Kingdom of Saudi Arabia
Ministry of Higher Education
Majmaah University
College of Science

Handbook of Student Academic Counseling

Student Counseling

Student academic counseling is an important activity in universities and colleges. It is an assistance program that helps fresh and returning students overcome difficulties and acquire more effective and efficient study skills. Student academic counselors are comprised of the same teaching faculty in the college. They conduct one-on-one and group workshops with their students. Thus, the very first step for new students is usually to get hold and converse with an academic counselor or advisor one on one on a regular basis. These counselors or advisors help the students to plan their academic calendars, and ensure that the students are taking the classes they need to graduate, in addition to many other types of advises. The responsibilities of students and advisors are explained in detail somewhere in this booklet.

Academic support and guidance is one of the pillars of higher education in the Kingdom. It aims at guiding students to get the best results, to adapt to the university environment, and to seize the opportunities available. This is achieved by providing the students with skillful advisors that provide sufficient information and guidance for smooth sailing of students' academic programs. Some of the important activities include, but not limited to:

- ✓ Inform about the impact of course selection and academic performance
- ✓ Information and explanations on academic policies and procedures
- ✓ Confidential discussions on personal, some academic, medical or religious issues thateffect performance and search for remedy
- ✓ Discussions on course load

- ✓ Discussions on transfer students and credits
- ✓ Permission requests for off campus courses at another university
- ✓ Scholarship, or other monetary inquiries
- ✓ Advisors should recommend students to register only in one level, and avoid extensive registrations in different levels so to be eligible to sit for a re-examination in a quiz .
- ✓ Students missing quizzes are advised to present a written and acceptable reason for doing so to be eligible to sit for a re-examination in a quiz.

Some major duties of the council include :

- Formulation of well-thought-out strategy for academic counseling in the college of Science
- Introduction of effective awareness programs in the college environment on the availability of this support service for students and its importance
- Distribution of student lists to academic advisors beginning of every semester
- Introduce a scheduled meeting initiative that suits both council and advisors
- Organize and monitor student-advisor relationship and ease up any difficulty associated it
- Work to solve issues such as psychological, financial, social, and professional problems of students with the Deanship of Student Affairs, and at the college administration levels
- Help advisors to solve any difficulties that may arise in coordination with Vice Dean for Academic affairs
- Review student advisor reports and provide recommendations

- Discuss student problems beforehand that may affect their grades and find solutions

Academic Advisors Responsibilities

Academic Counseling :

- Advisors are expected to be well versed with college's academic policies including but not limited to registration, cancellation, addition, and dropping of courses. Important dates and deadlines as announced by the Deanship of Admission and Registration .
- Introducing students to college's objectives, mission, academic programs, and academic departments, scope of the program
- Outcomes, and requirements of the program in the college of science
- Should have a prior knowledge and preparation that he will have student to support and provide counseling from the time of entrance into the program until graduation. The list of students will appear in advisors account beginning of semester. To obtain it :
  - ✓ Go to university web site
  - ✓ Log into your personal account
  - ✓ Point the cursor on the "Academics" to right
  - ✓ Scroll down to Academic Advisor or Counsello
  - ✓ Click and the list of your students will appear
  - ✓ Clicking on anyone will pull the details of their records
- Should have templates where study schedule, registered courses, student's grades, initial performance, and all types of forms are entered beginning of every semester that would serves as portfolio file for each student. As student progresses in levels, this file becomes permanent portfolio that includes student's GPA, regular meetings minutes, and regular monitoring and achievement reports, warnings,

or any other issues .

- Discovering talents among students and enhancing them .
- Advise to visit useful e-learning sites
- Encouraging students to participate in academic and extra-curricular activities.
- Signing a good conduct for students
- Filing a report on the problems that need the intervention of the unit or the college administration .

Strategies for guidance

- Let students assemble for an introductory meeting to get to know them and let them know you and your strategies ahead of time.
- This Clearly discussing your strategies in supervision and guidance and provision of help whenever needed .
- Introduction of plan of work that help the student to sail smoothly in their program years without delays or problems
- Let students be aware of any non punctuality or irresponsibility
- Agreement on a common communication mean that would enable them to contact at any time during work hours in the college or off campus
- Letting students be aware on deadlines, important dates, and maximum and minimums of passing marks, course loads, credit hours, and how to help them ahead of time to avoid difficulties

Couching for good conduct

- Trying to break the social boundaries for students to interact clearly and frankly for them to ex-press any type of difficulties that may face them .

- Try to gain their trust, and use it to introduce a positive attitude in his society.
- Be vigilant on some student behaviors and try not to rush to conclusions, take your time to seek on different strategies and plan-B if your plan does not apply to all. Seeks help from college authorities with the intention of provide help and guidance first.
- There will always be issues you can not solve; be frank and let them know that you will seek answers.
- If you have students with special needs, provide all the means you can and seek help for all that you can not
- Be absolutely firm that as much as you want them to succeed in their program, you will never help them illegally in any type of examinations.

Department of Physics

A brief on Department of physics:

Department of Physics was founded with the establishment of the College of Science in Zulfi in 1427 (2006) as one of the four departments of the College (mathematics, Physics, Medical laboratories, Computer). Department started its first year with eight students, and the number of students was growing gradually at a rate of 15 students each year until it reached 83 students in the academic year 1431-1432 AH. The Department of Physics teaches physics courses and gives its graduates Bachelor of Science degree in physics after the student passes the 136 study units successfully according to the new academic plan of the department that have been followed since the academic year 1429-1430 AH. In the future, the M.Sc. and the Ph.D. degrees will be establish, which would be awarded separately.

Vision:

To deliver scientific education and research in Physics and enhance the Knowledge of Society.

Message:

Providing a unique education and scientific research, to serve the community in building knowledge and skills in physics through conducive environment and society partnership.

