannian Geometry

Riemannian metric - Tangent Space - Vector bundle - Tangent bundle - normal bundle – Tangent map - Gauss Weingarten equations – Riemannian Curvature tensor Jacobi Field and Variation.

M713 Topology II

After introducing metric and general topological spaces - the emphasis will be on the algebraic topology of manifolds and cell complexes. Elements of algebraic topology to be covered include fundamental groups and covering spaces - homotopy and the degree of maps and its applications. Some differential topology will be introduced including transversality and intersection theory. Some examples will be taken from knot theory.

M714 Differential Equations

Existence and uniqueness of solutions of scalar differential equations - Existence and uniqueness theorems for system of differential equations -fixed-point methods - Properties of linear homogeneous systems - Inhomogeneous linear systems -Behaviour of solutions of nth order linear homogeneous equations - Continuous dependence and stability properties of solutions - Stability of linear and weakly nonlinear systems - Two-dimensional system - Stability by Liapunov's second method for autonomous systemsDifferential Equations:Liapunov Stability and boundedness of solutions for nonautonomous systems - Existence theorems for periodic solutions and almost periodic solutions. Functional Differnetial Equations:Existence theorems and uniqueness - Stability of solutions - Asymptotic behaviour of solutions - Boundedness of solutions. Existence theorems for periodic solutions and almost periodic solutions.

M715 Numerical Linear Algebra

Stability, Robust stability and distance instability – Numerical solutions and conditioning of Lyapunov and Algebraic Riccat equations - Eigen pair of a symmetric quadratic Eigen value problem in an interval-computational and optimization methods for quadratic inverse problems in vibration.

M716 Information Geometry

Geodesic distance and statistical manifold Geometry of parameter spaces- Information matric and metric tensor, J-divergence and Riemannian distance.

M717 Topics in Analysis II

Definition of Fourier series – Formulation of convergence problems – The (C,1) summablilty of Fourier series – The L^2 theory of Fourier series - convergence of Fourier series – orthonormal expansions in L^2 (a,b) – Bessel's inequality – parseval's theorem – Fejer theorem – pointwise convergence of Fejer theorem – some application of Fourier series.

M718 Integral Equations

Notion and examples of integral equations (IEs), Fredholm IEs, Unique solvability of the Fredholm IE, IEs as linear operator equations, Linear operator equations: the Fredholm theory, Picard's Method, The Homogeneous and Non-Homogeneous Linear Equation and Wronskians, The Sturm–Liouville Equation.

M719 Selected Topics related to Mathematical Logic

Introduction – quantifiers – propositional calculus – Methods of proof – Logically equivalence – contradiction – Logical reasoning – contra positive - Rules of Inference predicate calculus.

M720 Differential Geometry II

Differential forms. Integration on manifolds.Sard's Theorem.Derhamchomology.Morse theory. Submanifolds and second fundamental form.Applications to geometric problems.

M721 Special Course I

Topics of this course will be selected by Mathematics Department to meet new directions in pure mathematics.

• Ph.D Degree in Applied Mathematics

M722 Fluid Mechanics II

Magneto fluid dynamics – The theory of MHD generators – Mechanics of Fluid flow Through a porous medium – Heat transfer through a porous medium – Mass transfer through a porous medium – Forced convection – Mixed convection – Double – Diffusive convection – Convection with change of phase.

M723 Advanced Quantum Mechanics II

Scattering theory - Method of second order quantization in theory of Radiation - Relativistic quantum mechanics.

M724 Mathematical Methods II

Complex Inversion Formula for Laplace Transforms – The complex inversion formula. The Bromwich contour – Use of residue theorem in finding inverse Laplace transforms – Inverse Laplace transforms of functions with branch points – Applications to boundary-value problems.

M725 Elasticity Theory II

Basic Equations of the Linear electro elasticity – static problems of electro elasticity for Bimorphs with stress concentrators – Diffraction of shear wave – Mixed dynamic problems of electro elasticity – Harmontic oscillations of continuous piezoceramic – Magnetoelasticity Induced currents – Influence of Mangnetizability.

M726 Computational Method in Applied Mathematics II

Buoyant Flows – Coupled Turbulent Boundary Layers – Finite difference method for applied mathematics - Numerical methods for solving Boundary Layer Eqs. – Stability and Transition – Gird Generation.

M727 Electrodynamics II

Steady electric current in Linear conductors of continuous media – Quasistationary electromagnetic field in material media – Boundary value problem – Field of high frequencies – Substance in plasma state.

M728 Statistical Mechanics II

Physical Concepts and Exact Results – Quantum Statistics of-Many-Particle system – Application of Green's Function Technique to Coulomb systems – Equilibrium Properties in classical and Quasi classical Approximation – Quantum – Statistical Calculations of Equilibrium properties – Transport Properties – Green's Function Approach to Optical Properties.

M729 Nonlinear Dynamical Systems

Sine-Gordon system – The KdV system - The Nonlinear Schrödinger equation – Boussinesq equation – The AKNS system of nonlinear evolution equations – Exact solutions of nonlinear evolution equations – Backlund transformations and their applications to nonlinear equations of mathematical physics.

M730 Electromagnetic Theory II

Cylindrical and spherical waves- Spread of electromagnetic waves in presence of oriented surfaces - Damping and slowing-down electromagnetic waves in oriented systems - Spread of electromagnetic waves in layer medium - Electromagnetic waves in medium with random non-homogeneity.

M731 Quantum Electrodynamics II

Diagrams – Reineman Law – Calculation of integrals – diversion – Structure of diversion – explanation of real interaction.

M732 Theory of Relativistic Quantum Mechanics

Relativistic notations – Quantum mechanics and the theory of relativity – Free relativistic fields – The scalar field (Klein-Gordon equation) – Spinor field (Dirac equation and Dirac γ-matrices) – Massless vector field (Maxwell's equations).

M733 Special Course II

Topics of this course will be selected by Mathematics Department to meet new directions in applied mathematics.

• <u>Ph.D. Degree in Mathematical Statistics</u>

MS701 Advanced Probability

Probability space; distribution functions and densities; Poisson limit theorem; de Moivre-Laplace theorem; measure-theoretic definition of expectation; classification of measures on R; convergence of random variables; sigma-algebras and random variables; pi-systems and Dynkin systems; discrete Markov chains; random walks; gambler's ruin problem; Markov chains on a general phase space; Borel-cantelli lemmas; Kolmogorov inequality; three series theorem; laws of large numbers. Weak convergence of measures - characteristic functions - Central Limit Theorem and local limit theorem - stable laws - conditional expectations and martingales - optimal stopping theorem - convergence of martingales.

MS702 Multivariate Statistical Analysis

Matrix algebra and random vectors - Multivariate distributions and invariance - Properties of multivariate distributions - the Multivariate normal - Inference about the mean vector - basic multivariate sampling distributions - Discrimination and Classification

MS703 Time Series Analysis

The methodology of probabilistic description and statistical analysis of (primarily stationary) random sequences and processes. Correlation functions - Gaussian processes - Hilbert-space methods including Wold decomposition and spectral representation - periodogram and estimation of spectral densities - parameter estimation and model identification for ARMA processes - linear filtering - Kalman-Bucy filtering - sampling theorems for continuous-time series - multivariate time series.

MS704 Stochastic Differential Equations

Stochastic Analogs of Classical Differential Equations - Stochastic integrals - Ito's formula and Integrals - The Filtering Problem - The Stochastic Integral as a Stochastic Process - Stochastic Differentials - Stochastic Differential Equations - Linear Stochastic Differential

MS705 Fuzzy Probability and Statistics

Fuzzy Sets - Fuzzy Probability Theory - Discrete Fuzzy Random Variables - Continuous Fuzzy Random Variables - Convergence of Random Fuzzy Sets - Aspect of Statistical Inference - Fuzzy Statistical Analysis and Estimation

MS706 Nonlinear Regression Analysis

Review of Linear Regression - The Nonlinear Regression Model: Iterative Estimation and Linear Approximations - Practical Considerations in Nonlinear Regression - Multiresponse Parameter Estimation - Nonlinear regression models and asymmetric CAPM models - nonlinear interest rate models - and regime switching models - Logistic regression model.

MS707 Advanced Biostatistics

Read, critically evaluate - and discuss biostatistical primary literature - Learn about a variety of statistical techniques frequently used in biology - Learn to apply the techniques to real data - Learn new statistical techniques - some applications of probability in genetics - Experimental designs - Estimation of effects of treatments - Comparative experiments - Fisher-Irwin test - Wilcoxon tests for paired comparisons.

MS708 Experimental Design

Linear estimation - estimability of parametric functions and BLUE-Gauss-Markov theorem-Linear Hypothesis - Analysis of variance - one way and two way classification - Principles of design-randomization-replication-local control - Completely randomized design - Randomized block design-Latin square design. Missing plot technique-comparison of efficiency - Basic concepts of factorial experiments - factorial experiments - Duncan's multiple range test.

MS709 Reliability and Life testing

Structural properties of coherent Systems: System of components-series and parallel structure with example - dual structure function-coherent structure -preservation of coherent system in terms of paths and cuts - representation of bridge structure-times to failure - relative importance of components - modules of coherent systems, Reliability of Coherent systems: Reliability of a system of independent components, Parametric distributions in reliability: A notion of ageing (IFR and DFR only) with examples-exponential distribution-Poisson distribution.

MS710 Special Course

Topics of this course will be selected by Mathematics Department to meet new directions in mathematical statistics.

• Ph.D Degree in Computer Science

MC701 Advanced Computational Geometry

Advanced topics in computational geometry emphasizing problems in dimensions three and higher. Convex hulls - collision avoidance problems - minimal enclosing boxes - interlocking polyhedral - space partitioning - extremal sections of convex polyhedral - reverse search and enumeration - geometric problems from the manufacturing industry including injection molding - gravity casting – stereolithography - NC-machining and tolerancing metrology.

MC702 Nonlinear Optimization

Classical non-linear optimization Methods –Numerical methods for non- linear

MC703 Computational Complexity Theory

The goals of this course are to allow graduate students to:Understand the fundamental results and problems in complexity theory - Read and understand current research papers in complexity theory and related research areas such as theoretical cryptography, approximation algorithms, and computational learning theory.Apply complexity-theoretic tools and results in their own research.Therefore- the course covers these topics- Time and Space complexity - Circuit complexity - Randomized algorithms - Counting problems – Cryptography - Interaction, proofs and complexity.

MC704 Distributed and Parallel Computing

The course shows how to use the Parallel Computing Toolbox™ to increase both the speed and the scale of existing code. Attendees who are working with long-running simulations, or large data sets, will benefit from the hands-on demonstrations and exercises in the course. Topics include: Working with a MATLAB pool - Distributed jobs - Distributed programming considerations - Prototyping parallel jobs - Parallel programming considerations - Increasing scale with multiple systems.

MC705 Data Mining and Knowledge Discovery

Introduction to data mining and knowledge discovery in databases - data cleaning - statistical techniques - association rule learning - time series and spatial data mining algorithms - clustering algorithms - data visualization.

MC706 Advanced Artificial Intelligence

Temporal and nonmonotonic logic - truth maintenance systems - probabilistic reasoning - deductive databases - automated learning – planning - and tutoring - story understanding - structure of domain dependent expert systems.

MC707 Advanced Cryptography

Cryptography based on quadratic residuacity. Advanced techniques for factoring and extracting discrete logarithms.Hyperelliptic curve cryptography. Pairings and their applications to cryptography. Code based and lattice based cryptography. Additional topics may include provable security, secret sharing, more post-quantum cryptography, and new developments in cryptography.

MC708 Software Reliability Engineering

Learn how to analyze – predict – design - and engineer the required and expected reliability of software systems. Examine case studies of systems that worked well and of systems that failed in some crucial aspect. Case study examples include the London Ambulance Dispatch System, the Lucent Telephone Switching Systems and the Mars and Voyager missions.

MC709 Information Theory

Mathematical models for channels and sources; entropy - information, data compression - channel capacity - Shannon's theorems - rate-distortion theory - and introduction to multiuser information theory.

MC710 Special Course I

Topics of this course will be selected by Mathematics Department to meet new directions in computer science.

• __Ph.D Degree in Scientific Computing__

MC711 Parallel Computations for Large-Scale Problems

The aim of the course is to provide the knowledge needed for solving numerically large-scale industrially relevant - computational problems with methods using many processors efficiently -how to develop - select and adopt algorithms/data structures and how to implement and evaluate the performance of such software.

MC712 Computational Biology

This is a course in computational biology - focusing current problems in genomics. Our emphasis will be algorithmic - on discovering appropriate combinatorial algorithm problems and the techniques to solve these problems. Primary topics will include DNA sequence assembly - DNA/protein sequence comparison - hybridization array analysis - RNA and protein folding - and phylogenic trees.

MC713 Numerical Methods for Time-Dependent Partial Differential Equations

This course will introduce a variety of numerical methods for hyperbolic (e.g. conservation laws), elliptic and parabolic partial differential equations. Notions of weak and strong convergence, accuracy and stability will be discussed where appropriate. Special topics will include a (basic) introduction to certain integral equation methods and, if time permits - certain matrix factorizations.

MC714 Quantum Computing

This course deals with the new field of quantum computation - which is computation based on quantum mechanical principles. The course is taught from a computer science perspective. It will explain the model of quantum computation - and will cover the main quantum algorithms and complexity results as well as some elements of quantum information theory.

MC715 Bioinformatics and Genomes

Organization of genomes and Fundamental bioinformatics sequence analysis techniques - Sequence Alignments - Protein structure prediction - Secondary Structure Prediction -Transmembrane Helix prediction - Fold recognition - Gene finding - Repeats - Transcriptional Regulation - Phylogeny - Flux balance analysis

MC716 Computational Methods for Finance

Prerequisites: Scientific Computing or Numerical Methods

Computational techniques for solving mathematical problems arising in finance.Dynamic programming for decision problems involving Markov chains and stochastic games.Numerical solution of parabolic partial differential equations for option valuation and their relation to tree methods. Stochastic simulation - Monte Carlo - and path generation for stochastic differential equations - including variance reduction techniques - low discrepancy sequences - and sensitivity analysis.

MC717 Special Course II

Topics of this course will be selected by Mathematics Department to meet new directions in computer science.

-2<u>Physics Programs</u>

1-<u>Diploma in Medical Physics</u>

PMD501: Basic Human Anatomy and Physiology

Organization of the body - cell structure and function, introduction to viruses - microbe-human interactions - the skeletal system - the nervous system - the cardiovascular system - the digestive system - and the reproductive system.

PMD502 Medical Training

A hospital training to cover all aspects of the role of medical physicist in hospitals including radiodiagnoses – radiotherapy - nuclear medicine and others.

P503 Principles of Medical Imaging

Planner imaging - Central slice theory - Fourier transformers and convolution and deconvolution – Projection - and image reconstruction- Image processing and analysis- Nuclear magnetic resonance.

P504 Fundamentals of Radiological Sciences

Electromagnetic (EM) radiation - particulate radiation - radiation units - X-ray production - basic imaging science and technology - projection imaging concepts and detectors - general radiography – mammography - fluoroscopy and interventional imaging - computed tomography – ultrasound - and magnetic resonance imaging.

P505 Introduction to Nuclear Medicine

Structure of the atom - Atomic nomenclature - Electromagnetic radiation production mechanisms - Nuclear stability - Characteristics of radioactive decay - nuclear transformation - Nuclear reactions - Radiopharmaceutical and radioisotopes - Radionuclide generators - Detectors systems - Planner scintillation cameras (Gamma cameras) - Single photon emission computerized tomography (SPECT) - Positron emission tomography (PET) - PET radiotracers and radioisotopes- PET hot lab.

P506 Computation and Image Processing

Introduction to image processing - Imaging modalities - Digital imaging definition - Imaging tools - Image sampling - Image processing algorithms - Image compression algorithms - Image analysis - Parallel computation - fast image construction.

P507 Radiation Therapy

Radiotherapy machines - external beam radiotherapy - treatment planning systems - conformal radiotherapy - intensity-modulated radiotherapy - virtual simulation - brachytherapy.

P508 Selected Topics Related to Medical Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P509 Medical Accelerators

Introduction to particle physics - Charged particle acceleration - Medical electron accelerator - Radiotherapy modalities - Microwave principles for linear accelerators (Linacs) - Microwave accelerator structure - Treatment beam production - Dose monitoring and beam stabilization - Accelerator control and safety interlocking - Multi-X-Ray energy accelerator - Patiant support assembly and treatment accessories - Treatment simulator - Treatment planning and portal imaging.

P510 Clinical Dosimetry Measurements

Treatment terms - calculation parameters - dosimetry calculations - isodose charts - shaping isodose distribution - calculation points - dose volume histogram - and photon - electron and erapy.

P511 Radiation Physics and Protection

Overview on atomic and nuclear structure- radioactive decay and radioactivity - Binding energy and mechanisms of radioactivity- Radioactive decay modes- Beta emission- Alpha emission- electron capture- Isomeric transition- Gamma ray radiation- Naturally occurring radioisotopes- Overview of radiation interaction with matter- Overview of radiation detection- Radiation units - Dose estimation- External radiation hazard- Internal radiation hazard- ALARA principle - Equivalent dose calculations- Effects of radiation on biological systems- Radiation damage- Stochastic and deterministic effects of radiation- Radiation safety guides- Radiation safety standards.

• <u>M.Sc. Degree in Solid State Physics</u>

P601 Electromagnetic Theory I

Vector analysis- curvilinear coordinates- Electrostatics (fields and potentials) - Boundary-value problems in electrostatics (Laplace and poisson Equations) - Multipoles and dielectrics– Magentostatics- Time-varying Fields and Maxwell equations- Electromagnetic waves and wave propagation.

P602 Condensed Matter Physics

Electrical Properties of Dielectrics - Band Theory of Metals - Band Theory of Semiconductors and Dielectrics - Magnetic Properties of Materials - Electrical properties of metals - Magnetic properties of materials - Dielectric and related properties - Optical properties of solids.

P603 Quantum Mechanics I

Angular momentum - Internal angular momentum. Total angular momentum: LS and jj coupling - Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling - Wigner-Eckart theorem - Invariance principles and conservation laws - Time independent perturbation theory - The variation method - The WKB approximation method.

P604 Crystal Structure

The nature of crystal structures - geometry and chemistry of crystals – size – homogeneity – perfection – twinning – polymorphism - phase transitions – isomorphism - solid solutions - diagrams and models - Interatomic forces and structure building - Lattices and lattice complexes - Directions of planes and lines - Some simple structures (copper, iron, comparison of cubic and hcp, diamond - sodium chloride - cesium chloride - calcium chloride - zinc blende structures and the structure of various metallic alloys) - Structures of oxides (Perovskite – spinel – corundum – ilmenite - lithium niobate – calcite – aragonite – olivine - rutile structures - forms of silica - the quartz structure) - The determination of crystal structures (single crystal and powder methods - examples of structure determinations and the refinement.

P605 Advanced Electronics

Introduction to basic signal – spectrum - and amplifier concepts for the analog electronic circuits. The electronic devices including diodes - bipolar junction transistors (BJTs) - field effect transistors (FETs) and Operational Amplifiers (Op-Amps) will be discussed. In each device - its analysis is firstly presented after a particular device physics overview - and then the design some circuit applications follow. The main focus of this course is not only to develop the student ability to analyze and design basic analog electronic circuits with passive components and/or the active elements like diode - transistors and Op-Amp. Besides - some experiments are provided to help students to have a thorough grasp of the basic electronic circuit problem. Throughout this course - small signal analysis and low frequency operation are mainly considered for the students to have the first interesting impression in this important discipline of the ECE program.

P606 Statistical Physics

Thermodynamics - kinetic theory - probability distributions - Phase space and microcanonical ensemble - Canonical ensemble and partition functions with applications - Grand canonical ensemble and quantum statistics - Imperfect gas - Classical monoatomic liquids - Quantum statistical Physics - Transport theory.

P607 Magnetic Resonance

Magnetic properties of matter (paramagnetic susceptibility - phenomenon of resonance) - Principles and instrumentations of electron paramagnetic resonance (EPR) - The Hamiltonian (spin Hamiltonian operator - Zeeman interaction - hyperfine interaction) - Electron paramagnetic resonance spectra (analysis, spectra of liquid phase, calculation the spin energy levels - allowed transitions and evaluation the resonant fields) - Nuclear magnetic resonance (principle - chemical shift, spin – spin coupling, analysis) - Double – resonance technique (an ENDOR experiment - energy levels and transitions - relaxation processes in steady state - electron – electron double resonances) - Electron spin echo spectroscopy (pulsed EPR - electron spin echoes - the nuclear modulation effect - ESE- ENDOR) - Applications.

P608 Selected Topics Related to Solid state Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P609 Methods of Experimental Solid State Physics

Experimental methods in solid state physics. Applications:
An introduction to materials characterization - x-ray analysis – microscopy - molecular spectroscopy techniques - thermal Techniques - experimental measurement (Electrical conductivity – Magnetization - Dielectric and Optical properties).

P610 Thermal Analysis

Thermal events, concepts of thermal analysis. Thermal analysis techniques (thermogravimetry (TG) - differential thermal analysis (DTA) - differential scanning calorimetric (DSC) - thermoptometry (TP) - thermodilatometry (TD) - thermomechanical analsis (TMA) - combination of thermal analysis techniques) - Important theories & advanced topics - Using computers in thermal analysis - Tutorial of data analysis.

P611 Physics of Metals and Alloys

Chemical Bonding - crystal structure – Entropy - free energy - free energies of metallic compounds – Solids - liquids and solidification – alloys - thermal phenomena in materials - Metal crystals – periodicity - heat treatment of alloys - Microstructure and properties - mechanical properties - Electrical conduction in metals - Advanced topics in metal analysis.

P612 Thin Films and Technological Applications

Thin film technology - Thin film nucleation and growth - and growth models (2D, 3D, and 2D-3D combination) - Epitaxial growth of thin films - superlattice structures and quantum wells – Diffusion - Physical vapor deposition (thermal evaporation - e-beam evaporation – sputtering - MBE Laser - MBE PLD) - Chemical vapor deposition (PECVD, MOCVD) - Solution-based deposition techniques (Sol-Gel, PAD, liquid phase epitaxy - LPE and other deposition techniques) - Thin film characterization (structural, chemical and electrical characterizations) - Special topics on various thin film devices and fabrications - and a lab sessions.

P613 Semiconductor Properties and Applications

Crystal structure - Band structure - Electrical properties of S.C. Optical properties of S.C. thin films - Thermal properties of S.C. Other types of semiconductor materials - Wide band gap semiconductors.

P614 Introduction of Nanomaterials

History and scope - interdisciplinary nature - structure of nanomaterials - length scales - de Broglie wavelength & exciton Bohr radius - jellium model - quantum wells - quantum wires - quantum dots – fullerenes – graphite - carbon nanotubes - inorganic nanowires – nanoparticles - core-shell nanoparticles - Survey of the synthesis methods and strategies, top-down and bottom-up approaches - chemical vapor deposition - laser ablation - sol-gel processing – lithography - characterization of nanomaterials. Applications to nanoelectromechanical systems - nano-magnetic materials and devices - nano-optoelectronic materials and devices, medicine and pharmacology applications.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems, boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra, discretizations, convergence, stability, error propagation, finite differences, finite elements, finite volumes, method of lines, conjugates gradient methods, multigrid methods.

M.Sc. Degree in Nanomaterials

P601 Electromagnetic Theory I

Vector analysis, curvilinear coordinates- Electrostatics (fields and potentials)- Boundary-value problems in electrostatics (Laplace and poisson Equations)- Multipoles and dielectrics- Magentostatics- Time-varying Fields and Maxwell equations- Electromagnetic waves and wave propagation.

P602 Condensed Matter Physics

Electrical Properties of Dielectrics- Band Theory of Metals- Band Theory of Semiconductors and Dielectrics- Magnetic Properties of Materials- Electrical properties of metals- Magnetic properties of materials- Dielectric and related properties- Optical properties of solids.

P603 Quantum Mechanics I

Angular momentum, Internal angular momentum. Total angular momentum: LS and jj coupling. Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling. Wigner-Eckart theorem. Invariance principles and conservation laws. Time independent perturbation theory. The variation method. The WKB approximation method.

P606 Statistical Physics

Thermodynamics, kinetic theory, probability distributions. Phase space and microcanonical ensemble. Canonical ensemble and partition functions with applications. Grand canonical ensemble and quantum statistics. Imperfect gas. Classical monoatomic liquids. Quantum statistical Physics. Transport theory.

P607 Magnetic Resonance

Magnetic properties of matter (paramagnetic susceptibility, phenomenon of resonance). Principles and instrumentations of electron paramagnetic resonance (EPR). The Hamiltonian(spin Hamiltonian operator, Zeeman interaction, hyperfine interaction). Electron paramagnetic resonance spectra (analysis, spectra of liquid phase, calculation the spin energy levels, allowed transitions and evaluation the resonant fields). Nuclear magnetic resonance (principle, chemical shift , spin – spin coupling, analysis). Double – resonance technique (an ENDOR experiment, energy levels and transitions, relaxation processes in steady state , electron – electron double resonances). Electron spin echo spectroscopy (pulsed EPR, electron spin echoes, the nuclear modulation effect, ESE- ENDOR). Applications.

P608 Selected Topics Related to Nanomaterials

Topics are to be determined by the supervising committee and approved by the Physics Department.

P609 Methods of Experimental Solid State Physics

Experimental methods in solid state physics. Applications:

An introduction to materials characterization, x-ray analysis, microscopy, molecular spectroscopy techniques, thermal Techniques, experimental measurement (Electrical conductivity, Magnetization, Dielectric and Optical properties).

P612 Thin Films and Technological Applications

Thin film technology. Thin film nucleation and growth, and growth models (2D, 3D, and 2D-3D combination). Epitaxial growth of thin films, superlattice structures and quantum wells. Diffusion. Physical vapor deposition (thermal evaporation, e-beam evaporation, sputtering, MBE Laser, MBE PLD). Chemical vapor deposition (PECVD, MOCVD). Solution-based deposition techniques (Sol-Gel, PAD , liquid phase epitaxy, LPE and other deposition techniques). Thin film characterization (structural , chemical and electrical characterizations). Special topics on various thin film devices and fabrications, and a lab sessions.

P614 Introduction of Nanomaterials

History and scope, interdisciplinary nature, structure of nanomaterials, length scales - de Broglie wavelength & exciton Bohr radius, jellium model, quantum wells, quantum wires, quantum dots, fullerenes, graphite, carbon nanotubes, inorganic nanowires, nanoparticles, core-shell nanoparticles. Survey of the synthesis methods and strategies, top-down and bottom-up approaches, chemical vapor deposition, laser ablation, sol-gel processing, lithography, characterization of nanomaterials. Applications to nanoelectromechanical systems, nano-magnetic materials and devices, nano-optoelectronic materials and devices, medicine and pharmacology applications.

P616 Synthesis and Characterizations of Nanomaterials

Synthesis Methods and Strategies, Top-down and bottom-up approaches, Chemical vapor deposition, Laser ablation, Electric-arc, Sol-Gel Processing, Lithography. Characterization: Electron Microscopy – SEM, TEM, EDAX, X-ray Diffraction and Electron diffraction, Atomic Force Microscopy, Scanning Tunneling Microscopy, Spectroscopy: UV-Visible spectroscopy, Photoluminescence spectroscopy, IR spectroscopy – FTIR, Raman spectroscopy, X-ray spectroscopy - Energy dispersive X-ray spectroscopy, X-ray absorption spectroscopy, X-ray fluorescence; Electron spectroscopy – UV and X-ray photoelectron spectroscopy, Auger electron spectroscopy, Electron energy loss spectroscopy (EELS).

P615 Semiconductor Devices

Optical Devices; Wide Bandgap Semiconductors Indispensable for Short Wavelength Optical Devices, and Control of the Physical Properties of III–V Nitrides and II–VI Semiconductors. Electronic Devices; Silicon Carbide Electronic Devices, and Nitride Compound Semiconductor Electron Devices. Crystals and Band Structure; IV–IV Group semiconductors, II–VI Semiconductors, III–V Nitride Semiconductors, Heterostructures and Band Structure, Lattice Defects. Optical, Mechanical, and Thermal Properties of Wide Bandgap Semiconductors; Optical Properties, Quantum Structure of Wide Bandgap Semiconductors, Lattice Constants of Semiconductors. Electrical Properties of Wide Bandgap Semiconductors; Doping Technology, Mobility of Electrons and Holes, Electrical Properties of SiC, Electrical Properties of GaN.

P618 Nanocomposites

Introduction to nanocomposites - where are they from and where are they going. Materials science of nanocomposites - understanding the pieces inside a nanocomposite part. Properties of nanocomposites - identifying the property advantages of these interesting materials. Particulates - the building blocks of nanocomposites. Flow in nanocomposite systems. Solvent and in situ polymerization for maximal distribution control. Melt processes for high performance parts. Structural and distribution characterization - seeing what is too small to be seen. Property characterization - realizing the performance of engineered parts.

P617 Quantum dots

Low-Dimensional Systems. Energy States in Quantum Dots. Self-Organized Quantum Dots. Growth, Structures, and Optical Properties of III-Nitride Quantum Dots. Theory of Threshold Characteristics of Quantum Dot Lasers: Effect of Quantum Dot Parameter Dispersion. Applications of Quantum Dots in Semiconductor Lasers. Basics of quantum cryptography. Electronic structure of quantum dots based on nitrides and arsenides. Micro- and nano-characterization of semiconductors. Time-resolved investigations of quantum dots. The fine structure splitting of the excitons in quantum dots. Electrical driven single photon sources. Detectors for quantum cryptography.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems, boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra, discretizations, convergence, stability, error propagation, finite differences, finite elements, finite volumes, method of lines, conjugates gradient methods, multigrid methods.

Chemistry Department:

C601 Organic Chemistry for Physicist

- Selected topics approved by Chemistry Department for Organic nanoparticles: synthesis, applications, and perspectives.

C602 Inorganic Chemistry for Physicist

Selected topics approved by Chemistry Department for Inorganic nanoparticles: synthesis, applications, and perspectives.

• M.Sc. Degree in Nuclear Physics

P601 Electromagnetic Theory I

Vector analysis, curvilinear coordinates. Electrostatics (fields and potentials). Boundary-value problems in electrostatics (Laplace and poisson Equations). Multipoles and dielectrics. Magentostatics. Time-varying Fields and Maxwell equations. Electromagnetic waves and wave propagation.

P603 Quantum Mechanics I

Angular momentum, Internal angular momentum. Total angular momentum: LS and jj coupling. Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling. Wigner-Eckart theorem. Invariance principles and conservation laws. Time independent perturbation theory. The variation method. The WKB approximation method.

P606 Statistical Physics

Thermodynamics, kinetic theory, probability distributions. Phase space and microcanonical ensemble. Canonical ensemble and partition functions with applications. Grand canonical ensemble and quantum statistics. Imperfect gas. Classical monoatomic liquids. Quantum statistical Physics. Transport theory.

P608 Selected Topics Related to Nuclear Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P620 Nuclear Structure I

Nuclear two body problem: Ground and excited states of the deuteron - Inter nucleon forces: nucleon-nucleon scattering, phase shift analysis, general properties of nucleon-nucleon forces. Nuclear many body problem. Structure of complex nuclei and nuclear models: liquid drop model, shell model, Collective model, unified model, cluster model.

P619 Accelerators and Reactors Physics

Part I: Introduction to particle physics. Historical background. Accelerators: Introduction to accelerator physics, Early accelerators: Cyclotrons, Other early accelerator types, Synchrotrons, Fixed-target accelerators, Future and developing technologies, Applications.

Part II: Introduction to Reactors: Early reactors, Mechanisms, Fission, Heat generation, Cooling, Reactivity control, Electrical power generation, Reactor types: Current technologies, Future and developing technologies, Applications.

P622 Nuclear Reactions I

Direct and compound nuclear reactions. Plane wave theory of direct reactions. Distorted wave Born approximation. Optical model. Spin orbit interaction. Elastic and inelastic scattering.

P621 Methods of Experimental Nuclear Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P624 Physics of Nuclear Medicine & Instrumentations

Review of interaction of radiation with matter. Review of radiation detection. Imaging systems and collimation. Single photon emission computed tomography (SPECT). Positron emission tomography (PET). X-ray computed tomography. Hybrid imaging systems: PET-CT and SPECT-CT. Image reconstruction, processing and display. Technological approaches: position sensitive detectors and open PET imaging.

P623 Elementary Particles

Introduction to the Elementary Particles and the Standard Model - Elementary Particle Dynamics: The Four Forces, Quantum Electrodynamics (QED), Quantum Chromodynamics (QCD) , Weak Interactions, Decays and Conservation Laws,Unification Schiemes. Relativistic Kinematics: Lorentz Transformations, Four-Vectors, Energy and Momentum, Collisions Examples and Applications. Symmetries: Symmetries, Groups, and Conservation Laws, Spin and Orbital Angular Momentum, Addition of Angular Momenta, CP Violation, Time Reversal and the TCP Theorem. The Feynman Calculus: Lifetimes and Cross Sections , The Golden Rule, The Feynman Rules for a Toy Theory, Lifetime of the A, Lowest and Higher-Order Diagrams of A scattering.

P626 Quantum Field Theory

Classical Field Theory: Introduction; Lagrangian Field Theory; Lorentz Invariance; Noether's Theorem and Conserved Currents; Hamiltonian Field Theory.

Canonical Quantization: The Klein-Gordon Equation, The Simple Harmonic Oscillator; Free Quantum Fields; Vacuum Energy; Particles; Relativistic Normalization; Complex Scalar Fields; The Heisenberg Picture; Causality and Propagators; Applications; Non-Relativistic Field Theory.

Interacting Fields: Types of Interaction; The Interaction Picture; Dyson's Formula; Scattering; Wick's Theorem; Feynman Diagrams; Feynman Rules; Amplitudes; Decays and Cross Sections; Green's Functions; Connected Diagrams and Vacuum Bubbles; Reduction Formula.

The Dirac Equation: The Lorentz Group; Clifford Algebras; The Spinor Representation; The Dirac Lagrangian; Chiral Spinors; The Weyl Equation; Parity; Majorana Spinors; Symmetries and Currents; Plane Wave Solutions.

Quantizing the Dirac Field: A Glimpse at the Spin-Statistics Theorem; Fermionic Quantization; Fermi-Dirac Statistics; Propagators; Particles and Anti-Particles; Dirac's Hole Interpretation; Feynman Rules

Quantum Electrodynamics: Gauge Invariance; Quantization; Inclusion of Matter -- QED; Lorentz Invariant Propagators; Feynman Rules; QED Processes.

P625 Methods of Mathematical Physics

Series solution of differential. gamma and beta functions. legendre polynomials and functions. bessel functions. hermite polynomials. laguerre polynomials. chebyshev polynomials. gegenbauer and jacobi polynomials. hypergeometric functions. other special functions.

P628 Radiation Physics

Radiation sources, radiation interactions, counting statistics. Radiation detection and measurements (ionization of a gas, solid state detectors, photographic effect). Biological effects of radiation (human physiology, interaction of radiation with cells, genetic effects. Natural and man-made radiation (cosmic radiation, terrestrial sources, radioactivity in the body, doses). Man-made sources of radiation (external hazard, source of the hazard, time, distance and shielding , neutron sources, personal dose control, radiation survey). Internal radiation hazard (uncontained radioactivity, control of the contamination, radiotoxicity, design of areas for radioactivity work, treatment of contaminated personnel). Radiation protection in medicine (protection against sealed sources and unsealed sources). Control and disposal of radioactive materials.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems, boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra, discretizations, convergence, stability, error propagation, finite differences, finite elements, finite volumes, method of lines, conjugates gradient methods, multigrid methods.

M626 Mathematical Modeling

The main goal of this course is to learn how to make a creative use of some mathematical tools, such as difference equations, ordinary and partial differential equations and numerical analysis, to build a mathematical description of some physical problems. The course topics includes: Introduction to Modeling -Qualitative Modeling with Functions - Modeling with Dimensional Analysis - Modeling with Difference Equations - Modeling with Ordinary Differential Equations - Empirical Modeling with Data Fitting - Modeling with Partial Differential Equations.

• **M.Sc. Degree in Radiation Physics**

P601 Electromagnetic Theory I

Vector analysis, curvilinear coordinates - Electrostatics (fields and potentials) - Boundary-value problems in electrostatics (Laplace and poisson Equations) - Multipoles and dielectrics – Magentostatics - Time-varying Fields and Maxwell equations - Electromagnetic waves and wave propagation.

P603 Quantum Mechanics I

Angular momentum, Internal angular momentum - Total angular momentum: LS and jj coupling - Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling - Wigner-Eckart theorem - Invariance principles and conservation laws - Time independent perturbation theory - The variation method - The WKB approximation method.

P606 Statistical Physics

Thermodynamics, kinetic theory - probability distributions - Phase space and microcanonical ensemble - Canonical ensemble and partition functions with applications - Grand canonical ensemble and quantum statistics - Imperfect gas - Classical monoatomic liquids - Quantum statistical Physics. Transport theory.

P607 Magnetic Resonance

Magnetic properties of matter (paramagnetic susceptibility, phenomenon of resonance) - Principles and instrumentations of electron paramagnetic resonance (EPR) - The Hamiltonian(spin Hamiltonian operator, Zeeman interaction, hyperfine interaction) - Electron paramagnetic resonance spectra (analysis, spectra of liquid phase, calculation the spin energy levels, allowed transitions and evaluation the resonant fields) - Nuclear magnetic resonance (principle, chemical shift , spin – spin coupling, analysis) - Double – resonance technique (an ENDOR experiment, energy levels and transitions, relaxation processes in steady state , electron – electron double resonances) - Electron spin echo spectroscopy (pulsed EPR, electron spin echoes, the nuclear modulation effect, ESE- ENDOR). Applications.

P608 Selected Topics Related to Radiation Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P620 Nuclear Structure I

Nuclear two body problem: Ground and excited states of the deuteron.
Inter nucleon forces: nucleon-nucleon scattering, phase shift analysis, general properties of nucleon-nucleon forces. Nuclear many body problem. Structure of complex nuclei and nuclear models: liquid drop model, shell model, Collective model, unified model, cluster model.

P619 Accelerators and Reactors Physics

Part I:

Introduction to particle physics. Historical background. Accelerators: Introduction to accelerator physics, Early accelerators: Cyclotrons, Other early accelerator types, Synchrotrons, Fixed-target accelerators, Future and developing technologies, Applications.

Part II:

Introduction to Reactors: Early reactors, Mechanisms, Fission, Heat generation, Cooling, Reactivity control, Electrical power generation, Reactor types: Current technologies, Future and developing technologies, Applications.

P622 Nuclear Reactions I

Direct and compound nuclear reactions. Plane wave theory of direct reactions. Distorted wave Born approximation. Optical model. Spin orbit interaction. Elastic and inelastic scattering.

P621 Methods of Experimental Nuclear Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P624 Physics of Nuclear Medicine & Instrumentations

Review of interaction of radiation with matter. Review of radiation detection. Imaging systems and collimation. Single photon emission computed tomography (SPECT). Positron emission tomography (PET). X-ray computed tomography. Hybrid imaging systems: PET-CT and SPECT-CT. Image reconstruction, processing and display. Technological approaches: position sensitive detectors and open PET imaging.

P625 Methods of Mathematical Physics

Series solution of differential. gamma and beta functions. legendre polynomials and functions. bessel functions. hermite polynomials. laguerre polynomials. chebyshev polynomials. gegenbauer and jacobi polynomials. hypergeometric functions. other special functions.

P628 Radiation Physics

Radiation sources, radiation interactions, counting statistics. Radiation detection and measurements (ionization of a gas, solid state detectors, photographic effect). Biological effects of radiation (human physiology, interaction of radiation with cells, genetic effects. Natural and man-made radiation (cosmic radiation, terrestrial sources, radioactivity in the body, doses). Man-made sources of radiation (external hazard, source of the hazard, time, distance and shielding , neutron sources, personal dose control, radiation survey). Internal radiation hazard (uncontained radioactivity, control of the contamination, radiotoxicity, design of areas for radioactivity work, treatment of contaminated personnel). Radiation protection in medicine (protection against sealed sources and unsealed sources). Control and disposal of radioactive materials.

P630 Neutron Physics I

Neutron properties: Chadwick's experiment, the proton-neutron nuclear model, neutron capture, inertial mass properties, gravitational mass properties, neutron momentum analysis, neutron spin and statistics.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems, boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra, discretizations, convergence, stability, error propagation, finite differences, finite elements, finite volumes, method of lines, conjugates gradient methods, multigrid methods.

M626 Mathematical Modeling

The main goal of this course is to learn how to make a creative use of some mathematical tools, such as difference equations, ordinary and partial differential equations and numerical analysis, to build a mathematical description of some physical problems. The course topics includes: Introduction to Modeling -Qualitative Modeling with Functions - Modeling with Dimensional Analysis - Modeling with Difference Equations - Modeling with Ordinary Differential Equations - Empirical Modeling with Data Fitting - Modeling with Partial Differential Equations.

M.Sc. Degree in Plasma Physics

P601 Electromagnetic Theory I
Vector analysis, curvilinear coordinates - Electrostatics (fields and potentials) - Boundary-value problems in electrostatics (Laplace and poisson Equations) - Multipoles and dielectrics. Magentostatics - Time-varying Fields and Maxwell equations - Electromagnetic waves and wave propagation.

P603 Quantum Mechanics I
Angular momentum, Internal angular momentum - Total angular momentum: LS and jj coupling - Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling - Wigner-Eckart theorem - Invariance principles and conservation laws - Time independent perturbation theory - The variation method. The WKB approximation method.

P606 Statistical Physics
Thermodynamics - kinetic theory, probability distributions - Phase space and microcanonical ensemble - Canonical ensemble and partition functions with applications - Grand canonical ensemble and quantum statistics - Imperfect gas. Classical monoatomic liquids - Quantum statistical Physics. Transport theory.

P607 Magnetic Resonance
Magnetic properties of matter (paramagnetic susceptibility, phenomenon of resonance) - Principles and instrumentations of electron paramagnetic resonance (EPR) - The Hamiltonian(spin Hamiltonian operator, Zeeman interaction, hyperfine interaction) - Electron paramagnetic resonance spectra (analysis, spectra of liquid phase, calculation the spin energy levels, allowed transitions and evaluation the resonant fields) - Nuclear magnetic resonance (principle, chemical shift , spin – spin coupling, analysis) - Double – resonance technique (an ENDOR experiment, energy levels and transitions, relaxation processes in steady state , electron – electron double resonances) - Electron spin echo spectroscopy (pulsed EPR, electron spin echoes, the nuclear modulation effect, ESE- ENDOR). Applications.

P608 Selected Topics Related to Plasma Physics
Topics are to be determined by the supervising committee and approved by the Physics Department.

P613 Semiconductor Properties and Applications
Crystal structure- Band structure - Electrical properties of S.C. Optical properties of S.C. thin films- Thermal properties of S.C. Other types of semiconductor materials- Wide band gap semiconductors.

P625 Methods of Mathematical Physics
Series solution of differential - gamma and beta functions - legendre polynomials and functions - bessel functions - hermite polynomials - laguerre polynomials - chebyshev polynomials - gegenbauer and jacobi polynomials - hypergeometric functions - other special functions.

P627 Physical Electronics
The Kinetic Theory of Gases- Conduction and Breakdown of Gases - Transport Phenomenon in Gas Discharge - Emission of Electrons and Ions by Solids - The Self-sustaining Discharge - Ionization and Excitation in the Upper-atmosphere - Langmuir Single and Double Probes - Direct Power Generation- Arc Furnaces- The Geiger Counter- Introduction to Applied Plasma Chemistry- Double Barrier Discharge- Excimer formation in DBD Plasma- Plasma and Polymer Materials- Plasma Jet.

P632 Plasma Physics
Definition of plasma, orbit theory – diffusion - resistivity and conductivity - plasma oscillations - MHD waves - magnetic confinement - parametric instabilities - radio-frequency - plasma heating and magnetosphere propagation - Landau and cyclotron damping - turbulence in Plasma - non-neutral plasmas - shock waves - kinetic effects in a magnetic field - equations of non-linear plasma - space plasma- plasma diagnostic techniques- spectroscopic techniques- plasma radiation- microwave techniques- electron cyclotron emission- plasma semiconductor- Thomson scattering.

P634 Physics of Corona Discharge
The highly stressed positive electrode- the highly stressed cathode- Electron attaching gases- free electron gases- other types of corona- the temporal development of breakdown- Crystal growth phenomenon on corona in air with liquid metal- Discharge of nanosecond duration- gas temperature variation in millisecond pulsed discharges in air- Spectroscopic investigation of corona discharge. Applications.

P636 Methods of Experimental Plasma Physics

High vacuum technique (rotary and diffusion pumps. pressure, mechanical cold cathode ionization gauges……etc.), electromagnets, voltmeters and watt meters, the ohmmeter….etc. DC potentiometer and instrument calibration, precise resistance measurements, alternating current bridge, analog electronic instruments. Basic of digital instruments. Cathode-ray oscilloscopes, special oscilloscopes, graphic recording instruments, DC power supplies, signal generators.

P638 Gas Discharge

The atomic structure, breakdown voltage, ionization and deionization processes, electric and thermal emission by metals, behavior of charged particles in a gas in electric and magnetic fields, the self-sustaining discharge (glow, and arc discharges), Double probe measurements, discharge by single and two photons laser induced fluorescence, applications in gas discharge, variation of the breakdown voltage with ozone concentration in dielectric barrier discharge, DBD parameter for production of high ozone concentration, nanosecond discharges in water vapor.

P640 Plasma Physics Applications

Plasma coating, techniques of plasma TV screen, plasma chemistry, plasma nuclear fusion reactors (Tokamak ITER nuclear reactor), laser-plasma interactions, non-neutral plasma, high-intensity accelerators, plasma propulsion, plasma processing, and coherent electromagnetic wave generation, plasma cluster, laser induced fluorescence, Applications of low temperature plasmas for biomedical and technological biomedical.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems, boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra, discretizations, convergence, stability, error propagation, finite differences, finite elements, finite volumes, method of lines, conjugates gradient methods, multigrid methods.

M626 Mathematical Modeling

The main goal of this course is to learn how to make a creative use of some mathematical tools, such as difference equations, ordinary and partial differential equations and numerical analysis, to build a mathematical description of some physical problems. The course topics includes: Introduction to Modeling -Qualitative Modeling with Functions - Modeling with Dimensional Analysis - Modeling with Difference Equations - Modeling with Ordinary Differential Equations - Empirical Modeling with Data Fitting - Modeling with Partial Differential Equations.

• M.Sc. Degree in Laser Physics

P601 Electromagnetic Theory I
Vector analysis, curvilinear coordinates- Electrostatics (fields and potentials)- Boundary-value problems in electrostatics (Laplace and poisson Equations)- Multipoles and dielectrics- Magentostatics- Time-varying Fields and Maxwell equations- Electromagnetic waves and wave propagation.

P603 Quantum Mechanics I
Angular momentum- Internal angular momentum- Total angular momentum: LS and jj coupling- Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling- Wigner-Eckart theorem- Invariance principles and conservation laws- Time independent perturbation theory- The variation method- The WKB approximation method.

P606 Statistical Physics
Thermodynamics- kinetic theory- probability distributions- Phase space and microcanonical ensemble- Canonical ensemble and partition functions with applications- Grand canonical ensemble and quantum statistics- Imperfect gas- Classical monoatomic liquids- Quantum statistical Physics- Transport theory.

P607 Magnetic Resonance
Magnetic properties of matter (paramagnetic susceptibility, phenomenon of resonance)- Principles and instrumentations of electron paramagnetic resonance (EPR)- The Hamiltonian(spin Hamiltonian operator- Zeeman interaction- hyperfine interaction)- Electron paramagnetic resonance spectra (analysis- spectra of liquid phase- calculation the spin energy levels- allowed transitions and evaluation the resonant fields)- Nuclear magnetic resonance (principle- chemical shift- spin – spin coupling- analysis)- Double – resonance technique (an ENDOR experiment- energy levels and transitions- relaxation processes in steady state- electron – electron double resonances)- Electron spin echo spectroscopy (pulsed EPR- electron spin echoes- the nuclear modulation effect- ESE- ENDOR)- Applications.

P608 Selected Topics Related to Laser Physics
Topics are to be determined by the supervising committee and approved by the Physics Department.

P613 Semiconductor Properties and Applications
Crystal structure- Band structure- Electrical properties of S.C. Optical properties of S.C. thin films- Thermal properties of S.C. Other types of semiconductor materials- Wide band gap semiconductors.

P625 Methods of Mathematical Physics
Series solution of differential- Gamma and beta functions- Legendre polynomials and functions- Bessel functions- Hermite polynomials- Laguerre polynomials- Chebyshev polynomials- Gegenbauer and jacobi polynomials- Hypergeometric functions- Other special functions.

P642 Laser Physics and Quantum Electronics
Introduction- principles of laser operation- how lasers work- their properties- and some applications- Atomic transitions- atomic rate equations- Amplification- optical feedback- Laser oscillators- Optical beams and resonators- Laser Dynamics- linear propagation- Ultra-fast lasers- Quantum electronics- laser methods for detecting explosive residues- laser transmitter / receiver- laser communicates.

P644 Laser Applications
Interaction of light with matter- basic principle of lasers- some specific laser systems free electron and semiconductor laser- Laser lection criteria for specific applications- pulsed continuous- energy and power wavelength considerations pulse width and transient detections- line shape profile- gain profile and tune ability. Scientific applications- absorption spectroscopy- emission techniques- scattering techniques- Raman and coherent Raman- pump and probe techniques- diagnostics of exited states- signal to noise radio ratio considerations.
Industrial applications: cutting, welding- drilling ranging- barcode- scanners- CD players.
Medical-surgery- kidney stone treatment- eye treatment. Defense- battle field- direct energy weapon- anti-missile research. Spectroscopy- laser annealing- ablation- scattering and interferometers- commercial-laser: printers- laser pointers.

P646 Methods of Experimental Laser Physics
High vacuum technique (rotary and diffusion pumps. Pressure- mechanical cold cathode ionization gauges……etc.)- electromagnets, voltmeters and watt meters- the ohmmeter….etc. DC potentiometer and instrument calibration- precise resistance measurements- alternating current bridge- analog electronic instruments- Basic of digital instruments- Cathode-ray oscilloscopes- special oscilloscopes- graphic recording instruments- DC

power supplies- signal generators- The coherence length of a He-Ne laser- the argon-ion and argon pumped dye laser- laser cavity design- transverse Mode Structure- longitudinal Mode Structure- dye absorption and emission spectra- fiber optics.

P648 Laser Physics and Technology

Quantum Optics- ultra-fast lasers- laser methods for detecting explosive residues- laser transmitter/receiver- laser communicator- Laser measurement- consumer electronics- Fabry–Perot lasers- distributed feedback lasers- external cavity lasers- laser diode- quantum cascade laser- external cavity lasers- blue laser- semiconductor blue-laser technology- diode-pumped solid state (DPSS) laser modules- application of the blue laser include: telecommunications- medical laser- medical diagnostics- low level laser therapy monitoring- inter-band cascade laser- polarization laser- quantum cascade laser- physics of hybrid silicon laser- distributed feedback laser- cold laser for chiropractic- laser spectroscopy- lamp-pumped lasers- nonlinear fiber optics- consumer electronics- the laser triggered the photonics revolution and the foundation of modern photonics.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems- boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra- discretizations- convergence-stability- error propagation- finite differences- finite elements- finite volumes- method of lines- conjugates gradient methods- multigrid methods.

M626 Mathematical Modeling

The main goal of this course is to learn how to make a creative use of some mathematical tools- such as difference equations- ordinary and partial differential equations and numerical analysis- to build a mathematical description of some physical problems. The course topics includes: Introduction to Modeling -Qualitative Modeling with Functions - Modeling with Dimensional Analysis - Modeling with Difference Equations - Modeling with Ordinary Differential Equations - Empirical Modeling with Data Fitting - Modeling with Partial Differential Equations.

• <u>M.Sc. Degree in Theoretical Physics</u>

P601 Electromagnetic Theory I

Vector analysis, curvilinear coordinates- Electrostatics (fields and potentials)- Boundary-value problems in electrostatics (Laplace and poisson Equations)- Multipoles and dielectrics- Magentostatics- Time-varying Fields and Maxwell equations- Electromagnetic waves and wave propagation.

P603 Quantum Mechanics I

Angular momentum- Internal angular momentum- Total angular momentum: LS and jj coupling- Addition of total angular momenta (Clebsch Gordan Coefficient) 3j, 6j and 9j coupling- Wigner-Eckart theorem- Invariance principles and conservation laws- Time independent perturbation theory- The variation method- The WKB approximation method.

P604 Crystal Structure

The nature of crystal structures- geometry and chemistry of crystals- size- homogeneity- perfection- twinning-polymorphism- phase transitions- isomorphism- solid solutions- diagrams and models- Interatomic forces and structure building- Lattices and lattice complexes- Directions of planes and lines- Some simple structures (copper-iron- comparison of cubic and hcp- diamond- sodium chloride- cesium chloride- calcium chloride- zinc blende structures and the structure of various metallic alloys)- Structures of oxides (Perovskite- spinel- corundum-ilmenite- lithium niobate- calcite- aragonite- olivine- rutile structures- forms of silica- the quartz structure)- The determination of crystal structures (single crystal and powder methods- examples of structure determinations and the refinement.

P606 Statistical Physics

Thermodynamics- kinetic theory- probability distributions- Phase space and microcanonical ensemble- Canonical ensemble and partition functions with applications- Grand canonical ensemble and quantum statistics- Imperfect gas- Classical monoatomic liquids- Quantum statistical Physics- Transport theory.

P608 Selected Topics Related to Theoretical Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P620 Nuclear Structure I

Nuclear two body problem: Ground and excited states of the deuteron.

Inter nucleon forces: nucleon-nucleon scattering- phase shift analysis- general properties of nucleon-nucleon forces- Nuclear many body problem- Structure of complex nuclei and nuclear models: liquid drop model- shell model- Collective model- unified model- cluster model.

P622 Nuclear Reactions I

Direct and compound nuclear reactions- Plane wave theory of direct reactions- Distorted wave Born approximation- Optical model- Spin orbit interaction- Elastic and inelastic scattering.

P625 Methods of Mathematical Physics

Series solution of differential- gamma and beta functions- legendre polynomials and functions- bessel functions-hermite polynomials- laguerre polynomials- chebyshev polynomials- gegenbauer and jacobi polynomials-hypergeometric functions- other special functions.

P629 High temperature – High pressure Physics

Thermodynamics and statistical mechanics- review- Interaction potentials- pair potentials- Equation of state by a statistical mechanical theory- Equation of state at high pressures- Viscosity and thermal conductivity at high pressure and temperature- Applications to shock waves and detonation.

P631 Shock waves and detonation

Conservation of momentum and energy- Gas dynamics, Dense – fluid equation of state- Shock Hugoniot-Detonation products Hugoniot- Detonation products- chemical kinetics- Shock and detonation structure.

P633 Equation of state

Real gas equation of state- Viral equation of state- Intermolecular potentials- Statistical mechanical approach to equation of state- Hard- sphere equation of state- Dense fluid equation of state- Equation of state of compressed solid.

P650 Computational Physics

Approximation of a function: Interpolation- Least-squares approximation- Spline approximation- Random-number generators. Numerical calculus: Numerical differentiation- Numerical integration- Roots of an equation- Extremes of a function- Classical scattering. Ordinary differential equations: Initial-value problems- The Euler and Picard methods- predictor-corrector methods- The Runge-Kutta method- Chaotic dynamics of a driven pendulum- Boundary-value and eigenvalue problems- The shooting method- Linear equations and Sturm-Liouville problem- The one-dimensional Schroedinger equation. Numerical methods for matrices: Matrices in physics- Basic matrix operations- Linear equation systems- Zeros and extremes of a multivariable function- Eigenvalue problems- The Faddeev-Leverrier method- Complex zeros of a polynomial- Electronic structure of atoms- The Lanczos algorithm and the many-body problem- Random matrices.

P652 Dense Fluids Physics

Statistical mechanical approach- Radial distribution function $g(r)$- Relation between thermodynamic function and $g(r)$- Integral equations for $g(r)$- Correlation function- Hard-sphere fluid- Perturbation theories of liquids.

M603 Numerical Analysis I

The course contains: Numerical treatment of initial value problems- boundary value problems and eigenvalue problems for ordinary and partial differential equations. Relevant linear algebra- discretizations- convergence-stability- error propagation- finite differences- finite elements- finite volumes- method of lines- conjugates gradient methods- multigrid methods.

M604 Partial Differential Equations I

The topics of this course are: Non-linear PDE of elliptic hyperbolic and parabolic types and their applications - Backlund transformation and soliton theory.

M.Sc. Degree in Medical Physics

P606 Statistical Physics

Thermodynamics- kinetic theory- probability distributions- Phase space and microcanonical ensemble- Canonical ensemble and partition functions with applications- Grand canonical ensemble and quantum statistics- Imperfect gas- Classical monoatomic liquids- Quantum statistical Physics- Transport theory.

P619 Accelerators and Reactors Physics

Part I: Introduction to particle physics. Historical background. Accelerators: Introduction to accelerator physics, Early accelerators: Cyclotrons, Other early accelerator types, Synchrotrons, Fixed-target accelerators, Future and developing technologies, Applications.

Part II: Introduction to Reactors: Early reactors, Mechanisms, Fission, Heat generation, Cooling, Reactivity control, Electrical power generation, Reactor types: Current technologies, Future and developing technologies, Applications.

P635 Nuclear Medicine

Nuclear structures- Atomic models, Mass energy equivalence, electromagnetic spectrum, Radioactivity & Artificial Radioactivity, Radionuclide Production, Isotopes and nuclides, binding forces between nuclear particles , alpha & beta particles and gamma radiation, mechanisms of radioactive decay, half life, Interaction of electrons, X-rays & ɤ-rays with matter, Radiation intensity & exposure, radiation dose, Radiation Detectors, Radiation Protection in Nuclear Medicine, Application of PET & SPECT in Radiotherapy Planning, Single photon imaging (The Gamma Camera and other Imaging Equipment), Nuclear Medicine Imaging Techniques, Single Photon Emission Computed Tomography Fundamentals (SPECT), Positron emission tomography (PET) Fundamentals.

P637 Radiation Detection and Measurements

General properties of radiation, Overview of radiation interaction with matter, Properties of radiation detectors, Gas filled detectors, Diffusion and draft of charges in gases, Proportional counters, Gieger-Muller counters, Ionization chamber, Cloud chamber, Bubble chamber, Scintillation detectors, Liquid scintillation detectors, Photomultiplier tubes, Photo-detectors, Semiconductor detectors, High purity germanium detectors, Room temperature semiconductor detectors and efficiency considerations, Slow neutron detectors, Fast neutron detectors, Nuclear electronics and signal processing.

P639 Experimental Methods in Radiation Detection

Experiments in nuclear and radiation detection including gas filled detectors, charged particle detectors, scintillation detectors, semiconductor detectors, Detector efficiency, Detector resolution, Single and multichannel analyzer, Pulse shaping and processing, Analogue, linear and digital pulse functions, NIM and CAMMAC standards, Compton scattering and Compton suppression detectors, Time of flight, Angular correlation, Coincidence measurements applied to positron emitters, Detector arrays, Spectroscopic analysis.

P641 Applications of Laser in Medicine

Introduction to laser physics and laser types, Characteristics of laser sources, Tissue optical properties and light propagation in tissue, Interaction mechanisms between the laser radiation and biological tissue, Diagnostic applications in Medicine, Therapeutic applications, Femtosecond lasers in medicine.

P654 Medical Imaging

Planner imaging, Central slice theory, Fourier transformers and convolution and deconvolution, Projection, and image reconstruction, Image processing and analysis.Nuclear magnetic resonance, Nuclear magnetic imaging, ultrasound imaging, Ultrasound contrast and microscopy, Image Quality Management.

P656 Radiobiology and Radiotherapy

Types of ionizing radiation, sources of medical exposure, radiation effects. radiosensitivity, cell damage and cell survival curve, repair, stochastic and non-stochastic effects, dose response models, Radiotherapy machines, external beam radiotherapy, treatment planning systems, conformal radiotherapy, intensity-modulated radiotherapy, virtual simulation, brachytherapy.

P658 Biostatistics and Computer Simulation

Review of basic concepts of probability, Population, sampling and data collection, Random variables and distributions, Kinds of biological random variables, Statistical inference, Hypothesis testing and confidence limits, Descriptive statistics, Central tendency, Dispersion and standard errors, Tests for nominal variables, Tests for multiple measurement variables, Categorical data analysis, Relative risk, Different types of explanatory and related response variables, Analysis of variance, Regression and correlation, Survival analysis. Introduction to Monte Carlo methods in radiation and biology, Simulation of tracking and geometry of radiation in tissues.

P660 Radiation Dosimetry

Dosimetric principles, quantities and units, radiation dosimetry, radiotherapy with external photon and electron beams, calibration and characteristics of therapeutic photon and electron beams, acceptance testing, and commissioning.

P662 Radiation Protection

Overview on atomic and nuclear structure, radioactive decay and radioactivity, Binding energy and mechanisms of radioactivity, Radioactive decay modes, Beta emission, Alpha emission, electron capture, Isomeric transition, Gamma ray radiation, Naturally occurring radioisotopes, Radiation units, Dose estimation, External radiation hazard, Internal radiation hazard, Radiation shielding and moderation, ALARA principle, Equivalent dose calculations, Effects of radiation on biological systems, Radiation damage, Stochastic and deterministic effects of radiation, Radiation safety guides, Radiation safety standards, Reports of the international commission of radiation protection (ICRP), Recommendations of the international atomic energy authority (IAEA) concerning radiation protection, Overview of the Egyptian regulations for ionizing radiation safety and protection.

MD601 Human Anatomy and Physiology

Study of human body from the medical imaging point of view: Skeletal, respiratory, cardiovascular, digestive, and urinary systems, breast and women's issues, head and neck, and central nervous system. The organization and function of major organ systems that constitute the human body. Examples of pathology of diseases commonly encountered I the practical of medical physics such as cancer. Basic principles of cell and molecular biology and molecular imaging.

• **Ph.D. Degree in Solid State Physics**

P701 Selected Topics Related to Soild State Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P702 Advanced Condensed Matter Physics

Phase Diagrams and Phase Transformations, Single Photon Source Materials for Communications and Computer Technology, Polymers and Advanced Ceramics, Spectroscopic Characterization, Non-Linear Optics, Physics of Quantum Structures and Nano Photonics, Synthesis, Fabrication and Processing of Materials.

P703 Electromagnetic Theory II

Guided Electromagnetic Waves: Transmission line equations, transmission line transient waves, sinusoidal time variations, arbitrary impedance terminations, stub tuning, the rectangular waveguide, dielectric waveguide.

Radiation: The retarded potentials, radiation from point dipoles, point dipole arrays, long dipole antennas.

P704 Quantum Mechanics II

Time dependent perturbation theory. Theory of scattering. Relativistic Theory. Quantization and second quantization.

P705 Molecular Spectroscopy

Basics of molecular spectroscopy- Phenomenology- Diatomic molecules - Pure rotational spectroscopy - Vibrational spectroscopy of polyatomic molecules- Fundamentals of group theory. Infrared spectroscopy- Raman scattering - Electronic spectra of diatomic molecules- Nuclear magnetic resonance. Electron spin resonance- Mossbauer spectroscopy - High Resolution Spectroscopy.

P706 Applied Magnetic Materials

Magnetic properties of nanostructures and nanoparticles, single domain nanoparticles, nanospintronics: classifications, preparation and applications, Application of nanospintronics and nanoparticles in quantum communication, sensing, imaging, therapy.

P707 Ceramic Materials

Types of Ceramic Materials, Synthesis of Ceramics, Characterization of Ceramics, Physical Properties of Ceramics, Semiconductor Ceramics, Superconductor Ceramics, Ferroelectric and Supersets Ceramics, Nanostructure Ceramics, Applications of Ceramics.

P708 Advanced Functional Materials

Theories and technologies in the creation and application processes of excellent new materials and functional materials:

The industrial application of molecular functional materials that also lead to biofunctional materials.

Role of surface in the functional characteristics and physical properties of materials.

Principles of scientific as well as technical methods of evaluating surface activities using examples.

Applications of inorganic materials from engineering viewpoint, including synthesis, structure.

M706 - Numerical Analysis II

Different numerical methods for large problems with different time scales. Spectral methods, wavelets , multiple methods, preconditioned conjugate gradient methods, multigrid methods.

• Ph.D. Degree in Nanomaterials

P701 Selected Topics Related to Nanomterials

Topics are to be determined by the supervising committee and approved by the Physics Department.

P702 Advanced Condensed Matter Physics

Phase Diagrams and Phase Transformations, Single Photon Source Materials for Communications and Computer Technology, Polymers and Advanced Ceramics, Spectroscopic Characterization, Non-Linear Optics, Physics of Quantum Structures and Nano Photonics, Synthesis, Fabrication and Processing of Materials.

P706 Applied Magnetic Materials

Magnetic properties of nanostructures and nanoparticles, single domain nanoparticles, nanospintronics: classifications, preparation and applications, Application of nanospintronics and nanoparticles in quantum communication, sensing, imaging, therapy.

P707 Ceramic Materials

Types of Ceramic Materials, Synthesis of Ceramics, Characterization of Ceramics, Physical Properties of Ceramics, Semiconductor Ceramics, Superconductor Ceramics, Ferroelectric and Supersets Ceramics, Nanostructure Ceramics, Applications of Ceramics.

P708 Advanced Functional Materials

Theories and technologies in the creation and application processes of excellent new materials and functional materials - The industrial application of molecular functional materials that also lead to biofunctional materials - Role of surface in the functional characteristics and physical properties of materials - Principles of scientific as well as technical methods of evaluating surface activities using examples - Applications of inorganic materials from engineering viewpoint, including synthesis, structure.

P709 Advanced Fine Particle Engineering

Synthesis of organic molecules-modified inorganic particles using high temperature-pressure field in liquid: Nano crystalline oxide particles are synthesized by developed hydrothermal synthesis process providing controllability of crystal size, morphology and surface modification with organic modifiers such as polymers and biomolecules.

Synthesis of novel nanoparticles by plasma process: The chemical reaction place, where the material synthesis process progresses, is precisely controlled using plasma, and it aims at the creation of the exotic materials - Investigation of fundamentals of the magnetic field effects on materials processing: A remote, dynamic interaction controlled by a strong magnetic field is basically examined to provide novel material processing - Establishment of advanced shaping technology of ceramic using electrophoretic phenomenon of particle in liquid : The energy and environmental-related ceramics with tailored microstructure are fabricated by electrophoretic deposition process using pulsed electric field and a strong magnetic field

P710 Advanced Semiconductor Devices

Education and research on the growth and electronic property of semiconductor heteroepitaxial films and polycrystalline films as well as their application to quantum-effect devices, molecular electronics, and gas sensors. Phase transition and polarization reversal of ferroelectric crystals are also studied - Photonic Devices: Physical Properties, Visible LEDs, Ultraviolet Devices, White Light Emitting Devices, Laser Diodes (LDs) - Electronic Devices: High Frequency Power Devices, High Breakdown Voltage, High Current.

Density Power Devices, New Functional Devices.

Novel Nano-Heterostructure Materials and Related Devices: Nanostructure Devices and Materials, Novel AlGaN/GaN Heterostructure Devices.

B701 Biological Science

Cell, basic of molecular biology, transcription, translation, regulatory pathways, DNA damage and Repair, recombination DNA technology.

Nanoscience: explain concepts of nanotechnology and nanoscience including their importance in the development of Biomedical methods and technology.

Analyze the interdisciplinary nature of nanotechnology using examples from biology, medicine, chemistry, physics.

Discuss the different technologies used in the synthesis and analysis of nanostructures and also the phenomena that determine the interactions between nanoparticles and biological and artificial interfaces.

Describe how methods of molecular biology, i.e. PCR are applied within nanotechnology.

Apply adequate methods of molecular biology in the characterization of the impact of nanostrustures on biological systems.

The interactions of live cells and cellular structures with nanoparticles.

Ph.D. Degree in Nuclear Physics

P701 Selected Topics Related to Nuclear Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P704 Quantum Mechanics II

Time dependent perturbation theory. Theory of scattering. Relativistic Theory. Quantization and second quantization.

P711 Nuclear Structure II

Structure of deformed nuclei. Overview of angular momentum coupling Formulas. Second quantization. Particle hole excitation at closed shells: TDA and RPA approximations. Application of the Study of 1p - 1h Excitations.

P712 Nuclear Reactions II

Improvements within the framework of the DWBA. Distorted-Wave Impulse Approximation. Coupled equations for inelastic scattering. Microscopic theory of inelastic nucleon scattering from nuclei. Scattering from deformed rotational Nuclei. Two-nucleon transfer reactions. Heavy-ion reactions.

P713 Accelerators and Reactors Physics II

Part I: Linear Accelerators, Principle and operation, applications. Storage Rings, principle and operation High intensity hadron accelerators (Meson and neutron sources). Electron and low intensity hadron accelerators. Colliders: Electron-positron colliders, Hadron colliders, Electron-proton colliders, Light sources, Hypothetical accelerators.

Part II: Advanced reactors. Fusion reactors, Nuclear fuel cycle, Safety, Accidents, Natural nuclear reactors, Applications.

P714 Elementary Particle Physics II

Quantum Electrodynamics: The Dirac Equation, Solutions to the Dirac Equation, Bilinear Covariants, The Photon, The Feynman Rules for Quantum Electrodynamics, Casimir's Trick and the Trace Theorems, Cross Sections and Lifetimes, Renormalization.

Electrodynamics of Quarks and Hadrons: Electron-Quark Interactions, Hadron Production in e'e- Scattering, Elastic Electron-Proton Scattering, Inelastic Electron-Proton Scattering, The Parton Model and Bjorken Scaling, Quark Distribution Functions.

Quantum Chromodynamics: Feynman Rules for Chromodynamics, The Quark-Quark Interaction, Pair Annihilation in QCD, Asymptotic Freedom, Applications of QCD.

Weak Interactions.

Gauge Theories.

M706 - Numerical Analysis II

Different numerical methods for large problems with different time scales. Spectral methods, wavelets , multiple methods, preconditioned conjugate gradient methods, multigrid methods.

Ph.D. Degree in Radiation Physics

P701 Selected Topics Related to Rediation Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P704 Quantum Mechanics II

Time dependent perturbation theory. Theory of scattering. Relativistic Theory. Quantization and second quantization.

P713 Accelerators and Reactors Physics II

Part I

Linear Accelerators, Principle and operation, applications. Storage Rings, principle and operation High intensity hadron accelerators (Meson and neutron sources). Electron and low intensity hadron accelerators. Colliders: Electron-positron colliders, Hadron colliders, Electron-proton colliders, Light sources, Hypothetical accelerators.

Part II

Advanced reactors. Fusion reactors, Nuclear fuel cycle, Safety, Accidents, Natural nuclear reactors, Applications.

P715 Radiation Physics II

The radiation field, radiation interactions with matter, radiative transport, radiation dosimetry, shielding and dose calculations.

P716 Neutron Physics II

Neutron scattering and two-particles interactions. Neutrons and nuclear structure. Neutron and nuclear energy energetics of nuclear transformation and decay, nuclear fission, neutron transport and diffusion, neutron moderation, nuclear fission chain reactions, criticality, nuclear fusion, and controlled nuclear fusion.

Neutron optics: wave-particle duality, neutron propagation in condensed matter, neutron diffraction, neutron interference, neutron polarization.

M706 - Numerical Analysis II

Different numerical methods for large problems with different time scales. Spectral methods, wavelets , multiple methods, preconditioned conjugate gradient methods, multigrid methods.

Ph.D. Degree in Plasma Physics

P701 Selected Topics Related to Plsama Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P703 Electromagnetic Theory II

Guided Electromagnetic Waves: Transmission line equations, transmission line transient waves, sinusoidal time variations, arbitrary impedance terminations, stub tuning, the rectangular waveguide, dielectric waveguide. Radiation: The retarded potentials, radiation from point dipoles, point dipole arrays, long dipole antennas.

P704 Quantum Mechanics II

Time dependent perturbation theory. Theory of scattering. Relativistic Theory. Quantization and second quantization.

P705 Molecular Spectroscopy

Basics of molecular spectroscopy- Phenomenology- Diatomic molecules - Pure rotational spectroscopy - Vibrational spectroscopy of polyatomic molecules- Fundamentals of group theory. Infrared spectroscopy- Raman scattering - Electronic spectra of diatomic molecules- Nuclear magnetic resonance. Electron spin resonance- Mossbauer spectroscopy - High Resolution Spectroscopy.

P717 Methods of Experimental Plasma Physics II

Low-pressure arc, cold-cathode plasma formation, ambipolar diffusion in afterglow plasmas, Langmuir probe measurements of electron temperature and plasma density, Fabry-Perot spectroscopy for ion energy measurements, optical spectroscopy for species identification, microwave interferometry and cavity resonances for plasma density determination, momentum generated by a plasma thruster, determination of plasma aluminum oxide coating for semiconductors, electric conductivity measurements of low and high temperature plasma, design plasma TV screen.

P718 Plasma Physics II

Recombination processes in low temperature after glow plasma. Chemistry in glow discharges of H2 / O2 mixtures. Composition and Thermodynamic properties of H-He Plasma. Collective and nonlinear plasma phenomena. Modeling and simulation techniques. Plasma diagnostic methods. High frequency discharges. Non-equilibrium plasmas. Micro-plasmas at high pressures . Thermal plasmas. Complex and dusty plasmas, ion-ion plasmas. Plasma power and pulsed power technology. Thermodynamics and transport phenomena. Astrophysical, geophysical and other natural plasmas. Medical, biological, environmental and aeronautical applications. Interaction of R.F Plasma with Stainless steel.

P719 Fusion Energy Technology

Fusion basics, Fusion Plasmas, the Iter tokamak design, danger of fusion reactors, radiation, nuclear explosion with fusion reaction, the cooling system, the fuel system, the diverters, Systems for enhancing pre-ignition conditions of thermonuclear fusion reactions, fusion ignition, magnetic fusion energy, methods and device for realizing stable plasma confinement, stellarators , inertial confinement, Bubble Fusion.

M706 - Numerical Analysis II

Different numerical methods for large problems with different time scales. Spectral methods, wavelets , multiple methods, preconditioned conjugate gradient methods, multigrid methods.

Ph.D. Degree in Laser Physics

P701 Selected Topics Related to Laser Physics

Topics are to be determined by the supervising committee and approved by the Physics Department.

P702 Advanced Condensed Matter Physics

Phase Diagrams and Phase Transformations, Single Photon Source Materials for Communications and Computer Technology, Polymers and Advanced Ceramics, Spectroscopic Characterization, Non-Linear Optics, Physics of Quantum Structures and Nano Photonics, Synthesis, Fabrication and Processing of Materials.

P703 Electromagnetic Theory II

Guided Electromagnetic Waves: Transmission line equations, transmission line transient waves, sinusoidal time variations, arbitrary impedance terminations, stub tuning, the rectangular waveguide, dielectric waveguide.
Radiation: The retarded potentials, radiation from point dipoles, point dipole arrays, long dipole antennas.

P704 Quantum Mechanics II

Time dependent perturbation theory. Theory of scattering. Relativistic Theory. Quantization and second quantization.

P705 Molecular Spectroscopy

Basics of molecular spectroscopy- Phenomenology- Diatomic molecules - Pure rotational spectroscopy - Vibrational spectroscopy of polyatomic molecules- Fundamentals of group theory. Infrared spectroscopy- Raman scattering - Electronic spectra of diatomic molecules- Nuclear magnetic resonance. Electron spin resonance- Mossbauer spectroscopy - High Resolution Spectroscopy.

P720 Methods of Experimental Laser Physics II

Nd: Yag pumped dye lasers, Optically pumped parametric Oscillator Lasers, Nitrogen pumped dye lasers, diode lasers, Argon Ion lasers, etc.). Analyze a mass spectrum taken from laser adsorption and electron impact ionization, Mass spectroscopy. Laser induced fluorescence of iodine, He-Ne, Ar ion, tunable laser. He-Ne Laser Opto-galvanic Spectroscopy.

P721 Magnetic Resonance II

Magnetic properties of matter, magnetic resonance theory, spin Hamiltonian and hyperfine interactions, electron paramagnetic resonance (EPR), nuclear magnetic resonance (NMR), Double resonance technique, echo spectroscopy ESR-ENDOR, Application in science, imaging and therapy.

P722 Laser Applications II

Wave equation, Fresnel equations and photon population inversion polarization, Geometrical optics using matrix methods, Fourier Optics, Cavity modes and Gaussian beams, Fabry-Perot and Michelson interferometers, Basic rate equation models for 3 and 4 level systems, Simple laser theory (single- and multi-mode operation), Mode-locking and Q-switching, Diffraction and Fourier optics, Electro- and Acousto-optic effects, Nonlinear Optics. Fiber optics, Transverse mode structure, Longitudinal mode structure, Dye absorption and Emission spectra. Super-fast laser cooling, Laser-Tissue interactions: (Biological and Medical Physics, Biomedical Engineering), Laser crystals.

M706 - Numerical Analysis II

Different numerical methods for large problems with different time scales. Spectral methods, wavelets, multiple methods, preconditioned conjugate gradient methods, multigrid methods.

• <u>Ph.D. Degree in Theoretical Physics</u>

P701 Selected Topics Related to Theoretical Physics
Topics are to be determined by the supervising committee and approved by the Physics Department.

P702 Advanced Condensed Matter Physics
Phase Diagrams and Phase Transformations, Single Photon Source Materials for Communications and Computer Technology, Polymers and Advanced Ceramics, Spectroscopic Characterization, Non-Linear Optics, Physics of Quantum Structures and Nano Photonics, Synthesis, Fabrication and Processing of Materials.

P703 Electromagnetic Theory II
Guided Electromagnetic Waves: Transmission line equations, transmission line transient waves, sinusoidal time variations, arbitrary impedance terminations, stub tuning, the rectangular waveguide, dielectric waveguide.
Radiation: The retarded potentials, radiation from point dipoles, point dipole arrays, long dipole antennas.

P704 Quantum Mechanics II
Time dependent perturbation theory. Theory of scattering. Relativistic Theory. Quantization and second quantization.

P711 Nuclear Structure II
Structure of deformed nuclei. Overview of angular momentum coupling Formulas. Second quantization. Particle hole excitation at closed shells: TDA and RPA approximations. Application of the Study of 1p - 1h Excitations.

P712 Nuclear Reactions II
Improvements within the framework of the DWBA. Distorted-Wave Impulse Approximation. Coupled equations for inelastic scattering. Microscopic theory of inelastic nucleon scattering from nuclei. Scattering from deformed rotational Nuclei. Two-nucleon transfer reactions. Heavy-ion reactions.

P721 Magnetic Resonance II
Magnetic properties of matter, magnetic resonance theory, spin Hamiltonian and hyperfine interactions, electron paramagnetic resonance (EPR), nuclear magnetic resonance (NMR), Double resonance technique, echo spectroscopy ESR-ENDOR, Application in science, imaging and therapy.

M706 - Numerical Analysis II
Different numerical methods for large problems with different time scales. Spectral methods, wavelets , multiple methods, preconditioned conjugate gradient methods, multigrid methods.

M708 - Partial Differential Equations II
Basic constant-coefficient linear examples: Laplace's equation, the heat equation, and the wave equation, analyzed from many viewpoints including solution formulas, maximum principles, and energy inequalities. Key nonlinear examples such as scalar conservation laws, Hamilton-jacobi equations, and semilinear elliptic equations, analyzed using appropriate tools including the method of characteristics, variational principles, and viscosity solutions. Simple numerical schemes: finite differences and finite elements. Important PDE form mathematical physics, including the Euler and Navier-Stokes equations for incompressible flow.

Chemistry Programs
1- Professional Diploma in Biochemistry

C501 Food Chemistry and Analysis
Chemical/biochemical reactions of carbohydrates, lipids, proteins, and other constituents in fresh and processed foods are discussed with respect to food quality. Reaction conditions and processes that affect color, flavor, texture, nutrition, and safety of food are emphasized. Activation and control of enzymatic reactions in fruits and vegetables;

consequences of water migration on food quality; gelatinization-retrogradation in starch- based foods (e.g.,

pudding, bread, and rice); initiation and control of non-enzymatic browning (e.g., pretzels, meat); and food

emulsions (e.g., salad dressings, commutated meats products)

C502 Analytical Biochemistry
Classical and modern biochemical methods for the isolation and analysis of biological molecules, with an emphasis on proteins and nucleic acids. Principles and theory of techniques, application of the techniques during lab periods. Methods include affinity chromatography, electrophoresis, centrifugation, immunoblotting, spectrophotometry, fluorimetry, HPLC, quantitative PCR, mass spectrometry, and bioinformatics. Basic lab skills and concepts will be reinforced and use of the scientific method will be incorporated into the lab experiments. Proper scientific communication skills by writing lab reports.

C503 Endocrinology
General Principles of Endocrinology What are hormones, types of release, homeostasis and feedback, causative vs. permissive, organizational vs. activational. Techniques for Studying Endocrinology Extirpation/replacement, RIA, etc. General Principles of Endocrinology – Peptide Hormones. General Principles of Endocrinology Steroids, catecholamines and prostaglandins .The Hypothalamic-Pituitary System I Anatomy, Tropic Hormones. The Hypothalamic-Pituitary System II Tropic hormone regulation. The Hypothalamic-Pituitary System III Tropic hormone regulation; Vasopressin, and Oxytocin. Melatonin and Thyroid Hormones I Biochemistry and Mechanisms of Action. Thyroid Hormones II Biological functions. Topics in Endocrinology and Review . Reproduction I – Males Spermatogenesis, Testicular function, Sex Differentiation. Reproduction II – Females Ovarian cycles, Pregnancy, Lactation. Reproduction III – Comparative Aspects Vitellogenesis, Sex determination, Clinical Diseases. Reproduction IV: Seasonal Breeding Metabolism I – The Endocrine Pancreas Pancreatic Anatomy, Insulin and Glucagon. Metabolism II – Pancreatic Functions Metabolism, Gluconeogenesis, Diabetes, Feeding. Gastrointestinal Hormones Pepsin, Gastrin, Secretin, and Cholecystokinin. Calcium and Phosphate Homeostasis Parathyroid hormone, Calcitonin. Adrenal Steroids Adrenal anatomy, Aldosterone, Adrenal Medulla.

C505 Practical biochemistry I
Selected experiments in biochemistry emphasizing the theoretical courses of the first semester

C506 Practical biochemistry II
Selected experiments in biochemistry emphasizing the theoretical courses of the second semester.

B518 Biotechnology
Basic principles of genetic engineering : Methods of creating recombinant DNA molecule, splicing, properties of restriction endonucleases and their mode of action, construction of DNA library, genomic vs cDNA library, chemical synthesis of gene, cloning vectors (lambda phage plasmid, M-13 phage, cosmid, shuttle vectors, yeast and viral vectors, expression vectors) - Selection/screening - An anlysis of genomic DNA by Southern hybridization, Northern and Western blotting techniques - Restriction mapping : Restriction fragment length polymorphism (RFLP) - DNA sequencing techniques : plus and minus, dideoxynucleotide, Maxam and Gilbert etc - Preparation of radiolabelled and synthetic probes - Amplification of DNA by polymerase chain reaction (PCR) Site directed mutagenesis - Gene transfer methods for animals and plants; Agrobacterium mediated gene transfer, electroporation and particle gun. Transgenic animals and transgenic plants - Application of genetic engineering in medicine and agriculture, vaccine production.

B520 Advanced Molecular Biology
Concept and defination of the gene, complexity of the eukaryotic gene - Structural organization of the DNA in the nuclear material- General properties of histones, nucleosomes and solenoid structure - DNA synthesis : The enzymes of DNA replication in prokaryotes and eukaryotes, machanism of replication in bacteria and viruses, reverse transcriptase, salient features of eukaryotic nuclear and mitochondrial DNA replication - RNA synthesis : The enzymes of transcription in prokaryotes and eukaryotes, mechanism of transcription in bacteria, heteronuclear

RNA,post transcriptional processing of RNA, role of ribozymes - Protein synthesis : Concept of the genetic code, stucture of t-RNA and t-RNA, enzymes of translation in prokaryotes and eukaryotes, mechanism of protein synthesis, post translational processing of proteins - Regulation of gene expression in prokaryotes, structure and mechanism of different operons.

MC525 Bioinformatics

This course introduces fundamental concepts and methods for bioinformatics and the advanced applications. The topics covered include bioinformatics database, sequence and structure alignments, protein folding and protein structure prediction, protein-protein interaction, Monte Carlo simulation, and structural determination of macromolecules (X-ray crystallography and NMR). Emphasis is placed on the understanding of the concepts taught and on their practical utilization, with the objective of helping student use the bioinformatics tools/methods to solve problems in their own research.

MS504 Biostatistics with Statistical Software

Explain the scope and uses of statistics in biology and medicine, State types and sources of biological and medical data, various types of variability associated with bio-medical data, e.g. response and reactions to drugs, vital statistical indices, the standardized rates, the meaning of genetics, the simple Mendelian ratio, the fundamental principles of bioassay, the relative potency, simple assays, direct and parallel lines. Use of appropriate statistical softwares.

Z502 Enzymology

Isolation and purification of enzymes. Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalysed reactions. Kinetics of catalysed reaction : Single substrate reactions, bisubstrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, Activation energy and Arrhenius concept. Michaelis pH functions. Inhibition of enzyme activity –

Enzyme catalysis : enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes. Mechanism of catalysis : Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis.Mechanism of enzymes action : mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymease. Multienzymes system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex.

Coenzyme action.Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes,sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modification of enzymes, cascade systems. Immobilised enzymes and their industrial applications.

MD503 Biological Fluids

An introduction to the study of urine and body fluid analysis. Includes the anatomy and physiology of the kidney, physical, chemical and microscopic examination of urine, cerebrospinal fluid, and other body fluids as well as quality control, quality assurance and safety.

MD504 Medical Biomarkers

Liver function and diseases (in metabolism, storage and detoxification) viral infections fatty degeneration HCC, Kidney function and disfunction, cardiac action and cardiac enzymes, Bone markers and tumor markers.

MD505 Physiological Biochemistry

Composition and function of blood, plasma and blood corpuscles, functions of plasma proteins, structure and function of haemoglobin, abnormal haemoglobins, Blood coagulation – mechanisn and regulation. Blood groups. Structure of nephron, composition and mechanism of urine formation, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance.Hydrogen ion homeostasis, acid-base balance- metabolic and respiratory acidosis and alkalosis. Respiratory unit, exchange and transport of respiratory gases in the body, role of 2,3 DPG, Bohr effect and chloride shift. Classification of muscles, Structure of skeletal, smooth and cardiac muscles. Actin, myosin, tropomyosin, troponin, Z disc and H line components. The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscles. Structure of neuron, nerve impulse, origin and transmission, neuromuscular junction, mechanism of nerve conduction. Reflex action and reflex arc.

MD506 Intoxication of biological systems

Environmental chemical pollution, organophosphorus pesticides, heavy metals, pigments-food water and beverages contaminates, preservation, drugs endotoxin s and mycotoxins excreted urine.

MD507 Microbiology and immunochemistry

Microbiology: An Introduction to the study of bacteria, viruses, fungi, and protozoa, Topics include History of Microbiology, Prokaryotic and Eukaryotic cells, Classification, Microscopy, Staining techniques, Microbial growth and nutrition.

MD508 Environmental health community

Types of environmental diseases, causes, protection.

MD509 Human Nutrition

Direct and indirect calorimetry, energy value of the foods, thermal equivalent of oxygen, respiratory quotient, calorigenic action of the foods, basal metabolic rate definition and its measurement, factors affecting BMR, energy requirements of the human beings. Nutritional aspects of the carbohydrates-- Different dietary types, requirements, utilization and functions. Special role of the non starch polysaccharides. Nutritional aspects of the lipids-- Different dietary types, requirements, utilization and functions. Essential fatty acids. Nutritional aspects of the proteins-- classification of amino acids and proteins, essential amino acids, nutritive value of proteins and the methods for its determination, amino acid imbalance, protein requirements, utilization and functions. Nutritional aspects of the vitamins and minerals. Food processing and loss of nutrients during processing and cooking. Naturally occurring Anti- nutrients. Balanced diet-- Recommended dietary allowances for different categories of the human beings. Disorders related to the nutrition- Protein energy malnutrition, Starvation, Obesity.

• __Professtional Diploma in Quality Control__

C511 Measurement and Testing Techniques

 An in-depth discussion of equipment, principles and techniques of measurement assurance.

C512 Quality Function Management and TQM

A study of the functions and responsibilities of the quality organization. TQM and ISO concepts, and the tools for continuous improvement are analyzed for sequence of use and deployment.

C513 Customer Satisfaction and Quality Assurance

An in-depth study of current methods for obtaining customer satisfaction. Examines
the techniques for determining customer needs and the development of customer
service strategy quality control criteria.

C514 Advanced Experimental Design

Analysis of statistical experimental design strategies. Planning of experiments for the best strategy and objectives.

C515 Statistical Quality Control and Sampling

 The application of advanced statistical methodologies to the analysis and solution off quality and management problems, including probability theory, control charts, sampling, regression analysis and the design of experiments. Focus on statistical process control and related quality technologies.

C516 ISO 9000 and the Audit Function

A study of the ISO 9000 series of quality system standards with emphasis on manufacturing and service industry applications. The studies address the standards interpretation, documentation and implementation including preparation for and creation of internal and external audits.

C517 Advanced Probability and Statistics

A study of measures of central tendency and dispersion, important discrete and continuous probability distributions, sampling theory, hypothesis testing and estimation. Linear regression and correlation will also be covered. The use of statistics in testing, inspection, and production will be identified.

C518 Software Reliability

A study of the theory and application of reliability concepts as they relate to software design and implementation.

C520 Biomedical Quality Control Methods

In depth study of quality control disciplines as applied to medical device, pharmaceutical and/or biologics
regulated environments. Topics include influencing discipline and applying models; methods that monitor,
maintain and/or improve product or service quality; operational efficiency.

C521 Reliability

An overview of reliability engineering. Use of mathematical models of prediction, confidence assessment, and systems reliability. Emphasis on practical applications for product or system design.

C522 Statistical Quality Control for Service Professionals

Techniques for applying Statistical Quality Control (SQC) in controlling processes and delivering customer services are learned. Students will examine methods for establishing and maintaining SPC, QC auditing, and sampling, and continuous improvement in the service, health care, and public sectors.

C523 Good Manufacturing Practices

FDA Good Manufacturing Practice regulations as applied to medical device (21 CFR 820) and pharmaceutical production (21 CFR 210,211). Device design covers development, manufacturing, quality records, management and organizational requirements. Pharmaceutical includes personnel, facilities and equipment, process and product controls, laboratory, reporting.

C524 Six Sigma Principles and Applications

In depth study of the application of the six sigma process; covers content of the methodology areas of Define, Measure, Analyze, Improve and Control (DMAIC) including team concepts, project management, advanced statistical process control and techniques, and measurement systems analysis.

C525 Quality Assurance of the Service Delivery Process

 Analyzes processes used to deliver service and methods used to assure satisfaction. Examines the relationship of Strategic Quality Planning, the Delivery Process, and the usage of TQC and Quality Assurance to achieve strategic goals.

• <u>Professional Diploma in Applied Forensic Chemistry</u>

C531 Modern Analytical Technique

Different types of chromatography and the application towards forensic evidence - Produce data using chromatographs, GC, HPLC, and TLC, on forensic evidence - Compare and interpret different types of forensic evidence results from instrumentation - Mass Spectroscopy- Classify different types of mass spectroscopy and the application towards forensic evidence- Illustrate the parts of a mass spectrometer and the application - Produce data using mass spectrometers, GCMS and LCMS, on forensic evidence - Compare and interpret different types of forensic evidence results from instrumentation - Prepare samples for instrumental microscopy- Differentiate when instrumental techniques are used and needed - Identify fibers, paints, and inks using instrumental microscopy-Different types of fingerprinting and casting techniques used to collect and preserve impression evidence as well as interpretation of evidence found– Impression Evidence- Distinguish between different techniques used to collect and preserve fingerprints and other impressions- Prepare fingerprints and casts by using different methods - Analyze fingerprint patterns Compare casting molds to donor.