Objectives:

The Department of Physics aims in the context of the overall objectives of the Faculty of Science and objectives of the Department of Physics to the following:

- Conduct and develop distinct academic programs
- Attract a world-class and diverse faculty members
- Encourage the excellence of scientific research in Physics
- Partnership with peers at regional and international universities.
- Provide the community with highly qualified competents.

Study approach in the department:

Student in the Faculty of Science spends four years spread over eight semesters. The study courses include the core courses (the requirements of the University - Faculty of requirements -the requirements of the department and specialization). The student must finish 137 units of study.

Entry requirements for the department:

- General assimilation of the Department
- Cumulative average for the student
- The wishes of the student

Serving the environment and Society:

- Teaching Physics and Statistics in the different colleges.
- Participating in research projects for the environment and society.
- Participating in various committees within and outside the college.
- Participating in cultural and scientific activities at the college and university.

Career Opportunities for Graduates:

- Continue higher educations in physics and obtain their Ph.D.

- Work in research centers and universities.

1. King Abdulaziz City for Science and Technology (**http://www.kacst.edu.sa**).
2. King Abdullah City and Renewable Energy (**http://www.kacare.gov.sa**)

- Work in the public and private sectors of education.
- Work in the industry sector.

SABIC is the Saudi Basic Industries Corporation, one of the world's leading manufacturers of chemicals, fertilizers, plastics and metals. **(http://www.sabic.com)**

- Work in power stations.
- Work at water stations, petrol ministry.
- Work in specialized research centres, quality control labs. and standards and measurements bureau.

Educational methodology to get a Bachelor's degree

The students who study in the faculty of science spend four years spread over eight semesters which include basic courses (University requirements -Faculty requirements —the department and specialization requirements). The student must study 137 units.

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Study plan for the Bachelor's Degree in Physics

Program Study Plan

1- Compulsory and Elective Requisites

Requisite	Type of requisite	Total credit hours	Percentage of credit hours	Observations
University	Compulsory	--	--	
	Elective	12	8.76%	
College	Compulsory	29	17%21.	
	Elective	--	--	
Department	Compulsory	84	61.31%	12 hours from Mathematics from the Department
	Elective	9	6.57%	
Free courses		3	19%2.	
Total hours and percentage		137	100%	

2- University Requisites

Course Code	Course Number	Course	Credit Hours	Pre-requisite	Observations
ARAB	101	Linguistic skills	2(2+0+0)	--	Compulsory
SALM	101	Introduction to Islamic Culture	2(2+0+0)	--	Compulsory
SALM	102	Islam and building society	2(2+0+0)	--	Compulsory
SALM	103	Economical system in Islam	2(2+0+0)	--	Compulsory
--	--	University Elective	2(2+0+0)	--	Elective
--	--	University Elective	2(2+0+0)	--	Elective

3- Compulsory College Requisites					
Course Code	Course Number	Course	Credit Hours	Pre-requisite	Observations
PCOM	113	Computer Skills	2(2+0+0)	--	
PMTH	112	Introduction to Mathematics 1	2(2+0+0)	--	
PENG	111	English Language 1	8(2+6+0)	--	
PSSC	114	Learning and Communication Skills	2(2+0+0)	--	
PMTH	127	Introduction to Mathematics 2	4(3+0+1)	--	
PENG	123	English for engineering and science	2(2+0+0)	--	
PPHS	128	Physics	3(2+2+0)	--	
PENG	112	English Language 2	6(2+4+0)	--	

4- Elective College Courses					
Course Code	Course Number	Course	Credit Hours	Pre-requisite	Observations

5- Compulsory Department Requisites					
Course Code	Course Number	Course	Credit Hours	Pre-requisite	Observations
MATH	201	Calculus I	3(3+0+0)	--	
PHYS	201	General Physics I	4(3+2+0)	--	
PHYS	202	General Physics II	4(3+2+0)	PHYS 201	
MATH	202	Calculus II	3(3+0+0)	MATH 201	
PHYS	211	Classical Mechanics	3(3+0+0)	PHYS 201 MATH 201	
PHYS	231	Waves and Vibrations	3(3+0+0)	PHYS 201 MATH 201	
PHYS	241	Thermodynamics	3(3+0+0)	PHYS 201	
PHYS	291	Thermal Physics Lab.	2(0+4+0)	PHYS 201	
PHYS	330	Mathematical Physics I	3(3+0+0)	MATH 202	

MATH	310	Differential Equations	3(3+0+0)	MATH 202	
PHYS	321	Electromagnetism I	3(3+0+0)	PHYS 202	
PHYS	332	Optics	3(3+0+0)	PHYS 231	
PHYS	351	Modern Physics	3(3+0+0)	PHYS 231	
MATH	324	Partial Differential Equations	3(3+0+0)	MATH 310	
PHYS	304	Mathematical Physics II	3(3+0+0)	PHYS 301	
PHYS	393	Optics Lab.	3(3+0+0)	PHYS 332	
PHYS	342	Statistical Physics	3(3+0+0)	PHYS 241	
PHYS	339	Electromagnetism Lab.	2(0+4+0)	PHYS 321	
PHYS	352	Quantum Mechanics I	3(3+0+0)	PHYS 351 PHYS 324	
PHYS	322	Electromagnetism II	3(3+0+0)	PHYS 321	
PHYS	342	Electronics	3(3+2+0)	PHYS 202	
PHYS	345	Quantum Mechanics II	3(3+0+0)	PHYS 352	
PHYS	449	Modern Physics Lab.	2(0+4+0)	PHYS 351	
PHYS	481	Nuclear Physics I	3(3+0+0)	PHYS 351	
PHYS	471	Solid state physics I	3(3+0+0)	PHYS 352	
PHYS	445	Atomic and molecular physics	3(3+0+0)	PHYS 352	
PHYS	549	Practical Training	1(0+2+0)	PHYS 392 PHYS 393	- Co-requisite
PHYS	649	Solid state physics lab.	2(0+4+0)	PHYS 471	
PHYS	749	Nuclear Physics lab.	2(0+4+0)	PHYS 481	
PHYS	499	Project	2(0+4+0)	PHYS 497 PHYS 498	