C532 Forensic Chemistry

General Forensic Laboratory Procedures- Demonstrate good laboratory practices used in a forensic science laboratory - Identify important collection and preserving of evidence techniques -Dramatize and apply labeling and collection of different types of evidence – Statistics- Classify the use of statistics in forensic chemistry -Select the correct statistical technique for different types of evidence and data . Apply statistics in forensic data - Sample Preparation - Express how sample preparation is applied in forensic chemistry - Generalize different type of sample procedures for evidence - Identify what preparation needs to be done for particular types of evidence- Complete presumptive tests done of forensic evidence - The overall goal of this module is to understand different types of commonly used instrumental techniques in forensic chemistry and to apply the techniques to evidence-Spectroscopy- Classify different types of spectroscopy and the application towards forensic evidence-Illustrate the parts of a spectrophotometer and the application - Produce data using spectrophotometers, FTIR, UV-Vis-NIR, Raman, and Fluorescence, on forensic evidence -Compare and interpret different types of forensic evidence results from instrumentation.

C533 Environmental Forensics 1

What is Environmental Forensic Science- Toxicity- Identification of Hydrocarbons Fate of Chemicals: Partitioning- Fate of Chemicals: Biotranformations-Environmental Transport Models- Groundwater Transport Models- Atmospheric Dispersion Models.

C534 Biochemical Analysis

Biochemical analysis of urine, blood and food: pH, organics, inorganics, proteins,…

C535 Applied Statistics for Data Analysis

Introduction to Scientific Evidence and Statistics- Measures of central tendency and the normal distribution-Probability- Discrete random variables and probability distributions-Estimation of mean and standard deviation and the normal distribution-Hypothesis testing for one or two population means, Student t-test-Hypothesis testing for small sample sizes and multinomial experiments, Fisher's exact test- Analysis of Variance and multiple comparison tests-Simple linear regression

C536 Laboratory QA/QC

Introduction to QA/QC- Key Elements of a QA/QC Program- Personnel and Training - Validation of Analytical Procedures- Equipment -Test Article Tracking- Standard Operating Procedures-Study Protocols-The Final Report-Archiving, Archivist, Storage and Retrieval Specializations- Inspection and Compliance.

C537 Forensic Analysis of DNA

DNA Introduction-Quality Assurance and Performance Optimization - DNA Isolation-Assessment of Extracted DNA and Amplification- Introduction to Data Collection and Interpretation- Significance of a Match and Calculating Statistics Evaluation and Triage of DNA Samples- Paternity and Identification.

C538 Organic and Food Analyses

Isolation, fractionation, and identification of the desirable and objectionable organic flavor constituents in food; chemical mechanisms for the formation of flavor components in food; methods for measuring organic and flavor stability of food and food components; manufacture of food flavors.

C539 Spectral Analysis and Applied Spectroscopy

Introduction to structure elucidation - Separation techniques and isolation of compounds - Ultraviolet and Infrared Spectrophotometry. Introduction to Mass spectrometry- Advanced topics and tools in Mass spectrometry - Introduction to Nuclear Magnetic Resonance spectroscopy- Two-dimensional homo- and heteronuclear NMR. Advanced topics and tools in NMR spectroscopy- Organic solid state analysis techniques- Practical applications of structure elucidation techniques.

C540 Environmental Forensics 2

Design of a uranium mine environmental monitoring program- Assessment of a maritime oil spill event - Use of spreadsheet-based plume modelling software to model groundwater contamination-Assessment of the processes acting on the distribution and concentration of a dissolved phase hydrocarbon plume.

C541 Medicinal Chemistry of Drugs of Abuse

Drug Classes and Controlled substances Act -Drug Dependence and Addiction - CNS Depressants- Alcohol-Opioids- Cannabinoids- Hallucinogens- CNS Stimulants - CNS Volatile Substances

MD501 Principles of Forensic Science

Basic disciplines of forensic science- History and Nature of Forensic Science, Crime Scene Investigation, Latent Prints, Trace Evidence, Biological Evidence, Forensic DNA Analysis, Illicit Drugs, Forensic Toxicology, Firearms and Toolmarks, Death Investigation, Questioned Documents, Fire and Explosive Examination.

MD502 General Toxicology

Principles of Toxicology- Mechanisms of Toxicology- Risk Assessment- Absorption, Distribution, Metabolism and Excretion of Toxicology-Toxicokinetics-Genetic Toxicology-Chemical Carcinogenesis-Developmental Toxicology-Toxic Responses of the Blood-Toxic Responses of the Immune System-Toxic Responses of the Liver - Toxic Responses of the Kidney-Toxic Responses of the Respiratory System-Toxic Responses of the Nervous System-Toxic Responses of the Reproductive System.

MD503 Forensic Medicine

Death- Medicolegal Investigation of Death- Sudden Natural Death in Adults

The Autopsy- Post-Mortem Interval- Identification of the Dead- Wounds of Medicolegal Importance I- Wounds of Medicolegal Importance II- Thermal Injury and Fire Deaths Suicide- Head and Neck Injury- Drowning by Immersion- Asphyxia Related Deaths- Case Study.

MD501 Histochemistry

Chemical components of carbohydrates, proteins, lipids, nucleic acids,… in the cells and tissues including methods for their detection. Detecting methods of some enzymes in animal tissues.

• __Professional Diploma in Applied Organic Chemistry__

C551 Spectroscopic analysis

U.V and vis. Spectroscopy: theory and instrumentation, Jablonski diagram, application in organic chemistry, problems in U.V spectroscopy. Emission Spectroscopy.

I.R spectroscopy: Theory and instrumentation, application in organic chemistry, problems in I.R. spectroscopy: Mass spectroscopy: Theory and instrumentation, Applications in organic chemistry - Advanced techniques in mass spectra (GC/MS, isotopes in/MS), Problems in mass spectrometry - NMR Spectroscopy: Theory and instrumentation, Application of HNMR in organic chemistry, NMR of other elements ($13C$, $31P$). Advanced techniques in NMR spectra, problems in NMR spectroscopy. General Problems in Spectroscopic analysis of organic compounds.

C552 Chromatographic Techniques

Column Chromatography, Paper and thin-layer chromatography, Gas Chromatography, Supercritical fluid, High performance Liquid chromatography, Ion-Exchange chromatography, Gel chromatography, Chiral chromatography, electrophoreses

C553 Textile and fibers chemistry

Definition of Fiber; Microstructure of fiber, Burning Test for qualitative identification of fibers; Identification of fibers by solubility – Classification of Fibers: A- Natural fibers: 1- cellulosic family (cotton), 2– Protein fibers – (wool, hair and camel hair). Morphology of fiber; Chemical structure; Chemical reactions related to industry, B- Thermoplastic fiber: This is related to polymers and polymer chemistry.

C554 Dyes and pigments chemistry

Historical Introduction, Relation between colour and molecular constitution, Classification of chromogenes, Nomenclature of Dyes, Colour Index – pigments – Chemical Classification of Dyes: Azo Dyes: ((Structural features, Industrial production and types.); Carbonyl dyes; and Reactive dyes. Application classification of Dyes: Direct dyes; and Disperse dyes- Dyes in Biochemistry, Biology, Medicine and Analytical chemistry, Ecology and Toxicology of Colorants.

C555 Polymers

Classes of polymers. A) Natural polymers b) Synthetic polymers – Polymer Reactions: Condensation polymerization, Addition polymerization, Ring opening polymerization, Molecular weight of polymers, Characterization Techniques, Methods of polymer synthesis, Industrial Polymerization processes, Application of Polymers, Liquid crystalline polymers, Conducting polymers – Nanopolymers and its new applications.

C556 Petroleum and petrochemicals

Crude oil characteristics, Distillation of crude oil, Catalytic cracking.Alkylation, Catalytic Reforming, Hydrocracking, Gasoline blending, Isomerization, Petrochemical industries.

C557 Statistics

The basic concepts of probability, common distributions, statistical methods, regression analysis, and data analysis, This course provides principles of Analysis of Variance (ANOVA), including randomization and blocking, single and multiple factor designs, crossed and nested factors, quantitative and qualitative factors, random and fixed effects, split plot and repeated measures designs, crossover designs and analysis of covariance (ANOVA). Applications using SPSS program

C558 Practical applied chemistry

Selected experiments concerned with various techniques and separation methods.

C559 Drug Synthesis

The structures and mechanisms of a variety of drug classes, Topics include cardiovascular agents, diuretics, hormones, vitamins, anti-inflammatory, steroids and chemotherapeutics and etc.

C560 Review article

Review article in the field of Applied Chemistry

C561 Industrial inorganic Chemistry

Fuel gases. Glass industry, Cement industry, Fertilizer Industries, Semi Conductors.

C562 Food analysis

Elementary analysis of food stuff, water, carbohydrates, proteins, lipids, vitamins, minerals, trace elements, food additives, preservatives and contaminants.

C563 Environmental organic chemistry

Agrochemicals, carbon cycle, Nitrogen cycle, Air pollution, Water pollution.

C564 Synthetic organic chemistry

Metal intermediates organi synthesis, new reagents in organic synthesis.

C565 Nanomaterials and applications

Nanostructures (Definitions, characteristics and important properties), Preparation and characterization of nanomaterials, Industrial applications of nanoparticles and nanocomposites

• Environmental Analytical Chemistry Diploma

C571 Fundamentals of Environmental Chemistry

General principles and techniques, Analytical environmental data: assessment and interpretation. The environment (biogeochemical cycles, environmental pollution, environmental standards); Environmental analysis (aims, types, stages of); Sampling and storage; Sample treatment; Analytical methods; Standardization and calibration Specific applications: speciation (importance, definition, determination of trace metal.

C572 Instrumental Methods of Analysis

Molecular spectroscopy. Electroanalytical methods of analysis. Separation methods. Environmental sampling and analysis.

C573 Pollution and its Control

Introduction to the study of pollution and its control. Relationship between wastes and pollution. It further aims to develop basic scientific and technical skills for pollution assessment with respect to the source, composition and characteristics of the wastes. Available technologies for pollution control. Protection of water quality from municipal, urban, agriculture and industrial sources will be elaborated.

C574 Problem and Activity- Orientated Environmental Analysis

Environmental analysis-strategies and concepts. Ecotoxicological concepts for evaluating risk.

C575 Environmental Chemistry of Selected Xenobiotics and Heavy Metals

Pathways of pollutants, food chains and properties of materials. General decomposition pathways. Hydrocarbons: PAHs and PCBs. Dibenzodioxins and dibenzofurans. Pesticides and tensides. Heavy metals and their aspects.

C576 Laboratory Work, Environmental Analysis 1 & 2

Selected experiments concerned with various topics of environmental analysis

C577 Quality Assurance/Quality Control Principles

Good laboratory practice. Total quality management and cost of quality. Calibration and detection limits. Metrology in chemistry and traceability of analytical measurements results. Validation of analytical methods. Measurement uncertainty. Control charts. Certified reference materials

C578 Cement Analysis

Portland cement and its major constituents phases (Alite – Belite – Aluminate – Ferrite). Properties of Portland clinker and cement. Macroscopic and surface properties Scanning electro microscopy, X-ray diffraction. Quantitative phase composition from bulk chemical analysis. Determination of quantitative phase composition. Reactivities of clinker phases.

C579 Water Analysis

The Hydrosphere, Water Pollution, Biochemical Oxygen Demand (BOD), Acidification, Salinity, Coastal Pollution, Groundwater Pollution, Waste Treatment, Solids in Waters, Electrochemical measurements, Hardness, Alkalinity, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD(,

C580 Fertilizers Analysis

Chemistry of Fertilizers: Organic fertilizers, Inorganic fertilizers. Nitrogen fertilizers: production of synthetic ammonia, ammonium phosphate, ammonium polyphosphate, urea, ammonium sulphate, nitrate and chloride fertilizers. Phosphate fertilizers: triple superphosphate, ammonium monohydrogen phosphate - Potassium, magnesium and sodium fertilizers: potassium chloride (pure), potassium magnesium sulphate. Calcium fertilizers. Multinutrient fertilizers: ammonium phosphate nitrate, urea, ammonium phosphate, ammoniated superphosphate. Fertilizing with sulphur; Analysis of Fertilizers: Analysis of phosphorus in fertilizer. Total nitrogen, total phosphorus and total potassium (K2O). Fertilizer metal analysis. Heavy metal chelates. Organic fertilizer analysis. Liquid fertilizer analysis. Solid fertilizer analysis.

C581 Fuel Analysis

Analytical techniques used for identification and/or quantification of chemical properties of crude oils, gasoline, transmission fluids, aviation fuels, diesel and heating fuels and other specially petroleum products. Elemental analysis of fuels using ICP-AES, XRF techniques (determination of sulfur in gasoline and diesel -EDXRF, WDXRF). Sulfur determination in fuels. Mercury determination in crude oils.

Mang 501 Executive Development Skills

Executive development skills aim to expose and equip students with the essential skills to manage their lives effectively both personally and professionally

Mang 502 Oral and Written Communication

The course focuses on developing an understanding of the communication skills, venues, and processes commonly used by effective professionals. Topics include the need to focus on audience, purpose, resources and constraints; choosing appropriate channels; preventing or minimizing relational conflict and resolving substantive conflict; and developing and maintaining communication credibility.

M533 chemometrics

What is chemometrics?; Basic statistics. Single processing and time-series. Optimization and experimental design. Pattern recognition and classification. Modeling. Analytical database.

• M.Sc. Degree in Analytical Chemistry

C601 Analytical Separation Science

Fundamental principles and typical applications of modern separation techniques -Advanced practical aspects of separation techniques -Modern Liquid Chromatography instrumentation in detail including interfacing of liquid chromatography separation techniques to other analytical systems - Modern instrumentation relative to the appropriate techniques in depth - The interfacing of gas Chromatography to other analytical system - the practices of gel electrophoresis and capillary electrophoresis.

C602 Advanced Instrumental Analysis

Surface Analysis: microscopic techniques-scanning probe, atomic force, chemical force microscopy, X-Ray diffraction: powder and crystal methods, identification and structure determination, X-ray fluorescence, Applications - Thermal methods of analysis - analytical applications of NMR spectroscopy.

C603 Bioanalysis

Enzymatic analysis principles – mechanisms of enzyme activity, detection methods and reaction rate determinations – immobilized enzymes – enzymes as analytes. Immunosensors - Nucleic acid based assays – principles of DNA structure – aptamers – DNA profiling - PCR reactions – detection methods.

C604 Environmental Analysis (I)

General principles and techniques - analytical environmental data: assessment and interpretation - the environment (biogeochemical cycles, environmental pollution, environmental standards) - environmental analysis (aims, types, stages of) - sampling and storage - sample treatment - analytical methods - standardization and calibration - specific applications: speciation (importance, definition, determination of trace metal).

M605 Chemometrics (I)

The aim of this course is to introduce some modern statistical methods in chemistry - analyzing and understanding data - with spreadsheet programs and other accessible software, it is now possible to do this routinely. topics to be covered will include data acquisition, experimental design, filtering and fitting data to mathematical models - the approach will be fairly simple and open to students without a lot of sophisticated mathematical background.

C606 Nanochemistry-an Introduction and Potential Application

The nano world (general definition, philosophy)- Physico-chemical considerations (band structures, typical and useful "nano effects") - Colloids (typical syntheses of nanoparticles) - Fullerenes, C-nanotubes (synthesis, forms, variants, properties, applications)- Oxide-nanotubes + fibers (synthesis, forms, variants, properties, applications) - Other inorganic nano materials (synthesis forms, variants, properties, applications) - Bio-nano-link - Risk discussion and future perspectives.

C607 Thermal Analysis

Thermogravimetric analysis – differential thermogravimetric analysis – differential thermal analysis - differential scanning calarimetry - applications in industrial and research fields.

C608 Selected Topics related to Analytical Chemistry

Lectures and reading in areas not normally treated in standard courses - discussion of topics of current interest in analytical chemistry.

C609 Quantum Chemistry

Appreximation methods- the hydrogen molelcule - refined treatment of hydrogen molelcules – resonance – odd electron systems - spin functions – method of direct valence bonds.

C610 Bioinorganic Chemistry

Metals in Biological Systems- Non-Metals in biological systems- Inorganic drugs Metaloenzymes and vitamin B_{12}
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C611 Femtochemistry

Introduction to femtochemistry and lasers - experimental methods of femtochemistry - applications: molecular systems, isolated molecules, molecules in clusters, molecules in condensed phases, molecules with biological functions.

C612 Biophysical Chemistry

Introduction to basic principles of macromolecular structure – stability and interactions – protein structure – thermodynamics and kinetics of protein folding – nucleic acid structure and stability – principles of intermolecular recognition – modern techniques to study the structures, functions and interactions of biologically macromolecules.

C614 Laboratory Quality Control/ Assurance System

Lab quality system elements - lab quality assurance manual, good lab practices- internal quality control checks - procedures used to calculate and assess data quality.

• **<u>M.Sc. Degree in Inorganic Chemistry</u>**

C621 Recent Application of Organometalic Chemistry
Organometallic compounds in homogenous catalytic reactions – catalytic reactions in alkenes: hydrogenation of alkenes – hydroforomylation of alkenes- hydrosilylation of alkenes – alkene polymerization and oligomerization - palladium catalytic reactions .

C622 Organic Stereochemistry
Elements of symmetry - Chirality in carbon compounds - Stereochemical relation in nonorganic compounds

C623 Structural Inorganic Chemistry and Crystal Structure
Structural chemistry of some selected non-transition and transition metals including their oxides , hydroxides , sulphides, oxysulphides , nitrides carbides , carbonyls and coordination compounds .
Principles of X-ray diffraction of crystals – reciprocal lattice - unit cell dimensions – determination of the space group and its significance – structure analysis and determination of atomic position – experimental methods (trial and error , heavy atom method , patterson methods , direct methods) – refinement of the analysis

C624 Kinetics and Mechanism of Inorganic Reactions
Possibe mechanisms for ligand replacement reactions SN1 & SN2 mechanisms - ligand displacement reactions in square and octahedral complexes – base hdrolysis – methods of kinetics studies , e.g stopped flow , flash – photolysis and others.

C625 Applications of Spectroscopy Inorganic Chemistry
The following methods can be applied to investigate coordination compounds : Nuclear magnetic resonance spectroscopy (NMR) –electron spin resonance spectroscopy (ESR) – nuclear quadruple resonance spectroscopy (NQR)- Moessbaur spectroscopy

C626 Magnetochemistry of Inorganic Compounds
Magnetic susceptibility – paramagnetism – temperature –dependence and mechanism – temperature independent paramagnetism exchange reactions

C627 Application of Group Theory in Chemistry and Spectroscopy
Symmetry and chemical bonding – symmetry adapted linear combinations (SALCs) – formulating SALCs with projection operators – SALCs of Pi systems – vibrational modes and their symmetries - symmetry – based selection rules crystal field and molecular orbital theories and symmetry – terms of free ions with dn cfigurations-splitting terms

C628 Recent Methods and Advances in Calculating Stability Constants of Complexes
Thermodynamics of coordination bond formation – stability constants – factors which determine stability : nature of the central metal ion – nature of the ligand – nature of the solvent methods for the determination of stability constants : spectrophotometric – pH (Bjerrum`s methods) – polarographic method – ion exchange methods and advanced methods stability correlations : thermodynamic interpretation

C629 Thermal Analysis
Thermogravimetric anaylsis – differential thermogravimetric analysis – differential thermal analysis – differential scanning calarimetry - applications in industrial and research filed

C630 Luminescence Spectra of Inorganic Compounds
Luminescence of lanthanide complexes – antenna effect luminescence of coordination polymers – quencing of fluorescence photochromic complexes and their applications

C631 Femtochemistry and Laser Spectra
Introduction to femtochemistry and lasers – experimental methods of femtochemistry - application: molelcular systems, isolated molecular, molecules in clusters, molecules in condensed phases, molecules with biological functions

C632 Selected Topics related to Inorganic Chemistry (1)
 i)Metal hydrides : saline hydrides –lanthanide hydrides – actinide hydrides – hydrides of d- block transition metals – preparation of hydrides and chemical properties
ii)Chemistry of boranes :structure and bonding in boranes –borane anions and polyhedral borane anions and carboranes – metal complexes of carborane anions.

• M.Sc. Degree in Organic Chemistry

C651 Advanced Organic Synthesis

Heterocycles Synthesis, Heterocycles in Ring Elaboration, Cross Coupling Reactions, Metal, Mediated Cycloaddition and Metathesis Processes, Formation of C-C Bonds by Aldol/ Enolate Reactions, Formation of C-C Bonds by Radical Process.

C652 Spectroscopic analysis

The course provides fundamental theoretical background for and emphasizes practical application of: UV/Vis spectroscopy; FT-IR spectroscopy; fluorimetry, atomic absorption, ^{1}H and ^{13}C-NMR spectroscopy, 2D- NMR ; Mass spectrometry.

C653 Advanced physical organic chemistry

Structure, mechanism, reactivity of organic compounds based on(molecular orbital theory, Frontier molecular orbital theory, conformation analysis, stereoelectronic effects, thermodynamics, and equilibrium-kinetics), Linear free, energy relationships Acids and bases catalysis, Nonclassical ions and pericyclic reactions, Transition state theory, kinetic isotope effects, reactive intermediates, The Huckel MO theory, Aromaticity (NMR analysis of aromaticity, homo- and heteroaromaticity), An examination of the methods used to probe the mechanisms of organic reactions and of the chemistry of some important reactive intermediates, Topics will include isotope effects, kinetics, linear free energy relationships, solvent effects, a continuing discussion of orbital symmetry, Molecules rearrangements, Excited States and Strained Molecules.

C654 Advanced Stereochemistry

Stereoisomerism in aliphatic compounds (General revision), The stereochemistry of Ring Systems, Stereochemistry of biphenyl compounds, Stereochemistry of some elements other than carbon

C655 Dyes and textiles

Dyestuff chemistry: Historical Introduction, Relation between color and molecular constitution, Classification of chromogenes, Nomenclature of Dyes, Color Index Chemical Classification of Dyes: Azo Dyes:((Structural features, Industrial production and types.), Carbonyl dyes, and Reactive dyes, Application classification of Dyes: Direct dyes; and Disperse dyes Fiber and Fiber Chemistry: Introduction.; Definition of Fiber; Microstructure of Fiber, Burning Test for qualitative identification of fibers; Identification of fibers by solubility, Classification of Fibers: A- Natural fibers:1- cellulosic family (cotton). 2− Protein fibers (wool, hair and camel hair) Morphology of fiber.; Chemical structure.; Chemical reactions related to industry, B-Thermoplastic fiber: This is related to polymers and polymer chemistry.

C656 Selected Topics in Organic Chemistry

Topics chosen according to special interests of faculty and student.

May include one or more of the following topics:

Heterocyclic Chemistry, Photochemistry, Natural Product Chemistry, Free Radical Reactions, Pericyclic Reactions, Organic Materials, Stereoselective Synthesis, Retrosynthesis Approach, Reactive Intermediate in Organic Chemistry.

C657 Advanced NMR spectroscopy

^{1}H and ^{13}C chemical shifts and spin-spin coupling constants, Magnetically and chemically equivalent nuclei, second order 1H spectra, Homo and heteronuclear decoupling, One-dimensional NMR spectra, Multiplicity, edited ^{13}C NMR spectra, Nuclei other than ^{1}H and ^{13}C, Two-dimensional NMR Spectroscopy, Application of NMR spectra in solving structural and stereochemical problems.

C658 Organometallics in organic Synthesis

Organometallic mechanisms Organometallics in Organic Synthesis Palladium catalysed C-C cou8pling reactions, Metal carbene complexes

C659 Polymers synthesis and characterization

Polycondensation, Radical Polymerization, Ionic Polymerization, Anionic Polymerization, Cationic Polymerization, Ring Opening, Metathesis Polymerization.

C660 Statistics

The basic concepts of probability, common distributions, statistical methods, regression analysis, and data analysis. This course provides principles of ANALYSIS of VARIANCE (ANOVA), including randomization and blocking, single and multiple factor designs, crossed and nested factors, quantitative and qualitative factors, random and fixed effects, split plot and repeated measures designs, crossover designs and analysis of covariance (ANOVA). Applications using SPSS program

C661 Advanced heterocyclic chemistry

Synthesis of heterocycles from 1,4-dicarbonyl compounds (furans, pyrroles, thiophenes and pyridazines), Synthesis of heterocycles from 1,3-dicarbonyl compounds (pyrroles, isoxazoles, pyrazoles and pyrimidines), Synthesis of heterocycles from 1,5-dicarbonyl compounds (pyridines and dihydropyridines), Heterocycle formation through cycloaddition reactions (1,3-dipoles and [2+3]cycloaddition reactions), Rate of cycloaddition and regioselectivity.

C662 Chromatographic analysis

Specific chromatographic methods: Electrophoreses, Thin-layer chromatography (TLC), Centrifugal TLC - Gas Chromatography (GC), High-performance liquid chromatography (HPLC), Size-exclusion chromatography)SEC), Liquid chromatography (LC), Supercritical liquid chromatography, Affinity chromatography, Chiral chromatography.

C663 Green organic Chemistry

Introduction to Green Chemistry, Principles and concepts of green chemistry, Innovative green Technologies: Microwave, Ultrasound etc, Green synthetic methods: Solventless Reactions and Reactions in Water, Natural catalyst, Biocatalysis, Ionic liquids, solvents of the future (synthesis, applications, recycling....), Reactions using solar energy, Photochemistry reactions, Reactions with microwave Reactions ultrasounds, Sustainability, Challenges and Prospects of Green Chemistry.

C664 Biocatalysts and enzymes in organic synthesis

Introduction, Acyl transferases, Lipases, Esterases, Peptidases and amidases, Acylase, Carbohydrate processing enzymes, Glycosidases, Glycosyltransferases, Other carbohydrate processing enzymes, Other hydrolytic enzymes, Epoxidases, Nitrilases and nitrile hydratases, Other hydrolases, Reduction, CO, CN reduction , Other reductions, Oxidations, C bond formation, Aldolases, Oxynitrilases, Other enzyme systems, Novel biocatalysts, Engineered enzymes, Evolved enzymes, Catalytic antibodies, Enzyme models and mimetics, Conclusion.

C665 Computational Organic Chemistry

Quantum Mechanics for Organic Chemistry (Approximations of the Schrodinger Equation, the Hartree - Fock Method, Electron Correlation, Post-Hartree - Fock Methods, Density Functional Theory (DFT), Geometry Optimization, Population Analysis, Computed Spectral Properties).

C666 Molecular Photochemistry

Molecular photochemistry of organic molecules, Photophysical radiationless transitions, Energies of photochemical conversion, Radiation and molecular orbitals, Mechanistic organic photochemistry, Energy transfer, Photochemical reactions, Photo-addition, Photo-substitution and Photo-fragmentation reactions, Isomerization and rearrangements, Chemiluminescent organic reactions, Photooxidation of alkenes, Photochemistry in nature and applied photochemistry.

C667 Selected Topics in analytical chemistry

Designed to acquaint students with advanced topics in his field of specialization.

C668 Selected Topics in Inorganic Chemistry

Designed to acquaint students with advanced topics in his field of specialization.

C669 Organic electrochemistry

Practical problems in electrosynthesis, Cathodic reduction of hydrocarbons, Cathodic reduction of halogenated organic compounds, Cathodic reduction of nitro compounds, Cathodic reduction of saturated carbonyl compounds, Cathodic reduction carboxylic acids, Mechanism and reaction of Kolbe reaction.

Anodic oxidation of amines, oxygen and sulfur containing compounds, Electrolysis of heterocyclic compounds, Electrolysis of metallic organic compounds, Comparison between electrochemical and analogous chemical reaction, Industrial electroorganic chemistry, Electrochemical polymerization.

• M.Sc. Degree in Physical Chemistry

C651 Advanced Electrochemistry I

A review of the fundamental electrochemistry. Transport processes in electrochemistry, ion transport in solutions, solids, melts and polymers. Structure of the metal solution interface. Electrochemical and physical methods for probing metal/solution interface. Electrochemical deposition; adatoms, underpotential deposition, surface dynamic, nucleation and growth of metals.

C652 Theoretical Chemistry

Variation method - Simple Hückel method and applications - Matrix formulation of the linear variation method - The extended Hückel method -   The SCF – LCAO – MO method and extensions.

C653 Surface Chemistry

I) Solid Surfaces:

-. Structure of Solid Surfaces: Surface Structure of Metals- Surface Structure of fcc Metals- Surface Structure of hcp Metals- Surface Structure of bcc Metals- Energetics of Solid Surfaces- Relaxation and Reconstruction of Surfaces- Particulate Metals- Other Single Crystal Surfaces - Adsorption of Molecules on Surfaces: Introduction to Molecular Adsorption- Adsorption Kinetics - The Rate of Adsorption- PE Curves and Energetic of Adsorption- Adsorbate Geometries and Structures on Metals- The Desorption Process - Langmuir Isotherm- derivation from equilibrium considerations- derivation from kinetic considerations- Variation of Surface Coverage with Temperature and Pressure – Applications - Classification of Overlayer Structures-Low Energy Electron Diffraction - Reflection High Energy Electron Diffraction -Surface Structures.

II) Other Surfaces:

Surface tension and surface films – Surfactants-Detergents – Lubricants – Photographic materials – plastic – Elastomers – Water treatment (ion exchange resins) and dyes.

C654 Solid State Chemistry

  Structures of solids – Metallic solid – Bonding model – Free electron model (Jellium model) – Density of state – Nearly free electron model – Brilloum Zone - Classification of solids according to energy gap-Hall carrier – The role of impurities (n- , p-type semiconductor , transistor n-p types , Intrinsic and extrinsic semiconductors – Imperfection – Concentration and energies of formation of semiconductors – Vacancy - Electrical properties of metals – Drude theory – Conductivity of metals and temperature dependence-energy gaps and ionicity – Magnetic properties of solids – Superconductivity - The phase diagrams for solutions of materials and alloys- Crystal structure analysis- Chemical thermodynamics.

MS606 Computational Statistics

Modern methods of computational statistics and their application to both practical problems and research -Methods of random variate generation -simulation of random vectors -Topics include Monte Carlo simulation – bootstrapping- numerical optimization in statistics -the MCMC techniques

C656 Crystal Structure Analysis

Types of solids – external structure of solids – introduction to space group symmetry – internal structure of solids – basic crystallographic calculations – X-ray powder diffraction – crystal structure of elements and inorganic compounds – defects in solids – solid solutions - study of crystal structure using computer programs – X-ray single crystal analysis - X-ray emission technique (XRF).

C657 Theories and Mechanism of Catalytic Reactions

The modern theories of the homogeneous and heterogeneous catalytic processes – The dehydration and dehydrogenation reaction mechanisms of alcohols of different types – Catalytic oxidation reactions mechanism – Catalytic addition and polymerization reactions mechanism.

Femtochemistry and Lasers spectroscopy - Nuclear - The phase diagrams for solutions of materials and alloys-Crystal structure analysis - Photo catalysis.

C658 The Modern Aspects of Colloidal Chemistry

Introduction to Colloidal Dispersions - Charge in Colloidal Systems - Colloid Stability - Surfactant Aggregation and Adsorption at Interfaces Micro-emulsions - Polymers and Polymer Solutions - Polymers at Interfaces - Effect of Polymers on Colloid Stability - Wetting of Surfaces - Aerosols - Practical Rheology - Scattering and Reflection Techniques - Optical Manipulation - Electron Microscopy

C659 The Modern Aspects of Polarography and Voltammetry

Pulse polarography and voltammetry - Differential pulse polarography and voltammetry - Linear sweep voltammetry - Cathodic and anodic stripping voltammetry - Thermodynamic interpretation of the half wave potentials - Polarography and voltammetry of simple metals ions - Polarography and voltammetry of complex metals ions - Organic polarography, structure and linear free energy relationship - Voltammetric studies on the adsorption stages and interfacial orientations of some nucleic acid bases , nucleoside, nucleotides and olige nucleotides - Effect of the catalyst adsorption and of the double layer structure on the catalytic waves of hydrogen evaluation.

C660 Advanced Chemical Kinetics

Forces between atoms - molecules and ions - Molecular collisions and non-thermal reactions - Unimolecular reactions - Reactions in solutions - Empirical correlation and linear free energy relationships.

C661 Nuclear and Radiochemistry

Atomic nuclei – radioactive decay processes – nuclear reactions – equation of radioactive decay and growth – radio tracers – nuclear forces – nuclear structure -Interaction of radiation with matter – radiation detection and measurements - techniques in nuclear chemistry – nuclear models – nuclear processes as chemical probes .The trans uranium elements.

C662 The Phase Diagrams for Solutions of Materials and Alloys

The phase rule – phases – components – system degree of freedom and equilibrium. One component system (H_2O system and SiO_2system) .Two component condensed systems .Simple eutectic system (liquid us and solidus – eutectic –liver rule).Binary systems with compounds - Binary systems with solid solutions - Binary systems with solid – solid phase transitions - Binary systems with phase transitions and solid solutions . Some technologically important phase diagrams. The system Fe-C ,iron and steel making . The system $CaO-SiO_2$,Cement manufacture. The system Na_2O-SiO_2 , glass making. The system $ZrO_2-Y_2O_3$,yttria – stabilized Zirconia solid electrolyte. Purification of semiconducting Si by zone refining. The system Li_2O-SiO_2 , metastable phase separation and synthetic opals.

C663 Application of Group Theory in Chemistry and Spectroscopy

Theory of group theory – Symmetry elements – Point group symmetry – Character tables – Transformation matrices of symmetry species – Transition moments of IR and Raman – Selection rules of C3v point group – Multiplication table of C2r character table – Multiplication table of C3v character table – Overtones and combination-tons – Fermi resonance.

C664 Thermal and Surface Analysis and their Applications

Thermal analysis: Thermo gravimetric analysis – Differential thermal analysis – Calorimetric thermal analysis– Applications of thermal analysis to alloys- Identification of phase changes and crystallization positions for amorphous states – Thermal analysis of polymers – The use of thermal analysis.
Surface analysis: Electron spectroscopy, X-ray techniques , Surface imaging and detection.

C665 Quantum Chemistry

Hydrogen molecule : Approximation methods: The perturbation method - The variation method - The hydrogen molecule: Coulombic and exchange integrals - Symmetric and antisymmetric solutions - Evaluation Coulombic integrals - Energy of molecular hydrogen system - Refined treatment of hydrogen molecules: Use of atomic orbitals - Molecular orbital methods - Ionic terms - Method of Coolidge and James - Resonance: Columbic energy in the hydrogen molecule -Resonance energy in the hydrogen molecule - Resonance energy in the other molecules - Odd electron systems: The hydrogen molecule ion - Odd electron bonds - Spin functions: Pauli principle -The hydrogen molecule -Electron spin and valence -Interaction energy of electrons - Method of directed valence bonds.

5- M.Sc. Degree in Biochemistry

C671 Bioenergetics & the Metabolism of Carbohydrate and Lipids

Bioenergetics: The role of ATP, Biological oxidation, The Respiratory Chain & Oxidative Phosphorylation, Carbohydrates of Physiologic Significance, Overview of Metabolism & the provision of Metabolic Fuels, The Citric Acid Cycle: The Catabolism of Acetyl-CoA, Glycolysis & the Oxidation of Pyruvate, Metabolism of Glycogen, Gluconeogenesis & the Control of Blood Glucos, The Pentose Phosphate Pathway & Other Pathways of Hexose Metabolism, Oxidation of Fatty Acids: Ketogenesis, Biosynthesis of Fatty Acids, Metabolism of Acylglycerols & Sphingolipids, Lipid Transport & Storage, Cholesterol Synthesis, Transport & Excretion.

C672 Instrumental Chemical Analysis

Chromatography (TLC,Column, HPLC, Gas Ion Chromatography, Electrophoresis).
Spectrometry: 1H, 13C- NMR ,2D NMR techniques, Mass spectrometry.

C673 Biochemistry of Extracellular & Interacellular Communication

Membrane Structure & Function, The Diversity of the Endocrine System, Hormone Action & Signal Transduction, Nutrition, Digestion & Absorption, Micronutrients: Vitamins & Minerals   Free Radicals & Antioxidant Nutrients, Intracellular traffic & Storing of Proteins, Glycoproteins   The extracellular matrix, Muscle & the Cytoskeleton, Plasma Proteins &Immunoglobulins, Red & White Blood Cells.

C674 Metabolism of Proteins & Amino Acids

Biosynthesis of the nutritionally non essential amino acid, Catabolism of proteins & Amino acids   Conversion of Amino acid to specialized proteins, Porphyrins & Bile pigment.

C675 Structures & Functions of Proteins and Enzymes

Amino acids & Peptides, Proteins: determination of primary structure, Proteins: Higher orders of Structure, Myoglobin & Hemoglobin, Enzymes: Mechanism of Action, Enzymes: Kinetics, Enzymes: Regulation of Activity, Bioinformatics & Computational Biology.

C677 Biocatalysts and enzymes in organic synthesis

 Introduction, Acyl transferases, Lipases, Esterases, Peptidases and amidases, Acylase, Carbohydrate processing enzymes, Glycosidases, Glycosyltransferases, Other carbohydrate processing enzymes, Other hydrolytic enzymes, Epoxidases, Nitrilases and nitrile hydratases, Other hydrolases, Reduction, CO, CN reduction, Other reductions, Oxidations, Hydroxylation, Dihydroxylation, Baeyer–Villiger oxidations, Other oxidations, C–C bond formation, Aldolases, Oxynitrilases, Other enzyme systems, Novel biocatalysts, Engineered enzymes, Evolved enzymes, Catalytic antibodies, Enzyme models and mimetics, Conclusions.

C678 Chemistry of Natural Products

Polyketides, Steroids(The Sterols), Amino acids and peptides(β-Lactams, Glycopeptides), Alkaloids derived from ornithine, Alkaloids derived from lysine, Alkaloids derived from nicotinic acid, Alkaloids of polyketide origin, Alkaloids derived from anthranilic acid, Alkaloids derived wholly or in part from phenylalanine ortyrosine, Isoquinoline alkaloids, Alkaloids derived from tryptophan, Monoterpenoidindole alkaloids, Terpenoid alkaloids, Steroidal alkaloids, Putrescine alkaloids, Spermine and spermidine alkaloids, Peptide alkaloids, Purines, Pteridines and analogues

C679 Macromolecular Recognition

Structures and functions of nucleic acids, folding and catalysis of nucleic acids, motifs and domains of proteins, principles of protein-protein interactions, chemistry of protein/DNA and protein/RNA interfaces, conformational changes in macromolecular recognition .

C680 Green organic chemistry

Introduction to Green Chemistry, Principles and concepts of green chemistry, Innovative green Technologies: Microwave, Ultrasound etc, Green synthetic methods, Solventless Reactions and Reactions in Water. Natural catalyst, Biocatalysis, Ionic liquids, solvents of the future (synthesis, applications, recycling....), Reactions using solar energy, Photochemistry reactions, Reactions with microwave Reactions ultrasounds, Sustainability, Challenges and Prospects of Green Chemistry

C681 Xenobiotics Metabolism

Nutrition and Xenobiotic Metabolism, Nutrition and Alcohol, Nutrients as Toxins, Natural Toxins in Plant Products- Pesticides: Man Made and Natural, Emerging areas of concern in toxicity of plant products, Toxic Factors in Animal Products, Chemical Carcinogenesis and Diet

MD676 Molecular Biology & Cancer Biology

Nucleotides and Nucleic acids Chemistry, DNA Replication and Repair, Gene Expression and Transcription, Protein Synthesis and Modifications, Cell cycle; Regulatory factors, Apoptosis, Oncogens and Carcinogenesis, Recombinant DNA Technology, Principals Gene Therapy and Human Genome project

MD682 Histology

Introduction, Microtechniques & Cytology, Cytogenetics., Blood, Epithelium, Connective tissue, Cartilage, Bone, Muscle, Nervous tissue, Vascular system, Lymphatic system.

MD683 Physiology

Endocrine System.2- Nervous System, Digestive System.4-Urinary System.

C684 Selected Topics related to Biochemistry

According to the supervision committee

• Ph.D .Degree in Analytical Chemistry

C701 Quality Management in Analytical Chemistry

Basic concepts and definition of quality - quality control and quality management systems - quality policy - ISO 9000 standard - quality manual -   quality auditing -   introduction to ISO 14000 standard on environmental management systems and techniques for quality.
 improvement.- introduction to ISO/IEC 17025 standard for testing Labs.

M702 Chemometrics (II)

This course includes the basic statistics in chemometrics, single processing and time-series, optimization and experimental design, pattern recognition and classification, modeling and analytical database.

C703 Environmental Analytical Chemistry (II)

Modern approaches to the analysis of contaminants in environmental samples - methods of sampling and analysis of organic contaminants - (especially mass spectrometric methods of analysis) - traditional classes of contaminants such as petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), organochlorine pesticides - herbicides and emerging
classes of contaminants such as endocrine disrupters, polar compounds and various polychlorinated mixtures.

C704 Selected Topics related to Analytical Chemistry

Lectures and reading in areas not normally treated in standard courses. Discussion of topics of current interest in analytical chemistry.

C705 Laboratory Safety

Aspects of laboratory safety relating to chemical, electrical, optical, mechanical, cryogenic and radiological hazards. Safety equipment, techniques (including first aid), and facilities.

C706 Analytical Chemistry Lab

Topics serve the specialty

C707 Bioanalytical Chemistry and Chemical Sensors

Principles of electrochemical and optical biosensors - protein immobilization methods –
bioassay design.

C708 Advanced Analytical Chemistry

Discussion of recent advances in analytical chemistry and their applications to the environmental, material and biomedical fields. Topics will be selected from the current literature.

C709 Pharmaceutical & Toxicological Analysis

Importance of analysis from drug discovery to development. Analysis of drug substances and formulated drugs, impurity profiles, metabolism studies , therapeutic drug monitoring , and drugs abuse – the requirements of regulatory authorities : GLP, GPM and ICH.   – preparative scale separations and simulated moving beds. - analytical method selection for research and routine assays. – handling of body fluids, stability and bio hazards, whole blood plasma, serum, urine, extraction and other pre-analysis methods.

• Ph.D. Degree in Inorganic Chemistry

C720 Supramolecular Coordination Compounds

Definition and development of supramolecular chemistry – classification of supramolecular host – gest compounds – supramolecular host design – nature of supramolecular interactions – applications of supramolecular coordination chemistry (microporous materials- magnetic materials – non linear optics) different topologies and assembled structures of coordination polymers .

C721 Photochemical Reaction of Inorganic Compounds

Photophysical properties of excited states : absorption spectra and electronic transitions – properties of electronically excited states – radiative and non-radiative decays- criteria for classification of the excited states – solvent effects and dipole moments of the excited states – acid – base reactions of excited states – photochemical reaction of metal complexes : photosubstitution reaction – photoredox reactions- photoisomerization reactions – photochemical cleavage of water – photochemical cleavage of water – photochromism of metal complexes – photoelectrochemical solar cells

C722 Sterochemistry of Coordination Compounds

Topographical stereochemistry of mononuclear coordination units – coordination units with achiral monodentate and bidentate ligands topological stereochemistry of polynuclear coordination units – polynuclear complexes with simple bridging ligands – bridging ligands for molecular helices , chains and knots

C723 Bioinorganic Chemistry

Study of DNA using inorganic agents – oxygen utilization – supply and storage of iron – oxidation reduction processes – metaloenzymes and vitamin B12 .

C724 Application of Polarography and Cyclic Voltammetry to Inorganic Compounds

Application of polarography and cyclic voltammeter different types of complexes and inorganic compounds

• Ph.D. Degree in Physical Chemistry

C730 Advanced Electrochemistry II

-Oxides and semiconductors; electrochemical properties, photoelectrochemistry of semiconductors; oxide particles and oxide layers.

- Intrinsically conducting polymers; chemically and electrochemically synthesis, surface film formation, electrical and optical properties, copolymerization.

- Nanoelectrochemistry; atomic dimentions, co-deposition, compositionally multilayers, core-shell composites.

C731 Concepts of Modern Catalysis

Introduction to Catalysis Homogeneous Catalysis- Bio-catalysis- Heterogeneous Catalysis-

Why is Catalysis Important?- Catalysis and Green Chemistry- Environmental Friendliness- The Chemical Industry- Catalysis as a Multidisciplinary Science-The Many Length Scales of a "Catalyst"- Time Scales in Catalysis - Kinetics of Catalytic Reactions - Catalyst Characterization: X-Ray Diffraction -X-ray Photoelectron Spectroscopy -Extended X-Ray Absorption Fine Structure - Electron Microscopy- Mossbauer Spectroscopy- Ion Spectroscopy- Temperature-programmed Reduction, Oxidation and Sulfidation- Infrared Spectroscopy- Surface Science Techniques- Low Energy Electron Diffraction - Scanning Probe Microscopy- Scanning Tunneling Microscopy - The Atomic Force Microscope.

- Solid Catalysts - Oil Refining and Petro-chemistry - Environmental Catalysis.

C732 Advanced Kinetics for Modern Chemical Reactions and their Theories

The modern theories for identification of the reaction rate pathway – Methods of identification of the mechanism of reactions using the kinetic studies - Kinetics of chain reactions – Kinetics of fast reactions – The kinetic equations and solid state reaction mechanisms.

C733 Thermodynamics for Multi-Compound Reactions in Solution

Thermodynamics and properties of liquid solutions – Component properties for real solutions – The free energies of the solvent components – The free energies of the solutions of the solvents components - Solutes activity and applications on Gibbs and Dom equations – The probability functions.

C734 Advanced Nuclear Chemistry

Chemical reactions following nuclear transformation (hot atom chemistry) – production and use of nuclear energy – nuclear reactors – nuclear reactor kinetics and control – radiation protection and shielding – radio nuclides in medicine and biology . Radiation chemistry of water – gases and hydrocarbons – radiation chemical applications in science and industry.Nuclear chemistry in geology and astrophysics.

C735 Nanostructured Materials, Preparation, Characterization and Application

Basics of nanostructured materials -

Introduction - Properties of Nanocrystals- Geometric Structure - Magnetic Properties of Nanocrystals - Electronic Properties - Optical Properties - Other Properties

Synthesis of Nanocrystals

Physical Methods - Chemical Methods - Nanocrystals of Different Shapes.

Programmed Assemblies: One-Dimensional Arrangements -Rings and Associated Arrangements -Two-Dimensional Arrays-Metal Nanocrystals-Semiconductor and Oxide Nanocrystals - Other Two-Dimensional Arrangements- Mechanism of Organization -Three-Dimensional Superlattices- Superclusters- Colloidal Crystals

Properties: Melting Point and Heat Capacity- Electronic Properties - Catalysis and Reactivity - Optical Properties - Magnetic Properties - Tools: Electron microscopies: Transmission electron microscopy - Secondary electron microscopy - Probe microscopies: Atomic force microscopy - Scanning tunneling microscopy - Dip pen nanolithography - Microcontactprinting - Applications: Nan wires - Quantum dots - Medicine; Biological labeling – Lasing - Energy; Photovoltaic's - Lighting; Light emitting diodes - Memory; the Coulomb staircase - Island occupation number.

C736 Statistical Thermodynamics

The microscopic state of a system – The Boltzmann distribution – Evaluation of B – Calculation of mechanical thermodynamic properties for independent particles - Calculation of thermodynamic properties involving T for independent particles – Molecular partition function for an ideal gas – Translational contribution to the thermodynamic properties of ideal gases –Vibrational contributions to the thermodynamic properties of ideal gases - Rotational contributions to the thermodynamic properties of ideal gases - Electronic contributions to the thermodynamic properties of ideal gases – Nuclear partition function - Thermodynamic properties of ideal gases –

Direct calculation of equilibrium constants for ideal gases reactions – Equipartition – Special topics: Ensembles – Non ideal gases – Heat capacities of solids – Special topics: Calculation of the most probable distribution.

C737 Mass Transfer in Electrochemistry

Quantitative treatment of mass transfer during electrolysis – Hydrodynamic boundary layer theory and its applications – Dimensionless groups – Applications of dimensional analysis – Application of mass transfer process – Electro wining – Electro refining – Electroplating – Electroforming of metals – Mechanism of electro polishing and leveling process – Electro-organic synthesis and applications.

C738 Femtochemistry and Laser Spectroscopy

Introduction to femtochemistry and Lasers - Experimental methods of femtochemistry – Application: molecules systems , isolated molecules , molecules in clusters, molecules in condensed phases, molecules with biological functions.

C739 Selected Topics in Physical Chemistry II

The selected topics are chosen by the supervisor.

• __Ph.D. Degree in Organic Chemistry__

C750 Asymmetric synthesis
Why is asymetric synthesis important, Chiral auxiliaries in asymetric synthesis, Nucleophilic chiral amines as catalysis in asymetric synthesis, Asymetric aminohydroxylation of alkenes, Asymetric hydrogenation of alkenes, Asymetric reduction, Catalytic asymetric synthesis, Asymetric 1,3-dipolar cycloaddition.

C751 Toxins and medicinal chemistry
Toxins: What makes a chemical toxic?- How can toxic substances harm the body?, What are the different forms of toxic materials?- What are exposure limits?, How can exposure be measured and monitored?- How can exposure be reduced?, Medicinal Chemistry: Introduction - Biopharmaceutical Properties of Drug Substances, Pharmacologic Activity, Drug Design, Drug/Receptor Interactions, Drug Resistance and Metabolism, Metal-Based Drugs, Computer Aided Drug Design, Drug structure and solubility, Combinatorial chemistry, Drugs from natural sources, Receptors and messengers, Enzymes, Nitric oxide, drug and analogue synthesis .

C752 Supramolecular chemistry
Historical Notes, Keywords and Definitions, Different Types of Supramolecular Interactions, Discipline of Self‐assembly, Examples: (Grids, from Ligand Design to Self‐assembly Process), Application.

C753 Homogeneous and heterogeneous catalysis
Introduction to catalysis, Heterogeneous and homogeneous catalysts, Mechanism in homogeneous and heterogeneous catalysis, Advantages and disadvantages of homogeneous and heterogeneous catalysts, Examples of homogeneous and heterogeneous catalyzed reactions.

C754 Selected Topics in organic reaction mechanism
Designed to acquaint students with advanced topics in his field of specialization.

C755 Modern Physical Organic Chemistry
New mechanisms of organic reactions, Rearrangements and neighboring group effects, Applications of the Hammett equation and its extended forms, Approaches to molecular orbital theory, Woodward- Hoffmann rule

C756 Advanced natural products chemistry
Natural products: Alkaloids: Definition, Isolation, Purification, Structure determinations. Terpenoides: Classification, structures and syntheses. Steroids: Sterols, Structure, Synthesis; Vitamin D, Bile acids, Steroid sex hormones, Corticoids (Adrinocortical Hormones), Flavones, Anthocyanins and Prophyrins.

C757   Environmental organic chemistry
Short historical accounts, principles of environmental chemistry, chemical properties relationship, molecular structure and physical, pollutants from petroleum, PCB's, dioxins, pesticides, polymers, soaps and -detergents abiotic transformations and degradation of chemical species through, hydrolysis, oxidation, phototransformation and degradation processes, Theromodynamic and kinetic aspects, chemistry of natural waters and water pollution, the atmosphere and pollution chemistry of - soil contamination, transport and distribution of pollutants in the environment and among the -environmental compartments comparison between "classical" and "green" industrial processes for the -synthesis of chemicals, Ideal reaction, atom efficiency, environmental factor E, use and selection of the better reaction solvent.

C758 Advanced Biochemistry

Emphasis on experimental approaches and problem solving, Topics include protein structure-function, protein folding and modification, Enzyme kinetics, and the study of metabolic processes (pathways and their regulation) with a molecular genetic approach, Gene structures and techniques for studying them, replication, control of gene expression, post-translational processing, membrane associated energetic.

C759 Photochemistry and Chemistry of organic laser

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, Photooxidation 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).

• Ph.D. Degree in Biochemistry

C761 Drug Drug Interaction

Types and Mechanisms of Drug–Drug and Drug–Nutrient Interactions, Drug Interaction Risk Factors and the Unknown, Effects of Nutritional Status on Drugs, Effects of Drugs on Nutritional Status, Unclassified Interactions, Types of drug interactions, Pharmacokinetic, Pharmacodynamic.

C762 Drug Delivery

Introduction to drug delivery, Drug delivery: the basic concepts/principles, Controlled drug delivery systems, Traditional oral drug delivery, Nanotechnology in drug delivery, Drug modification, Transdermal drug delivery, Nasal and pulmonary drug delivery, Stimulated drug delivery, protein delivery, Gene delivery, Design of drug delivery systems, simulation.

C763 Nano Biotechnology

Introduction: From Nanotechnology to Nanobiotechnology, Nanostructured Materials (Nanomaterials), Interaction between Nanomaterials and Biological System, Nanofabrication and Materials Characterization, Nanotechnology in Biological and Biomedical Applications, Nanotechnology in Tissue Engineering.

C764 Genetic Engineering

Restriction Endonucleases and other DNA Modifying Enzymes, Cloning vectors, Plant Transformation vectors and Expression Vectors for high level protein expression, Cloning strategies, E. coli transformation, Selection and screening of recombinant transformants, Labelling and detection of nucleic acid sequences, Genomic DNA libraries and cDNA libraries, Nucleic acid sequencing methodologies and Dye chemistries, Site Directed Mutagenesis.

C765 Immunology

Introduction to the immune system: Overview of the Immune System, Elements of Innate and Acquired Immunity, Immunogens and Antigens, Antibody Structure and Function, Antigen, Antibody Interactions, The genetic Basis of Antibody Structure (Immunoglobulin Genes)

Antigene recognition and B AND T cell development: Biology of the B Lymphocyte, Biology of the T Lymphocyte, Role of the MHC complex in The Immune Response, Activation and Function of T and B Cells.

The immune system in health and disease: Cytokines, Tolerance and Autoimmunity, Immunodeficiency Disorders and Neoplasias of the Lymphoid System, Transplantation, Tumor Immunology.

C766 Selected Topics related to Biochemistry

According to the supervision committee

C767 Microbial Ecology

Development and significance of microbial Ecology, Biodiversity of microbial life, Quantitative and physiological ecology, Natural habitats: Air, water, soil, Biogeochemical cycling: specific nutrient Roles, Microbial interactions with plants and animals, Advanced population interactions, Microbial ecosystems and communities, Field and application methodology, Ecology of Biodeterioration and interactions with xenobiotics, Mineral and energy recovery/ Fuel and biomass production, Microbial control of pests/Biological control.

C768 Drug Synthesis and Design

Practical methods to make drugs currently in use and to design future drugs, Treats both chemical synthesis and biologics like monoclonal antibodies, Topics include fragment-based screening, solid phase synthesis, directed evolution, bioconjugation as well as efficacy, metabolism, and toxicity. Recommended preparation.

C769 3D reconstruction of macromolecules using single particle electron microscopy.
Single-particle electron microscopy has now used method in the examination of macromolecular structure. Using a small amount of purified protein, isolated molecules are observed under the electron microscope and the data collected can be averaged into a 3D reconstruction. Single-particle electron microscopy is an appropriate tool for the analysis of proteins that can only be obtained in modest quantities, like many of the large complexes currently of interest in biomedicine. Whilst the use of electron microscopy expands, new methods are being developed and improved to deal with further challenges, such as reaching higher resolutions and the combination of information at different levels of structural detail. More importantly, present methodology is still not robust enough when studying certain tricky proteins like those displaying extensive conformational flexibility. The course describes a brief outline of the methods currently used in the 3D analysis of macromolecules using single-particle electron microscopy, intended for those first approaching this field, techniques, software, some recent work, the spectacular improvements to the technique in recent years, advantages and limitations compared to other structural methods, and its future developments.

Geology Programs
Diploma Geology Programs
1-Diploma in Applied Geophysics

G501Geodynamics

Global patterns leading to the plate-tectonic concept, Structure of the crust and upper mantle, Geomagnetic reversals and oceanic anomalies, Patterns of seismicity, Hot spots and their traces, Geometry of plate motion, Plate motion reconstructions and the supercontinent cycle, Driving mechanisms, Divergent, Convergent, Transform

G502 Electric and Electromagnetic Prospecting

Electric Prospecting: Electrical properties of rocks (Electric potentials, Electric conductivities, lab. measurements of resistivity), Self Potential method: Origin of potentials- equipments- field procedure and applications, Telluric current methods: Theory, field procedure and applications, Resistivity methods L Elementary theory and concept of apparent resistivity, Galvanic resistivity methods and various electrode arrangements, Field procedure and the factor affecting the measured data - Characteristic parameters of geoelectric section, Analysis of stratified n-layered earth resistivity model. Graphical methods of interpreting the resistivity data, Resistivity contour maps and geoelectric sections, Applications of resistivity methods, Induced polarization methods: theory, methods of measurements, field procedure and applications

Electromagnetic EM Prospecting: Introduction, fundamentals and definitions, Classification of electromagnetic methods , Advantages of EM methods and their applications and comparison with electrical methods, attenuation of EM field, combination of EM fields, EM methods for tilt angle measurements, AFMAG and VLF methods (theoretical bases, field procedures, data processing and interpretations, case studies) , EM methods for phase and amplitude measurements Turam method (theoretical bases, field procedures, data processing and interpretations, case studies).

G503 Seismic Prospecting

Fundamentals of seismic wave propagation: Reflection, Refraction and Transmission. Manmade energy sources and receivers used on land, sea, and in boreholes. Factors affecting seismic wavelets.Reflection and transmission coefficients.Absorption.Multiples.Seismic Refraction methods.Noise analysis.Seismic field layouts.Common Reflection Point techniques.Static and dynamic corrections.Velocity concepts in Reflection Seismology and velocity analysis.Introduction to Seismic Data Processing and preparation of Seismic Stacked Sections.Seismic migration and conversion to depth.

G504Gravity and Magnetic Prospecting

Basic principles of gravity and magnetic methods, Gravityand magnetic data corrections, Regional residual separation, Interpretation ofBouguergravity anomaly maps, Interpretation of total magnetic intensity maps.

G505 Digital Data Processing

Mathematical Methods Applications in Geophysics: Probability, Fourier and Laplace transforms, Z–Transformation, Special Mathematical Equations, Partial Deferential Equations, Numbering and Sampling Theory, Noise processing of field Measurements, Practical Applications in Deferent Geophysics Data.
Computer Application in Geophysics: Necessity of Computer Application in Geophysics, Types of Geophysical data and Analysis Steps, The Flow Chart , Hardware and Software used in geophysics

G506 Well Logging and Petrophysics

Basic concepts in log interpretation.Self-potential log, Gamma-ray log, Natural gamma-ray log. Caliper log, Sonic and other porosity logs, Density log, Neutron log, Lithology and porosity interpretation, Clay correction, Electric logs, Induction logs, Micro resistivity logs, Water and hydrocarbon saturation evaluation, Cost control and data quality in well-logging, Log presentation standards.

G507 Earthquake Seismology

Elasticity and elastic properties of rocks, Elastic waves, Seismic waves, Earthquakes: causes and classification, Wave trajectories -Wave conversion- Distribution of earthquakes, Faulting and its relation to earthquakes, Energy of earthquakes, Intensity and Magnitude of earthquakes, Analysis of ground motion, Earthquake hazards, Earthquake mitigation.

G508 Telluric and Magnetotellric Methods

Introduction, The theoretical basis for electromagnetic induction, Earth's electromagnetic environment, Telluric current methods: Theory, field procedure and applications, Themagnetotelluricresponse function, Distortion ofmagnetotelluricdata: its identification and removal, The two- and three-dimensional forward problems, The inverse problem, Instrumentation and field procedures, Case histories and geological applications

G509 Special Topics in Geophysics

Some interested topics selected from different geophysical methods and their applications.

G510 Radioactive&Geothermal Methods

Principles :

Measurements & instruments - Quantative interpretation -Qualitative interpretation - Applications

• <u>Diploma in Petroleum Geology & Hydrogeology</u>

G511 Petroleum Geology-2

Concise revision of the elements of a 'Petroleum system' (source- migration- reservoirs- traps and seals) - The subsurface environment – Reservoir calculations - Sedimentary basins and petroleum systems – Methods of production - Nonconventional petroleum resources - Some details about oil and gas production in Egypt.

G512 Petroleum Reservoirs (Siliciclastic, Carbonate and Fracture)

Classification of siliciclastic reservoirs – Detailed characterizationof silisiclastic reservoirs - Classification of carbonate reservoirs – Detailed characterization of carbonate reservoirs - Classification and evaluation of naturally fractured reservoirs.

G513 Groundwater Hydrology

Groundwater Flow Patterns – Introduction - Regional groundwater flow 1 - Background to head and fluid potential - Regional groundwater flow 2 - Recharge due to Precipitation or Irrigation - Hydrological Processes - Darcy's law, Fluid mass balance, and Derivation of flow equations - Groundwater/Surface Water Interactions - Groundwater flow - Transient Systems and Groundwater Storage - Continuity and Flow Nets - Numerical Modeling of Groundwater Flow - Flow of groundwater to wells

G514 Advanced Hydrochemistry

Sorption – Introduction - Interactions in the liquid phase - Equilibrium reactions - Kinetics of various chemical processes - Thermodynamic fundamentals - Calculation of the reaction rate - Theories of ion dissociation and ion interaction - Reactive mass transport - Interactions at the liquid-gaseous phase boundary - Transport models - Henry-Law - Numerical methods of transport modeling - Interactions at the liquid-solid phase boundary

G515 Well Hydraulics

Well components, design and well screens – Introduction - Water well planning, construction, sitting and drilling fluids - Fluids Properties and classification - Pumping test analysis - Formation of aquifer systems - Well and Aquifer coefficients - Flow Classification - Borehole logs - Types of fluid motions - Radial flow to a well - Types of Aquifers - Well and aquifer analysis - Types of water wells and drilling methods

G516 Groundwater Aquifer Systems in Egypt

Nubian Sandstone Aquifer – Overview - The Nile Aquifer - Water resources in Egypt - The Moghra Aquifer - Water bearing formations - The fissured Carbonate Aquifer - Lithostratigraphy and sedimentary basins in Egypt - The Coastal Aquifer - Quaternary deposits in Egypt - The Basement Aquifer - Structure and depositional systems - Groundwater resources development and management options - Main hydrostratigraphic units in Egypt

G517 Sequence Stratigraphy-2

Concise revision of basic principles of Sequence Stratigraphy - Basin forming processes – Relative sea-level, tectonics and eustasy – Accommodation - Filling of accommodation - Concise introduction to sequence stratigraphic tools (seismic, well logs and outcrop tools).

G518Sedimentary Rocks and Sedimentary Environments

The objectives of the course are met by providing theoretical background on the controlling factors resulting in production, transport and deposition of detrital (siliciclastic) and biochemical (carbonates) sediments rocks and resultant sedimentary structures which are the basis of facies analysis and, ultimately, for the reconstruction of past depositional environments. In synthesis, the course covers:

The concept of facies, facies models , facies associations and how these related to depositional environments, Walther's Law and Uniformitarianism - Facies Models for continental (Fluvial), transitional (Coastal, Deltaic, Estuarine) and marine (Shelf and Deep Water) depositional environments - The role of climate and plate tectonics in the development of facies and facies associations, with focus on Egyptian examples - Provenance and transport processes of clastic sedimentary rocks and unconsolidated sediment - Classification systems for sedimentary rocks - Processes and facies of formation of carbonate rocks - Diagenetic processes and features in sedimentary rocks

G519 Advanced Structure Geology

An overview of the causes and mechanisms of tectonic deformation within the lithosphere and the analysis of the principal types of geological structure and their implications for applied earth science and earth resources engineering.

Deformation: components of deformation Principal strains, strain ellipsoid and strain ellipse - Pure shear and simple shear - **Deformation mechanisms:** grain boundary silding, fracturing/cataclasis, diffusive mass transfer,

and crystalline plasticity - **Brittle-ductile and ductile shear zones - Folds and folding - Global tectonics: geometry of structures.**

* Associations of sedimentary, igneous and metamorphic rocks in zones of - divergent, convergent and strike-slip tectonics - Egyptian case study

Mapping Geologic Structure (practical)

3- Diploma in Economic Ores & Minerals

G521 Ore Genesis

Classification of ore deposits - Igneous ore deposits processes - Magmatic – hydrothermal- ore forming processes - hydrothermal- ore forming processes - Sedimentary / surficial processes - Global tectonic & melallogeny - are deposits in Global tectonic context

G522Exploration of Mineral Deposits

Preliminary and detailed exploration - Methods of subsurface exploration - Exploratory systems - Categories of mineral reserves and degrees of geological assurance of the deposit – Sampling - Geological documentation of mineral deposits - Hydrogeological and engineering-geological investigations of mineral deposits - Exploration during mining operations - Prospecting and exploration of placer deposits - Reserves calculation - Economic evaluation of mineral deposits.

G523 Mineral Processing

Various ore-dressing operations: comminution, sizing and sorting, jigging, tabling, flotation, magnetic and electrostatic separations. Extraction of mineral species. Various separation processes for beneficiation of minerals, including adsorption, electrolysis, electrowinning, leaching, and solvent extraction by precipitation and by reaction. Typical examples from the local mineral processing industry.

G525Advanced Mineral Deposits of Egypt

Minerals associated with mafic – ultramafic rocks – mineral deposits in felsic associations - stratiform volcanogenic massive sulphides – precious vein type deposits- deposits in sedimentary – rocks -deposits in rules metamorphic association.

G526 Advanced Geostatistics

Theory of regionalized variables, semivariogram modeling, spectral analysis, kriging, multiple regression, multivariate extension of elementary statistics, discriminant functions, cluster analysis, principal component and factor analysis, analysis of directional data.

G527 Mineral Economics

Review of mineral commodities with regard to history, geologic occurrences, consumption, trade, price, financial control and the future positions of key mining countries - Study of fundamentals including business organization in the mineral industries, governmental control, national mineral policies, depletion allowance, taxation, tariffs, stockpiling, conservation and secondary usage - Global mineral reserves and resources - Egyptian mineral policies, mineral taxation and mineral profits - Assessment of the environmental impact of mineral exploitation and Use

G528 Structural Geology for Economic Geologists

Methods of geometrical analysis, structural geological data and data management, projections and diagrams, practical strain analysis, fold shape analysis, petrographicidentification of pervasive structural elements, regional fold and fault systems, structural geological maps and structural interpretation.

4- **Professional Diploma in Medical Geology**

G528 Environmental Geochemistry

Foundations and development of medical geology - Geochemical classification of the elements - Contribution to medical geology from public health and environmental medicine - * Natural distribution and abundance of elements - Natural background - A chemically variable earth - Mineral chemistry of rocks - Diversity in the chemistry of rocks - The biogeochemical cycle - Establishing geochemical base lines - Total analyses and bioavailability - Future challenges - Biological Functions of the elements - Essentiality of elements - Major, Minor and trace elements in biology - Brief description of the function of major - minor and trace elements - Metals and geo-environment -Biological monitoring of metals - Factors influencing the absorption and bioavailability of some metals in the environment -

I. Arsenic: Ingestion - Inhalation

II. Cadmium: Ingestion – Inhalation - Dermal Contact

III. Lead: Ingestion - Inhalation

G529 Air Pollution and Health

Atmospheric Chemistry cycles - Types and sources air pollutions - (Particles, Carbon gases, Sulfur gases - nitrogen gases. Ozone and Chlorofluorocarbones (CFC), Hand and other pollutants) - Acid rains - Air pollution and weather - Natural aerosolic mineral dust and human health - Radon and environmental Health – Introduction - Nature and measurement - Health effect of radiation and radon - Radon epidemiology - Source of natural radiation - Factors controlling release and transfer of radon gas - Radon migration pathways - Factors affecting radon in building - Radon Potential Mapping Methods - Radon site investigation methods -Health impact of volcanic activity - An introduction to volcanic toxicology - The health effects of Tephra dispersal - The health effects of volcanic gases emissions - Volcanic Dispersal of metal and trace elements - Volcanism and radiation hazards -Toxic exposure with other eruptive events - Volcanic monitoring and health protection

Md530 Soil and Health

A- Introduction - B- Deficiencies of essential trace elements

I. Soil and Iodine deficiency –II. Selenium deficiency

Md531 Environmental Metallotoxicology

General View - Special Target - II- Bioloical responses of Metals - III- Toxico dynamics - V- Risk assessment and management - VI- Toxicity investigation - VII- Therapy and management of Toxicity.

Selected investigations related to the topics covered by the lecture course.

Md532 Minerals and Health of Human and Animal

A. Introduction: The Asbestos Minerals - Mineralogy of Asbestos - Diseases related to exposure to Abestos (Fibers, Lung Cancer, Mesothelioma, Asbestosis) - The Silica minerals and amorphous Silica - Mineralogy of Silica - Diseases related to exposure to silica dust (Silicosis, Silicotuberculosis, Canser) – Coal - Mineralogy of coal Diseases related to exposure to coal dust (Coal workers "Pneumoconiosis, coal workers" silicoaia) - The Silicate minerals (other than Asbestos) - Mineralogy some silicates - Health effect of selected silicate minerals (Talc and pyrophyllite, the clay minerals, micas, and Zeolites)

Mineralogy of bone: The skeleton and mineralized tissues - Crystal chemistry of mineral in mineralized tissues. - The crystal structure of calcium apatite - Analsis of apatite biominerals – Osteoporosis - Mineral and mineralized tissue research and medical geology

B. Minerals and Animals: Introduction - Recognition of Problems - Mineral and trace element availability -Salt and mineral licks (P, Ca, Al, F, Mn, Co, Cu, Zn, As, Se, Mo, I)

Md533 Water and Health

I- Introduction: (Global water budget-Fluid storage and movement- Subsurface water- Consequences of groundwater withdrawal- Impact of urbanizations on groundwater systems).

II. Water Pollutions: General principles - Industrial Pollutions - Organic matter - Agricultural pollution - Reversing the damaged surface and groundwater - Groundwater pollution

III- Health impact of water pollution: I. Arsenic in groundwater and the natural environment - Introduction - Sources of arsenic in the natural environment - Arsenic in groundwater - Common features of high- arsenic groundwater provinces - Mitigation of high- arsenic groundwater Problems.

V. Fluoride in natural waters: Introduction - History of gluoride research and links with health - The hydro-geochemical cycle of fluorine - Case studies to illustrate high- fluoride groundwater systems - Remediation of high- fluoride groundwater

VI- Water hardness and health effect: Definition of water hardness - Natural hydro-chemical evolution of groundwater - The hard- water story - Studies at an individual level - Phhsiological importance of magnesium - Magnesium intake - Water magnesium and body magnesium status - Calcium in drinking water and Cardiovascular disease - Water hardness and other health effects.

G534 Waste Disposal and Pollution

I- Waste disposal: Solid wastes- general - Municipal waste disposal open Dumps - Sanitary Landfills - Incineration - Ocean Dumping

II-Reducing Waste Volume: - Handling (Non toxic) organic matter – Recycling -Other

III- Liquid- Waste Disposal: Secure landfills - deep-well disposal - other strategies

V- Sewage Treatment: Septic systems - Municipal sewage Treatment

VI-Radioactive Wastes: Nature of Radioactive Wastes - Historical Suggestion: Space, Ice, and plate tectonics - Seabed disposal - Bedrock Canverns for liquid waste - Bedrock Disposal of solid High- level wastes No high- level Radioactive waste –Introduction -Inorganic geochemistry techniques for solids (NAA,

G535 Inorganic Geochemistry Techniques

X-ray fluorescence spectrometry) - Inorganic geochemistry for liquids (Atomic absorption spectroscopy - Atomic emission spectroscopy, ICP-Ms) - Organic geochemistry techniques - Chromatography

Lab Work: Use of available analytical equipments like Atomic absorption spectroscopy (AAS), flame photometer, Chromatography and Scanning electron- microscope (SEM)

G536 Geological Impact on Nutrition

Geological sources of nutrition - Mineral elements needed for good health - Dietary sources of essential mineral elements - Mineral element bio-availability - Quantitative estimates of mineral needs and safe exposures - Clinical assessment of mineral status - Ecological aspects of mineral Nutrition.

Short Research Project: Ashort research project a selected area of medical geology has to be completed by the students during the two semesters

G537 GIS

GIS (Geographic Information System)

-Introduction; geographic data. Maps and automation; the maps as model of geographic data;

cartographic and GIS data structures; Input, storage and editing; Analysis; Measurement; classification; GIS in Human health studies.

5-Professional Diploma in Applied Environmental Geosciences

G539 Applied Geochemistry

Distribution of chemical elements - Major biogeochemical cycles - Isotope geochemistry - Geochemistry of the earth's surface - Analytical geochemistry.

Practical: Analysis methods of different chemical elements in water Isotope datingEffects of Pollutants at the Ecosystem Level

Biochemistry of different minerals

G540 Geographic Information Systems (GIS)

Introduction to the Geographic Information System - Components of GIS, Devices and file types specific of GIS - GIS data and data sources, Georeferencing and Modeling of the Real World -Spatial Data vs. Attribute Data, Raster Data vs. Vector Data - Reference systems and datums, Topology and Spatial Analysis - Geostatistics and Interpolation - Database management, Arc-objects, GIS-customization - Modeling in ArcGIS

Practical: Displaying Data, Editing data, Working with georeferenced data - Introduction, Elements of GPS, How GPS works, Collecting Random points reading, Importing reading to PC On-screen digitizing and vector data manipulation Designing a GIS Database, Populating a geo-database

G541 Remote Sensing & Image Processing

Introduction & overview - Fundamentals and concepts of Satellite image Acquisition - Satellites and Sensors - Satellite Orbit and Coverage Characteristics - Multi-Spectral Classification - Remote Sensing Applications -

Practical: Stitching images together, creating a new map composition - Using spectral characteristics, unsupervised classification - Preparing the classification for analysis, stream sensitivity

Multiple functions in the modeler - Using matrix and criteria functions

G542 Applied Sedimentology& Quaternary Geology

Part (I) Applied Sedimentology: Rock to Sediment - Sediment to Sediment - Sediment to Rock

Part (II) Quaternary Geology : Quaternary sediments and related geo-dynamics - The role of quaternary geosciences in the environmental engineering - Geographical relationship between quaternary and surficial deposits of the earth - Physical resource stratigraphy, Types of quaternary sediments - Geotechnical response to climatic and local environmental conditions.

Practical: Sediment parameters - Sediment accumulation rates - Sediment properties in monitoring the environment

G543 Soil Mechanics and Stabilization Techniques

Soil Properties, Soil Classification Tests and Common Systems - Soil Structure, Soil Exploration and Sampling, Swelling and Swelling Pressure - Consolidation, Stress-strain relations, Stability of Slopes, Shallow Foundations - Mechanical stabilization, Addition of cement, Chemical stabilization - Mineral polymerisation, Injection, Temporary stabilisations techniques

Practical: Soil Classification Tests - Stabilisations techniques - Stress-strain relations and shear strength - Shear Strength of Soil - Soil Exploration and Sampling

G544 Environmental Geosciences

Part One: Introduction to Environmental Geology - Rivers and Flooding, Landslides, Slope Failure, & Mass Wasting - Earthquakes & Their Effects, Volcanic Activity - Water Pollution, Waste Management, Coastal Hazards, Energy, Global Changes - Earth's internal structure dynamics

Part two : Interactions in the lithosphere-hydrosphere-atmosphere-biosphere system - Introduction to biogeochemistry, to global environmental changes - Distribution of mineral resources: energetic and non-energetic - Energy, fossil fuel, nuclear fuel, alternative sources - Mineral resources and non-energetic ores - Man-made hazards in the physical environment.

Practical : Landslides and Mass wasting - Earthquakes, epicenters, damage characterization - Water Pollution - Fossil Fuel, aging methods - Non-energetic ores

G545 Information Technology

Introduction to MATLAB: basic concepts, arrays and matrices, matrix operations, 2D- and 3D-plots - Brief Introduction to SPSS - Key Terms Related to Data Analysis - Multiple Regression - Factorial ANOVA and ANCOVA- Cluster Analysis

Practical: Arrays and matrices in Matlab - Selecting and Interpreting Inferential Statistics - Summaries of Data and Two-Sample T-Tests - Exploratory Factor Analysis and Principal Components Analysis
Logistic Regression and Discriminant Analysis

G546 Applications of GIS & Remote Sensing in Environmental Geosciences

GIS and RS principles - The electromagnetic spectrum - GIS/RS applications in NRM and environmental geosciences - RS data interpretation for land resource inventory - RS and GIS for soil resource change analysis - GIS tools for landscape and environmental management analysis - Map generalization aspects, Internet technology basics.

Case study - Map production - project for different environmental issues

G547 Hydrogeology

Fundamentals, Natural groundwater flow - Groundwater abstraction techniques - Groundwater flow equations and useful solutions - Groundwater chemistry, Pumping test analysis - Hydro-geochemical processes, Natural isotopes in groundwater - Groundwater contamination, Groundwater sampling, analysis and quality norms

Pumping test analysis - Groundwater flow equations - Groundwater quality evolution
sampling, analysis and quality norms

G548 Environmental Impact and Risk Assessment

Principles, structure and contents of EIA studies: general principles, comparison of the different kinds of procedures - Environmental screening of projects: aim, typology of screening procedures (lists of project types, manual check-lists, and computer assisted screening), examples, and documentation (procedures of several organizations: BADC, EU) - Scoping of projects: identification of data, analysis of the proposed action, search for possible alternatives, techniques to identify the relations between the proposed action and the expected environmental impacts (check-lists, matrices, networks), identification of the significant impacts (use of criteria and standards), determination of the contents (items to analyze and techniques to use) of the complete EIA - Overview of the most common negative environmental impacts of water resources projects and some corresponding mitigating measures - More detailed analysis of the impacts of water resources projects on human health, by creating a favorable natural environment for the transmission of pathogens and diseases - An environmental analysis of a project in an early planning phase.

M.Sc. Geology Programs

1- M.Sc. Degree in Applied Geophysics

G601 Earthquake Seismology

Revision of earthquake seismology definitions, Causes and characteristics of earthquakes, Types of telemetry devices and techniques, Processing of data from several stations using computers, Instruments structures and buildings, The effect of resonance, The effect of foundation on structures, Soil acceleration of seismic waves, The role of architecture in seismic hazard, The acceleration and strong ground motion, Relation between duration and acceleration, The vulnerability of different structures according to the materials, Case histories,.

G602 Gravity and Magnetic Prospecting

Basic concepts, laws, units, and definitions, Physical properties of rocks and minerals affecting the gravity and magnetic measurements, Similarities and differences in field vectors, origin, components, and fluctuations, between gravity and magnetic methods, Measuring instruments, Ground surveying designs, data acquisition, corrections, reduction techniques, Data processing, Isolation, gradient techniques, and continuations, Anomalies` pattern analysis and qualitative data interpretation, Quantitative interpretation of Potential field methods, Applications and case histories.

G603 Electric and Electromagnetic Prospecting

Principles of electric&electromagnetic methods (Electrical properties of rocks, Mechanism of electrical conduction in materials, Representative resistivity values, Conductivity mechanism, Fundamentals of the current flow in the earth, Potential distribution in a Homogeneous Medium, Apparent and true resistivity, Potential and current distribution across boundary)

D.C. Resistivity method (Electrode configurations, Electric sounding & Electric profiling, field procedures, Applications & Ambiguities, Qualitative & Quantitative Interpretation, Mise – A- la- Masse Method) - Electrochemical methods (self-potential method, induced polarization method)

Electromagnetic methods (Classification of electromagnetic systems, Principles of electromagnetic, Magnetotelluric Methods Vertical loop (VLEM), Slingram & Turam Systems, Very Low Frequency (VLF), Audio Frequency Magnetics (AFMAG), Time-Domain systems (TDEM), Airborne Method, Ground Penetrating Radar (GPR).

G604 Seismic Prospecting

Equation of wave motion -Seismic waves - The seismic signal - The seismic impulse and impulse response - Seismic sources - Impulse of the source - The seismic reflection series. Sampling of the seismic signal. Techniques of seismic acquisition: Procedures of field recording - A/D recording - Seismic noise - Seismic noise filtering - Seismic signal enhancement - Correlations - Fourier analysis Convolution - deconvolution filters -Static and dynamic corrections - Signal stacking -Seismic sections - Seismic velocities analysis- Migration of the seismic sections

G605 Geodynamics2

Introduction , Radial structure of the earth (The interior imaged by seismic waves, Earth's shape, mass, and gravity field, Radial variations of density and pressure, Temperature, composition and convection), Plate tectonics (Geomagnetism and paleomagnetism , Seafloor spreading, Earthquakes between and within plates, Plate motions), Lithosphere and asthenosphere (Isostasy: Gravity, topography, crustal structure, Thermal and flexural isostasy: the lithosphere)

G606 Inverse Theory and Inversion Concepts

Introduction (The difference between observed and predicted data , Why both are needed , Reasons why the inversion problem is "non-unique", Significant "prior knowledge," for geophysical work to be done at a site and preliminary appreciation for various ways of examining models that are built), Inversion and forward modeling, Fitting the data, Acrucial concept: non-uniqueness, Parametric problems (Significant prior information about the geosciences problem), Optimal model, Choose decision criteria, Usable results.

G607Marine Geophysics

An introduction to modern geophysics, Plate tectonics, earthquake and faulting, isostasy and gravity, heat and mantle dynamics, ocean ridges and transform faults, hydrothermal vents, trenches and oceanic islands, subduction zones, accretionary and erosion wedges, sedimentary basins and continental rifts. Exploration of the oceans using geophysical methods

G608Data Analysis Techniques in Geophysics

Definition of the frequency and time domains, Fourier series and fourier transform, Laplace transform and Z transform, Hankel transform - Hilbert transform, Convolution – Cross-correlation and auto-correlation, (F-K) filter and Band Pass filtering, Construction of filters&Optimum filter, Deconvolution and migration of seismic data - Conventional processing procedures, Interactive processing - Seismic data representation in 2,3 and 4 dimensions, Structural interpretation for seismic reflection data (folds, faults and unconformities), Criteria and applications of fault types (dip and strike(.

G609 Seismic Stratigraphy

Detection of Sedimentary features in seismic sections: Erosion surfaces, transgressions and regressions, on-lap, top-lap, down-lap concepts- Detection of Seismic facies' and seismic sequences: parallel, convergent, divergent, sigmoid, and chaotic layering - Detection of Sea level changes - Creation of fans and basins.

G610 Well logging and Petrophysics2

Responses of resistivity and porosity logs. Oil water contacts – Gas oil contacts. Empirical relations, determination of lithology from cross plots. Porosity and permeability estimation from logs. Gross, net and effective pay thicknesses of formations from composite logs. Use of well logs in detecting over pressured zones. Detection and evaluation of fractured reservoirs.Shale volume estimation from different logs.Shale effect on porosity and matrix.Volumetric model of shaly formations containing hydrocarbons.Elemental analysis from Spectral Gamma Ray and ECS logs.Interpretation in clean, shaly and complex formations.

2- M.Sc. Degree in Petroleum Geology

G612 Petroleum Geochemistry
Introduction, world energy, global supply and demand of oil and natural gas, perspectives - Hydrocarbons chemistry, physicochemical properties, composition of oil and gas - Origin of fossil fuels, carbon cycle, chemical composition of biomass - Organic matter in sediments, accumulation, preservation, transformation, formation of kerogene - Formation of oil and gas, abiogenic petroleum concept - Non-conventional fossil fuels, shales, tar-sands, hydrates - Analytical methods in petroleum geochemistry - Geochemical evaluation of analytical data

G613 Petroleum System2
Concise review of the processes of a 'Petroleum System' (generation, migration and accumulation) - Identifying and naming of a 'Petroleum System' - Temporal aspects of a 'Petroleum system (age, critical moment and preservation time) - Event chart – Burial history chart - Size of a 'Petroleum System' – Mapping a 'Petroleum System'.

G614 Geophysical Exploration
Gravity Exploration: measurement techniques, data reduction, interpretation and applications
Magnetic Exploration: magnetic anomalies of simple shapes - measurement techniques, data reduction, interpretation and applications
Seismic Exploration: travel time curves, normal move-out, resolution of seismic data - data processing: CMP gathers, time corrections, filtering, stacking, migration - interpretation: e.g., hydrocarbon traps, geological structures - seismic refraction - refraction along horizontal, dipping and non-planar interfaces interpretation methods and applications

G615 Advanced Sequence Stratigraphy and Sedimentary Basin Development
Revision of basic principles of Sequence Stratigraphy - Sequence stratigraphic tools (Seismic stratigraphy, Well log sequence stratigraphy, Outcrop sequence stratigraphy) and high resolution sequence stratigraphy - Sedimentary extensional, compressional and strike-slip basins development in relation to petroleum entrapment.

G616 Carbonate Reservoir Rocks
Carbonate depositional systems in relation to petroleum entrapment - Carbonate diagenesis and carbonate reservoir characterization - Examples of carbonate reservoirs in Egypt and the Middle East.

G617 Formation Evaluation
Applications to obtain water salinities, shale volumes and clay type - SP, GR and caliper - Acoustic Measurements - Neutron Porosity Measurement - Density Measurements - Deep Reading Resistivity (Rt) - Estimating porosity and lithology - Shallow Reading Resistivity (Rxo) - Computing the value of Vsh - Quick Look Interpretations for reservoir characterization - Estimating water saturations - Computing Sw in the presence of Shale - The carbonates challenge - Wireline formation Testing (WFT) - Pressure Gradient Interpretations - Magnetic Resonance Imaging (MRI) - Borehole imaging

G618 The Phanerozoic Eon of Egypt :
The PhanerozoicEonof Egypt - The Paleozoic rocks of Egypt - The Mesozoic rocks of Egypt - The Cenozoic rocks of Egypt - The evaluation of Egypt throughout the Phanerozoic Eon

G619 Siliciclastic Reservoir Rocks
Siliciclastic depositional systems in relation to petroleum entrapment- Siliciclastic diagenesis and silisiclastic reservoir characterization - Examples of silisiclastic reservoirs in Egypt and the Middle East.

G620 Advanced Sedimentology
Petrologyof clastic and carbonate deposits- tectonic and paleoclimatic records-paleocurrent and provenance analysis -Diagenesis & diagenetic effects on subsurface fluid flow, and volcanic sedimentation - An in-depth study of all the sedimentary processes and sedimentary structures involved in the formation of sediments and sedimentary rocks - Field observation, field and laboratory sampling, and data analysis of clastic sedimentary rocks; Advanced laboratory techniques.

G621 Environmental Sedimentology
Environmental Sedimentology provides a comprehensive introduction to this rapidly expanding field which addresses the functioning and dynamics of contemporary sediment systems and how these systems respond to a range of both natural and anthropogenically-induced disturbance events. It includes:

an overview of the basics of sedimentology, followed by chapters that present physical, chemical, and ecological perspectives on the processes and issues of a range of sedimentary environments (mountain, [fluvial](#), lake, arid, urban, deltaic and [estuarine](#), temperate coastal, tropical coastal, and continental shelf environments).

• <u>M.Sc. Degree in Stratigraphy & Paleontology</u>

G623 Applied Stratigraphy

Radiometric stratigraphy - Facies stratigraphy - Event stratigraphy & sequence stratigraphy - Fluid inclusion stratigraphy - Quantitative stratigraphy

G624 Applied Micropaleontology

Microfossils as thermal metamorphic indicators - Micropaleontology & biodiversity - Microfossils, stable isotopes & ocean-atmosphere history - Microfossils in stratigraphy - Microfossils as ecological pollution indicators

G625 Advanced Vertebrate Paleontology

Explores the fossil evidence for the evolution and diversification of verebrates during the geologic history ofEarth - Types of vertebrate fossils (fishes, ecocides dinosaurs, birds and mammals) - Museum exhibits for the vertebrate fossils

G626 Origin and Evolution of Earth

Geologic time & fossils - Evoluation of earth crust - The Precambrian Eon - The Paleozoic Eon - The Mesozoic Eon - The Cenozoic Eon

G627 Remote Sensing and Image Processing

Earth Resource and environmental satellites - Thermal Infrared images - Radar technology and terrain interaction - Digital image processing - Land use and Land cover: Geographic Information Systems - Natural Hazards

G628 Advanced Plant Fossils

Review- Palynomorphs & palynofacies - Extraction techniques - Palynology & oil industry - Applied palynology

G629 Advanced Invertebrate Paleontology

The fossils record and notes of evolution - Rates of evolution ,adaptive radiation sand extinction ,competition & its effects - The diversification of invertebrate life - Different invertebrate phyla.

G630 Paleogeography & Paleoclimatology:

Plate tectonics- global history , driving mechanisms- Paleogeography Reconstractions - Global plate model, paleo GIS - Paleoclimate Reconstractions - Climate & climatic variation - History of the earths climate- the ice age cycles sea level changes volcanic activity , change in atmosphere and solar radiation

• M.Sc. Degree in Sedimentary Geology

G631 Advanced Sedimentology
Petrology of clastic and carbonate deposits- tectonic and paleoclimatic records-paleocurrent and provenance analysis-Diagenesis& diagenetic effects on subsurface fluid flow, and volcanic sedimentation. An in-depth study of all the sedimentary processes and sedimentary structures involved in the formation of sediments and sedimentary rocks - Basic principles of field observation, field and laboratory sampling, and data analysis of clastic sedimentary rocks; introduction to laboratory techniques

G623 Applied Stratigraphy
Radiometric stratigraphy - Facies stratigraphy - Event stratigraphy & sequence stratigraphy - Fluid inclusion stratigraphy - Quantitative stratigraphy

G 644 Advanced Geochemistry of Sedimentary Rocks
Processes controlling the composition of natural waters and minerals in sedimentary realms will be examined with emphasis on subsurface environments. Interpretation of analytical data and theoretical treatments are used to understand geochemical cycling from weathering to precipitation of new minerals

G635 Quaternary Sedimentology
Methods used to identify, map, date and correlate Quaternary deposits and interpret Quaternary history. Covers glacial, fluvial, coastal, lacustrine and eolian chronologies, oxygen-isotope records from ocean sediments and continental ice cores, volcanic activity, and Quaternary climate change.

G636 Sedimentary Basin Analysis
The course presents theories of basin formation in various types of geotectonic setting, basin infill dynamics, subsidence history and consequences for reservoir and source rock development and the petroleum system. Subjects to be discussed include physical state of lithosphere, mechanisms of sedimentary basin formation by stretching, strike-slip, flexure and compression, effects of mantle dynamics, basin infill mechanisms and depositional systems, basin stratigraphy, subsidence and thermal history, changes of reservoir and petrophysical parameters during burial and tectonic processes, and application to the petroleum system, leading towards the play concept

G637 Clay Mineralogy
Classification and structural mineralogy of the major groups of clay minerals based on AIPEA nomenclature. Species variation within groups discussed in terms of substitution, layer stacking arrangement and ion exchange capacity. Dehydration-rehydration reactions and clay organic complexes.
Study origin, and geologic importance of clay minerals.
Industrial and other applications of clays.

G638 Advanced Geotectonics
Introduction/ Basic tenets of plate Tectonics- Tectonics of divergent boundaries compositions& styles of sedimentation- Tectonics of convergent boundaries& compositions and styles of sedimentation- tectonics of transform boundaries& compositions and styles of sedimentation

G640 Environmental Sedimentology
Environmental Sedimentology provides a comprehensive introduction to this rapidly expanding field which addresses the functioning and dynamics of contemporary sediment systems and how these systems respond to a range of both natural and anthropogenically-induced disturbance events. It includes - an overview of the basics of sedimentology, followed by chapters that present physical, chemical, and ecological perspectives on the processes and issues of a range of sedimentary environments.

G642 Advanced Depositional Systems
Advanced facies analysis-advanced insight into the characteristics and depositional mechanisms of sedimentary systems as well as a full understanding of the controls on these systems-Clastic depositional systems-Carbonate depositional systems, and depositional systems of other sediments (evaporates, phosphatic sediments…etc).

• M.Sc. Degree in Structural Geology

G639Advanced Structural Analysis

Measurement and representation of orientation data - Analysis of planar and linear structures - Tectonic analysis of joints and faults - Tectonic analysis of folds - Cross-folding and superposed folds - Kinematic indicators and their interpretation

G641 Applied Structural Geology (Case Study)

Use real geologic maps for a given area at variety of scales - Use publications to collect appropriate structural data from a range of sources - Describe the detected major structural elements in a report on the area - Apply procedures for deciphering geological history

G643Petrofabric Analysis

Fabrics: mechanisms and Fabric elements Homogeneous vs. heterogeneous domain, Isotropy and anisotropy, Penetrative or pervasive deformation.