6- Elective Department Requisites

Course Code	Course Number	Course	Credit Hours	Pre-requisite	Observations
PHYS	205	Introduction to Astronomy	3(3+0+0)	--	
PHYS	361	Health Physics	3(3+0+0)	PHYS 202	
PHYS	355	Laser Physics	3(3+0+0)	PHYS 351	

PHYS	362	Biophysics	3(3+0+0)	PHYS 202	
PHYS	407	Computational Physics	3(3+0+0)	PHYS 302	
PHYS	456	Plasma Physics	3(3+0+0)	PHYS 322	
PHYS	472	Solid state physics II	3(3+0+0)	PHYS 471	
PHYS	406	Mathematical Physics III	3(3+0+0)	PHYS 304	
PHYS	473	Semiconductors	3(3+0+0)	PHYS 471	
PHYS	474	Materials Science	3(3+0+0)	PHYS 471	
PHYS	475	Renewable Energy	3(3+0+0)	PHYS 471	
PHYS	482	Nuclear physics II	3(3+0+0)	PHYS 481	
PHYS	484	Radiation Physics	3(3+0+0)	PHYS 481	
PHYS	485	Neutron Physics and Reactors	3(3+0+0)	PHYS 481	
PHYS	483	Elementary Particle Physics	3(3+0+0)	PHYS 481	
PHYS	476	Nanotechnology	3(3+0+0)	PHYS 471	

7- Training Requisites

Course Code	Course Number	Course	Credit Hours	Pre-requisite	Observations

Suggested Distribution of Courses on Semesters

Year	Course Code	Course Title	Required or Elective	Credit Hours	College or Department
Prep Year					
1st semester	PCOM113	Computer Skills	Required	2(2+0+0)	Computer Science
	PMTH112	Introduction to Mathematics 1		2(2+0+0)	Mathematics
	PENG111	English Language 1		8(2+6+0)	
	PSSC114	Learning and Communication Skills		2(2+0+0)	
	PMTH127	Introduction to Mathematics 2	Required	3(3+0+0)	Mathematics

2nd semester	PENG123	English for Engineering and Science		2(2+0+0)	
	PPHS128	Physics		3(2+2+0)	Physics
	112PENG	English Language 2		6(2+4+0)	
Year	**Course Code**	**Course Title**	**Required or Elective**	**Credit Hours**	**College or Department**
					Second Year
1st Semester	101IC	General Elective	Free	2(2+0+0)	
	201MATH	Calculus 1	Required	3(3+0+0)	Mathematics
	201PHYS	General Physics 1		4(3+2+0)	Physics
	101ARAB	Linguistic Skills		2(2+0+0)	
	101ZPSY	Thinking skills and learning methods.		2(2+0+0)	
	-----	Free course	Free	3(3+0+0)	
	-----	University elective course	elective	2(2+0+0)	
2nd Semester	202PHYS	General Physics II	**Required**	4(3+2+0)	Physics
	202MATH	Calculus II		3(3+0+0)	Mathematic
	211PHYS	Classical Mechanics		3(3+0+0)	Physics
	231PHYS	Waves and Vibrations		3(3+0+0)	
	241PHYS	Thermodynamics		3(3+0+0)	
	291PHYS	Thermal Physics Lab		2(0+4+0)	
Year	**Course Code**	**Course Title**	**Required or Elective**	**Credit Hours**	**College or Department**
					Third Year
1st Semester	PHYS301	Mathematical Physics I	Required	3(3+0+0)	Physics
	MATH310	Differential Equations		3(3+0+0)	Mathematic
	PHYS321	Electromagnetism I		3(3+0+0)	Physics
	PHYS332	Optics		3(3+0+0)	
	324 MATH	Partial Differential Equations		3(3+0+0)	Mathematic
	PHYS351	Modern Physics		3(3+0+0)	Physics
2nd Semester	PHYS302	Mathematical Physics II	Required	3(3+0+0)	Physics
	IC102	Islam and building society		2(2+0+0)	
	PHYS393	Optics Lab.		2(0+4+0)	Physics

	PHYS342	Statistical Physics		3(3+0+0)	
	PHYS392	Electromagnetism Lab.		2(0+4+0)	
	PHYS352	Quantum Mechanics I		3(3+0+0)	
	PHYS322	Electromagnetism II		3(3+0+0)	
Year	**Course Code**	**Course Title**	**Required or Elective**	**Credit Hours**	**College or Department**
Fourth Year					
1st Semester	PHYS422	Electronics	Required	4(3+2+0)	Physics
	PHYS452	Quantum Mechanics II		3(3+0+0)	
	PHYS494	.Modern Physics Lab		2(0+4+0)	
	PHYS481	Nuclear Physics I		3(3+0+0)	
	PHYS471	Solid state physics I		3(3+0+0)	
	IC103	Economic system in Islam		2(3+0+0)	
	549PHYS	Practical Training		1(0+2+0)	
2nd Semester	PHYS454	Atomic and molecular physics	Required	3(3+0+0)	Physics
	PHYS496	Solid state physics lab.		2(0+4+0)	
	PHYS497	Nuclear Physics lab		2(0+4+0)	
	PHYS499	Project		2(0+4+0)	
		Department elective	Elective	3(3+0+0)	
		Department elective		3(3+0+0)	
		Department elective		3(3+0+0)	

Characterization courses:

PHYS 101: General Physics I

Theoretical part: Physics and measurements, Units and dimensions, Dynamics of particle in one dimension (displacement, average velocity, instantaneous velocity, acceleration, free fall), vector algebra and geometry, Motion in two dimensions, Projectile motion, Uniform circular motion, Tangential and radial accelerations, Newton's first law and inertial frames, Mass and weight, Newton's second law, Newton's third law, Friction, Work and energy, Vector scalar products, Work of variable forces, Kinetic energy and work-energy theorem, Conservative and non-conservative forces and potential energy, Power, Conservation of mechanical energy, The conservation law of linear momentum, Impulse, Collisions, Collision in one and two dimensions, Rotational motion with constant angular acceleration, Angular quantities, Moment of inertia, Torque and angular momentum, Work of rotational motion, Properties of matter: Elasticity, Stress, Strain, Modulus's, Strain energy, Fluid mechanics: Density and relative density, the concept of pressure, Pascal law, Archimedes principle, Fluid flow, Bernoulli's equation and its applications, Viscosity, Surface tension.