Fabric Data and Statistics: representation techniques, analysis - Subsurface conditions - effective pressure, temperature, Brittle - ductile transition – Relative strength and ductility-

Deformation Mechanism Maps - Overview of Deformation within the Crust and Mantle

G645Global Tectonics

Relative motions of two plates on a sphere - Divergent margins and rifting - Transform faults - Convergent margins - Tectonic s of triple junctions - Anatomy of orogenic belts

G646Advanced Structural Geology and Tectonics

Rheology &Deformation mechanisms - Fractures , Faults and faulting - Brittle-ductile and ductile shear zones - Folds and folding - Global tectonics) geometry of structures, associations of sedimentary, igneous and metamorphic rocks in zones of divergent, convergent and strike-slip tectonics - Eastern Desert of Egypt case study: extensional, contractional and strike-slip tectonics, granite emplacement, mineralization and the development of sedimentary basins.

G647Tectonic Evolution of the Arabian-Nubian Shield

Introduction and geologic setting of the ANS - Late Cryogenian–Ediacaran geochronologic data base - Post-amalgamation basins - Late Cryogenian–Ediacaran magmatism - Gneiss domes and belts - Middle Cryogenian–Ediacaran arc- and terrane-forming events - Late Cryogenian–Ediacaran structure - Late Cryogenian–Ediacaran mineralization - Gondwana assembly

G648 Tectonic Provinces of Egypt

Tectonic subdivision of Egyptian territory - Structural History of the Gulf of Suez region - Evolution of the Red Sea and Gulf of Aqaba - Northern Egyptian Folded Belt

G650Geographic Information Systems and Production of Geologic Maps and Cross Sections

Modern techniques of Cartography& GIS - Up to date software packages of geologic mapping - Construction of balanced geologic cross-sections

G652Morphotectonics and Analytical Geomorphology

Geomorphology and structures - Continental and global lineaments - Tectonic landforms - The quantitative analysis of geomorphic processes

G654 Engineering Geology

Soil and rocks geological background and importance for the applications. Production of concrete, aggregate for concrete, soil and rock for road construction, methods for stabilization, paving and facing stones, bricks and ceramics, membranes, dams, water and frost problems in soil including remediation techniques. Pores and fractures, chemical reactivity of soils.

• __M.Sc. Degree in Hydrogeology__

G649 Groundwater Modeling

Pre- and post-processing of data – Introduction - Finite Element Method - Darcy's law, Fluid mass balance, and Derivation of flow equations - Evaluation of simulated equivalents of the observations - Model conceptualization - Estimating parameters and updating results - Finite Difference Method - Solute Mass Balance - Numerical Solvers - Model Execution, Calibration and Parameter Sensitivity - Numerical Approach to Boundary Conditions - Model Prediction, Capabilities, and Historical Perspective - MODFLOW - The groundwater-flow process

G651 Water Quality Modeling

Mass transfer mechanisms – Introduction - Diffusion and distributed solutions - Types of physical-chemical pollution of surface and groundwater - Dissolved oxygen and Bacteria - Reaction Kinetics - Eutrophication and Temperature - Physical and chemical monitoring - Coupling equilibrium, chemistry and mass balance - Biological and microbiological modeling - pH modeling - Mass Balance, Steady-State solution - Non-Point source modeling - Toxic substances Modeling

G652 Surface Water/Groundwater Interaction

Interaction of groundwater/surface water in different landscapes – Introduction - Mountainous terrain - Riverine terrain - Natural processes of groundwater/surface-water interaction - Coastal terrain - Glacial and dune terrain - Karst terrain - The hydrologic cycle and interactions of groundwater and surface water - Effects of human activities on the interaction of groundwater/surface water - Interaction of groundwater and streams - Effects of climate change on the interaction of groundwater/surface water - Interaction of groundwater and lakes - The interface between groundwater and surface water as an environmental identity - Interaction of groundwater and wetlands - Use of environmental tracers to determine the interaction of groundwater/surface water - Chemical interactions of groundwater and surface water

G653 Hydrogeophysics

Magnetic and EC methods – Introduction - Seismic and Hydrological Properties - Fundamentals of Environmental Geophysics - Geophysical Well Logging - Characterization and monitoring in a heterogeneous subsurface - Airborne Hydrogeophysics - Geophysical methods in groundwater investigations - Hydrogeophysical Case Studies in the Vadoze Zone - Electrical and Hydrogeological Properties of Rocks and Soils - Properties of saturated porus media - DC Resistivity and Induced Polarization Methods - Evaluation and interpretation of geophysical data - GPR Methods for Hydrogeological Studies

G655 Field Hydrogeology

Surface water, Stream gauging, seepage meters - Overview, field methods - Surveying seawater intrusion - Hydrogeologic Overview; Spatial Mapping; Campus - Geophysics, Resistivity methods - Field evaluation of aquifers - Overview, lab methods - Depth to water, piezometric surface; Levels - Theory of lab measurements, groundwater flow - Wells: Drilling and well completion - Theory of lab measurements, hydraulic parameters - Sampling ; Water chemistry - Data analysis, interpretation and reporting - Pumping test; field methods

G657 Coastal Aquifers and Saltwater Intrusion

Seawater intrusion through heterogeneous aquifers – Introduction - Conceptual and mathematical modeling - Coastal aquifers, worldwide phenomena - Analytical solutions - Fresh groundwater systems in coastal aquifers - 2-D modeling techniques - Geometry of coastal aquifers - 3-D modeling techniques - Groundwater pump and upconong - Impacts of climate change and seawater level rise on coastal aquifers - Saltwater intrusion mechanisms and processes - Groundwater management in coastal – aquifers - salinization

G659 Water Resources in Arid Environments

Integrated use of surface water – Introduction - Unconventional water resources - Environmental aspects of arid environments - Draught and demand management - Introduction to general worldwide water status and climate change - Economic aspects of water distribution and storage - Climate change and water scarcity - Water legislation, water priorities, water sector coordination - Artificial recharge and full cost recovery - Transboundary waters and regional agreements, water regulations and policies - recycle, re-use, runoff management - water awareness campaigns, water economy and technical issues - Irrigation and efficient use in agriculture

G660 Applications of GIS in Water Resources

GIS data for water resources - An overview - ArcGIS hydrology analysis - GIS: Data formats, data input – ArcHydro - Data sources and Data acquisition - Data management in GIS - Vector vs raster and raster analysis - Geo-Database - Spatial relationships and Topology - Modeling in GIS - Working with tables in GIS - Populating a Geo-Database - Spatial data analysis

G662 Evaluation of Groundwater Resources

Hydraulic testing, Models – Introduction - Hydraulic testing, Methods - Flow equation - Hydraulic testing, Applications - Mass transport equations - Water resources Monitoring - Boundary conditions - Contaminants measures and control - Analytical vs numerical solutions - Water resources development - Response of ideal aquifers to pumping - Modeling techniques and management - Groundwater evaluation and management strategies

G664 Karst and Fractured Aquifers

Developing conceptual models – Introduction - Fractured rocks - Karst landscapes--Form and process - Groundwater flow in fractured rocks - Karst Landforms - Geometry of a fractured aquifer - Karst hydrogeology principles - Flow dynamics and physics - Sediments and Solutes - Modeling karst - Contamination in karst - Exploitation and management of karst and fractured aquifers - Paeoclimate and water origin

G666 Aqueous Geochemistry and Groundwater Contamination

Weathering - Introduction, chemical review - The solid-solution interface - Thermodynamics & Kinetics - Solute transport - Solution complexation reactions - Mass transport in groundwater flow - Acid-base & carbonate chemistry - Multiphase fluid systems - Carbonate chemistry - Geochemical Modeling - Redox reactions - Geochemical Modeling - Mineralogy and soil chemistry

• <u>M.Sc. Degree in Igneous & Metamorphic Rocks</u>

G661 Petrology of Metamorphic Rocks

Metamorphic Processes Classification and nomenclature of metamorphic rocks (Metamorphic facies versus metamorphic grade) - The role of the protolith Chemography and Thermobaromtery - (Depicting rock composition in 3D space – AFM Diagrams - Chemical zoning and its impact on calculated P-T.) - Equilibrium thermodynamics and calculations - Tectonothermal histories through time - Dating metamorphic processes and events - Fluids and Metamorphism - Metamorphic Mineral Reactions - General characteristics of metamorphic terrains

G663 General Characteristics of Metamorphic Terrains :

Definition - Types of metamorphic terrains - Metamorphic zones in contact aureoles - Heating of the different types of country rocks adjacent to various intrusions - Metamorphic zones in regional metamorphism - In pelitic sediments - In calcareous rocks - Mineral assemblages in mafic protoliths: a brief overview.

G665 Basement Tectonic of Egypt

Pre pan-African infrastructure in Egypt and Sandi Arab - pan-African super infrastructure in Egypt and Sandi Arab – ophiolites - island arc – granites – gravity - dokhan volcanic - Hammat Molasse sedimentary rocks

G667 High Grade Metamorphism andAnatexis

Regional hypersthenes zone (Granolite high grade(- Nomenclature and mineralogical features of granulites - Metamorphism of granolites and related granoblastites - Petrogenetic considerations – Eclogites - Anatexis, formation of migmatites, and origin of granitic magmas - Formation of migmatites - Formation of granitic magmas by anatexis

G669 Alkaline Rocks

Introduction - Definition of term Alkaline rocks – History of study of the alkaline rocks - Regional discrimination & tectonic relations -
** Continental rift- associated Alkaline magmatism
The East –African rift system - Trends in East African Rift Magmatism - Isotopic & trace element characteristics of East African Rift Magma
** Conditions of formation - Carbonatites
Carbonatite Classification& mineralogy - Carbonatite occurrences - Field characteristics of Carbonatites - Carbonatite geochemistry
** Kimberlites
Petrogenesis of the feldspathoidal rocks and Carbonatites – Economic mineralogy of alkaline rocks

G670 Petrology of Igneous Rocks2

Origin of magmas through melting of the mantle and crust - Crystallization of magmas - Petrology of the mantle - Igneous rocks of the oceanic lithosphere - Plate tectonics and magmatism.

G672 Advanced Geochemistry

Concept of fractionation in igneous processes - Behavior of compatible and incompatible elements during melting and crystallization - Geochemical aspects of magma generation and evolution - Applied geochemistry

G674 Advanced Mineralogy

Advanced theory and practices in mineralogy - Phase equilibria in mineralogy - Detailed study of selected mineral groups - Genetic mineralogy - origin of minerals in magmatic process.Typical minerals, phase relations, PTX conditions - Genetic mineralogy - origin of minerals in metamorphic process. Typical minerals, phase relations, PTX conditions - Genetic mineralogy - origin of minerals in hydrothermal, and sedimentary processes - Typical minerals, phase relations, PTX conditions.

G676 Igneous Petrogenesis and Plate Tectonics

Major element, trace element and radiogenic characteristics of magmas generated in different tectonic settings - Processes responsible for chemical diversity of magmas - Petrogenetic models for magmatism in terms of global tectonic processes**.**

G678 Petrology of Mantel

** Kimberlites
Introduction to kimberlites & related rocks - Descriptive geological nomenclature and classification - The geology of Kimberley Type - Geochemistry and origin of kimberlite magm - Upper Mantle Petrology - Mantle overview and rock types - Pressure, temperature and geotherms - Ages of diamonds - Overview of mantle rocks in the Mantle Room – Diamonds - Diamond formation through time - Diamonds - characteristics and value -

Interpretation of diamond data in exploration and evaluation - Kimberlite Indicator Minerals - Overview of kimberlitic indicator minerals (KIM) - Use of indicators in exploration - Early-stage evaluation of kimberlites.

• <u>M.Sc. Degree in Ores & Economic Geology</u>

G671 Minerals Deposit & Plate Tectonic

Introduction - Convergent plate boundary - Mineral deposits assocrated with arcs - Divergent plate boundary - Melallogeny of ocean type crust - Intra continental hotspots, anorogenic magmatism , and associated mineral deposits - mineral deposits associated with rift - mineral deposits in relation to collusion.

G673 Mineral Deposits in African Belt

Archem craton geology ,metallogeny - Paleoprolerozoic belts geology and melallogeny - Mesoprotozoic to early neoproterozoic belts geology and melallogeny - Neoproterozoic- Cambrian (pan- Africa-belts) geology and melallogeny - Paleozoic – Mesozoic basins geology and melallogeny - Cenozoic cover geology and melallogeny

G675 Geochemistry Of Mineral Deposits

Theories of formation of mineral deposits - Deatailed study of the geochemistry of mineral deposits, physical chemistry of ore forming fluids.

G677 Mining Geology and Resource Estimation

Mining operations and activities - Drilling techniques and their advantages and disadvantages - Collection of lithological and structural data from drill core and drill chips - Application of mining software (Vulcan/Surpac) to mine geological data visualization and modeling - Conventional and geostatistical methods of resource estimation - Sampling, grade control and reconciliation - Quality assurance and quality control (QA/QC) for exploration and mining data.

G679 Applications of Industrial Minerals and Rocks

Abrasires - Ceramie raw - Chemical raw - Bulding stones – Fertilizers – Filters – Solrents – Foundary - Gem stones - Materials of glass and cement industries.

G682 AdvancedOre Petrology

Use textural relationships, mineral chemistry, and trace elements to establish the mode of formation and evolution of different rock types - Theoretical basis for understanding processes such as unmixing into immiscible fluids and melts in different systems - Textural data and phase equilibria - Separation of gasses from melts - Distribution of elements between different phases - Geothermometry, geobarometry, changes in petrophysical properties

G684 Fluid Inclusions: Techniques and Applications

Introduction-Basic principles (sample selection-sample preparation-assumption for fluid inclusion analysis- petrographic examination-Terms and abbreviation used in phase equilibria and microthermometry)-Fluid inclusion analysis techniques (microthermometry-chemical analyses)-Data handling and interpretation- Fluid inclusion applications in geology.

G686 Exploration Geochemistry

Planning – Sampling - Chemical analysis techniques and applied to exploration - Interpretation - Follow up - Basic principles of geochemical prospecting, primary dispersion, soil formation, secondary dispersion - Soil and drainage survey, biogeochemical and geobotanical surveys.

G688 Prospecting of Mineral Deposits

Introduction - Industrial types of mineral deposits - Geological criteria for ore prospecting – Geological prospecting methods and indications - Remote sensing in the search of mineral deposits - Phases of prospecting - The geological prospecting-exploratory works on mineral deposits - Geochemical prospecting methods. Geophysical methods of prospecting for and exploration of metallic, non-metallic and coal deposits) - Case histories of prospecting and exploration - Prospecting and exploration of oil and gas deposits - Prospecting for and exploration of mineral raw materials of seas and oceans

G690 Advanced Ore Deposits

Minerals and related materials - Equilibrium and phase diagrams - Geochemical and petrological tools - Physical and chemical processes - Characterization and interpretation of processes

Ph.D. Geology Programs

1-Ph.D. Degree in Applied Geophysics

G701 Electric and Electromagnetic Prospecting

RESISTIVITY METHODS: Electrode configurations, Electric sounding & Electric profiling, field procedures, Ambiguities, Qualitative & Quantitative manual and computerized Interpretation techniques, Different Applications and case studies.

ELECTROMAGNETIC METHODS: Magnetotelluric Methods (Advantages of EM methods applications and their comparison with electrical methods, attenuation of EM field, combination of EM fields. EM methods for tilt angle measurements, AFMAG and VLF methods (theoretical bases, field procedures, data processing and interpretations), EM methods for phase and amplitude measurements, Turam method (theoretical bases, field procedures, data processing and interpretations), Airborne Method, Ground Penetrating Radar (GPR), Different Applications and case studies.

G702 Well Logging and Petrophysics-3

Measurement while drilling –Logging while drilling –Array Sonic tool- Array Induction Log - Nuclear Magnetic Resonance log. Dipmeter: Definitions- Principle- Picking up depth differences of microresistivity logs across the dipping bed plane-Computing dip angle and strike by standard nomograms or computers –Other concepts like Formation Micro Imaging by electrical conductivity and acoustic methods. Interpretation of dipmeter logs. Electrofacies and depositional environments.Preparation facies maps. Identification of depositional environments through electrofacies

G703 Gravity and Magnetic Prospecting

Gravity and magnetic potential theory: Introduction of Vectors, vector calculus, vector differentiation and integration, Derivation of gradient, divergence and curl of vectors, Laplace differential Equations for scalar and vector potential, Poisson differential Equations for scalar and vector potentials, Green Equations in Potential theory, Applications to solve problems in gravity and magnetic fields

G704 Seismic Exploration

Standard display patterns on seismic sections, polarity conventions, information boxes. Seismic stacked, migrated, and depth sections.

Vertical and lateral resolution concepts in seismic sections:

Thin-bed effects and attenuation, Fresnel zone. Pitfalls in seismic interpretation: Multiples, diffractions and effects from third dimension, and problems due to velocity variations. Properties of seismic reflection amplitudes: Bright-spot, dim-spot, flat-spot.

Tectonic features in seismic sections: Recognition of normal, reverse, strike-slip, listric faults, and flower structures.

Sedimentary features in seismic sections: Erosion surfaces, transgressions and regressions, on-lap, top-lap, down-lap concepts. Seismic facies' and seismic sequences: parallel, convergent, divergent, sigmoid, and chaotic layering. Sea level changes.Creation of fans and basins.

G705 Shallow Geophysical Exploration and Applications

Introduction, Shallow or near surface geophysics techniques, Using Shallow Geophysics for groundwater resource mapping, groundwater character discrimination, ore deposits exploration and environmental studies.

Gravity and magnetic application to map regional aquifers and large scale basin features.

Seismic methods utilization to delineate bedrock aquifers, fractured rock systems and engineering properties of soil and bed rocks.

Electrical and electromagnet methods uses to groundwater and environmental studies (porosity and permeability of rocks, mapping the depth and thickness of aquifer, Locating preferential fluid migration paths such as fractures and fault zones and mapping contamination to the groundwater such as that from saltwater intrusion).

G706 Seismic Hazard and Geophysical Site Investigations

Classification of Materials at the Soil-Rock Interface, Microearthquakes and Neotectonics, What Is a Reference Site, Seismicity and kinematic evolution, Site Amplification, Seismological and geological evaluation, Forms of

ground motions, Procedures for selecting earthquake ground motions, Acquisition and evaluation of geotechnical data, Liquefaction.

G707 Advanced Sequence Stratigraphy-2

Concise Review of sequence stratigraphic tools- Applications of Sequence stratigraphy in:Fluvial systems - Coastal plain to shoreline-shelf systems – Deltaic systems- Estuarine systems - Deep-marine systems - Carbonate systems - Some examples of applying sequence stratigraphic tools to surface and subsurface Egyptian successions

G708 Fast African Rift and Geology of NileBasin

Levant Fault System (The North Anatolian Fault (NAF), The East - Anatolian Fault (EAF) Gulf of Aqaba- Dead Sea transform fault) - Gulf of Suez and Red Sea Tectonic Evolution - Triple junction & Afar Triangle - Bust African rift evolution, The Great African Lakes - Gulf of Aden(Pre-rift setting- Oligocene-Miocene continental rifting) - Tectonic framework of East Sudan, Erythrea& Abyssinian Plateau

- # **Ph.D. Degree in Petroleum Geology**

G710 Petroleum System-2

Reservoir Rocks - Structures and trap configurations - Typical and specialized logging suites - Geophysical tools integrated with geology - Correlation principles and exercise - Sequence stratigraphy primer and applications - Frontier exploration and examples - Exploration and Exploitation and examples from Egypt - Appraisal Methods and Examples - Reservoir mapping and volumetrics - Development and examples - Unconventional Resources

G711 Advanced Geophysical Hydrocarbon Exploration

The application of geophysical techniques to exploration of subsurface hydrocarbons, including borehole geophysical methods and the acquisition, processing and interpretation of seismic reflection data - techniques employed in the exploration for hydrocarbons - methods of reflection seismic data acquisition, processing and interpretation - description and assess the methods of borehole geophysical data acquisition and interpretation - write a technical report in the style and to the standard required by the hydrocarbon industry - The course covers the application of geophysical techniques to exploration of subsurface hydrocarbons, including borehole geophysical methods and the acquisition, processing and interpretation of seismic reflection data.

G712 Petroleum Geochemistry

Chemical properties of oil and natural gas - Source rock analyses. Alteration of petroleum in the reservoir rock - The application of petroleum geochemistry in the exploration of oil and natural gas - Biomarkers geochemistry I - Biomarkers geochemistry II - Fate and transport of hydrocarbons in the subsurface, applications of reservoir geochemistry - Basics of petroleum refining - Environmental aspects of petroleum production, fingerprinting.

G713 Advanced Sedimentary Basin Analysis

Modern concepts of tectonics and analysis of sedimentary basins. Application of geophysical logs and seismic stratigraphy to basin analysis, facies distribution, and structural style in a variety of basin types will be covered. The focus is on the evolution of the Arabian Plate but specific examples from around the world will also be covered. The course includes applications of organic geochemistry and techniques of hydrocarbon assessment in basinal settings.

G714 Modern Applications of Remote Sensing Techniques to Geologic Problems

Current and future sensing systems - Spatial, spectral resolution and sampling – LIDAR remote sensing - Application of LIDAR techniques and DEM in geology – RADAR remote sensing principles and interferometric SAR - Remote sensing and GIS in mineral exploration - Infrared sensing methods.

- # **Ph.D. Degree in Stratigraphy & Paleontology**

G716 Global Stratigraphic Correlation
Correlationof the Paleozoic rocks in Egypt-This course intends in correlation the Paleozoic ,Mesozoic & Cenozoic rocks with those countries at Africa,south America &Europe - Discussing the relationship between the rocks of same geologic age

G717 Micropalaeontology in the Petroleum Exploration
Calcareous microfossils – Siliceous - Origin-walled microfossils (palynomorphs) - Biostratigraphy and paleoenvironmental interpretation - Integrated stratigraphy

G718 Geological Time Scale & the World Type Geologic
Rues of the global strato type sections&points - List of the global strato type sections & points - Paleozoic ,Mesozoic & Cenozoic - Global boundary strato type sections & points in Egypt .

G719 Phanerozoic Mass Extinctions
The definition of the mass extinctions - mass extinctions & their geology ages - the explanation of causes of the mass extinctions

G720Advanced Quaternary and Environmental Geology
Concise revision of the Quaternary geology and environmental geology. Methods used to identify, map, dale and correlate Quaternary deposits and interpret Quaternary history and Quaternary climate change. Utilization of geologic principles to resolve environmental issues in land use, land management and development. Methods of Acquiring, compiling, and applying geologic information for site assessment and environmental impact.

G721Stratigraphy of Africa
The Archean between 3800-2550 MA :formation of cratons - Paleoprterozoic growth of Archean cratonic blocks - Mesoproterozoic continental break-up and growth - Neoproterozoic continental break-up and growth - The phanerozoic evolution of Africa

Ph.D. Degree in Sedimentary Geology

G707 Advanced Sequence Stratigraphy-2
- Concise Review of sequence stratigraphic tools.

- Applications of Sequence stratigraphy in:Fluvial systems - Coastal plain to shoreline-shelf systems – Deltaic systems- Estuarine systems - Deep-marine systems - Carbonate systems.

- Some examples of applying sequence stratigraphic tools to surface and subsurface Egyptian successions

G708 Fast African Rift and Geology of Nile Basin

- Levant Fault System (The North Anatolian Fault (NAF), The East

- Anatolian Fault (EAF) Gulf of Aqaba- Dead Sea transform fault)

- Gulf of Suez and Red Sea Tectonic Evolution

- Triple junction & Afar Triangle

- Bust African rift evolution, The Great African Lakes

- Gulf of Aden(Pre-rift setting- Oligocene-Miocene continental rifting)

- Tectonic framework of East Sudan, Erythrea& Abyssinian Plateau

- ### G713 Advanced Sedimentary Basin Analysis.
  Modern concepts of tectonics and analysis of sedimentary basins. Application of geophysical logs and seismic stratigraphy to basin analysis, facies distribution, and structural style in a variety of basin types will be covered. The focus is on the evolution of the Arabian Plate but specific examples from around the world will also be covered. The course includes applications of organic geochemistry and techniques of hydrocarbon assessment in basinal settings.

G71 4Modern applications of remote sensing techniques to geologic problems

- Current and future sensing systems

- Spatial, spectral resolution and sampling

- LIDAR remote sensing

- Application of LIDAR techniques and DEM in geology

- RADAR remote sensing principles and interferometric SAR

- Remote sensing and GIS in mineral exploration

- Infrared sensing methods

G720 Advanced Quaternary and Environmental Geology

Concise revision of the Quaternary geology and environmental geology .Methods used to identify ،map, dale and correlate Quaternary deposits and interpret Quaternary history and Quaternary climate change .Utilization of geologic principles to resolve environmental issues in land use, land management and development .Methods of Acquiring, compiling, and applying geologic information for site assessment and environmental impact.

Stratigraphy of Africa
- The Archean between 3800-2550 MA :formation of cratons
- Paleoprterozoic growth of Archean cratonic blocks
- Mesoproterozoic continental break-up and growth .
- Neoproterozoic continental break-up and growth .
- The Phanerozoic evolution of Africa

- **G723 Advanced Geochemistry of Sediments and Sedimentary Rocks**

Concise revision of the basics and tools of the geochemistry of sediments and sedimentary rocks. Advanced analysis of one or more topics of the mineralogy and geochemistry of sediments find sedimentary rocks using the most recent techniques, interpretations, and data

- **G724 Selected Topics related to Sedimentary Geology**

• Ph.D. Degree in Structural Geology

G725 Modern Concepts in Structural Geology and Tectonics
Experimental Rock Deformation – Microtectonics - Shear sense indicators - 3-D Structural Geology

G726 Geodynamics and Neo-Tectonics
Active Tectonics - Tectonic Geomorphology - Seismo Tectonics – Geodesy - Present-Day Earth geodynamics

G727 Quantitative Geomorphology
Fluid dynamics and solid mechanics - Geomorphometryand field measurements - Drainage basins and channel networks - Landscape evolution modeling.
weathering and the interactions between climate, tectonics, erosion, and deposition

G728 Tectonic Framework of the Middle East
North Africa: Geological Framework & Pan-African Orogeny - Paleozoic sedimentation history - Mesozoic rifting and extension - Alpine Uplift - Tertiary Volcanism
Arabian Peninsula: Phases of the Arabian Plate tectonic history :
Pre-Cambrian - Ordovician-Silurian Glaciation / de-Glaciation - Carboniferous (Hercynian Orogeny) - Early Triassic (Zagros Rifting) - Late Cretaceous (First or Early Alpine Orogeny) - Tertiary (Second or Late Alpine Orogeny) - Neogene Separation from Africa.

G729 Tectonics of Sedimentary Basins
Methods of formation - Lithospheric stretching and triple junction - Lithospheric compression/shortening and flexure - Strike-slip deformation and pull-apart basins - Ongoing development

G730 Tectonic Setting of the Mediterranean Basins
Structure and evolution of the mediterranean basins - LavantineBasin - Nile Delta and northern Sinai off-shore structures

• Ph.D. Degree in Hydrogeology

G732Integrated Water Resources Management
Course contents:
Determination of sustainable yield – Introduction - Water Scarcity and its impacts - Data requirement for water resources management - Water demand management - Conventional vs. non-conventional water resources - Water

resources management - Surface water resources - Functions of water resources management - Groundwater resources - Artificial storage and recovery - Non-conventional water resources - Water resources in Egypt - Water resources planning

G733 Socio-Hydrology

Co-evolutionary dynamics of human-water systems – Introduction - Human-modified water cycle across time - Human and the environment - Environmental impacts - Hydrological processes - Interaction between water and human - Social processes - Comparative analysis of human and water systems - Water in different cultures and religions - Integrated water resources management - Water in ecosystem - Modeling of coupled based human-water systems - Human impacts on water systems

G734 Integrated Watershed Management

What is Restoration? – Introduction - Land use and water use - Watershed basin analysis - Socioeconomic drivers: contamination - Water availability - Ecosystem services - Watershed and climate change - Uncertainty and Complexity in Watershed Management - Conceptual Framework and Motivation for Management - Legal/Institutional Framework: Quality and Quantity - The Watershed Concept: History and Implications - The future of watershed management - The Biophysical Template: Water Availability

G735 Isotope Hydrology

Determination of the origin of water masses - An overview - Dating Old Groundwater - Environmental isotopes in hydrology - Determination of the residence time of water - Tracing the hydrologic cycle - Radiogenic Strontium and Other Miscellaneous Isotopes - Surface and groundwater studies - The Practical Side of Environmental Isotopes - Tracing the Inorganic Carbon Cycle - Study of transport and degradation of contaminants - Using Stable Isotopes in Water Quality Studies - Isotope eco-hydrology - Dating Modern Groundwater

G736 Environmental Impact Assessment

Hydrology, flooding, erosion/deposition - Introduction and brief history of the EIA - Water quality, water supply - EIA as decision making process - Air quality, climate change, energy conservation - EIA as research - Cultural Resources/Archaeology, Historic Preservation - EIA process in Egypt - Social/Demographics, Community Services - Types of Environmental documents - Noise Impact Analysis - Environmental Assessments - Visual Impact Analysis - Geology, topography, soils

• __Ph.D. Degree in Igneous & Metamorphic Rocks__

G738 Micro Tectonics

Deformation - Foliation,lineations& lattice preferred orientation - Shear zones - Dilatation sites : vibrous veins, strain shadows, strain fringes and boudins - Porphyroblasts and reaction rims - Natural microgauges

G739 Modern and Ancient Volcanic Successions :

Some properties of magmas relevant to their physical behavior- Volcaniclastic deposits and their eruptions - Lava flows - Modern pyroclastic fall deposits and their eruptions - Transport and deposition of subaerial pyroclastic flows and surges - Ignimbrite and ignimbrite – forming eruptions - Subaqueous pyroclastic flows and deep- sea ash layers - Classification of modern and ancient Volcaniclastic rocks - Modern volcanoes and volcanic centers .

G740 Metamorphic Mineral Reaction & Equilibra

Polymorphic transformations - Exsolution reactions - Solid – solid net-transfer reactions - Devolatization reactions - Continuous reactions - Ion exchange reactions - Phase diagenesis for multicomponent systems that involve several reactions - Metamorphic reactions in different rocks types - Reactions mechanism.

G741 Metamorphism and Tectonics

Introduction - Thermal considerations - Abrief overview of metamorphism in orogens - Ocean –ridge metamorphism - Petrology of metamorphosed seafloor rocks - Intact slabs of ophiolite - Near- trench metamorphic associations

G742 The Evolving Continents

Archean high-grade regions - Arcchean (archaeangreenatone belts) - Crustal evolution in the archaean - Early to mid-proterozoic basic – ultrabasic intrusions - Mid- late proterozoicbasins ,dike ,glaciations and life forms - Continental evolution in the proterozoic - Caledonian –appalachian fold belt - Hercynian fold belt - The evolving continents.

G743 Isotope Geology

Introduction - Radiogenic isotopes and their applications – Geochronology - Stable isotopes and their applications

- ## **Ph.D. Degree in Ores & Economic Geology**

G745 Hydrothermal Alteration :

Water and hydrothermal fluids on Earth- Hydrothermal processes and whole rock alteration - Tectonic setting geodynamics and time-dependent evolution of hydrothermal mineral systems - Intrusion-related hydrothermal mineral systems - Porphyry systems, fossil and active hydrothermal systems - Skarn systems - Submarine hydrothermal mineral systems, orogenic amagmatical and indefinite-origined hydrothermal mineral systems - Hydrothermal systems and the Biosphere - Hydrothermal processes associated with meteorite impact - Uranium hydrothermal mineral systems - Geological issues formed by hydrothermal alteration - Industrial raw materials due to hydrothermal alteration, and their usage, hydrothermal alteration samples from Egypt

G746 Isotope Geochemistry for Economic Geologists

Mechanisms of radioactive disintegration; mass spectrometry; different radiogenic and stable isotope systems (e.g., Rb-Sr, Sm-Nd, Re-Os, Lu-Hf, Sm-Nd and U-Pb and Pb-Pb; S and C isotopes); examples of the use of isotopes in the research of ore deposits. calculate the ages of rocks using given isotope measurements of different isotopic systems and based on isotopic rations, can make inferences on - origin of different rocks types including ore deposits.

G747 Applications in Industrial Minerals &Rocks :

Separation of ores into concentrates - Mineral chemistry & its implications - Study of some minerals and rocks

G748 Fluids in Earth Crust

Introduction : history – the development of ideas about crustal fluid compositions and there effects on rocks - Crustal fluid : the basres - The solvent perspective : where do fluid occur? – Geological setting of crustal fluid

G749 Mineral Hazards to Human Health

Position effects of minerals on human health: environmental mineralogy, minerals as conditioners, clay, mud and health, special sands, mineral – medicinal water - Negative effects of minerals on human health: quality of soil, water and oil and toxicity, diseases influenced by minerals.

G750 Advanced Mineral Exploration

Mineralogy, economics and models- reconnaissance exploration.

Geophysical methods : airborne ,magnetic, gravity, seismic, ground radar…..etc.- exploration geochemistry – data storage , integration and GIS

Botany and Microbiology Programs
1- Professional Diploma in Applied Microbiology

B501 Virology and Immunology
Infection process in details - Strategies of virus maintenance in communities - Virus replication strategy - Resistance to viral infection - Determination of physical and Chemical characteristics of viruses - Polyclonal and monoclonal antibodies against viruses.

B502 Applied Phycology
Commercial uses of algae. Fundamental research development of techniques and practical applications in algal and cyanobacterial biotechnology, genetic engineering, tissues culture, collections commercially useful, micro-algae and their products, mari culture algalization and soil fertility pollution, fouling monitoring toxicity tests, toxic compounds, antibiotics and other biologically active compounds.

B503 Yeasts systematics
Introduction – Isolation and maintenance of yeasts – Criteria employed in yeast taxonomy:- A. Morphological characteristics (Vegetative reproduction – Vegetative cells).   B. Cultural characteristics (Growth on liquid medium – Growth on solid media). C. Sexual characteristics (Ascus and ascosporic formation – Infertility of ascomycetous yeasts – Aeciospores and sporadic). D. Physiological characteristics (Utilization of carbon compounds – Utilization of nitrogen compounds – Growth in vitamin-free medium – Growth on high osmotic pressure - Growth at elevated temperature – Acid production of extract lunar compounds – Fat splitting- Pigment formation – Ester production – Cycohexamide resistance – Hydrolysis of urea – Diazonium Blue B Test (DBB) - Gelatin liquification). E. New trends (Kits and automated programs – Molecular techniques applied in yeast identification). F. Study representative genera of common and wide latitude yeasts.

B504 Microbiological Analyses
The spatial distribution of microorganisms, Ideal sampling quantities, Sampling plans, isolate and enumerate microorganisms in samples, aerobic plate count, aciduric flat sour sore formers, Detection and determination of anaerobic spore former, Detection of coliform, faecal coliforms and E coli in samples, Direct microscopic count, Fermentation test, Detection and confirmation of salmonella species in samples, Detection and confirmation of Shigella in samples, Detection and confirmation of Staphylococcus aureus in samples, Detection and confirmation of sulfide Spoilage sporeformers species in samples, Bacteriological examination of water, Culture media, Biochemical tests.

B505 Medical Microbiology
Medical Bacteriology- A systematic bacteriology, ways of infection, diagnosis and treatments of the studying pathological bacteria groups.
Medical Mycology - Topics of this course cover the fundamentals of fungi causing infections to humans. Each micro-organism is studied from the following topics: Morphology and characters, virulence factors "surface antigen, toxins and enzymes", pathogenesis.

B506 Selected Topic in Microbiology
The course title and description are submitted by the department committee.

B507 Biofuels and Renewable Energy
Introduction to Biofuels, Bio-oil-Biodiesel-Biohydrogen, solid biofuels, liquid biofuels (bioalcohols, such as bioethanol, and oils, such as biodiesel), and gaseous biofuels (biogas, landfill gas and synthetic gas). Fermentation of the sugar components of plant materials. Solar energy. Biomass.Green renewable energy.

B508 Microbial Bioremediation
The definition of bioremediation and the organisms involved are covered. The ability of microbes to degrade or transform pollutants (organic and inorganic) is discussed; especially the limitations of bioremediation and use of inoculants. Fundamental knowledge on microbial-based bioremediation will be applied in the form of case studies which will enhance and add to the lectures e.g. full-scale treatment of industrial effluents.

B509 Aquatic Hyphomycetes
Introduction; isolation and identification; nutrition and sporulation; role in food webs; adaptation; attachment and germination of conidia, factors affecting the occurrence of aquatic hyphomyctes; species composition and water chemistry; aquatic hyphomycetes occurring on wood and role of woody debris in life cycle; anamorph–teleomorph

relationships, interaction with invertebrates; ecological and biological role of aquatic hyphomycetes. Water pollution and aquatic hyphomycetes.

B510 Food Microbiology

Food as substrate for microbes – Factors influencing microbial growth in foods – The role of microorganisms in food processing and preservation – Relation of microorganisms (bacteria, fungi viruses and bacteriophages) to food spoilage, foodborne illness and general food quality – Role of microorganisms in healthpromotion – Types of microorganisms in foods, meat, poultry, seafoods, fruits, vegetables and frozen foods.

B511 Environmental Microbiology

This course covers fundamental aspects of microbial physiology and ecology. Specific areas of focus include energetics and yield, enzyme and growth kinetics, cell structure and physiology, metabolic and genetic regulation, microbial/environmental interactions, and biogeochemical cycles. The goal of this course is to provide a basic understanding and appreciation of microbial processes which may be applicable to environmental biotechnology.

B512 Applied Bacteriology

Composition and ultrastructure of bacterial cell; Peptidoglycan synthesis and antibiotic effects; Protein synthesis and antibiotic effects; DNA replication and antibiotic effects; Quorum sensing and mechanisms of bacterial pathogenicity; Regulation of gene expression and control metabolic activity; Plant growth promoting bacteria; Anaerobic fermentation; Anaerobic respiration.

B513 Microbial Toxins

Soil environment, Taking soil samples, Methods for isolation of micro-organisms from different substrates, Micro-organisms in the plant rhizosphere, Formulae of selected culture media, Bacterial toxins (Protein Toxins), Phycotoxins (Cyanobacterial toxins), Mycotoxins (Fungal toxins), Classification and history of microbial toxins. Factors affecting microbial toxins production.

B514 Biosafety and Biocontrol

Importance of biotechnology, application of biotechnology, bioethics, product safety, release of genetically modified organisms; public perception of biotechnology and biotechnological products. Biosafety regulation. Biosafety precautions.

MD515 Medical Biochemistry

Introduction to metabolism; methods for studying biochemical abnormalities; Body fluids, electrolytes, acid-base balance; Proteins; Enzymes including clinical enzymology; Membranes; Energy metabolism; Molecular mechanisms of movement; Molecular basis of inheritance; Nucleotide metabolism; Digestion and absorption; Mode of action of hormones; Carbohydrate metabolism; Lipid metabolism; Protein metabolism; Amino acid metabolism; Vitamins; Mineral metabolism; Metabolic integration;   Biochemistry of Diabetes mellitus, Atherosclerosis, Fatty liver, and obesity; Liver function tests; Kidney function tests; Thyroid function tests; Adrenal function tests; Pancreatic function tests; Gastric function tests; Biochemical changes in pregnancy and lactation; Cancer Biochemistry.

MD 516 Medical Biochemistry

Introduction to metabolism; methods for studying biochemical abnormalities; Body fluids, electrolytes, acid-base balance; Proteins; Enzymes including clinical enzymology; Membranes; Energy metabolism; Molecular mechanisms of movement; Molecular basis of inheritance; Nucleotide metabolism; Digestion and absorption; Mode of action of hormones; Carbohydrate metabolism; Lipid metabolism; Protein metabolism; Amino acid metabolism; Vitamins; Mineral metabolism; Metabolic integration;   Biochemistry of Diabetes mellitus, Atherosclerosis, Fatty liver, and obesity; Liver function tests; Kidney function tests; Thyroid function tests; Adrenal function tests; Pancreatic function tests; Gastric function tests; Biochemical changes in pregnancy and lactation; Cancer Biochemistry.

Z664 Selected Topics in Parasitology

M.Sc. Botany and Microbiology Programs
1- M.Sc. Degree in Plant Physiology

B601 Molecular Physiology
Understanding the nature of membrane transport processes at the cellular, molecular, biophysical and physiologic levels. Students will learn about the different classes of molecular machines that mediate membrane transport and their mechanisms of action. Emphasis will be placed upon the relationship between the molecular structures of transport proteins and their individual functions. The interactions among transport proteins in determining the physiologic behaviors of cells and tissues will also be stressed. Molecular motors will be introduced and their mechanical relationship to membrane transport proteins will be explored. Signal transduction molecules Molecular mechanisms of plant metal tolerance and homeostasis.

B602 Physiology and Plant Biochemistry
Introduction - Photosynthesis – History and environment - Photosyntheticsapparatus – Light - reactions- Dark reactions - Respiration - Nitrogen metabolism- Fat metabolism - Signal transduction- Programmed cell death- Coarse activity.

B603 Mineral Nutrition
Introduction - Absorption of minerals by root system- Active and passive absorption of minerals - Availability of different minerals in the soil - translocation of minerals across different plant tissues and organs - Function and assimilation of macro- and micro-elements - Factors affecting the absorption and translocation of minerals.

B604 Plant Hormones
Introduction - History and environment of growth regulators - Biosynthesis of plant growth - hormones - Physiology and Biochemistry of plant growth regulators – Type of plant growth hormones, Modes of hormone action, Photoperiodism , phototropism, Vernalization and abscission, Fruit ripening and parthenocarpy, Hormones and stress physiology.

B605 Plant Water Relations
B606 Selected Topics related to Plant Physiology
The course title and description are submitted by the department committee.

B607 Environmental Pollution
B608 Physiology of Salt Tolerance
The course will start with an overview and discussion of the key elements in economic growth of any country, population dynamics, current trends and future needs of improved plant production in actual context (sustainable agriculture). Types of saline soil, salt stress, how to measure salinity, adverse effects of salt stress on plants, plant adaptations to salt stress, strategies for crop improvement against salt stress will be introduced.

B609 plant Biotechnology
Introduction - Plant genome structure and regulation - Protein synthesis and translocation -Vector and restriction enzymes- Methods for plant transformation -Analyses of the transgenic plants – Protein over expression systems - Gene silencing and RNAI - Hazards , risk assessment and public acceptance for the genetic modified organisms.

B610 Enzymology
Introduction - Structure and classification - Enzyme kinetics Regulation - application in agriculture and medicine. Types of enzymes and their nomenclature- Inhibitors of enzymatic activity- Factors affecting enzymatic activity- Methods for measuring enzymatic activity.

B627 Soil Microbiology
M640 Biostatistics
Fundamentals of statistics - Sampling techniques - Estimation theory - Tests of hypotheses - Curve fitting and regression analysis - Basic statistical tests: goodness of fit test - ANOVA, t-test - Chi-square test - Mann-Whitney test - Multivariate analysis - Using computer software to analyze and express data SPSS and Excel.

• M.Sc. Degree in Plant Ecology

B603 Mineral nutrition
B605 Plant Water Relations

Physio-chemical properties of water based on the phase rule. Chemical potential of water in relation to solutions. Soil physio-chemical properties affecting chemical potential of soil water. Absorption of water and the role of plant roots. Anatomy of root and stem affecting water movement in plants. Role of leaves in plant water relations and metabolism. Continuum theory in plant water relations. Role of micro-climate in affecting transpiration water loss. Resistances affecting water flow in the soil. Plant atmosphere continuum. Water balance in plants and its reflection on metabolism.

B607 Environmental Pollution

Water Pollution :- (Types of water pollution - Sources of water pollution - Biodegradation - Effects of water pollution upon plants- Biological waste treatment).

Air pollution :- (Causes of atmospheric pollution - Harmful effects of air pollution - Toxic metals - Plant response to air pollution - Reducing pollution) .

Soil pollution:- (Sources of soil pollution - Common hazardous wastes- Contamination release and transport from the sources- Phytoremediation).

Radioactive Pollution:- (Radiation - Sources of radioactive waste- Radioactive waste management).

B611 Ecology of Halophytes

Distribution and synecology of halophytes - Classification of halophytes - Sources of salinity - Ion transport and mineral nutrition - Regulation of salt content of salt content of shoots - Water relations - Salt resistance- Salt secreting halophytes.

B612 Environmental Soil Chemistry

Important concepts in studying soil chemistry - Oxidation and reduction in soil systems – Inorganic-solid phase of soil system - Soil organic matter-weathering and soil development- Cation exchange in soils - Anion and molecular retention in soils - Soil PH and acid soils - Salt- affected- soils- Contaminated soils.

B613 Ecology of Mediterranean Region

The Mediterranean Climate from a Biological view point - Subdivision of the Mediterranean climate - The Bioclimatic Area of a Species or of a plant community- Mediterranean type of vegetation of the world- Physiography and soil of Mediterranean lands- The origin of Mediterranean biota- Main physiognomic types and geographic distribution of shrub system related to Mediterranean climates-Floristic composition and phytosociological structure of sclerophyllousmatoral around the Mediterranean- California chaparral.

B614 Phytogeography and Natural Ecosystems

How the living world is organized?– The Biosphere- Biomes and ecosystems –Components of the ecosystem including man– How do ecosystems work?– Food chains and food webs– Flow of energy and matter in the ecosystem– Entropy– Biomass and ecological pyramids- Nutrient cycles– Ecosystem balance and imbalance– Ecosystemstability, definition and causes– Correcting imbalance in ecosystems: Succession – Human impact on ecosystems, effects and assessment – Restoration ecology- Re-establishing the balance.

B615 Biology of Seeds Dispersal and Germination

Introduction - Guidelines for laboratory studies on germination ecology - Causes of within species variations in seed dormancy and germination characteristics - Germination of desert plant seeds - Germination of halophytic seeds - Metabolic changes during seed germination - Germination ecology of seeds in the persistent seed bank.

B616 Selected Topics related to Plant Ecology

The course title and description are submitted by the department committee.

B618 Microenvironment of Plants

Introduction- Soil as the medium for growth - Movement of water in the soil toward roots - The plant in the water-potential gradient between soil and atmosphere (SPAC) - Water relations of plant communities - Evapotranspiration from a stand - Rhizosphere and Electrochemical gradient - Definition of Climatology, Microclimatology and Meteorology - Relations with Biota - Microclimate and plants: the principal effects - Elements of the microclimate and their direct effects on plant life - Principal factors affecting plant water relations; quantitative relations (thermodynamics and energies)- Specific role of microclimate in water use efficiency of plants - Desert microclimate; extremes and their reflections on desert vegetation - Wind and leaf boundary layer - Light and canopy.