Practical part: Error and measurements, Force table, Hook's Law, Free fall, Projectile motion, Inclined planes, Verifying the equations of motion and collisions using air track, Young's Modulus.

PHYS 202: General Physics II

Theoretical part: Electric Charge, Insulators and conductors, Coulomb's law, Point charge, The electric field, Electric field of multiple point charges, The electric field of continuous charge distribution, examples of various shapes (disks, rings, spheres, planes), The parallel plate capacitor, Electric dipole, motion of point charge and electric dipole in electric field, Electric flux, Gauss's law, Applications of Gauss's law, Conductor in electrostatic equilibrium, The electric current, Batteries, current density, Conductivity and resistivity, Electric potential, The potential of point charges, The potential of dipole, The electric potential of many charges, Capacitance and capacitors, Energy stored in a capacitor, Fundamental circuits, Ohm's law, Series

resistors, Parallel resistors, Kirchhoff's laws, RC circuits, Magnetism and magnetic force, source of magnetic fields, Magnetic field of a current, Magnetic dipoles, Ampere's law and solenoids, The magnetic force on a moving charge, The magnetic force on a current-carrying wire, Forces and torques on current loops, Induced current, Motional emf, Magnetic flux, Lenz's law, Faraday's law, Induced fields and EM waves, Inductors, LC circuits, LR circuits, AC circuits and phasor, Capacitors in AC circuits, RC filter circuits, Inductor circuits, The RLC circuits, Power in AC circuits, Wave phenomena, Longitudinal and transverse waves, Sound, The nature of light and the laws of geometric optics, Image formation, Interference of light waves, Diffraction patterns and polarization.

Practical part: Verification of Ohm's Law, Metric bridge, Charge and discharge of capacitors, Inductive Reactance, Capacitive Reactance, RCL circuits, Transformers, Speed of sound in air, Refractive Index of a Prism, Focal length of Lenses, Focal Length of Mirrors, Jouls equivalence.

PHYS 211: Classical Mechanics

Integration of Newton's equations of motion, motion under a constant force, motion under a force that is a function of time, velocity and position, time varying mass system. The Lagrangian Formulation of Mechanics, Generalized Coordinates and constraints, D'Alembert's Principles and Lagrange's Equations, Hamilton's Principle, Integrals of motion, Nonconservative systems,……etc. Hamiltonian Dynamics, the Hamiltonian of a dynamical system, Hamilton's Canonical equation, integrals of Hamilton's, phase space and liouville's theorem, the passage from the Hamiltonian. General force motion, The two body problem, general properties of central force motion, effective potential

and classification of orbits, general solutions of the problem of motion, Galilean references, Non Galilean references, inverse square law, kepler's law, application of general force, Newton's law of gravity, stability of circular orbits, the upsides and the advance of perihelion, hyperbolic orbits and Rutherford scattering. Collisions Between Particles, Direct impact of two particles, centre of mass coordinate system, scattering cross section in the L and C systems, Scattering by a central force field. Linear Oscillations, the simple harmonic oscillator, and harmonic oscillation in two

and three dimensions, Damped Oscillations, relaxation time phenomena…… etc. Nonlinear Oscillation, Qualitative analysis - energy and phase diagrams, Elliptic integrals and Nonlinear oscillations, Fourier series, the method of perturbation, Ritz method, Methods of successive approximation, chaotic oscillations.

PHYS 231: Vabiration and Waves

Periodic motion - Simple harmonic oscillation - Damped oscillation - Forced oscillation - Application of damped and forced oscillations - Superposition of simple harmonic oscillations- traveling waves, standing waves, Beats - Transverse wave in wires - Longitudinal waves in rods - Application of longitudinal wave in open and closed air columns -Fourier analysis -Doppler effect

PHYS 241: Thermodynamics

Fundamental concept in heat and thermodynamics, Thermal Equilibrium and zeroth law of thermodynamics, Ideal gases, First law of thermodynamic, Application of first law of thermodynamic - isothermic and adiabatic processes. Irreveriable process - reversible processes. Carrnot cycle - otto cycle - cleapeyron lattent heat equation-

Second law of thermodynamic, Entropy, Thermodynamic functions, Maxwell relation, Third law of thermodynamic, Phase change, Applications on thermodynamic laws.

PHYS 291: Thermal physics lab.

Specific Heat of a Solid, Coefficient of Thermal expansion, Surface tension, viscosity coeffcient, Newton's law of cooling, Determination of the Paraffin wax fusion temperature, Boyle’s Law, resistivity dependence on temperature.

PHYS 303: Mathematical Physics I

Determinants, Matrices, Solving linear equations and differential equations by matrices, Application on the motion of the rotation of the rigid body, Vector Algebra: Vector products, Position, Displacement, Vector transformation, Gradient, The Divergence, The Curl, Laplace operator, Line, Surface, and Volume Integrals, Gauss theorem, Stock's theorem, Green's theorem, Spherical polar coordinates, Cylindrical coordinates, The Dirac delta function.