B620 Phytosociology and Functional groups

Historical aims and concept of plant community – Plant grouping and populations –Evolutionary processes structuring communities – Evolution and succession of vegetation – Community analysis – Community

classification and ordination – Value of functional groups (FG) - FG and fragmentation – FG and competition – FG and precipitation - Examples to some communities in Egyptian deserts.

M640 Biostatistics

- ## <u>M.Sc.Degree in Taxonomy of Flowering Plants and Flora of Egypt</u>

B613 Ecology of Mediterranean Region
B614 Phytogeography and Natural Ecosystems
B617 Principles of Plant Taxonomy
Introduction - Flower structure - Inflorescences - Fruits - Systems of classification - Study of representative families of angiosperms

B619 Cytotaxonomy
The course contains: Introduction -Historical review – Embryology - Embryo formation – Parthenogenesis – Agamospermy - Types of ovule axes - Chromosomes in Angiosperms: (structure, types, numbers, behavior) - Influence of environment - 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.

B621 Comparative Plant Morphology

Introduction - Evidence from inflorescences, Fruits and seeds - Evidence from Paleontology - Evidence from anatomy -Evidence from embryology.

B622 Advanced Palynology

Definition and importance of palynology- Historical review- Methods of pollen slide preparation and staining- Development of pollen sacs- Sporogenesis- Microsporogenesis- Pollen Composition- Pollen Morphology: (Pollen nucleus number- Pollen storage product - Pollen units -Polarity and symmetry - Pollen size - Pollen shape - Aperture characters) Exine structure and sculpture- Pollen morphology in Gymnosperms - Spores in pteridophyta - The production and dispersal of pollen grains – Pollination - Significance of cross pollination - Means of pollination - Pollen morphology and the taxonomy of Angiosperms (Identifications of Plants - Classification of Plants)- Pollen morphology and the theory of continental drift - Pollen analysis - Isolation of pollens - Identification of fossil pollen - Pollen diagram -Pollen germination and its viability -Factors affecting on pollen germination -Applications and scope of palynological studies -The matrix containing pollen and spores (Pollen preparations - Fossil material -Sandy and clayey sample(.

B623 Taxonomy of Aquatic Plants

The course contains: Introduction - Historical review – Main characters of Aquatic plants - Classification of Aquatic plants - Adaptation of Aquatic plants - Anatomy and physiology of Aquatic plants - Reproduction of Aquatic plants - Economic value of Aquatic plants - Examples of Aquatic plants in the Egyptian flora.

B624 Chemotaxonomy

Introduction - Historical review - Chemotaxonomic investigation - Evidence from phenolics and betalains - Evidence from alkaloids - Evidence from carbohydrates - Characters of taxonomic molecules - Classification of molecules – Micromolecules – Macromolecules – Allozymes – Semantides – Serology – Electrophoresis.

B625 Botanical Gardens and Herbaria

This course deals with the sources of plant identification (botanical gardens and herbaria)- Types of botanical gardens, Role and functions of botanical gardens- Botanical gardens network- Historical development- Importance of making good herbarium specimens- collecting plant material of preparation of herbarium specimens- and pressing- drying and mounting of plant specimens- Floras and checklists- A survey of plant in an area can be made by listing all species of which have been collected in the area.

B626 Selected Topics related to Plant Taxonomy

The course title and description are submitted by the department committee.

B628 Medicinal Plants

Introduction - Plants and phytomedicine - Pharmacopoeia wild medicinal plants in Egypt - Wild plants used in folk medicine.

B630 Fossil Plants

The course contains: Introduction – Preservation of fossil plants – Extraction techniques – Terrestrial and marine palynomorphs – Biostratigraphy and palaeoecology of fossil plants – Applied palynology.

- ## **M.Sc. Degree in Microbiology**

B627 Soil Microbiology
A-Microbial ecology: The soil environment – Taking soil samples – Methods for the isolation of Micro-organisms from different substrates –Micro-organisms in the plant rhizosphere – Formulae of selected culture media. B-The Carbon Cycle: Organic matter decomposition – Microbiology of cellulose and hemicelluloses – Lignin decomposition – Microbiology of other polysaccharides (e.g. starch, pectic substances, inulin and chitin).

B629 Microbial Secondary Metabolites
Basic understanding of secondary metabolites based on the structural elucidation, biosynthesis of key secondary metabolites and biological activity of representative compounds. Microbial Metabolites Derived Frome Glucose, Actyl CoA Pathway, Acetone-malonate-pathway, Shikimic acid pathway or aromatic amino acids, Aliphatic Amino acids, Intermediates of TCA cycle, Several Metabolic Pathways.
Chemotaxonomy of different microbial groupsdepend up on the 2ry metabolites - Regulations of the microbial 1ry and 2ry metabolisms - Yeast and Aspergillusterreus 1ry and 2ry Metabolism - Catabolism and anabolism of the structural & functional molecules - Yeast and Aspergillusterreus Metabolites Derived from Glucose, Acetyl CoA Pathway, Acetone-malonate-pathway, Shikimic acid pathway or aromatic amino acids, Aliphatic Amino acids, Intermediates of TCA cycle, Several Metabolic pathways - Regulations of the Yeast and Aspergillusterreus 1ry and 2ry metabolisms.

B631 Microbial Enzymes
Introduction - Sources & location of enzymes - Screening of microbes for selection of enzyme producers - Production of microbial enzymes on laboratory & industrial scales - Isolation & purification of microbial enzymes - Detection of enzymes - Application of microbial enzymes (Different application forms –Amylolytic, Proteolysis, Cellulolytic, Ligninolytic, Biolytic, and other enzyme groups).

B632 Aquatic Microbiology

Nature of aquatic environment; Microbiology of water supply; Microbial flora of surface and ground waters, aquatic bacteria, aquatic fungi, distribution of bacteria and fungi in waters, influence of physical and chemical factors on aquatic microorganisms, influence of biological factors on aquatic microorganisms, Classify microorganisms based on environmental factors prevailing in their habitats (fresh waters, seawaters and ground waters; Bacteria and fungi as food for other organisms, Waste-water and sewage microbiology, Microorganisms inhabiting plants and animals, the role of microorganisms in the cycling of elements in waters, microorganisms and sedimentation, role of microorganisms in the origin of mineral resources, microorganisms and water pollution, economic significance of aquatic microorganisms.

B633 Advanced Virology

Infection process in details - Strategies of virus maintenance in communities – Virus replication strategy – Resistance to viral infection – Determination of physical and Chemical characteristics of viruses – Polyclonal and monoclonal antibodies against viruses.

B634 Microbial Biotechnology

Production of bioactive pharmaceutical compounds (antibiotics – anticancer agents) – Production of enzymes, vitamins, polysaccharides, alcohols, pigments, lipids, etc.) - Role of microbes in Food biotenology- Manufactured of mycopesticides - biodegradativeactivities of microbes – Agriculture and industrial waste treatment.

B635 Advanced Bacteriology

The course contains: Composition and ultrastructure of bacterial cell - Polysaccharide biosynthesis and the assembly of cell surface structures (Glycogen, Murein and Teichoic acid synthesis- protein, Lipopolysaccharide (LPS) and Phospholipid translocation) - effect of antibiotics on cell wall formation, DNA replication and protein synthesis - Export of cell surface structural components (Protein transport- Protein translocation across the outer membrane in Gram-negative bacteria).

B636 Selected Topics related to Microbiology

The course title and description are submitted by the department committee.

B637 Advanced Mycology

Techniques of isolation and identification of various genera and species- Specific diagnostic mycological techniques-Molecular techniques for identification of fungi. Establishment of phylogenetic tree based on DNA sequencing- Current trends in mycology - Description of various representative fungal groups - Disease(s) caused in human and animals- Mechanisms of infection. Specific antifungal agents.

B638 Host Parasite Relationship

Introduction - Causes of plant diseases – Symptoms - Identification of plant diseases - Pathogensis (survival of pathogens – dispersal of pathogensis) - Infections (phenomenon of infections – effect of infections on physiology of the host and on the growth of the host – defense mechanisims in plants and post-infection structural defense).

B639 Advanced Algae

Definition of Algae - Habit – Habitat - Phytoplankton (Buoyancy of   phytoplankton - Concentration In Lab. & Field - Standing crop – Diversity)-Factors affecting population (Nutrients - Light – Temperature – pH – Turbidity – Grazing) – Economic importance of algae (Pollution - Heavy metals – Sewage – Processing of sewage Purification - Role of algae played in oxidation ponds - COD, BOD - Types and determination – Eutrophication – Algae and hydrogen production – Algae effect on and affected by pollution – Symbiosis, parasitism and saprophytes by algae).

B640 Industrial Microbiology

Scope of Industrial Microbiology (soil and Agricultural Microbiology, Medical Microbiology, Microbial Physiology, Cytology and Morphology, Virology, Genetics, Marine Microbiology, Food and Dairy Microbiology and Immunology) -Characteristics of Ideal Fermentor or bioreactor: Selection of active microbial strains- Microbes involved in food, detergent and therapeutic industries – Enrichment culture technique- Production of biofules.

B642 Physiology of Bacteria

Introduction to bacterial physiology and metabolism - Composition and structure of prokaryotic cells - Membrane transport - Nutrient uptake and protein excretion – Glycolsis - Tricarboxylic acid (TCA) cycle - Electron transport and oxidative phosphorylation - Biosynthesis and microbial growth - Heterotrophic metabolism on substrates other than glucose - Anaerobic fermentation - Anaerobic respiration – Chemolithotrophy - Photosynthesis - Metabolic regulation - Energy, environment and microbial survival. Practical for Advanced Bacterial Physiology Diploma Students.

B644 Microbial Pollution

Microbial pollution of air, water, soil seeds, foods, cheese , fruits (Bacteria , fungi, Algae)- Natural mycotoxins in infected foods and feeds – Factors responsible for ecosystem pollution by microorganism – Diseased caused to human health – Strategies for prevention and control the microbial pollution – Ideal methods for food Storage – Pesticide and their relation to microorganisms (Effect of pesticides on fungi – Microbial hydrolysis of pesticides) – Microbiological control of insects – Fertilizers - Heavy metals and their relation to microorganisms (their effect on fungi – Treatment of pollution by bacteria and fungi) – petroleum pollution and its hydrolysis by microorganism – Dangerous effect of algae to filters and concretes).

Ph.D. Botany and Microbiology Programs
• Ph.D. Degree in Plant Physiology

B701 Growth Regulators
Introduction - Physiology and biochemistry - Plant growth hormones -Photoperiodism -Vernalization and abscission.

B702 Plant Metabolism Regulation
Some Aspects of Calcium-Dependent Regulation in Plant Metabolism, The 14-3-3 proteins: cellular regulators of plant metabolism, Hydrogen peroxide is produced predominantly in plant cells during photosynthesis and photorespiration, and to a lesser extent, in respiration processes. It is the most stable of the so-called reactive oxygen species and Sucrose plays a central role in plant growth and development.

B703 Bioinformatics
Introduction to bioinformatics.Bioinformatics and molecular biology techniques.Major Research areas of bioinformatics (Sequence analysis, Genome annotation, Computational evolutionary biology, Measuring biodiversity, Analysis of gene expression). Bioinformatics software tools, formats & web-services (BLAST, FASTA format, Bioinformatics web-services (NCBI, Entrez, GeneBank). Alignments and Phylogenetic Trees(Global and local alignments, Pairwise alignment, Multiple Sequence Alignment (MSA),Structural Alignment, Phylogenetic analysis).

B704 Plant Signals
Introduction to Plant Responses to Environmental Stimuli, types of signals Plants Receive Signals (Plants can respond to darkness or light by etiolating or de-etiolating (greening), respectively), Transduction Process and Second Messengers, Regulating Enzyme Activity, Transcription Factors and That Regulate De-etiolation and Etioltion. The biochemical and molecular mechanisms of signal transduction in plants. Receptors and photoreceptors in plants and their role in signal perception and transduction. The central role of protein degradation in the regulation of signal transduction in plants.The central regulatory role of protein phosphorylation and dephosphorylating in signal transduction. Calcium and calcium-binding proteins as second messengers in signal transduction. The role of large and small G-proteins in signal transduction in plants. Transcription factors (trans elements) and response elements (cis elements) in promoters of genes acting downstream the signaling pathways. Defense-related proteins in higher plants.

B705 Secondary Metabolites
Secondary plant metabolites, types, biosynthetic pathways, role of 2ry compounds in growth and developments of plants, biological functions of 2ry compounds, Isoprenoid compounds, Nitrogen containing secondary plant products, Plant phenolics and their relatives.Biosynthesis of key secondary metabolites and biological activity of representative compounds.

B706 Environmental Stresses
stress and strain terminology; the nature of stress injury and resistance; water stress, dehydration and drought injury; drought avoidance; drought tolerance; the measurement of drought resistance; excess water or flooding stress; radiation stress - visible and UV radiation; ionizing radiations; salt and iron stresses; other stresses and comparative stress responses. Tolerance of temperature extremes, salt, pathogens and other plants.

B707 Mechanisms Associated With Environmental Stress Tolerance in Plants

History of the study of plant tolerance Tolerance-Resistance Trade, Mechanisms of Tolerance, Ontogenetic shift Effects of Resource Levels on Tolerance Growth rate model (GRM) Compensatory continuum hypothesis (CCH) Limiting resource model (LRM) Species Interactions.

B708 Plant Tissue Culture

Introduction, History, Safety, Media composition and culture environment – Hormones, Types of tissue cultures – Mutagenesis – Regeneration Transformation (Agarobacterium, Bioblstic) – Micropropagation – Commercial applications – Ethics of transformation and GM) – Coarse activity.growth measurements of cell suspension cultures factors influencing cell growth in continuous cultures, experimental design and statistical analysis of cell cultures, automation in cell culture management, in vitro propagation techniques, somatic embryogenesis and production of synthetic seeds, secondary metabolite production.

B709 Genetic and Molecular Biology

This course will emphasize on the molecular mechanisms of DNA replication, repair, transcription, protein synthesis, and gene regulation in different organisms. The techniques and experiments used to discern these mechanisms, often referring to the original scientific literature. In addition, an in-depth look at some rapidly evolving fields, including chromatin structure and function, RNA polymerase dynamics, and regulation of gene expression by different types of RNAs.

B710 Selected Topics related to Plant Physiology

The course title and description are submitted by the department committee.

• <u>Ph.D. Degree in Plant Ecology</u>

B711 Phytotechnology

Introduction - Contaminated soil and bioremediation - Biotechnology selection - Factors affecting the use of bioremediation - Advantages and disadvantages of phytoremediation - Metal phytoremediation Strategies involved in phytoremediation (1- Phytoextraction (concentration; accumulation; hyperaccumulation); PhytovolatilizationPhytostabilization; Phytofiltration; Phytodegradation (or detoxification); Biosorption - Biotechnology and transformation - Organic pollutants and mechanisms of action (xenobiotics; organophosphates; chlorinated aromatics; otherproblematic compounds); (phytodegradation; rhizodegradation; phytovolatilization) – oxygenation, Increasing biodegradation, Nano-phytoremediation as a new technology.

B712 Ecology of Xerophytes

Introduction - Desert ecosystem - Classification of xerophytes - Types of xerihabitats - Nature of drought and heat stresses in xeric habitats - Adaptional features of xerophytes - Osmo-regulation and osmotic adjustment in xerophytes.

B713 Vegetation Analysis

This course describes the classification and ordination of vegetation using systematically collected data from the field. In order to obtain an effective analysis of the vegetation and related environmental factors, both classification and ordination techniques must be employed using specific computer program for vegetation analysis - classificationEach floristic matrix will be subjected to classification by Two Way Indicator Species Analysis (TWINSPAN) – Ordination: The basic goal of ordination is to summarize the community patterns, and to compare these with the environmental information. (1) Indirect gradient analysis. The indirect gradient analysis must be employed using Detrended Corresponding Analaysis (DCA). (2) Direct (constrained) gradient analysis Canonical Correspondence Analysis (CCA) is a multivariate analysis technique developed to relate community composition to known variation in the environment.

B714 Ecology of Aquatic Plants

Types of hydrophytes.Flow, substrate and plant distribution. Flow, substrate, and how they affect individual plants. Depth and plant distribution. Light. Nutrients. Productivity. Vegetation of streams. Vegetation of channels. Uses and benefits of hydrophytcs,

B715 Botanical Maps

The course contains Introduction – Study the factors affecting on the distribution of wild plants – Distribution of wild plants – Using Geographic Information System (GIS) and Remote sensing (RS) to design the botanical maps - Using Global Position System (GPS) to certify the distribution of wild plants.Major types of concept mapping techniques including spider ,hierarchy ,flowchart ,systems and network concept maps .Specialized types of concept maps, including IMHC maps, mind maps ,logic trees, decision trees, fishbone diagrams, pictorial maps, multi-dimensional/3-D maps ,and Mandela maps.

B716 Physiological Plant Ecology

The environment of plants- Radiation and temperature - Carbon utilization and dry matter   production – The utilization and cycling of mineral elements - Water relations.

B717 Evolutionary Ecology

Introduction - Darwin and "The theory of evolution by natural selection- Science before the theory of evolution - Geologists, Uniformitarianism and Paleontology - Concepts of Naturalists - Mechanisms of selection - Difference between Genealogy and Evolutionary Ecology - Molecules and origin of life - Atmosphere before life - Biological elements - Early atmosphere and the beginnings of life - Problematic in which molecule came first - Models and concepts about the origin of life - Role of organisms in the changes of early Earth's atmosphere - (Geomicrobiology) - Evolution of relationships between different organisms - Evolution of relationships between organisms and abiotic – components - Identification of species and concepts of taxonomy - Biological filters and evolution - Evolution, development and regulation or mechanisms.

B718 Selected Topics related to Plant Ecology

The course title and description are submitted by the department committee.

- ## **Ph.D. Degree in Taxonomy of Flowering Plants and Flora of Egypt**

B715 Botanical maps
B719 Molecular Systematic
Introduction - Contribution of PCR- based methods in plant systematic and Evolutionary biology - The origin and evolution of plastids - Chloroplast DNA andthe study of plant evolution - Role of mitochondrial   DNA in Plant systematic - Role of ribosomal RNA as phylogenetic tool in Plant systematic.

B720 Flora of Egypt in Relation to Neighbouring regions

Historical notes – Egypt as a part of the floral regions of the world – Phytogeographical regions and domains that influence the Flora of Egypt - Flora of the Nile region and Oasis –Flora of the deserts and semi-deserts –Flora of red sea coast –Flora of Sinai peninsula and Gable Elba.

B721 Paleobotany

Introduction and plant structure – Phylogenetic - Fossils and preservation Early land plants – Lycophytes - Sphenopsids and ferns - Origin of seed plants – Medullosa and Cycads -Ginkgo, cordites and conifers - Glossopteris through entophytes - Interpreting ancient climate - Biogeography.

B722 Numerical taxonomy

Introduction to the numerical approach to taxonomy - Aims and principles of numerical taxonomy – Selection of taxonomic characters –Applications of numerical taxonomy for biological disciplines – Advantages and problems with numerical taxonomy.

B723 Plant Nomenclature

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.

B724 Modern trends in Plant Identification

History of classification: (1- Preliterature, 2- Ancient Literature, 3- Medieval or dark ages 4- Renaissance, 5- Theory of Evolution, 6-Taxonomy Revolt.). Morphology. Vegetative morphology. Floral morphology and anatomy. Palynology. Embryology. Seed and fruit morphology. Karyomorphology. Anatomy. Chemotaxonomy and serology. Paleobotany. Phylogeny. Molecular biology. Diversity and adaptation. Ecotaxonomy. Cladistic analysis. Host-parasite relationships with relation to plant taxonomy.

B725 Selected Topics related to Plant Taxonomy

The course title and description are submitted by the department committee.

• <u>Ph.D. Degree in Microbiology</u>

B726 Actinomycetes

Taxonomic outline of phylum actinobacteria - isolation and screening of actinomycetes - distribution of actinomycetes in nature - discovery and production of new antibiotics - growth, product formation and fermentation technology - actinomycetes enzymes and growth promoting substances - actinomycetes in agriculture and forestry - actinomycetes as biodeteriogens and pollutants of the environment - actinomycetes in biodegradation of agricultural and urban wastes - actinomycetes in Biotechnology and as causative agents of plant and animal diseases.

B727 Algal Toxins

Cyanobacteria and Dinoflagellates: definition- description; harmful algal blooms, Incidence and distribution of blooms, ; Factors contributing to bloom formation ; Cyanobacterial and Dinoflagellates toxins, Types of toxins; chemical structure- mechanism of action- symptoms and treatments of toxicoses in human; Factors contributing to toxin production, Toxin persistence and degradation, Removal of cyanobacterial and Dinoflagellates toxins.

B728 Ecophysiology of Aquatic Fungi

Introduction; aquatic ecosystems; Origin, evolution, Biogeography, biodiversity and adaptation degree of aquatic fungi. Fungal loop and the Food Web in a aquatic System; Factors and adaptive mechanisms that affect the presence of aquatic fungi in fresh and marine water environment; Interaction and association of aquatic fungi with other water-inhabiting organisms. Ecological and biological role of aquatic fungi; Aquatic fungi in terms of physiological capability and biogeochemical role; Aquatic fungi inhabiting wood; Aquatic fungi related to aquaculture.

B729 Bacterial Biotechnology

Introduction to biotechnology – genetic recombination in bacteria- genetic approaches for improving bacterial strains – selective isolation of mutants – kinetics of bacterial cell growth – role of biotechnology in production of antibiotics, vitamins, enzymes and food additives - production of insulin, interferon and growth hormones in bacterial cells using genetically microbial biocatalysts – bacterial bioremediation and bio fertilizers.

B730 Biochemistry and Physiology of the Plant Pathogenic Viruses

An advanced course in biochemistry, biochemical methods, and reading of the primary literature, featuring systematic coverage of the biochemistry of the central dogma, including DNA (replication, repair, recombination), RNA (regulation and mechanism of transcription, processing, turnover), and proteins structure, synthesis, modification, degradation, mechanisms of action, function).Plant viral disease, symptoms, pathogenicity and virulence, pathogenesis, tolerance, compatibility and incompatibility, hypersensitive reaction and biotrophs.

B731 Bioremediation of Environmental Pollutants

The definition of bioremediation and the organisms involved are covered. The ability of microbes to degrade or transform pollutants (organic and inorganic) is discussed; especially the limitations of bioremediation and use of inoculants. Fundamental knowledge on microbial-based bioremediation will be applied in the form of case studies which will enhance and add to the lectures e.g. full-scale treatment of industrial effluents.

B732 Biosensors and Their Biological Functions

Genral principles: A historical perspective of biosensors technology; bioassay and bioindicators, Signal transduction; Physico-chemical and biological transducers; Sensor types and technologies. Definitions and Concepts: Terminology and working vocabulary; Main technical definitions: calibration, selectivity, sensitivity; reproducibility, detection limits, response time; Problems and trade-offs. Physico-chemical transducers: Electrochemical transducers (amperometric, potentiometric, conductimetric); Semiconductor transducers; Optical transducers; Thermal transducers; Piezoelectric and acoustic-wave transducers; Limitations & problems to be addressed; An Overview of Performance and Applications. Types of Biosensors:Optical biosensors, Surface Plasmon resonance (SPR) biosensor, Bioluminescence, Fluorescence, Colormitric, Absorption, Turbidity. - Electrochemical biosensors: Amperometric, Potentiometry, Voltammetry, Impedimetric, Conductivity, Microbial fuel cell. - Thermal and other biosensors: Thermal Biosensors, Nucleic Acid-based Biosensors, Nanobiosensors - Microbial biosensors: BOD biosensor, Nitrite Biosensor, Ammonia Biosensor. Dissolved oxygen biosensor, Phenol biosensor, Cyanide biosensor, and other microbial biosensor. Microtox biosensor, Photobacterium biosensors, heavy metal microbial based biosensor. Biosensors application. Biosensors for Environmental Applications: Environmental monitoring, Toxicity assessment. Biosensors for clinical application: Glucose biosensor, Urea determination biosensor, Drug development and detection. Biosensors for Food quality control. Biosensors for agricultural uses. Immobilization: Enzyme immobilization Peptide immobilization; Antibody immobilization; Oligonucleotides and Nucleic Acid immobilization; Cell immobilization. Affinity-based Biosensors: Catalytic biosensors: electrodes and enzyme competition electrodes; Affinity-based biosensors; Inhibition-based biosensors; Cell-based biosensors; Biochips and biosensor arrays. Biosensor Engineering: Methods for biosensors fabrication, microcontact printing, Engineering concepts for mass production. Biosensor limitation and problems.

B733 Cyanobacteria

Classification of cyanobacteria: Ecology of Cyanobacteria, Role of cyanobacteria in ecosystem ; Morphology, Cell wall and gliding, cell structure; Growth and metabolism; Nitrogen fixation, Symbiosis, Cyanobacteria and the quality of drinking water, Utilization of cyanobacteria as food, Cyanophages, Cyanotoxins.

B734 Freshwater Algae

Introduction to freshwater algae, Algae as primary producers, Freshwater environments, Planktonic and benthic algae, Taxonomic variation- the major groups of algae, Biochemistry and cell structure.

B735 Fungal Biotechnology

Biotechnological potential of entomo-pathogenic fungi and ergot alkaloids, applications of *Trichoderma* in disease control, and the development of mycoherbicides. Fungal control of nematodes, control of plant disease by arbuscularmycorrhizal fungi - Production of edible fungi, fermented foods, and high-value products like mycoprotein -Production of enzymes, vitamins, polysaccharides, polyhydric alcohols, pigments, lipids, and glycolipids, immume enhancers, immune suppressors, antibiotics, anticancer agents.-cholesterol lowering agents.

B736 Fungal Enzymes

Fungal Invertases – Amylases – Lipases - Pproteases – Pectinase - Cellulases, Hemicellulases - Lignolytic Enzymes – Thermostable fungal enzymes.

B737 Medical Mycology

Laboratory Diagnosis- Histopathologic Diagnosis of Mycoses- Antifungal Agents - Principles of Antifungal Therapy - Superficial Mycoses- Dermatophytoses – Keratomycosis - Infections Caused by Malassezia Species - Subcutaneous and Deep Mycoses – Aspergillosis – Blastomycosis - Candidiasis – Chromoblastomycosis – Coccidioidomycosis – Cryptococcosis– EntomophthoramycosisHistoplasmosis – Mucormycosis– MycetomaParacoccidioidomycosis – Phaeohyphomycosis - Pseudallescheriasis – Sporotrichosis - Basidiomycosis- Geotrichosis, Hyalohyphomycosis- Penicilliosis – Pythiosis - Infections due to Trichosporonand other yeast-like fungi.

B738 Industrial Mycology

Types of fermenters (Small Laboratory fermentors - Pilot plant fermentors - Large industrial fermentors) –Role of pH, temperature, agitation, and aeration- Foam control- Selection of active fungal strains- Enhancers and inhibitors of fungal growth – Production of ethanol, glycerol, citric acid.

B739 Lichens

Introduction – A fungus (Mycobiont) – Photo, or phycobionts (A green alga, or a cyanobacterium) – The morphological and anatomical structures (Foliose, Fruticose, Squamulose and Crustose) – The partnership - Growth and development - Reproduction (Reproduction of the mycobiont and phycobiont) - The classification - Ecology of lichens - Lichen conservation - Biology of lichens - Economic relevance.

B740 Marine and Fresh Water Bacteria

General diversity, habitat preferences, and ecological significance of freshwater and marine bacteria - taxonomic, biochemical, and molecular characterization of freshwater bacteria - genetic interactions - metabolic activities - bacterial populations and productivity - bacterial communities in the lotic environment - bacterial interactions with phytoplankton.

B741 Marine Phytoplankton

Introduction to marine algae, Classification, Marine Chlorophyta, Marine Cyanophyta, Marine diatoms; cell structure; cytology- morphological diversity- ecology.

B742 Microbial Biotransformations

Introduction – Reactions, processes and microorganisms used for Biotransformation: Oxidations (hydroxylation of saturated positions,epoxidation, oxidation of alcohols and ketones, dehydrogenation of C-C bonds,oxidation of nitrogen and sulfur group, Baeyer-Villiger oxidation, partial oxidative degradation & other) – Reductions (reductions of mono – and diketo substrates, reduction of aldehydes and carboxylic acids, reduction of double bonds, reduction of heteroatoms & other) – Hydrolytic Reactions (hydrolysis of esters, ethers and glycosides, hydrolysis of C=C and C=N bonds & hydrolysis of epoxides) – Condensations and Additions (Formation of esters, lactones and amide bonds, Glycosidations, Addition of ammonia to C=C bonds &varios other coupling reactions) – other biotrasformations.

B743 Microbial Genetics

Operons and Transcriptional Regulation in Bacteria (Negative Transcription Regulation in Prokaryotes, Operons and Prokaryotic Gene Regulation, Simultaneous Gene Transcription and Translation in Bacteria. Microbial Genomes (Genome Packaging in Prokaryotes: the Circular Chromosome of E. coli, Simple Viral and Bacterial Genomes. Microbial Virulence (Genetics of the Influenza Virus, Genetic Origins of Microbial Virulence, Antibiotic Resistance, Mutation Rates and MRSA).Principles and concepts of modern microbial genetics. Study of the genotype of microbial species and also the expression system in the form of phenotypes.

B744 Mycorrhizae

Introduction – Taxonomy - Morphology of mycorrhizal symbiosis, Infection process - Function of arbuscularmycorrhizal fungi (AM) - Plant regulation of fungal development - Uses of PCR in identification of AM, Application of AM in Agriculture.

B745 Mycotoxins

Classification of Mycotoxins – Classification of Penicillium according to mycotoxin – Classification of Aspergillus - Classification of Fusarium - Classification of Alternaria and other genera - Mycotoxins in various media and environments – Mycotoxicoses of Aspergillus toxins - Penicillium toxins – Fusarium toxins – Alternaria& other genera – Analysis of fungal toxins using Elisa – Advanced biosynthesis of mycotoxins specific to Aspergillus, Penicillium, Fusarium group.

B746 Nitrogen Fixing Prokaryotes

Introduction to the nitrogen cycle in nature - biological forms of N_2 fixation (Classification of nitrogen fixation) - Symbiotic nitrogen fixation - Process of nodulation - Different forms of nodules - Metabolism of N_2 fixation - Assessment technique for N_2 Fixation - Influence of environment.

B747 Seaweeds

Introduction to seaweeds, Phaeophyceae, Rhodophyceae, chlorophyceae; classification; cell structure; chloroplasts ; life cycles ; Commercial utilization of seaweeds.

B748 Seed-Borne Fungi

Introduction- Seed Infection Mechanisms - Systemic Infection of the Seed- Seed contamination or infestation- Infection of the embryo- Non embryo infection- Episperm contamination- Prevention of Seedborne Diseases- seed deterioration by fungi - Examples of seed borne diseases.

B749 Serological Techniques and Plant Viruses

Introduction- principles of immunology- antigens- antibodies- serological techniques polyclonal and monoclonal antibodies production- application of serology in medical treatments, industry, microbial labs and food examinations.Histological and cytological effects of plant virus, Serological reactions and their interpretation,Explain the advanced serological and molecular techniques for viral detection.

B750 Viroids

What are virolds ;taxanomy (Family Pospiviroidae and Family Avsunviroidae) ; Circular RNA; RNA world hypothesis; Viroids and RNA silencing.

B751 Plant Viruses and the environment

Host-virus relationship - Transmission of viruses - Virus-cell interaction - Viral Pathogenesis - Relationship between plant viruses and invertebrates a. Vectors groups in the invertebrates - Nematodes (Nematod -Vector genera , Virus transmitted, Mechanism of transmission, Aphides) - Life cycle and feeding habits- Vector groups of Aphids - Type of Aphid- virus relationship- Non-persistent transmission - Semi-persistent transmission - Circulative transmission - The Most important viral disease - plant viral disease - Human viral disease - Animal viral disease. Presence of viruses in different habitats- factors affecting distribution of viruses- ways of virus transmission in nature.

B752 Selected Topics related to Microbiology

The course title and description are submitted by the department committee.

Zoology Programs

M.Sc. Degree in Zoology

Z601 Cell Biology
Cell growth and proliferation, cell cycle, cell death, cell signaling, transcription and translation regulations.
Z602 Histology
The fine structure of tissues, digestive system excretory system, and skin..
Z603 Molecular Biology
Cell–based assays, genome structure and function, gene expression, protein expression, gene cloning, gene transfection.
Z604 Histochemistry
Enzymes and histochemical reagents, immunocytochemistry, fluorescence microscopy, light microscopy.
Z605 Practical Cell Biology
Cell and tissue culture, synchronous cell cultures, RNA analysis, protein analysis, proliferation and toxicity analysis.
ZM606 Biostatistics
Examination of statistical methods, statistical analysis, programs for biostatistics, analysis, prism, SPSS and Excel.
Z607 Cellular Traffic and Endocytosis
Cell receptors, Trans membrane receptors, membrane biology, and endocytosis.
Z608 Stem Cells
Types of stem cell, origins of stem cells, uses of stem cells, stem cells and future studies, stem cells and therapeutic potentials.
Z609 Tumor Biology
Types of tumors, mechanisms of tumor promotion and progression, Benign VS malignant tumors inhation, cancer metastasis.
Z610 Special Course in (Cell Biology)
This course is left to the Department as a kind of flexibility of the syllabus.
Z611 Signal Transduction
Cell surface receptors, cytoplasmic signal transduction, nuclear receptors, transcription factors, cell cycle regulation.
Z612 Selected Topics related to in Cell Biology
Selected topics related to Cell biology.
Z613 Histochemistry and micro Techniques
Special requirements for histochemical methods, requirements of chemical nature, requirements of morphological nature, the chemistry of fixation, proteins and amino acids, Fluorescent antibody methods, the histochemistry of some important simple proteins, Nucleic acids and nucleoproteins, Carbohydrates and mucosubstances, applied mucosubstances, lipids, lipoproteins and proteolipids Microscopy: general principles microscopes light Microscope ,phase contrast Microscope ultraviolet Microscope, polarizing Microscope, fluorescent Microscope, electron Microscope. general types of biological mounts: whole mounts, smears, squashes. The basic steps in preparing histological sections (paraffin technique)
Z614 Physiology
The course deals with understanding of how various organ system of the body perform their functions and how these functions are integrated. The course covers the major physiological organ systems including cardiovascular, respiratory, renal, gastrointestinal, and endocrine as well as basic concepts of cellular physiology.
Z615 Special course in (Histology)
This course is left to the Department as a kind of flexibility of the syllabus.
Z616 Basic Toxicology

A survey of interaction of environmental pollutants with living systems; general principles underlying the effects of toxic substances on biological systems; the mechanism of toxic action, biotransformation of xenobiotics; strategies for management of toxic chemicals.

Z617 Immunology (1)

An overview on the immune system, the differences between innate and acquired immunity, types of antigens, allergens, antibodies and antigen-antibody interaction, types of cytokines and their receptors. An overview on the autoimmunity. immunological basis of tumors . Basics of immuno histochemistry to discriminate between normal and pathological cells and tissues.

Z618 Aquatic Pollution

Introduction. Aquatic Toxicology. Organic Pollution. Eutrophication. Acidification. Heavy metals and organochlorines.

Z619 Pathology

Terminologies, etiology and pathogenesis of disease, cell injury types - congenital, Acquired (Hypoxic injury, chemical injury, physical injury, immunological injury), cell death & necrosis apoptosis, definition, causes, features and types of necrosis, pathological calcifications, inflammation, vascular response, cellular response, chemical mediators, chronic inflammation, granulomatous inflammation, repair mechanisms, healing by primary intention, healing by secondary intention, factors influencing healing process, complications immunological mechanisms in disease, hypersensitivity & autoimmunity, general aspects of neoplasia, differences between benign and malignant neoplasms, The neoplastic cell, metastasis, carcinogenesis, tumor biology, oncogene and antioncogenes.

Z620 Biochemistry

Chemistry of biological molecules: proteins, lipids, carbohydrates, nucleic acids, etc. Mechanisms of enzyme catalysis. Metabolic pathways, integrated metabolic systems, and molecular physiology.

Z621Genetic and Molecular Biology

The course covers the molecular nature of genes, gene function, the inheritance of genes, and the genetic basis of traits. Topics include Mendelian inheritance, mutation, linkage and recombination, gene regulation and interactions. Mechanism of DNA replication, recombination, transcription, and protein synthesis are emphasized. Advanced topics including gene expression during cell differentiation, retroviral infection, and regulation of cell proliferation.

Z622 Endocrinology

A comprehensive study to the chemical and physiological principle of hormonal regulation in animals. Molecular mechanisms by which hormones elicit specific responses and regulate gene expression and hormone-receptor interaction.   Study of different endocrine glands and its hormones secretion.

Z623 Invertebrate Structure and Function

The foundations of Animal life
1- Living systems. 2- Organization and life. Movement. Aspects of metabolism. Information and control.

Z624 Special Course in Histology

This course is left to the Department as a kind of flexibility of the syllabus.

Z625 Animal Ecology

-Introduction: - Individual organism, population, community and ecosystem -Organism and its environment :Abiotic factors: moisture, temperature, light and periodicity ‹ironing ‹radiation ‹ wind ‹nutrients and animal life .Population and its properties, life history, patterns, population growth, intraspecific regulation, competition regulation, competition ‹perdition ‹parasites ‹mutualism and commensalism .Community and ecosystem :succession, production in ecosystem, food chains.

Z626 Selected Topics

Z627 Fresh Water Ecology

Introduction. The structure of aquatic ecosystems. Chemistry of natural waters. Organisms in Lakes, streams, and Estuaries. Zooplankton and zoobenthos.

Z628 Principles of Systematic Zoology

The science of taxonomy. The species category. The species taxon. Intrapopulational variation and the comparison of population samples. Speciation and taxonomic decisions. Theory and practice of Biological classification. Taxonomic characters.

Z629 Ecophysiology

Introduction. The organism and its environment. Desert animals, physiological problems of heat and water. Animal reproduction mechanisms in relation to environment **.**

Z630 Practical Invertebrates
How to make a culture of different invertebrate groups in lab.

Z631 Special course in Invertebrates
This course is left to the Department as a kind of flexibility of the syllabus.

Z632 Biology of Mollusca
Survey of Mollusca. Field studies, Origin, and Evolution. Morphology and anatomy of a mollusk. Embryonic development. Harmful and Medical mollusks. Molluscs and Pollution. Economic importance of mollusks.

Z633 Parasitic Protozoa
Morphology - Structure and developmental stages, basic life cycle, diagnosis and control - Taxonomy

Z634 Immunology of Invertebrates
Concepts of modern immunology and their importance in biology. Topics include humoral and cellular immune responses, antibody structure and biosynthesis, antigen-antibody interactions, cellular immunology, immunological tolerance, autoimmunity, and tumor immunology.

Z635 Histo-Pathology
Disturbances in cell metabolism - Intra cellular degeneration - Extra cellular degeneration - Pathological calcification - Pathological Pigmentation - Necrosis and Apoptosis - Gangrene. Disturbances in circulation – Congestion – Hemorrhage – Edema – Thrombosis - Infarction - Shock- Inflammatory and repair:- Components of inflammatory response. Inflammatory cells
 classification of inflammation- Healing. 4-Disturbances in growth.

Z636 Soil Ecology
Introduction to the complex world of soils including information on how they are formed, characterized, and populated by a wide array of organisms. An overview of soil types is presented, followed by the study of soil habitats and their properties. Soil animal populations. Diversity and functioning of soil communities. Nutrient recycling. The soil food web, man and the soil.

Z637 Parasites of Fishes
Protozoan parasites - a-myxozoa - b-Blood parasites - c-some other ecto and endo parasitic protozoa - 2- Helminthic parasites - a-Monogenea - b-Trematoda - c-cestoda - d-Nematoda - e-Acanthocephala.

Z638 Invertebrate Relationships
Introduction to animal phylogeny sources of evidence in invertebrate phylogeny
Phylogeny of magor groups.

Z639 Biochemistry
Chemistry of biological molecules: proteins, lipids, carbohydrates, nucleic acids, etc. Mechanisms of enzyme catalysis. Metabolic pathways, integrated metabolic systems, and molecular physiology

Z640 Selected Topics related to Invertebrates
This course is left to the Department as a kind of flexibility of the syllabus.

Z641 Special Course in Parasitology
This course is left to the Department as a kind of flexibility of the syllabus.

Z642 Parasitic Helminthes
Morphology - Anatomy and developmental stages, basic life cycle, diagnosis control – Taxonomy

Z643 Comparative Physiology -The significance of all physiological mechanisms in the ecological theaters with be viewed with evolutionary perspective.
-Emphasis in the interrelation ships between animals and their environment, relation between from and function, similarities and differences among vertebrates and invertebrate s in achieving homeostasis focusing on the excretory, reproductive, muscular, nervous ‹respiratory and digestive system.

Z644 Intermediate hosts and biological vectors
-vectors transmitted parasites
land snails). – Terrestrial Oligochitae) terrestrial snails-Insects -
.vectors interactions – parasites -
 -Control strategies of vectors.**Z645 Physiological Biochemistry**

The course show how the physiological actions of selected organs can be explained by their particular biochemical processes. The course provide information on the following topics: biomarkers of cell organelles, enzymes, and enzyme mediated control of metabolic pathways and bioenergetics, models of control of metabolic pathways, biochemistry of intercellular communication, signaling molecules and target tissue response to signals, metabolism of xenobiotics, cytokines, oxidative stress and diseases.

Z 646 Immunology

Concepts of modern immunology and their importance in biology - Topics include humoral and cellular immune responses, antibody structure and biosynthesis, antigen-antibody interactions, cellular immunology, immunological tolerance, autoimmunity, and tumor immunology

Z647 Nutrition and Metabolism

This course will integrate the biochemical and physiologic aspects of metabolic processes, with a focus on nutritional impact. Lectures will center on the function and regulation of major metabolic processes involving anabolic and catabolic hormones. Also, the course discuses the relationships between diet and disease and nutritional mechanisms of disease prevention. Nutritional Disorders, starvation, obesity, malnutrition, pathogenesis of deficiency diseases with special reference to disorders of vitamins & mineral.

Z 648 Practical and Research Project in Parasitology

Z649 Immunohistochemistry

This course explain various immunohistochemical (IHC) techniques used in the laboratory. The course will also focus on the following points: Identify appropriate quality control (QC) used while performing IHC procedures. Describe slide preparation procedures used in IHC procedures. Define epitope unmasking and retrieval procedures that may be used in performing IHC procedures. Identify and solve problems that can occur when performing IHC procedures. Determine the principles underlying the fixation of proteins in tissues. The strategies for detecting the presence of specific antigens in cells.

Practical and research project in Parasitology related to the registered topic.

Z650 Selected Topics related to Parasitology

This course is left to the Department as a kind of flexibility of the syllabus.

Z651 Pharmacology

This course introduces the study of the properties, effects, and therapeutic value of the primary agents in the major drug categories. Topics include introduction to drug usage, drug dosage forms, determining factors of dosages, routes of drug administration, drug actions and body responses, nutritional products, blood modifiers, hormones, diuretics, cardiovascular agents, respiratory drugs, and gastrointestinal agents.

Z652 Selected Topics in Physiology

This course is left to the Department as a kind of flexibility of the syllabus.

Z653 Comparative Reproductive Biology

The course provides an overview of mammalian reproductive biological processes with an emphasis on the diversity of reproductive mechanisms that have evolved in placental, marsupial, and monotreme mammals. The lecture topics include sex determination and sex differentiation, development of the gonads, gonadal ducts and external genitalia. The cell and molecular biology of sperm-egg interactions at the time of fertilization are then given, followed by the processes involved in egg activation and differentiation of the early embryo. Macromorphological and cellular changes associated with implantation, placentation and lactation in various groups of mammals are then covered.

Z654 Molecular Immunology

This course covers wide range topics, including an overview of tissues and cells of the immune system, biology of cytokines and their receptors; major histocompatibility complex genetics and function; and tumor antigens.

Z655 Limnology

Introduction to limnology, physical limnology of lakes, chemical limnology of lakes. Biological /Ecological limnology of lakes, Wetlands. Physical and chemical stream ecology. Biological stream Ecology. Pond and Small lake management and Applied limnology /lake Restoration.

Z656 Cell physiology

Basic concepts of cellular organization, function, regulation. Emphasis on molecular/biochemical approach to fundamentals of bioenergetics; plasma membrane functions such as transport, secretion, and signal transduction; organelle function and biogenesis; cell growth.

Z657 Fish Ecology

Introduction to the biology and ecology of freshwater and marine fishes . Topics include taxonomy, physiology, biogeography , competition, predation, fishing, and conservation. Lab exercises and field trips emphasize familiarity with local fishes and their ecological interactions.

Z658 Pathology

Water, electrolyte and Acid-Base homeostasis., Renal functions, disorders and urinalysis.
Liver functions, disorders including enzymology., Lipid metabolism and cardiac biomarkers
Endocrinology disorders (Diabetes, thyroid and calcium homeostasis). Erythropoeisis, anemia and polycythemia., Leucopoiesis and disorders of white blood cells.
Homeostasis and Bleeding disorders.., Blood transfusion medicine. Clinical microbiology and proper test selection and interpretation. Autoimmune diseases, hypersensitivity and immunodeficiency. Immunological diagnosis of liver diseases and tumor markers., Laboratory statistical applications and performance criteria of laboratory tests.

Z659 Fish Physiology

Fish physiology is the study of the physiological systems of fish. Topics emphasized include sensory systems, feeding circulatory, nervous and endocrine, digestion, osmoregulation, movement, reproduction and development.

Z660 Biotechnology

This course is designed to introduce the student to the concepts of biotechnology as they relate to working in the biotechnology industry. The student should be provided proper handling of laboratory chemicals, operate common analytical instruments, describe the theory and applications of various analytical instruments including types of electrophoresis, spectrophotometry, chromatography, and centrifugation, practice laboratory safety, basic laboratory math and statistics, buffer preparation, and introduction to relevant biotech databases available on the Web.

Z661 Special Course in Fish Biology

This course is left to the Department as a kind of flexibility of the syllabus.