PHYS 221: Electromagnetism I

Review of vector Operations and algebra, Linear and rotational transformation of vectors, Vector field, Review of vector differential calculus: (gradient, the divergence, the curl, product rules, Second Derivatives), Review of integral Calculus: (linear, surface, and volume integrals), The fundamental theorem for: (calculus, gradient, divergence, curl), Curvilinear Coordinates: (spherical polar and cylindrical coordinates), The Dirac delta function in one and three dimension, The divergence of reciprocal square of radial distance, The Helmholtz theorem, Coulomb's law, The electric field, Continuous charge distributions, Divergence and curl of electrostatic fields, Field lines and flux, Gauss's law and its applications, Electric potential, The potential of a localized charge distribution, The work done to move a charge, The energy of a point charge distribution, The energy of a continuous charge distribution, Properties of conductors and induced charges, Surface charge and the force on a conductor, Capacitors, Poisson's equation, Laplace's equation in one, two and three dimensions, Boundary conditions and uniqueness theorems, Conductors and the second uniqueness theorem, The Method of images and induced surface charge and calculating force and energy, Multipole expansion and approximate potentials at large distances, The monopole and dipole terms, The electric field of a dipole, Polarization, Field of a polarized object, Induced dipole and dielectrics, Polar molecules, Bound charges, The field inside a dielectric and the electric displacement, Gauss's law in the presence of dielectrics, Boundary conditions, Linear Dielectrics: (susceptibility, permittivity, dielectric constant), Boundary value problems with linear dielectrics, Force and energy in dielectric systems, Magnetostatics and the Lorentz law, Magnetic fields and magnetic forces, The Biot-Savart law, The magnetic field of a steady current, The divergence and curl of the magnetic field, Ampere's law and its applications, Magnetic vector potential, Magnetostatic boundary conditions, Multipole expansion of the vector potential, Magnetic fields in matter and the magnetization, Magnetic materials: (diamagnets, paramagnets, ferromagnets), Torques and forces on magnetic dipoles, Effect of magnetic field on atomic orbits, The field of a magnetized object, Bound currents, The magnetic field inside matter and the auxiliary field, Ampere's law in magnetized materials, Boundary Conditions, Linear and nonlinear media, Magnetic susceptibility and permeability, Ferromagnetism.

PHYS 332: Optics

The nature of light, The superposition of waves, Interference of two-beams of light (division of the wave front & division of amplitude) Interferometers (Young's, Fresnel's biprism, loyed mirror, Fresnel's double mirrors, wedge interferometer, Newton rings, Michelson interferometer, Jamin & Mach-Zehnder refractometers), Interference of multiple beams, Fabry-Perot interferometer, Applications of interferometry. Diffraction, Fraunhofer diffraction (single slit, two slits, multiple slits) - diffraction grating - Fresnel diffraction (circular aperture & circular Obstacle). Polarization - polarization by absorption, reflection, refraction & double refraction - Optical active materials & polarometer. Interference of polarized light, Analysis of

polarized light, Electro-optics (Kerr effect & Pockels effect), Magneto - optics (Faraday effect)

PHYS 351: Modern Physics

Special Theory of Relativity: wave propagation - Michelson Morley experiment - Galilean transformation – Lorentz transformations – Relative velocity - Lorentz contraction – Time Dilation – relativity of mass – Mass and energy – Applications. The particlelike properties of Electromagnetic radiation: Electromagnetic waves – The photoelectric effect – black body radition - The Compton Effect - X-rays. Waveslike properties of particles: De-Broglie hypothesis – Electron diffraction experiment of Davison and Germer – Electronmicroscope – Uncertainity principle, quantum theory. Atomic Structure: atomic properties - The Thomson model - Rutherford Model for atomic nuclei - alpha particle scattering - Atomic Spectra – Bohr theory of the hydrogen atom – Sommerfeld's Model – Failure of the Bohr theory Frank-Hertz experiment – The basic ideas of the Quantum Mechanics

PHYS 304: Mathematical Physics

Complex numbers, Analytic functions - Limits and Continuity – Analyticity - The Cauchy-Riemann Equations, Elementary Functions, Complex Integration – Contours - Independence of path - Cauchy integral theorem - Bounds for analytic Functions, Series representations for analytic functions, Residue Theory. Conformal Mapping-Invariance of Laplace's Equation - Geometric Considerations - Bilinear Transformations - The Schwartz-Christoffel Transformations.

PHYS 322: Electromagnetism II

Electromotive force, Ohm's law, Motional electromotive force, Electromagnetic induction, Faraday's law, The induced electric field, Inductance, Energy stored in magnetic fields, The modified Ampere's law, Maxwell's equations in vacuum, Maxwell's equations in matter, Boundary conditions, Conservation laws and the continuity equation, Poynting's theorem, Newton's third law in electrodynamics and momentum, Maxwell's stress tensor, Conservation of momentum, Angular momentum, Electromagnetic waves in one dimension, The wave equation, Sinusoidal waves, Boundary conditions: reflection and transmission, Polarization, Electromagnetic waves in vacuum, Monochromatic plane waves, Energy and momentum in electromagnetic waves, Electromagnetic waves in matter, Propagation in linear media, Reflection and transmission at normal incidence, Reflection and transmission at oblique incidence, Absorption and dispersion, Electromagnetic waves in conductors, Reflection at a conducting surface, The frequency dependence of permittivity, Guided waves and wave guides, TE waves in a rectangular wave guide, The coaxial transmission lines, Electric dipole radiation, Magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charge, Radiation reaction with matter.

PHYS 391 : Optics Lab

Prism spectrometer (refractive index and dispersion), Grating spectrometer, Fresnel's biprism with He-Ne laser, Fresnel's double mirrors with He-Ne laser, Newton's rings, Michelson interferometer, Mach-Zehnder-interferometer, Diffraction at a single slit, Diffraction at double slits, Diffraction at one-and two-dimensional gratings, Diffraction at a single slit measuring and evaluating with Video Com, Polarimter and optical activity, Abbe's refractometer, Inverse square law of light radiation and absorption coefficient of glass or plastic materials, Polarization of light.