Z662 Environmental Physiology

Physiological adaptations that allow animal life to survive in diverse environments. The course will look at the strengths and weakness of the comparative approach and its relationship to phylogeny. Topics that may be addressed include osmoregulatory physiology and water balance, thermoregulation, metabolic rates, exercise, acid-base regulation and cardiovascular physiology.

Z663 Electron Microscopic Technique

Principles of electron microscopes, comparison of light microscope and electron microscope, structure of transmission electron microscope, structure of scanning electron microscope, specimen preparation for scanning electron microscope.

Z 664 Cell Physiology

Basic concepts of cellular organization, function, regulation. Emphasis on molecular/biochemical approach to fundamentals of bioenergetics; plasma membrane functions such as transport, secretion, and signal transduction; organelle function and biogenesis; cell growth.

Z665 Vertebrate Taxonomy

Vertebrate groups, principles of vertebrate classification, adaptive strategies and natural history of the vertebrates. Methods of collecting, preserving, and identifying local vertebrates.

Z666 Selected Topics in Comparative anatomy and Embryology

This course is left to the Department as a kind of flexibility of the syllabus.

Z667 Vertebrate Embryology

A comparative study of the biochemical and cellular mechanisms associated with the morphological development of vertebrates. Embryological development of the frog, chick and human will be emphasized.

Z668 Aquaculture

Introduction, ponds and fish suitable for cultivation ,Techniques and methods of fish cultivation, control and increase of production in fish cultivation, cultivation of aquatic animals other than fish, Biotechnology in aquaculture.

Z669 Vertebrate Comparative Anatomy

Vertebrate design, its origin, function and diversification. A critical comparative anatomy organs and systems of the vertebrates. Taxonomy, evolutionary relationships and morphological adaptations of fish, amphibians, reptiles, birds and mammals will be emphasized.

Z670 Fish Population Dynamics

History, population size, virtual population analysis, minimum viable population, maximum sustainable yield, recruitment, overfishing, metapopulation cycle, trophic cascades, basic models, predator –prey equations.

Z671 Advanced Histology

The ultra-structure of tissues through the visual examination of morphology and physiology at the cellular level. The principles and theories of routine and advanced histological techniques and the basic principles. Cell structure and function using various staining techniques and describe recent advances in microscopy. Methodology of immunohistochemistry.

Z672 Cryo Preservation

Introduction, mechanisms of freezing damage, cryopreservation of animal cells, mechanisms of cryoprotectant action.

Z673 Comparative Physiology

-The significance of all physiological mechanisms in the ecological theaters with be viewed with evolutionary perspective - Emphasis in the interrelation ships between animals and their environment, relation between form and function, similarities and differences among vertebrates and invertebrate s in achieving homeostasis focusing on the excretory, reproductive, muscular, nervous, respiratory and digestive system.

Z674 Fish Biodiversity

This course will study the diversity, evolution, relationships and identification of the fishes, the most diverse of all vertebrate groups and the dominant group of vertebrates in aquatic habitats. This course will provide concrete lab skills and will help prepare you for careers in fisheries science, ichthyology, oceanography or vertebrate biology.

Z675 Molecular Biology

Cell–based assays, genome structure and function, gene expression, protein expression, gene cloning, gene transfection.

Z676 Fisheries Managements

Historical back ground and process of fisheries management, fish sampling and gear bias, statistics for fisheries management, Abundance estimation, Estimating mortality rates, Age and growth, populations dynamics, stock assessment, great lakes fisheries.

Z677 Special course related to the thesis

Z 678 Fish Taxonomy

This course will provide students with an introduction to the biology and taxonomy of fishes . During lecture sessions, students will be introduced to the taxonomy, major groups, general morphology, physiology, and natural history of fishes. During lab sessions, students will gain "hands- on" , practical knowledge of material learned in lecture. Specifically, students will become familiar with fish morphology and anatomy will learn fish taxonomy and fish identification and will be exposed to local aquatic habitats and their associated fish fauna.

Z 680 Selected Topics related to Fish Biology

This course is left to the Department as a kind of flexibility of the syllabus.

Z682 Chordate Evolutionary Biology

Chordate biology emphasizes the diversity and evolution of modern vertebrate life, drawing on a range of sources (from comparative anatomy and embryology to paleontology, biomechanics, and developmental genetics). Much of the work is lab-based, with ample opportunity to gain firsthand experience of the repeated themes of vertebrate body plans, as well as some of the extraordinary specializations manifest in living forms. The instructors, who are both actively engaged in vertebrate-centered research, take this course beyond the boundaries of standard textbook content.

Z684 Developmental Biology

It covers major topics on the developmental biology of vertebrate embryos (e.g. formation of the germ line, gastrulation, segmentation, nervous system development, limb patterning, organogenesis). The course makes extensive use of the current primary literature and emphasizes experimental approaches including embryology, genetics, and molecular genetics.

Z686 Comparative Physiology

-The significance of all physiological mechanisms in the ecological theaters with be viewed with evolutionary perspective.

-Emphasis in the interrelation ships between animals and their environment, relation between form and function, similarities and differences among vertebrates and invertebrate s in achieving homeostasis focusing on the excretory, reproductive, muscular, nervous, respiratory and digestive system.

ZM 688 Biomechanics

Laws of mechanics and their application on vertebrate body using different examples inhabiting different environment. Introduction to Newton's Laws of Mechanics, and multiple applications of those laws to vertebrate motions. Mechanical Analysis of Human Performance.

Z 690 Special Course in Comparative Anatomy and Embryology

This course is left to the Department as a kind of flexibility of the syllabus.

Z 692 Selected Topics related to Comparative anatomy and Embryology

This course is left to the Department as a kind of flexibility of the syllabus.

Ph.D. Zoology Programs

Z701 Advanced Cell Biology

Cell abnormalities, receptor-ligand interaction, protein–protein interactions, DNA- protein binding.

Z702 Advanced Histology

Different changes of tissues, Identification of nicrosis, apoptosis and how to detect them.

Z703 Advanced Molecular Biology

DNA biology, RNA biology, micro RNA synthesis and regulation, gene cloning, gene and protein regulation, transcription factors.

Z704 Advanced Signal Transduction

Cell surface receptors, cytoplasmic signal transduction, nuclear receptors, transscription factors , cell cycle regulation .

Z705 Advanced Cellular Traffic and Endocytosis

Training on how to use the statistical methods to perform the statistical analysis of any given data, mechanism of Auto phagy.

Z706 Advanced Stem Cell

Definition of stem cell – types- origin characteristics, and uses.

Z707 Advanced Tumor Biology

Gene expression analysis, protein expression analysis, mi RNA expression analysis, gene cloning, cell culture, cell based assays, promoter analysis.

Z708 Advanced Principles of Cellular Immunology

Concepts of modern immunology and their importance in biology. Topics include humoral and cellular immune responses, antibody structure and biosynthesis, antigen-antibody interactions, cellular immunology, immunological tolerance, autoimmunity, and tumor immunology.

M708 Mathematical and Statistical Packages

How to use different mathematical and statistical programs to analyze biological data.

Z709 Selected Topics related to Cell Biology

This course is left to the Department as a kind of flexibility of the syllabus

Z710 Histochemistry

Immunocytochemistry - substrate film techniques - Enzymes and histochemical reagents - Autoradiography and its applications - Fluorescence microscopy.

Z711 Biochemical Toxicology

Molecular biological aspects of toxicology - reactive metabolites and toxicity - Biochemical toxicology of nervous system – hepatotoxicity - pulmonary toxicity - renal toxicity - cardiovascular toxicity.

Z712 Advanced Immunology

Advanced topics in immunology - Topics include antigen processing and presentation - B-cell differentiation - T-cell structure - function and activation - MHC molecule - cytokine release and effects self and non-self recognition - and immunopathology of HIV.

Z713 Aquatic Pollution

Introduction, thermal pollution – Radioactivity – Oil - Biological assessment of water quality in the field - Intrusive microorganisms and Bioassays - Management of water resources.

Z714 Genetic Engineering

Recombinant DNA - Restriction enzymes and basic cloning - DAN sequencing and PCR - Prokaryotic and Eukaryotic gene expression - molecular diagnosis - therapeutic agents, vaccines - microbial insecticides - animal genetic engineering – regulation - ethics and patenting of biotechnology.

Z715 Microbiology

A survey to provide a general understanding of fungi - bacteria and viruses - Bacterial structure – growth – ecology - pathogenic mechanisms - and viral life cycle.

Z716 Selected Topics related to Histology and Histochemistry

This course is left to the Department as a kind of flexibility of the syllabus

Z717 Invertebrate Haematology

Aspects of the evolution and development of body cavities, circulatory systems and blood cells organisms without special circulatory systems:

Annelids and related phyla; Comparative aspects of the structure and function of invertebrate and vertebrate leucocytes

Z718 Nanobiology

Nanoscale analysis of biological specimens - CryoEM characterization of virus structures and infection - Nanosensors and nanoarrays - AFM based diagnosis of cancer - Single cell analysis of signaling events using microfluidic devices - Signal transduction networks and systems biology - Vault nanoparticles and their use as carriers of DNA, RNA, proteins and small molecles

Z719 Aquatic Pollution

Introduction, types of pollution, Aquatic, Air Organic Pollution. Eutrophication. Acidification. Heavy metals and Organochlorines. Other types of pollution.

Z720 Soil Biology

An overview of soil types is presented, followed by the study of soil habitats and their properties. Soil animal bilogy. Diversity and functioning of soil communities. Nutrient recycling. The soil food web, man and the soil

Z721 Invertebrate Biodiversity and Conservation

What is biodiversity?; measuring biodiversity; patterns of biodiversity in space; effects of habitat disturbance and destruction; what is conservation?; sustainable exploitation of natural resources; selection and design of protected areas; conserving species In Situ; conserving species Ex Situ. Investigating mechanisms maintaining biodiversity in natural and managed ecosystems.

Z722 Aquatic Ecotoxicology and Terrestrial Ecotoxicology

Ecotoxicology deals with the dispersal and transformation of xenobiotics in environment and their deleterious effects on fauna .in addition to the damage on the individual organism , ecotoxicology comprises the effects of chemicals on higher levels of biological organization , I.e. population and communities - The course in ecotoxicology focus on the uptake and biotransformation of xenobiotics in living organisms and their harmful effects from molecule to population.

Z723 Advanced Biology of Hirudinea

Anatomy, Physiology, taxonomy, Behavior.

Z724 Biology of Crustacea

General characters and taxonomy of crustacean, embryology of crustacean, larval morphology and diversity, comparative morphology of crustacean, growth, reproduction and sex determination, hormones and neurosecrtion, photoreception, chemoreception, thermoreception and mechanoreception, the population and communities of crustacean, and economic importance of crustacea.

Z725 Invertebrate Taxonomy

The new trends and principles in the taxonomy of invertebrates.

Z726 Ecotoxicology

Adaptations of animals facilitating their survival in natural environments where physiological stress is induced by prevailing physical conditions temperature; water availability; and oxygen availability ;and oxygen availability often restrict their abilities to exploit specific environments Biochemical; cellular; and organismal responses to these factors will be studied. A major theme will include the range of adaptive responses that can be implemented in order to overcome a specific limitation in the environment

Z727 Special Course

This course is left to the Department as a kind of flexibility of the syllabus

Z728 Selected Topics related to Invertebrates

This course is left to the Department as a kind of flexibility of the syllabus

Z729 Advanced Parasitology

-Myxozoa. –Apicomplexa- Helminthes.

Z730 Ultrastructure of Histopathology

Ultrastructure of cells and organilles- Electron microscopy of different parasites. Abnormalities of cellular structures.

Z731 Special Course in Parasitology

This course is left to the Department as a kind of flexibility of the syllabus

Z732 Selected Topics related to Parasirology

This course is left to the Department as a kind of flexibility of the syllabus

Z733 Haematology

Homeostasis - blood coagulation and fibrinolysis - acquired haemostatic defects - red blood cells and gasses transport, anemia - leukocytes and immunity - blood grouping and Rh – preparation - storage and transfusion of blood and blood products.

Z734 Ecotoxicology

Ecotoxicology deals with the dispersal and transformation of xenobiotics in the environment and their deleterious effects on fauna .in addition to the damage on the individual organism ecotoxicology comprises the effects of chemicals on higher levels of biological organization i.e. population and communities.The course in ecotoxicology focus on the uptake and biotransformation of xenobiotics in living organisms and their harmful effects from molecule to population.

Z735 Neurophysiology

Topics to be covered include neuron morphology, electrical properties, resting potential of neurons; the structure and function of voltage-gated and neurotransmitter-gated ion channels; generation and propagation of action potentials; the physiology of fast synaptic communication. Physiological basis of sensory systems, language, learning and memory. Biochemical, molecular, physiological, and behavioral changes associated with normal aging versus changes associated with pathologic conditions such as Alzheimer's and Parkinson Disease.

Z736 Neurophysiology

Topics to be covered include neuron morphology, electrical properties, resting potential of neurons; the structure and function of voltage-gated and neurotransmitter-gated ion channels; generation and propagation of action potentials; the physiology of fast synaptic communication. Physiological basis of sensory systems, language, learning and memory. Biochemical, molecular, physiological, and behavioral changes associated with normal aging versus changes associated with pathologic conditions such as Alzheimer's and Parkinson Disease.

Z737 Immuno-Regulation and Cell Signaling

This course introduces regulatory pathways and molecular themes employed in signal transduction and their modulation by pharmacological agents. The molecular basis of diverse diseases and existing therapies for them engage the various pathways that will be covered in the course. This course covers the basic biology of normal and cancer cells at the cellular and molecular levels with special emphasis on aberrant signal transduction pathways in cancer cells. The course involves lectures and discussion of original research/review articles.

Z738Molecular Genetics

Principles of genetics, including the structure of RNA and - DNA, molecular replication, transcriptions, translation - Protein synthesis. Basic introduction to PCR technology y and to the analysis of genetic diversity using both lecturer-directed and student-directed learning.

Z739 Cell Cycle Control and Cancer

This course will present an overview of the cancer development process at the cellular and molecular level, including regulatory networks involved in growth control and tissue organization and an introduction to animal, cell and molecular techniques for studying progression, treatment and prevention of cancer.

Z740 Applied Immunology

This course provides advanced training in designing, implementing and evaluating Immunological techniques that measure immune responses. The course also covers the following topics: Basic immunology, organ and bone marrow transplantation, congenital and acquired immunodeficiency, immunopathogenesis of infectious diseases (including HIV, HCV, and influenza virus infections), vaccinology, cancer immunology and immunotherapy.

Z741 Dysfunction of some Organs

The course deals with pathophysiological mechanisms and interpretation of organ dysfunctions. For example disorders of some organs such as liver, kidney, brain, heart, gonads and bone marrow. Also, the course focus on the understanding of the value of laboratory tests in diagnosis and management of dysfunctions.

Z742 Molecular Endocrinology

The course provide advanced knowledge on hormone receptors and the mechanisms of hormone action on target cells, molecular mechanisms by which hormones elicit specific responses and regulate gene expression and hormone-receptor interaction. Brain hormones and their precursors, insulin and its receptor, gene-associated peptides, new glycoprotein hormones, growth factors, steroids, the superfamily of steroid and thyroid receptors, pheromones, oncogenes, and immunoendocrinology

Z743 Reproduction and Infertility Problems

 Different protocols for reproduction, different measurements for reproduction effecting, types of infertility problems, different causes of infertility (Hereditary and Acquired), diagnosis and treatment of infertility, control of infertility, and methods to improve reproductive performance

Z744 Molecular Hematology

The course focuses on the physiology and pathology of blood and its use as a diagnostic and therapeutic tool. Also to highlight to hematopoiesis, erythrocytes, granulocytes, lymphocytes, normal hemostasis, red cell immunohematology, blood cell antigen an antibodies, general aspects of hematologic malignancy and bone marrow implantation. Cellular Hematology, Immunohematology and Homeostasis. Molecular Science and Diagnostics., Discussion of the physiology and pathology of blood cells and bone marrow ; reviews physiology of blood hemopoisis; discuss hematologic results as relate to normal, anemic, and leukemia conditions. To study disorders of red cells such as: hemolytic anemia, hereditary disorder of hemoglobin structure and synthesis and other disorders of red cells. Study of aplastic anemia and its causes. Acute leukemia and hematologic malignancy.

Z745 Reproduction and infertility problems

Different protocols for reproduction, different measurements for reproduction effecting, types of infertility problems, different causes of infertility (Hereditary and Acquired), diagnosis and treatment of infertility, control of infertility, and methods to improve reproductive performance

Z746 Selected Topics in Physiology

This course is left to the Department as a kind of flexibility of the syllabus

Z747 Fish Biogeography

This course will examine patterns of distribution and abundance of fishes and plants and the physiological and ecological process that produce these patterns .topics include human mediated effects on distribution and abundance, historical causes of these patterns at both geological and ecological time scales.

Z748 Aquatic Ecosystem

An aquatic ecosystem is an ecosystem in a body of water. Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems. The two main types of aquatic ecosystems are marine ecosystems and freshwater ecosystems.

Z756 fish hatchery management purpose, Production steps (Brood stock, spawning, Fertilization, larvae, settlement of shellfish), Hatchery design, issues (Genetic, fish farms).

Z749 Fish Hatchery Managements

fish hatchery management purpose, Production steps (Brood stock, spawning, Fertilization, larvae, settlement of shellfish), Hatchery design, issues (Genetic, fish farms).

Z750 Aquatic Toxicology

This course provides participants with a strong foundation of aquatic toxicology and how these concepts are applied to managing pollutants in aquatic environments. The course covers terminology. Common test designs, and endpoints such as lethality and endocrine disruption. Important legacy and emerging pollutants of concern such as heavy metals, organic pesticides, PAHS, PCBDEs, pharmaceuticals, personal care products, and nanoparticles will also be presented. Fate and transport as it relates to bioavailability and pollutant partitioning in aquatic environments will be discussed. Water Quality criteria from the clean water Act with an emphasis on, and examples of site specific criteria for metals using hardness correction, water effects ratio (WER) and the biotic ligand model (BLM) are included.

Z751 Fish Embryology

What is a fish larva?-Development and ontogenetic state –An overview of teleostean phylogeny- Embryology, hatching, growth and metamorphosis –Food, feeding, predition –Physical process –Mortality, cohort dynamics and recruitment theory- Condition, growth, energetic –Culture, stocking, restoration –Egg and larval surveys, applications.

Z752 Bioinformatics

In order to facilitate the approach to bioinformatics, the course focuses on problems from the fields of biology, biochemistry, molecular biology and structural biology. Which can be addressed by applying bioinformatics methods. The current available DNA and protein sequence databases and sequence analysis methods will be described. Prediction methods will be presented which let one gain insight into the three-dimensional structure and function of a protein starting from its DNA sequence.

Z753 Nano Technology

Nanotechnology represents one of the fastest growing fields in science and technology. Applications of nanotechnology range widely from advanced electronics to energy storage and conversion to biomedical uses including drug delivery and imaging. I this course we will explore the history of the field, the tools used to characterize these unique materials, and discuss the implications for future development on science and society. Focus will be given to the production of these materials, including in-class hands-on synthesis of gold nanoparticles and characterization by electron microscopy and other methods. Specific attention will be give be given to the environmental and ethic considerations for nanomaterials in consumer products.

Z754 Fish Reproduction

In particular relation to the reproductive biology of fish, this option offers the following taught modules:
Sex determination and differentiation in fish –neuroendcrinology- ovogenesis- spermatogenesis- genetic selection- cryropreservation and genome regeneration.

Z755 Fish Food and Feeding Biology

Introduction, feed composition and analysis, Experimental design in feeding Experiments, Gustation and feeding behavior, Environmental factors and feed intake, feeding Rhythms, feeding anticipatory activity, Effects of feeding time on feed intake and growth, Effects of nutritional factors and feed characteristics on feed intake, Regulation of food intake by transplantation immunity in Arthropods: Is immunorecognition merely wound healing.- Evolution of histoincompatibility –the refnce reaction –Encapsulation in arthropods –cellular immune responses and their genetic aspect in drosophila –hemolymph clotting in insect -The prophenoloxidase activating system: the biochemistry of its activation and role in arthropod cellular immunity , with special refrence to crustaceans

Z756 Selected Topics related to Fish Biology

This course is left to the Department as a kind of flexibility of the syllabus

Z757 Experimental Embryology

The mechanisms controlling the individual development of animals by means of experiments. Types of methods as marking, removal, transplantation, and isolation of body parts and organs. The action of various external factors on embryonic development. By removing, inactivating, or transplanting cell nuclei, experimental embryologists investigate the interaction of the nucleus and cytoplasm during gametogenesis and embryonic development, as well as the stages and factors of differential activation of genes in the course of development.

Z758 Functional Anatomy of Vertebrates

Comparative investigations of functional morphology across major vertebrate lineages. Evolutionary history and patterns of development. Integumentary, skeletal and muscular systems. Sensory systems and neural and endocrine integrations. Biomechanical and physiological performance of biological structures, from cells to organ systems, and on the origins and diversification of form-function complexes among vertebrates. Lab exercises

include dissections, observation of prepared specimens and other material, and modeling/simulation of biomechanical systems.

Z759 Vertebrate Physiology
Principles of physiology and physiological processes. Integration of physiological systems. Osmoregulation and ionic balance in a challenging environment.

Z760 Genetic Engineering
Principles and basics of genetic engineering. Constraction and use of cloning and expression vectors containing recombinant DNA in prokaryotic and eukaryotic system. Study biological systems utilized for the large scale production of recombinant autologous or eterologous proteins, focusing on advantages and disadvantages of each system. The major applications of genetic engineering in biotechnology.

Z761 Advanced Developmental Biology
It covers major topics on the developmental biology of vertebrate embryos (e.g. formation of the germ line, gastrulation, segmentation, nervous system development, limb patterning, organogenesis). The course makes extensive use of the current primary literature and emphasizes experimental approaches including embryology, genetics, and molecular genetics.

Z762 Practical and Research Project
Practical and research project related to the registered topic.

Z763 Selected Topics related to Comparative anatomy and Embryology
This course is left to the Department as a kind of flexibility of the syllabus

Entomology Programs

E601 Insect Comparative Anatomy
Integument in insects. Digestive system in various insect orders. Respiratory organs in insects from different habitats. Locomotory organs in insects. Nervous system in insect orders and some immature stages. Excretory system in insects from different habitats. Reproductive system in insects.

E602 Insect Physiology and Behavior
This course is a detailed study of the physiology and biochemistry of insect organ systems - Topics include: circulation – digestion – respiration – excretion - hormonal regulation – pheromones – metabolism – growth - reproduction and nerve and muscle physiology - Types of communication - Physical communication (sound – light - tactile) - Chemical communication (semiochemicals – allelochemicals - pheromones) - Sensory modalities used in insect communication - Insect pheromones - Types of pheromones - Nature and characteristics of pheromones - Processing of olfactory information - Factors affecting pheromone communication systems.

E603 Insect Taxonomy and Ecology
Fundamentals of insect classification - Types of keys - Recognition of insect orders - Identification of adult insects to family level - Identification of immature insect stages to family level, using different types of keys - Life histories of selected pest and beneficial species - Community development, structure and organization - Communities & distributions. Population dynamics - Coevolution of prey and predator - Predator and prey populations - Diversity and stability - Structure of tropic community - Energy Flow - Social systems.

E604 Insect Control
Basic tenets of integrated pest management emphasizing ecological principles; integration of chemical, biological, cultural and physical tactics into an overall strategy for the agroecosystem; chemical pesticides, cultural practices, host resistance, biological control, sterility principle, economics of pest control and pest/host relationships.

E 605 Selected Topics

EM606 Biostatistics
Fundamentals of statistics - Sampling techniques - Estimation theory - Tests of hypotheses - Curve fitting and regression analysis - Basic statistical tests: goodness of fit test - ANOVA, t-test - Chi-square test - Mann-Whitney test - Multivariate analysis - Using computer software to analyze and express data SPSS and Excel.

E607 Medical Entomology

Arthropods as vectors of diseases (Mechanical and Biological transmission) - Biology and medical importance of culicine mosquitoes - Biology and medical importance of blackflies - Flies and myiasis - Ectoparasitic insects.

E609 Insect Toxicology

Classification and properties of major types of insecticides; chemistry, metabolism and mode of action; selectivity, use hazards, residues and resistance; environmental problems: biological magnification, persistence and effects on non-target organisms. How to measure toxicity. The routes of death. Pesticides that disturb energy production. Pesticides inhibiting enzymes in nucleic acid synthesis. Bacillus thuringiensis and its toxins. Inhibitors of chitin synthesis. Inhibitors of cholinesterase. Interference with signal transduction in nerves. Translocation and degradation of pesticides.

E610 Molecular Biology

Types of nucleic acids. Gene structure and function in prokaryotes and eukaryotes. Mechanism of DNA replication. Gene expression. Fundamentals of recombinant DNA technology. Advanced topics of molecular biology, including gene expression during cell differentiation, retroviral infection, and regulation of cell proliferation. Mutation and repair mechanisms.

E611 Microtechnique

How to obtain (histological specimens) from an insect? The steps of preparation of histological slides& the name of each step Fixation: definition, purpose, classification of fixatives, & types of fixatives, washing, dehydration, clearing, infiltration, Sectioning, staining. The histochemistry of some important simple proteins, Nucleic acids and nucleoproteins, Carbohydrates and mucosubstances, Applied mucosubstances, Lipids, lipoproteins and proteolipids. Types of light microscopes, and how to use electron microscope?

E612 Practical Entomology

Methods of insect rearing, including techniques of keeping, types of diets and rearing conditions. Basic practice, including designing of experiments, collecting results, and analyzing data. Selection of appropriate statistical tests. Presenting data, both graphically and as written texts. Pass Expressing the data for scientific audience. Training on dissemination of results.

E613 Social Insects

Sociality as a means for life in insects and other animal taxa. The evolution of insect societies. Degrees of social interactions between insects. Structure of colony in eusocial insect species. Caste formation and selection pressures. Nest-mate recognition and its significance. The honeybee language. Kin selection.

E614 Chemical Ecology

Definition of chemical ecology, chemical interactions between organisms (semiochemicals, pheromone, allelochemicals) Host plant selection, Tritrophic interaction, Parasitoids and predators, chemical defense in animals, social insects, plant-plant interaction, plant-microorganism interaction.

E615 Insect Immunity

Behavioral defense in insects. Chemical defense. Structure of insect blood. Cellular immune responses: phagocytosis, nodulation, encapsulation. Molecular events controlling cellular immune response (recognition and mediation). Humoral immune response in insects.

E616 Selected Topics

Ph.D. Entomology Program

E701 Advanced Insect Physiology
Behavior and physiology. Ecology and physiology. Physiology and development. Physiology and systematics. Immune responses of insects to parasitoids, entomopathogenic fungi, and bacteria. Insect defense against viruses. Bidirectional connection between the immune system and nervous system in insects. Neurobiology of insects.

E702 Advanced Insect Behavior
Types of communication. Physical communication (sound, light, tactile). Chemical communication (semiochemicals, allelochemicals, pheromones). Sensory modalities used in insect communication. Insect pheromones. Types of pheromones. Nature and characteristics of pheromones. Processing of olfactory information. Factors affecting pheromone communication systems.

E703 Insect Endocrinology
The general principles of endocrinology. The system-based endocrinology. The endocrine system and its hormonal products, including the hormone producing cells, synthesis and modification of the hormones, release and transport of the hormones, hormone receptors and the mechanisms of hormone action, the effects of hormones on target cells, and the effects of hormones on physiological processes. The relationship between hormones, nervous system and anatomical function and structure.

E704 Insect Sensory Physiology
Morphology of sense organs in insects. Simple eyes, compound eyes, and ocelli. Tactile organs. Olfactory and taste organs. Auditory organs. Proprioceptors. Processing of information acquired through the different sensory modalities. Adaptation of sense organs to insect habitats.

E705 Forensic Entomology
Explores the science, methodology and technology employed to gather, preserve and present information about insects and other arthropods in such a manner that this information can be used in courts of law as evidence and testimony to help resolve issues of a criminal or civil nature.

E706 Histology and Histchemistry
Basic types of animal tissues. Histological structure of insect integument, alimentary canal, excretory system, gonads and genital system, brain and nerves, and fat body. Special requirements and precautions for histochemistry. Classification and demonstration of carbohydrates, lipids, proteins, and nucleic acids. Using autoradiographic techniques and immunohistochemical methods to follow up cell activities. Demonstration of mucopolysaccharides and other compounds.

E707 Advanced Insect Control
A brief history of pest control, Ecological concepts, pest management tactics, culture control, chemical control, genetic manipulation of crops, Genetic manipulation of pest population, Biotechnology, Theory and practices relating to the role and use of natural enemies in arthropod and plant population regulation; review and analysis of projects in biological control; biology and behavior of entomophagous arthropods. Biological control of insects, plant diseases and weeds.

E708 Biochemistry
Chemistry of biological molecules: proteins, lipids, carbohydrates, nucleic acids, etc. Mechanisms of enzyme catalysis. Metabolic pathways, integrated metabolic systems, and molecular physiology.

E709 Selected topics

E711 Insect Behavior 2
Types of communication. Physical communication (sound, light, tactile). Chemical communication (semiochemicals, allelochemicals, pheromones). Sensory modalities used in insect communication. Insect pheromones. Types of pheromones. Nature and characteristics of pheromones. Processing of olfactory information. Factors affecting pheromone communication systems.

E712 Insect Endocrinology
Endocrine glands in insects: corpora cardiaca, corpora allata, prothoracic glands, neurosecretory cells, and neurohemal organs. Hormone structure and release site. Mode of action of ecdysone, juvenile hormone, and peptide hormones. The role of hormones in controlling insect development (growth and metamorphosis). Hormones controlling functions other than metamorphosis.

E713 Insect Sensory Physiology

Morphology of sense organs in insects. Simple eyes, compound eyes, and ocelli. Tactile organs. Olfactory and taste organs. Auditory organs. Proprioceptors. Processing of information acquired through the different sensory modalities. Adaptation of sense organs to insect habitats.

E714 Insect Control
A brief history of pest control, Ecological concepts, pest management tactics, culture control, chemical control, genetic manipulation of crops, Genetic manipulation of pest population, Biotechnology, Theory and practices relating to the role and use of natural enemies in arthropod and plant population regulation; review and analysis of projects in biological control; biology and behavior of entomophagous arthropods. Biological control of insects, plant diseases and weeds.

E715 Advanced Histology and Histochemistry
Basic types of animal tissues. Histological structure of insect integument, alimentary canal, excretory system, gonads and genital system, brain and nerves, and fat body. Special requirements and precautions for histochemistry. Classification and demonstration of carbohydrates, lipids, proteins, and nucleic acids. Using autoradiographic techniques and immunohistochemical methods to follow up cell activities. Demonstration of mucopolysaccharides and other compounds.

E716 Molecular Biology 2
DNA-binding motifs in gene regulatory proteins. The influence of chromatin structure and gene location on gene expression. Mechanisms of transcriptional activation. Transcriptosome – profiling gene expression at the mRNA level. Gene control and micro RNAs. A view of genome function obtained by profiling gene expression at the protein level (the proteome). Global changes in protein expression and the systematic study of protein interactions in cell physiology.

E717 Genetic Engineering
Rccombinant DNA, Restriction enzymes and basic cloning, DAN sequencing and PCR, Prokaryotic and Eukaryotic gene expression, molecular diagnosis, therapeutic agents, vaccines, microbial insecticides, animal genetic engineering, regulation, ethics and patenting of biotechnology.

E718 Insect Molecular Systematics
Fundamentals of insect evolution. Approaches to insect phylogenetics and classification. Insights from molecular genetics into phylogeny and classification. Species boundaries and hybridization and phylogenetic relationships. PCR and DNA amplification. Sequencing of nucleic acids and amino acids. DNA hybridization. DNA polymorphism. Intraspecific and interspecific differentiation and phylogeny reconstruction. The molecular clock. Speciation and macroevolution (Anagenesis and cladogenesis). Genetic differentiation during speciation.

E719 Cell Biology
Intracellular compartments. Co-translational translocation of proteins. Golgi apparatus and lysosomes. Protein folding, protein aggregation and protein degradation. Mechanisms of cell signaling. Microtubules. Intermediate filaments. Actin filaments. Cell contraction and locomotion. Cell cycle and programmed cell death (apoptosis). Signals that trigger cell death, growth and proliferation. Extracellular matrix (ECM), Cell-cell junctions, Cell-ECM junctions.

E720 Insect Physiology 2
The course introduces the exoskeleton as an evolutionary influence on the various physiological processes. Regulatory processes including neural and endocrinal details. The course includes detailed discussions on: insect growth hormones and the control of molting; respiration; the hemolymph and immune systems; digestive and excretory systems; control of water balance; energy sources and metabolic hormones; muscle function and flight; reproductive maturation and vitellogenesis; chemical communication systems, the control of sex-pheromone biosynthesis and olfactory sensory reception; endogenous cycles and synchrony of biological processes. The course culminates in a discussion of the physiological adaptations of insects to the external environment.

E722 Forensic Entomology
The significance of insects as carrion feeders. Carrion flies and carrion beetles and other insects that feed on different parts of cadavers. Estimation of development time of insects. The use of insects for detecting post-mortem interval (PMI). Effects of temperature, drugs, and toxins on insect development. The Sequence of insect arrival to cadavers. Effects of geography on succession of insects on cadavers. Differences between urban and rural crime scenes. Faunal characteristics in dead bodies found inside vehicles, buildings, and closed spaces.

E723 Insect Molecular Systematics

Fundamentals of insect evolution. Approaches to insect phylogenetics and classification. Insights from molecular genetics into phylogeny and classification. Species boundaries and hybridization and phylogenetic relationships. PCR and DNA amplification. Sequencing of nucleic acids and amino acids. DNA hybridization. DNA polymorphism. Intraspecific and interspecific differentiation and phylogeny reconstruction. The molecular clock. Speciation and macroevolution (Anagenesis and cladogenesis). Genetic differentiation during speciation.

E724 Advanced Insect Behavior
Types of communication. Physical communication (sound, light, tactile). Chemical communication (semiochemicals, allelochemicals, pheromones). Sensory modalities used in insect communication. Insect pheromones. Types of pheromones. Nature and characteristics of pheromones. Processing of olfactory information. Factors affecting pheromone communication systems.

E725 Economic Entomology
Major types of economically important insects. Medically important insects: pathogen vectors, ectoparasites, and insects producing drugs. Insect pests: plant pests, stored product pests, household pests. Beneficial insects: pollinators, biological control agents, honey production, silk production and production of commercial commodities.

E726 Advanced Insect Control
A brief history of pest control, Ecological concepts, pest management tactics, culture control, chemical control, genetic manipulation of crops, Genetic manipulation of pest population, Biotechnology, Theory and practices relating to the role and use of natural enemies in arthropod and plant population regulation; review and analysis of projects in biological control; biology and behavior of entomophagous arthropods. Biological control of insects, plant diseases and weeds.

E727 Histology and Histochemistry
Basic types of animal tissues. Histological structure of insect integument, alimentary canal, excretory system, gonads and genital system, brain and nerves, and fat body. Special requirements and precautions for histochemistry. Classification and demonstration of carbohydrates, lipids, proteins, and nucleic acids. Using autoradiographic techniques and immunohistochemical methods to follow up cell activities. Demonstration of mucopolysaccharides and other compounds.

E728 Aquatic Insects
Types of aquatic habitats: marine, brackish, inland, and fresh. Water inhabiting insects: swimmers, skaters, and striders. Insect immature stages that live in water. Basic morphological and anatomical modification as adaptation to water life. The importance of aquatic insects in food web.

E729 Advanced Chemical Ecology
Overview of chemical ecology: design and significance of bioassays, chemical techniques in studying ecological interactions, Infochemicals: semiochemicals, pheromones, allomones, kairomones, Chemical interactions among plants: allelopathy, higher plant parasites, chemical communication, Chemical recognition: chemosensory and neurophysiological basis, behavioral mechanisms, Herbivory and the chemical defenses of plants, Coevolution of herbivores and plant allelochemicals.

E730 Apiculture and Bee Keeping
Fundamentals of the biology of honeybee. Division of labor in the hive of honeybee. Initiation of a honeybee colony. Factors affecting the potentials of honeybee colony. Diseases of bees and protective measures. Swarming and reproduction of bee hives. Vegetation structure and the performance of bees. Large scale production and packaging of honey and other bee-produced materials, e.g. propolis and royal jelly.

E731 Acarology
Position of acarina among arthropods. Ontogeny, diversity and lifestyles of ticks and mites. Taxonomy of ticks and mites. Economic importance of acarina: ectoparasitic ticks and mites, acarine pathogen vectors, and plant pests. The role of mites in ecosystem. Soil mites: isolation, identification, classification and examination).

E732 Advanced Insect Physiology
The course introduces the exoskeleton as an evolutionary influence on the various physiological processes. Regulatory processes including neural and endocrinal are detailed. The course includes detailed discussions on: insect growth hormones and the control of molting; respiration; the hemolymph and immune systems; digestive and excretory systems; control of water balance; energy sources and metabolic hormones; muscle function and flight; reproductive maturation and vitellogenesis; chemical communication systems, the control of sex-pheromone biosynthesis and olfactory sensory reception; endogenous cycles and synchrony of biological

processes. The course culminates in a discussion of the physiological adaptations of insects to the external environment.

E733 Selected topics

الدراسات العليا بكلية العلوم

تمهيـد

بدأت الدراسات العليا بكلية العلوم – جامعة أسيوط في عام 1958 ومنذ ذلك التاريخ تشارك الكلية في إعداد الكوادر العلمية من أعضاء هيئة التدريس والباحثين في مصر والعالم العربي وبعض الجامعات ومراكز البحوث الأجنبية. صدرت اللائحة الأولى للدراسات العليا في عام 1957 ثم صدرت اللائحة الجاري العمل بها الآن في 1994/4/26، ثم تم تعديلها في 1997/9/24، 1999/8/16، 2006/10/10، 2008/7/20 ، 2011/7/11، واللائحة المقدمة تهدف إلى معالجة المشكلات التي واجهت لائحة 1994 والأخذ بالنظم الحديثة في الدراسات العليا والبحوث.

الرؤية:

تتطلع كلية العلوم جامعة أسيوط إلي أن تتبوأ مكانة علمية مرموقة بين كليات العلوم المصرية والإقليمية وإمداد المجتمع بخريجين متميزين قادرين على الابداع والابتكار والمنافسة محلياً ودولياً في مجالات التعليم والبحث العلمي وخدمة المجتمع.

الرسالة:

كلية العلوم بجامعة أسيوط مؤسسة للتعليم العالي والبحث العلمي في مجال العلوم الأساسية لتحقيق رسالة الجامعة بما يتوافق مع التقاليد والقيم الأخلاقية والدينية عن طريق:

●إعداد أجيال من العلماء والعاملين بالمراكز العلمية والبحثية والتعليمية والصناعية.

●تقديم أفضل الخدمات التعليمية للطلاب في مجال دراسة العلوم الأساسية لمرحلة البكالوريوس لإكسابهم المهارات المطلوبة في التخصص من خلال برامج تعليمية وفقا للمعايير القومية.

● المساهمة في تقدم علوم الرياضيات وعلوم الحاسب والعلوم الفيزيائية والكيميائية والبيولوجية والجيولوجية من خلال برامج الدراسات العليا والبحوث.

●توظيف مواردها البشرية وإمكانياتها البحثية وخبراتها الاستشارية للمساهمة في حل مشكلات البيئة وخدمة قطاعات الإنتاج والخدمات والعمل على تنمية المجتمع.

●الحفاظ على السمة المميزة للكلية في تفردها بدراسات تنمية جنوب الوادي وتنفيذ المشروعات الداعمة لسياسة الخروج من الوادي الضيق في جنوب مصر.

أهداف الدراسات العليا

1. إعداد الكفاءات العلمية المتخصصة في مجالات العلوم الأساسـية المختلفـة وذلك بإتاحة فرص البحث والتدريب لاكتساب الخبرات البحثية والتطبيقية.

2. إعداد كوادر من المتخصصين الأكاديميين في مجالات البحث العلمي والتعليمي وذلك لتغطيــة احتياجات التعليم العالي والجامعي ومراكز البحث العلمي داخل الوطن وخارجه.

3. الاهتمام بالدراسات الميدانية والتجريبية لمواجهة مشكلات الإنتاج والمشكلات الاقتصادية والتعليمية داخل وخارج كلية العلوم – جامعة أسيوط .

4. تشجيع الكفاءات العلمية في التخصصات العلمية المختلفة على ممارسة النشاط العلمي في جو مناسب عن طريق توفير كافة الإمكانات حتى يتمكنوا من مسايرة الركب العلمي العالمي، الأمر الذي ينمي عندهم ملكة الإبداع والابتكار لخير الوطن والمواطن.

5. مواكبة الجديد والمبتكر في المجالات العلمية المتخصصة على المستوى المحلي والعالمي.

ويمكن إبراز أهم <u>ملامح اللائحة المقترحة</u> فيما يلي :

• تطبيق نظام الساعات المعتمدة .

• استحداث درجة ماجستير العلوم في تخصصات جديدة .

• استحداث دبلوم الدراسات العليا المهنية بالإضافة إلى دبلوم الدراسات العليا (التخصصية).

• العمل على أن تكون القواعد العامة وجميع مواد اللائحة واضحة وشاملة.

وعلى التوازى مع وضع هذه اللائحة الجديدة ، تعكف مجالس الأقسام بالكلية على وضع خطتها البحثية لسنوات خمس قادمة على أن ترتبط الخطة البحثية بالصناعة والقطاعات الإنتاجية والخدمية للمناطق والمحافظات المحيطة بالجامعة بما يعمل على سد إحتياجات الأقسام من أعضاء هيئة التدريس من ناحية وزيادة فاعلية دور الكلية في المجتمع وحل مشكلاته التي تقع في دائرة إختصاصها، من ناحية أخرى.

يوجد بالكلية ستة أقسام علمية ساهمت في وضع برامج الدراسات العليا المقترحة ، كل في اختصاصه. ويبين الجدول التالي الرقم الكودي للأقسام العلمية بالكلية

الجدول رقم (1)

القسم	الكود
الرياضيات	01
الفيزياء	02
الكيمياء	03
الجيولوجيا	04
النبات والميكروبيولوجي	05
علم الحيوان وعلم الحشرات	06

<u>قواعــــــد أساســـــية</u>

<u>مادة (1): الدرجات العلمية</u>
تمنح جامعة أسيوط بناءً على موافقة مجلس كلية العلوم الدرجات العلمية التالية:
1 - دبلوم الدراسات العليا المهنية.
2 - دبلوم الدراسات العليا التخصصية.
3 - درجة الماجستير في العلوم (M. Sc).
4- درجة دكتوراه الفلسفة في العلوم (Ph. D).
5 - درجة الدكتوراه في العلوم (D. Sc).
<u>مادة (2) : الشروط العامة للقيد:</u>
1 - استيفاء شروط القبول بكل برنامج.
2- استيفاء شروط القبول التي يضعها المجلس الأعلى للجامعات بالنسبة للطلاب الوافدين.

3- الحصول على موافقة مجلس القسم المختص.

4 ـ استكمال جميع المستندات المطلوبة من إدارة الدراسات العليا.

5- سداد الرسوم الدراسية المقررة قبل بدء الدراسة وفي المواعيد التي تحددها إدارة الدراسات العليا بالجامعة.

6- يجوز لمجلس الجامعة أن يضيف شروطاً يراها ضرورية للقبول مثل إجراء امتحان قبول (شفوي أو تحريري) للطلاب الجدد وطلب دراسة مقررات تكميلية وتكون إضافة هذه الشروط بناء على اقتراح مجلس القسم المختص وموافقة مجلس الكلية.

7 - تحديد عدد الطلاب المقبولين حسب الإمكانيات المتاحة بالقسم والكلية.

8- ألا يكون الطالب مقيدا بالدراسات العليا في أي كلية أو جامعة أخري.

9 ـ على الطلاب المصريين تقديم مستند يفيد موقف كل منهم من التجنيد.

مادة (3): تعريف الساعة المعتمدة:

الساعة الدراسية المعتمدة تعادل: محاضرة نظرية مدتها ساعة واحدة في الأسبوع أو فترة تدريبات أو عملي مدتها ساعتان أو ثلاث ساعات في الأسبوع طوال الفصل الدراسي.

مادة (4): مواعيد القيد والدراسة والامتحان:

1- تعلن كلية العلوم بجامعة أسيوط في شهر يونيو من كل عام عن القيد لدبلوم الدراسات العليا والدراسة التمهيدية لدرجة الماجستير في العام الدراسي التالي، ويكون موعد التقدم بالطلبات المستوفاة لمدة شهر اعتبارا من أول يوليو من كل عام وتبدأ الدراسة في بداية الأسبوع الثالث من شهر اكتوبر، وذلك للطلاب المقبولين والمستوفين لشروط القيد والمسددين لرسوم الدراسة.

2- تقسم السنة الأكاديمية بالنسبة لدبلومات الدراسات العليا والدراسة التمهيدية للماجستير إلى فصلين دراسيين على النحو التالي:

• الفصل الدراسي الأول : يبدأ من الأسبوع الثالث من شهر اكتوبر ولمدة 15أسبوع.

• امتحان الفصل الدراسي الأول: يبدأ من الأسبوع الأول من شهر فبراير.

• الفصل الدراسي الثاني : يبدأ من الأسبوع الثالث من شهر فبراير ولمدة 15أسبوع.

• امتحان الفصل الدراسي الثاني: يبدأ من الأسبوع الثالث من شهر يونيو.

3- يتم القيد لمرحلة دكتوراه الفلسفة في العلوم مرتين خلال شهري يناير وسبتمبر من كل عام بعد استيفاء شروط القيد ودفع الرسوم المقررة.

4- تقسم السنة الأكاديمية لطلاب دكتوراه الفلسفة في العلوم على النحو التالي:

1- الطلاب المقيدون في شهر يناير:

● الفصل الدراسي الأول: يبدأ من الأسبوع الثالث من شهر فبراير ولمدة 15أسبوع.

● امتحان الفصل الدراسي الأول: يبدأ من الأسبوع الثالث من شهر يونيو.

● الفصل الدراسي الثاني: يبدأ من الأسبوع الثالث من شهر اكتوبر ولمدة 15أسبوع.

● امتحان الفصل الدراسي الثاني: يبدأ من الأسبوع الأول من شهر فبراير.

2- الطلاب المقيدون في شهر سبتمبر:

● الفصل الدراسي الأول : يبدأ من الأسبوع الثالث من شهر اكتوبر ولمدة 15أسبوع.

● امتحان الفصل الدراسي الأول: الأسبوع الأول من شهر فبراير.

● الفصل الدراسي الثاني: يبدأ من الأسبوع الثالث من شهر فبراير ولمدة 15أسبوع.

● امتحان الفصل الدراسي الثاني: الأسبوع الثالث من شهر يونيو.

مادة (5): رسوم الدراسة:

1- يجوز تحديد رسوم للقيد ورسوم لاختبار القبول تسدد عند التقدم، وذلك بمعرفة مجلس الجامعة بناء على اقتراح مجلس الكلية.

2- تسدد رسوم القيد عند بدء كل عام دراسي.

3- يعفى المعيدون والمدرسون المساعدون وطلاب المنح الدراسية من سداد الرسوم الدراسية.

4- يجوز تحديد رسوم دخول امتحانات الدبلوم والتمهيدي ومناقشة الرسائل بمعرفة مجلس الجامعة بناء على اقتراح مجلس الكلية.

مادة (6): إيقاف القيد:

يجوز لمجلس الكلية بناء على اقتراح مجلس القسم المختص وموافقة لجنة الدراسات العليا والبحوث بالكلية إيقاف قيد الطالب المقيد للدراسات العليا لمدد لا تزيد **عن خمس سنوات** وذلك في الحالات التالية:

1- **التجنيد** : وعلى الطالب أن يتقدم بطلب لإيقاف قيده طوال مدة تجنيده خلال الثلاثة أشهر الأولى من تاريخ تجنيده مدعوما بالمستندات الدالة على ذلك.

2- **السفر إلى الخارج:** وعلى الطالب أن يتقدم بطلب لإيقاف قيده قبل سفره (أو خلال الشهر الأول من سفره) في إعارة أو مهمة علمية أو إجازة دراسية أو مرافقا للزوج أو الزوجة مدعوما بالمستندات الدالة على ذلك.

3- **المرض** : وعلى الطالب أن يتقدم بطلب لإيقاف قيده عند مرضه مدعوما بشهادة مرضية معتمدة من الإدارة الطبية بالجامعة ومحددا فيها فترة إنقطاعه بسبب المرض.

4- **الوضع ورعاية الطفل** : وعلى الطالبة أن تتقدم بطلب إيقاف القيد لرعاية الطفل مدعوما بشهادة ميلاده.

5- **حالات أخرى** : تقبلها لجنة الدراسات العليا والبحوث بالكلية ويعتمدها مجلس الكلية.

وفي كل الأحوال على الطالب تسديد الرسوم الدراسية المستحقة عن فترة إيقاف القيد عند تقديم طلب إيقاف قيده.

مادة (7): إلغاء القيد:

1- يقوم مجلس الكلية بإلغاء قيد الطالب للدبلومات إذا استنفد مرات الرسوب في امتحان المقررات الدراسية لعامين متتاليين.

2- الطالب الذي يرسب في مقرر واحد أو أكثر في تمهيدي الماجستير يتقدم في العام التالي لأداء الامتحان فيما رسب فيه وإذا تكرر رسوبه بعد ذلك ألغي قيده للدرجة ويجوز إعادة قيده في تخصص آخر بعد موافقة مجلس الكلية بناء على اقتراح مجلس القسم المختص.

3- يقوم مجلس الكلية بإلغاء قيد الطالب لدرجة الماجستير في الحالات الآتية :

1. انقطاعه عن الدراسة أو عدم جديته وذلك بعد موافقة مجلس القسم المختص ولجنة الدراسات العليا والبحوث ومجلس الكلية بناء على تقرير من لجنة الإشراف.
2. إذا رفضت لجنة الحكم الرسالة وأوصت بعدم منح الدرجة
3. عدم منح الدرجة أو تجاوز الطالب المدد المنصوص عليها بقانون تنظيم الجامعات مع مراعاة حالات وقف القيد.
4. إذا تقدم الطالب بطلب لإلغاء قيده.
5. عدم سداد الرسوم المقررة طبقاً للقواعد المنظمة لذلك، ويجوز إعادة قيد الطالب بنفس حالته إذا سدد الرسوم الدراسية قبل نهاية العام الجامعي الذي تم إلغاء قيده فيها.
6. إذا صدر عن الطالب تصرف يتعارض مع التقاليد والقواعد الجامعية، بعد التحقيق الجامعي المناسب.
7. إذا لم يلتزم بالأمانة العلمية في البحث.

4- يقوم مجلس الكلية بإلغاء قيد/ تسجيل الطالب لدرجة الدكتوراه في إحدى الحالات الآتية:

1. انقطاعه عن الدراسة أو عدم جديته في البحث وذلك بعد موافقة مجلس القسم المختص وتوصية لجنة الدراسات العليا والبحوث بناء على تقرير من لجنة الإشراف واعتماد مجلس الكلية.
2. إستنفاذ مرات الرسوب في الامتحان التأهيلي الشامل لدرجة الدكتوراه.
3. إذا رفضت لجنة الحكم الرسالة وأوصت بعدم منح الدرجة .
4. إذا لم يمنح الدرجة خلال المدة المنصوص عليها بقانون تنظيم الجامعات.
5. إذا تقدم بطلب لإلغاء قيده لدرجة الدكتوراه.
6. إذا لم يسدد الرسوم الدراسية المقررة في الموعد المحدد لذلك، ويجوز إعادة قيد الطالب بنفس حالته إذا سدد الرسوم الدراسية قبل نهاية العام الجامعي الذي تم إلغاء قيده فيها.
7. إذا صدر عن الطالب تصرف يتعارض مع التقاليد والقواعد الجامعية بعد التحقيق الجامعي المناسب.
8. إذا لم يلتزم بالأمانة العلمية في البحث.

مادة (8) أرقام و رموز المقررات:

1- توحيد **أرقام** الدرجات العلمية كما يلي:

الدبلوم 500 – الماجستير 600– الدكتوراه 700

2- تدل الأرقام الفردية على المقررات التي تطرح في الفصل الدراسي الأول وتدل الأرقام الزوجية على المقررات التي تطرح في الفصل الدراسي الثاني للماجستير و الدبلومات فقط.

3- يعبر عن المقرر بحرف واحد فقط يعبر عن القسم الذي يقدم المقرر، مثل P للفيزياء، وفي حالة وجود مقرر مطروح في قسم بالتعاون مع قسم آخرفي كلية العلوم أو كلية أخرى بالجامعة يضاف حرف اخر يدل على القسم الآخر مثل MD=Medical

وبيان **رموز المقررات**على النحو التالي:

B	**Botany**
C	**Chemistry**
E	**Entomology**
G	**Geology**
Mang	**Management**
M	**Mathematics**
MC	**Mathematics - Computer**
MD	**Medical**
MS	**Mathematics -Statistics**
P	**Physics**
Z	**Zoology**

مادة (9): المرشد الأكاديمي:

1- يحدد مجلس القسم مرشداً أكاديمياً من أعضاء هيئة التدريس بالقسم لكل طالب من طلاب دبلومات الدراسات العليا وذلك لتقديم النصح والإرشاد له خلال فترة الدراسة ومساعدته في اختيار المقررات الدراسية اللازمة لمجال تخصصه، والمقررات الدراسية الإضافية التي قد يحتاجها الطالب للبرنامج الدراسي المقيد به.

2- يقوم أقدم أعضاء لجنة الإشراف أو من ينوب عنه من أعضاء اللجنة بدور المرشد الأكاديمي في حالة قيد الطالب لدرجة الماجستير أو درجة دكتوراه الفلسفة في العلوم.

مادة (10): قواعد دراسة مقرر:

1. يجوز للجنة الدراسات العليا والبحوث بالكلية وبناء على اقتراح الأقسام العلمية طرح مقرر أو أكثر في غير موعده.

2. لمجلس الجامعة بناء على اقتراح مجلس الكلية إضافة مقررات جديدة غير الواردة في اللائحة بعد أخذ رأي مجلس القسم المختص.

3. يحق للطالب أن يحذف أو يضيف أي مقرر قبل نهاية الأسبوع الثالث من بداية الفصل الدراسي دون أن يظهر المقرر الذي حذفه في سجله الكاديمي.

4. لا يسمح للطالب بدخول الامتحان النهائي إلا إذا حضر 75% من الساعات الدراسية للمقرر، وفى حالة عدم استيفاء هذه النسبة يعتبر الطالب محروما (Barred) في المقرر ويكون تقديره (محروم Bar).

5. إذا انقضت ثلاث سنوات على اجتياز الطالب للدراسات التمهيدية **للماجستير أو الدكتوراه** دون أن يسجل لا يحق له التسجيل إلا بعد إعادة المرحلة التمهيدية دراسة وامتحانا .

مادة (11):

1- يخصص لكل مقرر 100 درجة (نقاط المقرر= نقاط التقدير× عددالساعات المعتمدة للمقرر)

توزع درجات المقرر كالتالي:

أولا: المقررات التي لا تشتمل على أجزاء عملية :

20% للاختبارات الدورية القصيرة والأنشطة الفصلية.

30% لاختبار نصف فصلي.

50% امتحان التحريري في نهاية الفصل.

ثانياً : المقررات التي تشتمل على أجزاء عملية:

10% للاختبارات الدورية القصيرة والأنشطة الفصلية.

15% لاختبار نصف فصلي.

25% لاختبار العملي النهائي.

50% للاختبار التحريري النهائي.

ثالثا: المقررات العملية:

25% للاختبارات الدورية القصيرة والأنشطة الفصلية.

25% لاختبار نصف فصلي.

50% امتحان العملي في نهاية الفصل.

رابعاً: مقررات التدريب الحقلي في بعض التخصصات:

يتم عمل عرض شفهى للتدريب الحقلي بالإضافة إلى تقرير تحريرى يقدم من الطالب و يتم التقييم كالتالى:

50% للقائمين بالتدريب من الجهة التي يتم التدريب فيها طبقا لنموذج معد من الكلية.

50% للمشرف على الطالب.

خامسا: مشروع البحث:

يتم عرض شفهي لمشروع البحث بالإضافة إلى التقرير التحريري المقدم من الطالب ويكون التقييم كالتالي: 50% للمناقشة 50% على التقرير التحريري المقدم عن مشروع البحث.

وتقدر الدرجات التي يحصل عليها الطالب في كل مقرر على النحو التالي:

الجدول رقم (2)

التقدير	الرمز	عدد النقاط	الدرجة
ممتاز	A	4.00	من 90 -100%
	A-	3.7	من 85 > 90%
جيد جداً	B+	3.3	من 80 - 85%
	B	3.00	من 75 > 80%
جيد	B-	2.7	من 70 - 75%
	C+	2.3	من 65 - 70 %
مقبول	C	2.	من 60 > 65%
راسب	F	صفر	60% >
غائب	F	صفر	----

المعدل الفصلي = مجموع حاصل ضرب نقاط كل مقرر فصلي × عدد ساعاته المعتمدة

حاصل جمع الساعات المعتمدة لهذه المقررات التي تم دراستها

المعدل التراكمي = مجموع حاصل ضرب نقاط كل مقرر تم دراسته × عدد ساعاته المعتمدة

حاصل جمع الساعات المعتمدة لهذه المقررات التي تم دراستها

ويقرب الناتج إلى رقمين عشريين.

2 - يحدد التقدير العام للطالب على أساس **معدله التراكمي** كالتالي:-

4- **ممـــتاز : إذا كان معدله التراكمي من 3.7 فأكثر.**

5- **جيد جداً : إذا كان معدله التراكمي من 3. 0 إلى أقل من 3.7 .**

6- **جـــــيد: إذا كان معدله التراكمي من 2.3 إلى أقل من 3.0 .**

7- **الطالب الذي لم يحقق عند إتمامه دراسة المقررات معدلا تراكميا 2.3 على الأقل يجب عليه إعادة دراسة عدد من المقررات الدراسية لمرة واحدة وبحد أقصى ست ساعات معتمدة والتي سبق أن حصل فيها على تقدير C ويحسب له تقدير كامل . وما زاد عن ست ساعات معتمدة يحسب له متوسط التقديرين بحيث يستطيع بواسطتها رفع معدله التراكمي إلى 2.3 .**

مادة (12): معادلة المقررات للطلاب المحولين:

1- بعد توصية لجنة الدراسات العليا والبحوث بالكلية وبناءً على اقتراح مجلس القسم يسمح للطالب بمعادلة عدد من المقررات الدراسية سبق له أن درسها في كلية أخرى أو جامعة أخرى ، على أن تكون من بين المقررات المطلوبة للحصول على الدرجة ، وأن يكون قد نجح فيها بتقدير لا يقل عن C+ أو ما يعادلها، بشرط ألا يزيد مجموع ساعات هذه المقررات عن 30% من مجموع ساعات المقررات الدراسية اللازمة للحصول على الدرجة ، على ألا تكون قد احتسبت له وحصل بها على درجة علمية أخرى، كما لا يجوز معادلة مقررات سبق للطالب دراستها في نفس الجامعة أو أية جامعة أخرى مر عليها أكثر من ثلاث سنوات.

2- يجوز للطالب المسجل في أحد برامج الدراسات العليا أن يعادل مقررات يكون قد نجح فيها بتقدير لا يقل عن C+ سبق له دراستها في جامعة أسيوط في برنامج لم يستكمله إذا كانت هذه المقررات من متطلبات البرنامج.

مادة (13): الاعتذار عن عدم دخول الامتحان :

يجوز قبول اعتذار الطالب عن دخول الامتحان خلال دراسته إذا تقدم بطلبه قبل بدء أو أثناء الامتحان مدعماً بمبرر تقبله لجنة الدراسات العليا والبحوث بالكلية و يعتمده مجلس الكلية.

مادة (14) التقييم:

يتم تقييم طالب الدراسات العليا طبقاً للآتي :

1- اختبارات دورية قصيرة وأعمال فصلية و أنشطة علمية.

2- اختبار نصف فصلى.

3- اختبار عملي نهائي.

4- اختبار تحريري نهائي زمنه يساوي عدد الساعات النظرية المعتمدة بحد أقصى ثلاث ساعات وبحد أدنى ساعتان للمقرر الواحد.

5- المهارات العملية واستيفاء عمل التدريبات العملية هي أساس التقويم العملي على مدار الفصل الدراسي.

6- اختبارات شفوية.

مادة (15): لجان الإشراف:

1- يعين مجلس الكلية بناء على اقتراح مجلس القسم المختص وتوصية لجنة الدراسات العليا والبحوث لجنة للإشراف على الطالب من بين الأساتذة أو الأساتذة المساعدين بالكلية ، ويجوز إشراك أحد المدرسين في الإشراف، ويجوز بموافقة مجلس الكلية أن يشارك في الإشراف من في مستواهم من الأساتذة المتخصصين من خارج الكلية وفي جميع الحالات لايقل عدد المشرفين عن اثنين ولا يزيد عن ثلاثة، ويكون الاستثناء من العدد ثلاثة بقرار من مجلس الجامعة، على أن يكون المشرف الرئيسي من القسم المختص.

2- يجوز أن يكون الإشراف على رسائل درجة دكتوراة الفلسفة في العلوم مشتركاً بين مشرفين من جامعة أسيوط ومشرف آخر من إحدى الجامعات أو المعاهد الأجنبية المعترف بها من المجلس الأعلى للجامعات.

3- في حالة سفر أحد المشرفين إلى الخارج أو حصوله على أجازة خاصة يجوز لمجلس الكلية أن يترك لجنة الإشراف كما هي، أو يضيف عضوا إلى لجنة الإشراف، أو يرفع المشرف الذي سافر إلى الخارج من لجنة الإشراف، أو كليهما وذلك بناء على اقتراح مجلس القسم المختص و لجنة الدراسات العليا والبحوث و بناء على التقرير الذي يقدمه المشرف قبل السماح له بالسفر مدعماً برأي لجنة الإشراف.

4- لا يجوز إشراف عضو هيئة التدريس على الرسائل العلمية أو المشروعات البحثية المقدمة من أحد أقاربه حتى الدرجة الرابعة نسباً أو مصاهرة .

5- في حالة إضافة مشرف على الرسالة لا يتم تشكيل لجنة الحكم والمناقشة للرسالة إلا بعد مضي ستة أشهر من إضافة المشرف، أما في حالة الإضافة بسبب وفاة أحد المشرفين أو اعتذاره عن الإشراف فيمكن مناقشة الرسالة فور اعتماد صلاحية العرض على مجلس القسم.

6- في حالة تسجيل إستمارة رقم 2 والخاصة بعنوان الرسالة ، يقوم الطالب بعمل ندوة علنية (seminar) بالقسم المختص وتقديم خطة بحث موقعة من لجنة الاشراف، قبل موافقة مجلس القسم على تسجيل موضوع البحث.

7- في حالة تعديل موضوع الرسالة تعديلا جوهريا (يحدد ذلك مجلس القسم المختص) لا تقدم الرسالة للحكم قبل مضي ستة أشهر من تاريخ موافقة مجلس الكلية على التعديل وذلك بما لا يخل بأقصى وأقل مدة للحصول على الدرجة، أما التعديل غير الجوهري فلا يترتب عليه أية آثار.

8- تقدم لجنة الإشراف للقسم في نهاية كل عام أكاديمي تقريرا عن الطالب، على أن يحتوى التقرير على بيانات مستوفاة عن مستوى تقدم الطالب، وما تم إنجازه، والمعوقات إن وجدت، ورأى صريح عن استمرار التسجيل أو إلغائه، ويتم اعتمادها من رئيس مجلس القسم ، ووكيل الكلية لشئون الدراسات العليا والبحوث وعميد الكلية.

مادة (16): لجان الحكم:

لجنة الحكم على رسائل الماجستير و الدكتوراه:

1- عند الانتهاء من الرسالة يقوم الطالب بتوجيه من لجنة الإشراف بتقديم ندوة علنية (Seminar) في القسم المختص عن نتائج الرسالة.

2- تكتب الرسالة باللغة الإنجليزية مع ملخص باللغة العربية، ويجب اتباع التعليمات الخاصة بإعداد الرسائل الجامعية والمعتمدة من مجلس جامعة أسيوط.

3- عند الانتهاء من إعداد الرسالة يقدم المشرفون على الرسالة تقريراً عن صلاحية الرسالة، ويشكل مجلس الكلية بناء على اقتراح مجلس القسم المختص لجنة ثلاثية للحكم على الرسالة بعضوية المشرف (أو المشرفين من الأساتذة والأساتذة المساعدين ويكون لهم صوت واحد) وعضوين آخرين من الأساتذة أو من في مستواهم من المتخصصين أحدهما من خارج

الجامعة على الأقل بالنسبة لرسائل الماجستير، أوعضوين آخرين من الأساتذة أو من في مستواهم من المتخصصين بالجامعات ومعاهد البحوث المختلفة من خارج جامعة أسيوط بالنسبة لدكتوراه الفلسفة، وللجنة الحكم أن تجيز الرسالة أو تطلب استكمال أوجه النقص ويعطى الطالب فرصة لذلك. وتكون دعوة الممتحن الخارجي مرة واحدة في العام الميلادي ويستثنى من ذلك بقرار من عميد الكلية في حالات الضرورة.

4- تكون موافقة مجلس القسم على تشكيل لجنة الحكم على رسالة الماجستير مشروطة بقبول أو نشر بحث في مجلة علمية محلية أو أجنبية أو بحث كامل منشور كـ (Proceedings) لمؤتمر أو أي قواعد إضافية يراها القسم المختص، كما يجب حضور مؤتمر علمي وورشة عمل في مجال التخصص.

5- تكون موافقة مجلس القسم على تشكيل لجنة الحكم على رسالة دكتوراه الفلسفة مشروطة بقبول بحثين منشورين على أن يكون أحدهما في مجلة علمية عالمية (دولية) ويجوز للبحث الآخر أن يكون منشورا في مجلة علمية محلية أو كبحث كامل كـ (Proceedings) لمؤتمر أو أي قواعد إضافية يراها القسم المختص، كما يجب حضور مؤتمر علمي وورشة عمل في مجال التخصص.

6- لا يجوز لمجالس الأقسام المختصة الموافقة على صلاحية عرض الرسالة إلا بعد مرور عام كامل على التسجيل بالنسبة للماجستير ومرور عامين كاملين على التسجيل لرسالة الدكتوراه.

7- يجوز أن يكون عضو لجنة التحكيم الخارجي من إحدى الجامعات الأجنبية، وفي جميع الأحوال يكون رئيس لجنة الحكم والمناقشة أقدم الأساتذة الأعضاء في اللجنة.

8- في حالة اختلاف المشرفين على تحديد مدى صلاحية الرسالة للمناقشة يؤخذ بتقرير أغلبية المشرفين (فيما عدا المدرسين)، وإذا تساوت الأصوات يؤخذ برأي مجلس القسم في تحديد مدى الصلاحية من عدمه.

9- في حالة اختلاف مجلس القسم على مدى صلاحية الرسالة يحيل مجلس القسم الموضوع إلى مجلس الكلية باعتباره الجهة المنوط بها إقرار مدى الصلاحية، وتشكيل لجنة الحكم، ويحق لمجلس الكلية إرسال الرسالة إلى لجنة حكم ثلاثية.

10- لا تناقش الرسالة إلا بعد مرور ثلاثة أسابيع على الأقل من تاريخ اعتماد نائب رئيس الجامعة للدراسات العليا والبحوث لتشكيل اللجنة، ويعلن عن موعد ومكان المناقشة بالقسم والكلية، وتكون المناقشة علنية بمقر الكلية.

11- يقدم كل عضو من أعضاء لجنة الحكم والمناقشة تقريراً علميا مفصلا عن الرسالة، وبعد المناقشة يقدم أعضاء لجنة الحكم تقريرا جماعيا عن أحقية الطالب في الحصول على الدرجة العلمية وتعرض التقارير الفردية والتقرير الجماعي على مجلس القسم ثم على لجنة الدراسات العليا والبحوث ثم مجلس الكلية، وللجنة الحكم أن توصي بإعادة الرسالة إلى الباحث لاستكمال ما تراه من نقص على أن تتقدم اللجنة بتقرير جماعي إلى القسم المختص توصي فيه بمنح الطالب مهلة لاستكمال ملاحظاتها خلال ستة أشهر على الأكثر من تاريخ المناقشة، على أن نوافق لجنة الحكم أو من تفوضه على إجازة الرسالة.

12- يجوز أن تعقد المناقشة بحضور أحد ممثلي لجنة الإشراف في لجنة الحكم في حالة تعذر المشرفين الآخرين.

13- تتم المناقشة بحضور ثلاثة أعضاء من لجنة الحكم الثلاثية وبشرط أن يكون من بينهما المشرف الأقدم وذلك في حالة اختيار عضو محكم من خارج البلاد حيث يمكن أن يكتفى بتقريره الفردي أو في حالة سفر أحد المحكمين للخارج أو مرضه لفترة تتجاوز تاريخ إنتهاء صلاحية تشكيل اللجنة على أن يقوم رئيس مجلس القسم بتكليف أحد الأساتذة المتخصصين من أعضاء القسم بالمشاركة فى لجنة المناقشة.

14- في حالة اعتذار عضو واحد أو أكثر من أعضاء لجنة الحكم تتخذ الإجراءات السابقة لاختيار ممتحن أو أكثر بدلا ممن تقدموا بالاعتذار، ويتم إخطاره أو إخطارهم بعضوية اللجنة بمعرفة وكيل الكلية للدراسات العليا والبحوث، على ألا تناقش الرسالة إلا بعد مرور ثلاثة أسابيع من تاريخ موافقة نائب رئيس الجامعة للدراسات العليا والبحوث على لجنة الحكم أو أي تعديل فيها.

15- لا يجوز إشتراك عضو هيئة التدريس في لجنة الحكم على الرسائل المقدمة من ذوي قرابته حتى الدرجة الرابعة نسباً أو مصاهرة.

16- في حالة مرور ثلاثة أشهر على اعتماد تشكيل لجنة الحكم دون مناقشة الرسالة يتم إعادة تشكيل لجنة الحكم بناء على اقتراح مجلس القسم المختص ولجنة الدراسات العليا والبحوث وموافقة مجلس الكلية (بعد مناقشة أسباب التأخير)، واعتماد نائب رئيس الجامعة للدراسات العليا والبحوث ، ويعطى التشكيل الجديد مدة ثلاثة شهور، يتم بعدها النظر في تحديد أسباب عدم إجراء المناقشة في مواعيدها، وذلك بمعرفة عميد الكلية و نائب رئيس الجامعة للدراسات العليا والبحوث.

البرامج الدراسية للأقسام العلمية

أولاً: دبلوم الدراسات العليا

8- دبلوم الدراسات العليا المهنية نظام السنة الواحدة

الهدف من هذه الدبلومة رفع الكفاءه المهنية في المجالات العلمية المختلفة ويلتحق بها خريجو كليات العلوم أو خريجو الكليات العملية الأخرى و هي مرحلة منتهية لا تتيح لحاملها استكمال الدراسة للحصول على درجة الماجستير.

مادة (17): شروط الالتحاق وقواعد منح دبلوم الدراسات العليا المهنية:

1- يلتحق بها الطلاب الحاصلون على البكالوريوس في مجال تخصص الدبلوم من جامعة أسيوط أو من إحدى الجامعات المصرية أو العربية أو الأجنبية المعادلة من المجلس الأعلى للجامعات بتقدير عام مقبول على الأقل ، ويجوز قبول الطلاب الحاصلين على درجة البكالوريوس من إحدى الكليات العملية في التخصصات التي تتناسب مع طبيعة الدراسة بعد موافقة مجلس القسم المختص ومجلس الكلية ، ويحدد ذلك عند الإعلان عن فتح باب القيد.

2- تمنح جامعة أسيوط بناء على طلب مجلس كلية العلوم دبلوم الدراسات العليا المهنية ويحدد في شهادة التخرج اسم الدبلوم وكذلك فرع التخصص.

مادة (18): الساعات الدراسية للبرنامج:

1- يحصل الطالب على دبلوم الدراسات العليا المهنية بعد اجتياز عدد 30 ساعة معتمدة، منها 18 ساعة معتمدة مقررات إجبارية و6 ساعات معتمدة مقررات اختيارية و6 ساعات مشروع بحثي تطبيقي في مجال الدبلوم موزعة على فصلين دراسيين من الكود 500 بمعدل تراكمي 2.3، على أن يقدم الطالب عرضا شفهيا بنهاية المشروع البحثي لتقييمه

2- الحد الأقصى لمرات التقدم لدراسة دبلوم الدراسات العليا المهنية سنتين (4 فصول).

2ـ دبلوم الدراسات العليا التخصصية

مادة (19) شروط الالتحاق وقواعد منح دبلوم الدراسات العليا التخصصى:

أـ يلتحق بإحدى دبلومات الدراسات العليا التخصصية الطلاب الحاصلون على بكالوريوس العلوم من جامعة أسيوط أو من إحدى الجامعات المصرية أو العربية أو الأجنبية المعادلة من المجلس الأعلى للجامعات في مجال تخصص الدبلوم بتقدير عام مقبول على الأقل.

بـ تمنح جامعة أسيوط بناء على طلب مجلس كلية العلوم دبلوم الدراسات العليا في التخصصات المختلفة المبينة باللائحة ويحدد في شهادة التخرج اسم الدبلوم وكذلك فرع التخصص وهي مرحلة منتهية لا تتيح لحاملها القيد لدرجة الماجستير.

مادة (20): الساعات الدراسية لدبلوم الدراسات العليا التخصصى:

أـ يحصل الطالب على الدبلوم التخصصي بعد اجتياز عدد 30 ساعة دراسية معتمدة ، منها 18 ساعـة معتمدة مقررات إجبارية و 6 ساعات معتمدة مقررات اختيارية موزعة على فصلين دراسيين بالإضافة إلى 6 ساعات معتمدة لمشروع بحثي من الكود 500 بمعدل تراكمي 2.3.

بـ مدة دراسة دبلوم الدراسات العليا التخصصية سنة واحدة.

مادة (21): دبلومات تخصصية أخرى:

يجوز لمجلس الكلية التوصية بإنشاء دبلومات دراسات عليا في تخصصات أخرى غير المذكورة باللائحة على أن يتقدم القسم المعني باقتراح البرنامج الدراسي للدبلوم والمقررات الدراسية له ومحتواها العلمي ويوافق عليها مجلس الكلية ومجلس الجامعة.

مادة (22): دبلومات مشتركة:

يجوز لمجلس الكلية التوصية بإنشاء دبلومات مشتركة بين أكثر من قسم وفي هذه الحالة يشكل مجلس الكلية مجلسا لكل دبلوم مشترك برئاسة وكيل الكلية لشئون الدراسات العليا والبحوث وعضوية رؤساء الأقسام المشتركة في الدبلوم.

ثانياً: درجة الماجستير في العلوم

مادة (23): فروع الدراسة:

تمنح جامعة أسيوط بناء على اقتراح مجلس كلية العلوم درجة الماجستير في العلوم من خلال الدراسة بالأقسام العلمية الموضحة في الجدول رقم (1) ويوضح في الشهادة اسم صاحب الشهادة والتخصص وعنوان الرسالة وتاريخ منح الدرجة.

مادة (24): شروط القيد:

1- يقيد الطالب لدرجة الماجستير إذا كان حاصلا على درجة بكالوريوس العلوم بتقدير عام تراكمي جيد على الأقل كما لا يقل تقديره في مادة التخصص عن جيد جداً من إحدى الجامعات الحكومية أو العربية أو الأجنبية المعادلة من المجلس الأعلى للجامعات وبما لا يخالف القواعد التي يقرها المجلس الأعلى للجامعات المصرية.

2- يشترط للقيد لدرجة الماجستير في العلوم تفرغ الطالب يومين من كل أسبوع على الأقل، ويجوز لمجلس الكلية بناء على اقتراح مجلس القسم المختص إعفاء الطالب من هذا الشرط.

3- الحد الأدنى للحصول على درجة الماجستير هو سنتان من تاريخ القيد أو سنة من تاريخ التسجيل والحد الأقصى للحصول على درجة الماجستير هو خمس سنوات من تاريخ التسجيل مع مراعاة فترات وقف القيد ويجوز مد التسجيل فترات أخرى بناء على اقتراح لجنة الإشراف وموافقة مجلس القسم المختص ولجنة الدراسات العليا والبحوث ومجلس الكلية، وبحد أقصى سنتان بناء على تقرير من لجنة الإشراف وتكون مسئولية المشرف إنهاء الرسالة قبل انتهاء فترة المد.

مادة (25): الساعات الدراسية للبرنامج:

يشترط لنيل درجة الماجستير في العلوم أن يجتاز الطالب عدد 48 ساعة دراسية معتمدة موزعة كالتالي:

- 24 ساعة دراسية معتمدة من المقررات الدراسية لمرحلة ما بعد البكالوريوس من الكود 600 منها 18 ساعة معتمدة مقررات إجبارية و6 ساعات معتمدة مقررات اختيارية على فصلين دراسيين .

- 22 ساعة معتمدة للرسالة العلمية.

- 2 ساعات لحضور الندوات العلنية (seminars) بما لا يقل عن 75% من عدد الندوات العلنية (seminars) المنعقدة سنويا خلال فترة الدراسة .

مادة (26): خطة الدراسة للماجستير:

1- يقوم مجلس القسم المختص بتحديد المقررات الدراسية للطالب والتي تلائم التخصص حسب الجداول المرفقة ، ويعتمد وكيل الكلية للدراسات العليا والبحوث هذه المقررات الدراسية.

2- يمكن لمجالس الأقسام العلمية فرض مقررات تكميلية من الأكواد 200 إلى 400 وذلك عند تسجيل الطالب لرسالة الماجستير في تخصص مخالف إلى حد ما عن التخصص الذي حددت بناء عليه الدراسة التمهيدية التي اجتازها.

3- لا يتجاوز عدد المقررات التكميلية أربعة مقررات وبحد أقصى 8 ساعات معتمدة وفي حالة زيادتها عن أربعة مقررات يقضي الطالب سنة تأهيلية للنجاح في هذه المقررات كشرط للتسجيل للرسالة.

4- بعد انتهاء الطالب من دراسة 24 ساعة معتمدة بمعدل تراكمي لا يقل عن 2,3 يسجل موضوع البحث في ضوء الخطة البحثية للقسم والبرامج المطروحة باللائحة، ويعد رسالة علمية تقيم على أنها 22 ساعة معتمدة في موضوع تحدده له لجنة الإشراف ويعتمد من مجلس القسم المختص ولجنة الدراسات العليا والبحوث ومجلس الكلية.

5- يقوم الطالب بعمل ندوة علنية (seminar) عند تسجيل موضوع البحث وندوة علنية (seminar) على الأقل كل ستة أشهر لمتابعة ما توصل إليه من نتائج، على أن تخطر إدارة الدراسات العليا بموعد إلقاء الندوة العلنية (seminar) ولجنة الدراسات العليا والبحوث.

6- على الطالب قبل تسجيل موضوع البحث أن يجتاز امتحان شهادة **TOEFL** في اللغة الإنجليزية بمعدل 450 درجة على الأقل أو ما يعادل هذا الامتحان من امتحانات اللغة الإنجليزية المعترف بها.

7- يجوز لمجلس القسم المختص أن يوافق على تعديل عنوان الرسالة بناء على طلب لجنة الإشراف ، ويعتمد ذلك التعديل من لجنة الدراسات العليا والبحوث ومجلس الكلية.

مادة (27): شروط المنح :

يوصي مجلس الكلية بناء على توصية مجلس القسم المختص ولجنة الدراسات العليا والبحوث بمنح درجة الماجستير في العلوم في حالة استيفاء الطالب للشروط الآتية:

1- مرور سنتين على الأقل من تاريخ القيد أو سنة من تاريخ التسجيل.

2- نجاح الطالب في امتحانات جميع المقررات الدراسية بمعدل تراكمي لا يقل عن 2,3.

3- قبول الرسالة من لجنة الحكم والتوصية بمنح الدرجة.

4- استيفاء متطلبات اللغة طبقا لقواعد الجامعة والكلية .

ثالثاً: درجة دكتوراه الفلسفة فى العلوم

مادة (28): فروع الدراسة:

تمنح جامعة أسيوط بناء على اقتراح مجلس كلية العلوم درجة دكتوراه الفلسفة في العلوم من خلال الدراسة بالأقسام العملية الموضحة في الجدول رقم (1) ويوضح في الشهادة اسم صاحب الشهادة والتخصص وعنوان الرسالة وتاريخ المنح.

مادة (29): شروط القيد:

1- أن يكون حاصلا على درجة ماجستير العلوم في نفس التخصص العام من إحدى كليات العلوم بالجامعات المصرية أو العربية أو الأجنبية المعترف بها من المجلس الأعلى للجامعات.

2- يتقدم الطالب لعميد الكلية بطلب لقيده لدرجة دكتوراه الفلسفة في العلوم الذي يحيله إلى مجلس القسم المختص للنظر في تشكيل لجنة الإشراف ومجال البحث في ضوء الخطة البحثية للقسم والبرامج المطروحة باللائحة ثم يعرض على لجنة الدراسات العليا والبحوث ثم يعتمد من مجلس الكلية.

مادة (30):الساعات الدراسية للبرنامج:

يشترط لنيل درجة دكتوراه الفلسفة في العلوم أن يجتاز الطالب عدد **66** ساعة معتمدة موزعة كالتالي:

- **12 ساعة دراسية معتمدة من المقررات الدراسية (كود 700)**
- **44 ساعة معتمدة للرسالة العلمية**
- **6 ساعات للامتحان التأهيلي الشامل**
- **4 ساعات لحضور الندوات العلنية (seminars) بما لا يقل عن 75% من عدد الندوات العلنية (seminars) المنعقدة سنويا خلال فترة الدراسة .**

مادة (31) : مدة الدراسة

1- الحد الأدنى للحصول على درجة الدكتوراه هو سنتان من تاريخ التسجيل.

2- الحد الأقصى للحصول على درجة الدكتوراه هو خمس سنوات من تاريخ التسجيل، مع مراعاة مدة وقف وإيقاف القيد، ويجوز مد التسجيل فترة أخرى بناء على اقتراح لجنة الإشراف وموافقة مجلس القسم المختص ولجنة الدراسات العليا والبحوث ومجلس الكلية وبحد أقصى سنتين بناء على تقريرمن لجنة الإشراف وتكون مسئولية المشرف إنهاء الرسالة قبل انتهاء فترة المد.

مادة (32): خطة الدراسة للدكتوراه

1- يدرس الطالب مقررات دراسية من كود 700 عدد ساعاتها 12 ساعة معتمدة على فصلين دراسيين ويحددها القسم المختص بناء على اقتراح لجنة الإشراف واعتماد لجنة الدراسات العليا والبحوث وموافقة مجلس الكلية.

2- يعقد للطالب امتحان شامل (Comp. Exam) في مجال التخصص بعد إجتياز المقررات الدراسية بنجاح وبمعدل تراكمي لا يقل عن 2.3

3- بعد الانتهاء من دراسة 12 ساعة معتمدة بمعدل تراكمي لا يقل عن 2.3، وإجتياز الامتحان التأهيلي الشامل يسجل الطالب موضوع البحث ويعد الطالب رسالة علمية تقيم على أنها 44 ساعة معتمدة في موضوع يقترحه ويوافق عليه المشرف (لجنة الإشراف) ويعتمد من مجلس القسم المختص ولجنة الدراسات العليا والبحوث ومجلس الكلية.

4- تحدد لجنة الإشراف للطالب مجالاً للبحث في ضوء الخطة البحثية للقسم والبرامج المطروحة باللائحــة ويعتمـد من مجلس القسـم المختــص ولجنـة الدراسات العليا والبحوث بالكلية، ويقدم الطالب رسالة علمية طبقاً للقواعد تتضمن نتائج البحث وتمثّل إضافة جديدة في فرع التخصص.

5- يقوم الطالب بعمل ندوة علنية (seminar) عند تسجيل موضوع البحث، على أن تخطر إدارة الدراسات العليا بموعد إلقاء الندوة العلنية (seminar).

6- يجوز لمجلس القسم بناء على طلب من لجنة الإشراف أن يوافق على تعديل مجال البحث مرة واحدة فقط أثناء دراسة الدكتوراه. ويعتمد ذلك التعديل من لجنة الدراسات العليا والبحوث بالكلية ومجلس الكلية ولا يترتب على ذلك التعديل الإخلال بالمدد الزمنية المنصوص عليها في المادة (30) من اللائحة.

7- يجوز لمجلس القسم المختص أن يوافق على تعديل عنوان الرسالة بناء على طلب لجنة الإشراف ، ويعتمد ذلك التعديل من لجنة الدراسات العليا والبحوث ومجلس الكلية، ولا يترتب على ذلك الإخلال بالمدد الزمنية المنصوص عليها في المادة (30) من اللائحة. وفي حالة التغيير الجوهري يجوز لمجلس القسم المختص أن يكلف الطالب باجتياز بعض المقررات الدراسية الإضافية من الكود 700   تحددها له لجنة الإشراف من ضمن المقررات الدراسية باللائحة أو التي تدرس في أقسام أخرى بالكلية أو في إحدى كليات أو معاهد جامعة أسيوط أو الجامعات الأجنبية المعترف بها بشرط ألا تزيد في مجموعها عن تسع (9) ساعات معتمدة. ولا تحسب للطالب هذه الساعات ضمن الساعات المعتمدة المذكورة في الفقرة (1) من هذه المادة.

8- على الطالب قبل تسجيل موضوع البحث أن يجتاز امتحان شهادة **TOEFL** في اللغة الإنجليزية بمعدل 450 درجة على الأقل أو ما يعادل هذا الامتحان من امتحانات اللغة الإنجليزية المعترف بها.

مادة (33): معادلة المقررات

يجوز لمجلس الكلية بناء على اقتراح مجلس القسم المختص معادلة مقررات ذات كود 700   سبق للطالب دراستها بالكلية أو بمعهد علمي معترف به من المجلس الأعلى للجامعات والنجاح فيها بتقدير جيد على الأقل خلال الثلاث سنوات السابقة للقيد للتمهيدي بشرط ألا تتجاوز عدد ساعات هذه المقررات عن 6 ساعات معتمدة.

مادة (34) : الامتحان التأهيلي الشامل:

1- يعتمد مجلس الكلية لجنة الممتحنين للامتحان التأهيلي الشامل لطالب الدكتوراه، وتشكل لجنة الممتحنين بالامتحان الشامل بناء على توصية من لجنة الإشراف وموافقة مجلس القسم المختص ولجنة الدراسات العليا والبحوث بالكلية وتتكون اللجنة من أربعة من الأساتذة أو الأساتذة المتخصصين في المجال العام للبحث، على أن يكون أحد الأعضاء على الأقل من خارج القسم، بالإضافة إلى المشرف.

2- تقوم اللجنة بوضع الامتحان التأهيلي الشامل ويشمل:

*امتحانا تحريريا في مجالات التخصص العام والدقيق وتقوم اللجنة بتحديد أسلوب الامتحان ويخصص له أربع ساعات معتمدة.

** امتحاناً شفويا يخصص له ساعة معتمدة واحدة ويشمل :

- موضوعات التخصص العام.
- موضوعات التخصص الدقيق.
- خطة البحث (موضوع الدراسة).

3- الحد الأقصي لتقدم الطالب للامتحان التأهيلي الشامل ثلاث مرات، وفي حالة عدم اجتيازه للمرة للثالثة يلغي قيد الطالب لدرجة الدكتوراه.

مادة (35): شروط منح الدرجة:

يوصي مجلس الكلية بناء على توصية مجلس القسم المختص ولجنة الدراسات العليا والبحوث بالكلية بمنح دكتوراه الفلسفة في حالة استيفاء الطالب للشروط الآتية:

1- مرور سنتين على الأقل من تاريخ التسجيل.

2- قبول الرسالة من لجنة الحكم والتوصية بمنح الدرجة.

3- قبول بحثين منشورين على أن يكون أحدهما في مجلة علمية عالمية (دولية) ويجوز للبحث الآخر أن يكون منشورا في مجلة علمية محلية أو كبحث كامل كـ (Proceedings) لمؤتمر أو أي قواعد إضافية يراها القسم المختص، كما يجب حضور مؤتمر علمي وورشة عمل في مجال التخصص.

4- اجتياز الطالب امتحان شهادة TOEFL اللغة الإنجليزية بمعدل 450 درجة على الأقل.

5- اجتياز الطالب الامتحان التأهيلي الشامل .

6- استيفاء متطلبات اللغة طبقا لقواعد الجامعة والكلية .

رابعاً : درجة الدكتوراه في العلوم D. Sc

المادة(36) : شروط التقدم للحصول على درجة الدكتوراة في العلوم

1- أن يكون حاصلا على درجة دكتوراه الفلسفة في العلوم ومضى على حصوله عليها خمس سنوات على الأقل.

2- أن يقدم أبحاثا مبتكرة منشورة في مجلات علمية متخصصة وأن يمر على نشرها عام أو أكثر، على أن تتسم أبحاثه بالإستمرارية.

3- على المتقدم أن يبين الإتجاهات العامة لبحوثه وما قدمه للعلم من فائدة ملموسة وكذلك مدى ما قام به في البحوث المشتركة ، وللمتقدم علاوة على ذلك أن يقدم بيانا بالأعمال العلمية غير المنشورة والتي تدل على إضافات جديدة للعلم.

4- تقديم بيان تفصيلي باللغتين العربية والإنجليزية يتضمن إسهاماته العلمية والإضافات الجديدة ومدى ما قدمه للعلم من فائدة من بحوثه المنشورة.

5- تقديم ملخص باللغة العربية والإنجليزية لإنتاجه العلمي موضحا دور المتقدم في الأبحاث المشتركة .

6- يقدم فهرسا مرجعيا (Citation Index) لإنتاجه العلمي.

7- يقدم قائمة بالرسائل العلمية التي أشرف أو شارك في الإشراف عليها وموضحا بها لجنة الإشراف على كل رسالة باللغة العربية والإنجليزية ومعتمدة من الكلية المانحة للدرجة.

المادة(37):

1- يدعو عميد الكلية لجنة دكتوراه العلوم(.D. Sc) للاجتماع وتشمل اللجنة العميد ووكيل الكلية لشئون الدراسات العليا والبحوث ورئيس مجلس القسم المختص وثلاثة من الحاصلين على درجة الدكتوراه في العلوم ، وإذا كان المتقدم عضوا في اللجنة تنعقد اللجنة بدونه .

2- تقوم اللجنة بالتأكد من استيفاء شروط التقدم الواردة في المادة (35).

3- في حالة استيفاء شروط التقدم يرفع الأمر إلى مجلس الكلية لتشكيل لجنة الحكم من ثلاثة من المحكمين من خارج مصر ، ويفضل الأعضاء في الجمعية الملكية البريطانية والحاصلين على دكتوراه العلوم.

المادة(38):

1- يقدم كل عضو من أعضاء لجنة الحكم تقريرا عن مدى أصالة المتقدم في مجال تخصصه ومدى صلاحية الإنتاج العلمي للمتقدم للتوصية بمنحه الدرجة.

2- تجتمع لجنة دكتوراه العلوم (D. Sc.) بالكلية لفتح مظاريف تقارير المحكمين الثلاثة وتوصي بمنح الدرجة في حال التوصية الصريحة من المحكمين الثلاثة بمنح الدرجة ويرفع الأمر بعد ذلك إلى مجلس الكلية.

3- يسدد المتقدم قيمة مكافأة السادة المحكمين في حالة عدم حصوله على الدرجة.

4- يجوز التقدم مرة ثانية واحدة بعد مرور خمس سنوات على الأقل من تاريخ قرار مجلس الكلية بعدم المنح على أن يتضمن إنتاجه العلمي إضافة علمية جديدة وتشكل لجنة من محكمين جدد.

5- بالنسبة للمتقدمين من خارج الجامعة يشترط أن يكون المتقدم على درجة أستاذ ويقوم بتسديد رسوم تحددها اللجنة.

المادة(39):

يذكر في الشهادة الخاصة بدرجة دكتوراه العلوم التخصص الدقيق للمتقدم.

المادة(40):

يعمل بهذه اللائحة فور صدور القرار الوزاري بها، ويلغى كل نص أو لائحة سابقة.

QAAU

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