PHYS 342: Statistical Physics

Probability, One random variable, Some important probability distributions, Many random variables, Sums of random variables and the central limit theorem, Rules for large numbers, entropy, Kinetic theory of gases, Maxwell's distribution of the velocities of gas molecules and its applications, Distribution function of the energy of molecules, Liouville's theorem, Equilibrium properties, The microcanonical ensemble, Two-level systems, The ideal gas, Mixing entropy and the Gibbs paradox, The canonical ensemble, Canonical examples, The Gibbs canonical ensemblem, The grand canonical ensemble, Quantum statistical mechanics, Maxwell-Boltzmann distribution, Bose Einstein distribution, Fermi-Dirac distribution, Vibrations of a solid, Black-body radiation, Quantum microstates, Quantum macrostates, Ideal quantum gases, Hilbert space of identical particles, Canonical formulation, Grand canonical formulation, The degenerate fermi gas, The degenerate bose gas.

PHYS 352: Quantum Mechanics I

Reviews of the fundamental experiments in modern physics, the need for quantum mechanics. Wave packet and uncertainty principle, Schrödinger equation for free particle, Continuity relation, The dynamical variables and calculating the expectation values, Schrödinger equation with a potential in one dimension, Dynamical variables and calculating the expectation values in momentum space, Commutation relations. Hermitian operators, Linear operators, Completeness relation and orthonormality. Schrödinger equation in three dimensions, The fundamental postulates of quantum mechanics, Particle in an infinite well, Spectral expansion theory, The parity, Constants of motion and conservation laws, Momentum eigenfunctions and free body, One-dimensional potentials: The potential step, The finite potential well at scattering and bound states, The potential barrier, The delta-function potential at Scattering and Bound states, Simple harmonic oscillator, Oscillator eigenfunctions and eigenvalues, Ladder operators and dynamical variables, Schrödinger equation in three dimensions in Cartesian coordinates, Schrödinger equation in three dimension curvilinear coordinate system, Angular momentum and its eigenfunctions and eigenvlaues, The addition of angular momentum, The central potentials.

PHYS 393: Electromagnetism Lab

Practical part: Measurement of the electric charge by Millikan oil drop method, measurement of e/m of the electron, Verification of Biot - Savart law, Verification of Faraday's law, Transformers, Measuring the force on current carrying conductors in a

homogenous magnetic fields, RLC circuits, Generators, Motors, Magnetic moment of magnetized rod, Helmholtz coils, Magnetic induction.

PHYS 494: Modern Physics Lab

The Balmer series of hydrogen and determination of Rydbergs constant, Franck-Hertz experiment, characteristics of microwaves, Fabry – Perot interferometer, Kerr effect, Faraday effect, Pockels effect, Zeeman effect, Planck s constant, Studing X-ray spectra.

PHYS 423: Electronics

Analog Electronics: The P-N junction diode and Zener diode with their applications – Junction Field effect transistor - Bipolar junction transistor (Bias and amplifiers: JFET & BJT) – Differential and Operational Amplifiers, Introduction to Feedback Circuits, Multivibrators and Oscillators.

Digital Electronics: Binary and Hexadecimal System, Logic Gates, Karnaugh Maps Flip Flops, Shift Registers, Counters, Memories.

Practical part: P-N junction application (half-wave rectifier, full-wave rectifier, clampers and limiters, Zener regulation) - Transistors JFET & BJT amplifiers. Amplifiers with 741 (Inverting & Non inverting Amplifiers, Active Filters, Wien Oscillator, Astable Multivibrator). Half and Full Adder (7483), Flip Flop (7474-7476), Shift Register (7495-74194), Counters (7493-74193).

PHYS 453: Quantum Mechanics II

Dirac notation, Vector space algebra and Hilbert space, Rephrasing wave mechanics and operator methods in abstract view, Angular momentum commutation relations, Raising and lowering operators for angular momentum, Expansion theory in abstract view, Matrix representation of angular momentum operators, General relations in matrix mechanics, Eigenstates of spin ½, The intrinsic magnetic moment of spin ½ particles, Addition of two spins, Addition of Spin ½ and orbital angular momentum, Time-independent perturbation theory and energy shifts, Degenerate perturbation theory, The Stark effect, Hyperfined splitting, Variational principle and its applications, The WKB approximation, Time-dependent perturbation theory, The interaction of charged particle with electromagnetic field, Two level-system, emission and absorption of radiations, spontaneous emission, Transition rate, selection rule, scattering theory, Partial wave analysis, The Born approximation.

PHYS 471: Solid State Physics I

Different states of matter, classification of solids, crystal structure (Bravais lattices & Millor indices), methods of determination of crystal structure (X-ray diffraction, electron and neutron diffraction), crystal defects, crystal binding (interatomic forces, types crystal bonds), lattice dynamics (crystal vibration modes and phonons), thermal properties of insulators (specific heat of insulators: classical model, Einstein's model,

Debye model, thermal conductivity of insulators), Dependence of thermal conductivity on temperature, free electron theory (classical model of free electron, Fermi gas of free electrons, Maxwell- Boltzmann distribution, Fermi-Dirac distribution function), band theory (zone theory and tight binding theory).

PHYS 481: Nuclear Physics I

Properties of the nucleus: Constituents – determination of nuclear charge, radius and mass – Nuclear binding energy. Natural Radioactivity: Decay law-Nuclear stability-Radioactivity and theory of transformation. Artificial Radioactivity: Discovery of artificial radionuclides – Transuranium elements-Interaction of radiation with matter: Interaction of heavy elements - interaction of light electrons - interaction of gamma rays with matter - interaction of neutrons with matter. Radiation Detectors: Gas detectors - Scintillation detectors - solid state detectors. Nuclear Reactions: Reactions of matter by gamma-rays - reactions by alpha particles - reactions by protons - reactions by neutrons. Nuclear fission: Discovery of Nuclear fission – theory of Nuclear fission. Nuclear fusion: Energy production in stars – control of thermonuclear reactions. Nuclear accelerators

PHYS 495: Practical Training

The student carries out a research under the supervision of one of the Staff members in one of the following branches: Theoretical Physics - Nuclear Physics - Solid State Physics - Fiber Optics – Laser – Plasma. The student learns how to write a report and trains on how to use research equipments or any necessary softwares as a preparation to the project course.

PHYS 454: Atomic and Molecular Physics

Introduction: Comparing between atomic emission spectroscopy and atomic absorption spectroscopy; Optical spectroscopy, Atomic spectrum, Atomic emission / absorption spectrophotometry Molecular spectroscopy, Spectroscopy of inner electrons. Zeemen's effect, Sodium spectrum, Effect of magnetic field on the energy levels of atom. Theory of magnetic energy, Anomalous Zeeman's effect and Lande splitting factor. Molecular Spectra of diatomic molecules. Vibrational energy levels in both classical mechanics and quantum mechanics. Rotational spectra of diatomic molecule in gaseous state and rotational energy levels. Molecular spectra; Anharmonic Oscillato- Non Rigid Rotator - Infrared Vibration-Rotation spectra; visible spectrum, IR spectrum, RBS spectra, XRD spectrum - measurements of Absorbance, Transmitting and Reflecting using double beam Spectrophotometers in all ranges of wavelengths (UV-VIS-NIR-IR), Normal modes of vibrations; Natural of infrared absorption, Basic Laser principles, Laser behavior, Properties of laser radiations, Different types of lasers, Laser spectroscopy, The total losses of the laser system, Transmission at the mirrors. Absorption and scattering by the mirrors, Absorption in the laser medium. Diffraction losses at the mirrors, The Ruby Laser - Three Level Laser (Helium-Neon Laser) - Four Level Laser (Carbon dioxide Laser), Laser applications.

PHYS 496: Solid State Physics Lab

Studying the characteristics of the solar cell - electron diffraction experiments - characteristics curves of an optical (photo) resistor - the electron spin resonance (ESR) - Calculation of the energy gap of germanium by an electrical method - determination of the thermal coefficient of a noble metal (platinum) by computer - the magnetic susceptibility of some materials and its classification – X-ray spectroscopy and calculation of Planck's constant and Miller indices of crystal planes in NaCl single crystal - Thermoelectric effect in semiconductors (calculation of Seebeck, Peltier and Thomson coefficients) - Superconductivity and determination of the transformation temperature of YBCO specimen by computer – Determination of the absorption coefficient of Aluminum for X-ray, Hall effect, Studying the crystline structure by using the field effect microscope.

PHYS 497: Nuclear Physics Lab

Statistical nature of Radioactive decay law –Determination of the half life of Thoron isotope Rn220 - Rutherford Scattering - Attenuation of gamma radiation - Absorption of beta radiation passing through different materials – Inverse square law in case of gamma-rays - Velocity of alpha particle - Backscattering of beta particles - Alpha spectroscopy of radioactive elements - Determining the energy loss of alpha particles in aluminum and in gold - Recording a beta spectrum with a scintillation counter - Effect of a magnetic field on beta particles motion.

PHYS 498: Project

The student carries out a research under the supervision of one of the Staff members in one of the following branches: Theoretical Physics - Nuclear Physics - Solid State Physics - Fiber Optics – Laser – Plasma. The student submit a report about his work, and is evaluated by a committee selected by the department.

ELECTIVE COURSES

PHYS 406: Mathematical Physics III

Series Method for solving linear differential equations, Legendre polynomials, Hermite polynomials, Lagurre polynomials, Bessel Functions, Fourier transformation and its application, Laplace transformation and its application, Eigenvalue problem, Differentional equations of Boundary value problem.

PHYS 361: Health physics

Review of the sources of radiation, basic dosimetry, and hazards of ionizing radiation, Radiation safety guides and codes in the environment, industry, medical and nuclear facilities, Techniques for the detection, use, and safe handling of radiation sources, Radiation protection and shielding: monitoring of sources, planning of facilities,

waste management, and radiation protection for the public, radiation detection and counting statistics. Radiation laws and regulating agencies.

PHYS 361 : Bio-Physics

Biomechanics Forces affects on our bodies. Vector analysis. Levers and equilibrium of rigid bodies. Stress-strain curve. Young's and Shear modulus for materials and biological tissues. Stress-Strain Curve - Young's and Shear Modulus for materials and applications. Properties of Fluid. Viscosity and Surface tension. Bernoulli's Equation and its applications. Effect of gravity and acceleration on blood pressure. Nature of sound and sound intensity level. Ultra-sound, production and its applications in diagnostic and treatment. Nervous system. And electricity within the body. Equilibrium potential and Nernst equation. Factors affecting the propagation of action potential. Action potential measurements of some organs; EGG, EEG and ERG. Nonionizing Radiation, Physical and biological effects.

PHYS 355: Laser physics

Absorption and Emission of light, Einstein Relations, Population inversion, Gain coefficient, Optical resonator, Laser Modes, solid state lasers, semiconductor lasers, Gas lasers, Dye lasers, Free electron laser and some new lasers. Laser beam properties, Line width, Divergence, coherence, Brightness, Focusing properties of laser, Q - switching, Frequency doubling, Phase conjugation. Applications: medical, industrial, Military, Scientific, Holography and compunctions.

PHYS 473: Semiconductor physics

Semiconductor Fundamentals: Carrier distribution functions, Carrier densities, Carrier Transport, Carrier recombination and generation, Continuity equation, The drift-diffusion model.

P-N Junctions: Electrostatic analysis of a P-N diode, The P-N diode current, Reverse bias breakdown.

Bipolar Junction Transistors: Structure and principle of operation, Ideal transistor model, Non-ideal effects, Base and collector transit time effects, BJT circuit models, BJT Technology.

MOS Capacitors: Structure and principle of operation, MOS analysis. MOS Field-Effect-Transistors: Structure and principle of operation, MOSFET models, Threshold voltage, MOSFET Circuits and Technology.

PHYS 205: Introduction to Astronomy

Introduction: modern astrophysics – History of astronomy. Laws of motion: Kepler laws, Gravitational law, newton's modified law, Orbits of planets, speed in the orbit,

proceeding velocity. Solar system: planets: 1- Earth-like planets: Mercury, Venus, Earth, Mars. 2 - giant planets (like Jupiter): Jupiter, Saturn, Uranus, Neptune. 3 – satellites, the rings, comets, asteroids. Stars: Stars dimensions, Destiny, Luminosity, spectrum types, HR form, double stars and stars masses. Evolution of stars. Galaxies: Milky Way, types of galaxies, galaxies properties, anomalies galaxies, galaxies crowds, the universe.

PHYS 474: Materials science

States of matter (liquid, crystalline and vitreous); crystal structure of metals; Metallography (reflecting optical microscope, transmission electron microscope) specimen preparations; Mechanical testing (hardness & tensile test); Defects in crystals (point defects and dislocations); Diffusion in solids; (phase transformation and phase diagrams) strengthening mechanisms (alloying, cold work, precipitation & fiber strengthening); heat treatment of steel & T T T curves

PHYS 463: Medical Physics

Introduction to Medical Physics, Electromagnetic Spectrum and Radiation, Basic Interactions of ionizing and non-ionizing Radiation with biological matter. Radiological Imaging: Introduction to Imaging, Conventional X-ray imaging, Computed Tomography, Diagnostic ultrasound. Radiation therapy: Introduction to Radiotherapy Physics Linear Accelerators, Introduction to External Beam Treatment Planning, Brachytherapy, Machine calibration and quality assurance. Magnetic Resonance Imaging: Introduction, Basic NMR Physics, MR Imaging Principles, Applications. Nuclear medicine: Introduction, Isotopes, PET scan.

PHYS 407: Computational Physics

Introduction: Computation and Science, The emergence of Modern Computers, Computer Algorithms and Languages: Applications: Newton and Kepler Laws. Numerical linear Algebra: Systems of linear equations, Eigen values and Eigen vectors. Interpolation, Extrapolation and Data Fitting: Polynomial Interpolation, Data fitting, Least squares fitting. Ordinary differential equations: Initial-value problems, The Euler and Picard methods, The Runge-Kutta method, Chaotic dynamics of the driven pendulum, Boundary -value and eigenvalue problem, The one-dimensional Schrödinger equation.

PHYS 485: Neutrons Physics and Reactors

Neutron reactions: cross-sections, attenuation, reaction rate, fission cross-section. Nuclear fission, fission yield, Energy distribution among fission neutrons and fragments, regeneration factor. Thermal neutrons: energy distribution, effective cross section, moderation, average energy loss, Average energy logarithmic decrement, SDP, MR and resonance escape probability. The Nuclear chain reaction: neutron cycle, thermal utilization factor and calculating the four factors formula.

PHYS 484: Radiation Physics

Definition of radiation quantities, doses and their units, instruments for measuring personal doses, radiation monitoring and radioactive contamination, biological effects of radiation, external and internal radiation exposure, radiation protection and

shielding, recommendations of IAEC, protection against different radiations sources, decontamination, radioactive waste management

PHYS 475: Renewable Energy

Energy Fundamentals, Fossil fuels, Renewable energy part 1:- Solar radiation and solar energy (thermal, photvoltaics and electrochemicals) Renewable energy Part II: Alternatives (hydropower, wind power, ocean thermal energy conversion, biomass, geothermal energy, tidal and wave energy), Energy conservation & storage, energy and transportation, air pollution and environment

PHYS 456 : Plasma physics

Introduction (Definition of Plasma, Processing Plasmas, Plasma Physics and Plasma Chemistry). Single Particle Motions (Orbits in direct current electric and magnetic fields, Collisions, Transport Phenomena, Chemical Reactions in Plasmas). Plasma Statistical Mechanics (Ensemble Theory, Liouville's Theorem, Particle Distribution Functions, the Boltzmann and Vlasov Equations). Plasma Magnetohydrodynamics (MHD Equilibrium, Magnetic Confinement, Stability). Waves in Cold Plasmas (Wave Equations, Dispersion Functions, The effects of Magnetic Fields). Waves in Hot Plasmas (Acoustic and Magnetoacoustic waves, Landau Damping, Nonlinear Waves). Kinetic Theory and Radiation (Cyclotron emission, Bremsstrahlung). Applications (Fusion, Plasma-Aided Manufacturing).

PHYS 483 : Elementary Particle Physics

Elementary particles: properties, classifications and detections. Fundamental forces between elementary particles. Symmetries and their role in studying elementary particle physics.
Strong force. Electromagnetic force. Weak force. Relativistic quantum mechanics. Feynman diagram.

PHYS 472 : Solid State Physics II

Semiconductors and its applications (semiconductor materials - Band theory in semiconductor - energy gap in semiconductors – holes - Fermi level in semiconductor - effect of impurities on semiconductors – applications) Magnetism in solid state (magnetic moments - origin of magnetism – diamagnetism – paramagnetism – Ferromagnetism - molecular field theory - exchange energy – Antiferromagnetism – Ferrimagnetism - hystresis loop - magnetic domains - magnetic resonance) Superconductivity Electrical properties of Superconductors - magnetic properties of superconductors - thermodynamic properties of superconductor - electrodynamic properties of superconductor (London theory - Ginzeberg Landau theory) type I and type II superconductors - cooper pair - microscopic theory of superconductors (BCS theory) Dielectric properties of solids (polarization and dielectric constants, electric damage for insulators - Ferroelectric) Optical properties of solids (Reflection, absorption and emission - optical conductivity)

PHYS 482: Nuclear Physics II

The fundamental forces in nature, quark theory and the origin of nuclear force, inter nucleon force, nuclear reactions and reaction cross section (Coulomb scattering, optical model, resonance reactions and Breit-Wigner formula), nuclear models (liquid drop model, shell model, collective model) elementary particles, fundamental

symmetries and gauge theory, lepton-hadrons interactions, quantum chromo dynamics, electro-weak interactions, physics of modern accelerators.