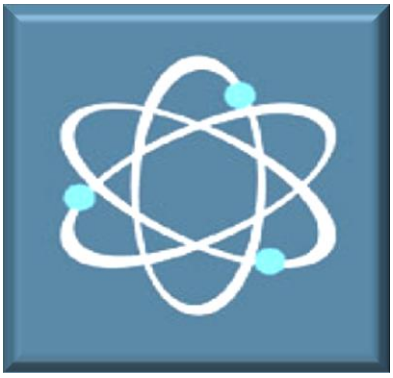
King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans

Physics Study Plan



Physics and Astronomy Department

2013 – 1434H

King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans

Physics Study Plan

1st Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect.- Exre.-Pract.)**
CI 140	Learning, Thinking and Research Skills	-	-	3 (3+0+0)
CHS 150	Health and Fitness (2)	-	-	1 (1+0+0)
ENG 140	English Language (1) (E)	-	-	8 (8+0+0)
MATH 140	Introduction to Mathematics (E)	-	-	2 (1+1+0)
Total of Credit Hours				**14**

2nd Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect.- Exre.-Pract.)**
CT 140	Computer Skills (E)	-	-	3 (0+0+3)
MC 140	Communication Skills	-	-	2 (2+0+0)
ENG 150	English Language (2) (E)	ENG 140	-	8 (8+0+0)
MATH 150	Differential Calculus (E)	140 MATH	-	3 (2+1+0)
ENT 101	Entrepreunership	-	-	1 (1+0+0)
Total of Credit Hours				**17**

3rd Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. –Pract.)**
110 PHYS	General Physics (1)	140 MATH	-	4(3+0+1)
111 PHYS	General Physics (2)		-	4(3+0+1)
111 MATH	Methods of Integration (E)	150 MATH	-	4(3+1+0)
201 PHYS	Mathematical Physics I (E)		-	3(2+1+0)
Elective course from University requirement			-	2(2+0+0)
Total of Credit Hours				**17**

4th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
209 MATH	Differential Equations	111 Math	-	4(3+1+0)
210 PHYS	Classical Mechanics I	150 Math	-	4(3+1+0)
222 PHYS	Electromagnetism	111 PHYS+	-	4(3+1+0)
234 PHYS	Vibrations and Waves	111 MATH	-	4(3+1+0)
Elective course from outside the speci. (list A)			-	3(3+0+0)
Total of Credit Hours				**19**

5th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. –Pract.)**
301 PHYS	Mathematical Physics II (E)	209 MATH	-	3(2+1+0)
312 PHYS	Classical Mechanics II	210 PHYS	-	3(3+0+0)
331 PHYS	Optics	201 PHYS	-	3(3+0+0)
352 PHYS	Modern Physics (E)	111 PHYS	301 PHYS	4(3+0+1)
394 PHYS	Electromagnetism Laboratory	222 PHYS	-	2(0+0+2)
395 PHYS	Wave Physics Laboratory	234 PHYS	331 PHYS	2(0+0+2)
Total of Credit Hours				**17**

6th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
325 PHYS	Electronics	222 PHYS	371 PHYS	3(2+0+1)
343 PHYS	Thermal and Statistical Physics (E)	209 MATH	-	4(3+1+0)
371 PHYS	Solid State Physics I	352 PHYS	-	3(3+0+0)
391 PHYS	Thermodynamic Laboratory	-	343 PHYS	2(0+0+2)
396 PHYS	Modern Physics Laboratory	352 PHYS	-	3(0+0+3)
Elective course from University requirement				2(0+0+2)
Total of Credit Hours				**17**

7th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. –Pract.)**
400 PHYS	Computational Physics	301 PHYS	-	2(1+0+1)
404 PHYS	Mathematical Physics III		-	3(3+0+0)
453 PHYS	Quantum Mechanics (E)	352 PHYS	-	4(3+1+0)
481 PHYS	Nuclear physics I (E)	352 PHYS	-	3(3+0+0)
490 PHYS	Research Skills	396 PHYS	-	2(0+0+2)
Elective course from outside the speci. (list A)				3(3+0+0)
Total of Credit Hours				**17**

8th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. Exre. – Pract.)**
491 PHYS	Solid state physics laboratory	371 PHYS +396 PHYS	-	2(0+0+2)
492 PHYS	Nuclear physics laboratory	481 PHYS + 396 PHYS	-	2(0+0+2)
499 PHYS	Research Project	400 PHYS +453 PHYS	-	3(0+0+3)
Elective course from University requirement			-	2(2+0+0)
Elective course from University requirement			-	2(2+0+0)
Elective 1 course from inside the speci. (list B1)			-	3(3+0+0)
Elective 2 courses from inside the speci. (list B2)			-	4(4+0+0)
Total of Credit Hours				**18**

(Lect - Exer – Pract) = (Lecture – Exercise – Practical)

List of the Elective Courses of the University Requirements
(Student elects 8 credit hours)

Course Code	Course Title	Pre-requisite	Credits (Lect. – Exer. - Pract.)
IC 100	Studies in the Biography of the Prophet	-	2 (2+0+0)
IC 101	Introduction of Islamic Culture	-	2 (2+0+0)
IC 102	Islam and Building up the Society	-	2 (2+0+0)
IC 103	Economic System in Islam	-	2 (2+0+0)
IC 104	Political system in Islam	-	3 (2+0+1)
IC 105	Human Rights	-	3 (2+0+1)
IC 106	Islamic Jurisprudence	-	2 (2+0+0)
IC 107	Ethics of Occupation	-	2 (2+0+0)
IC 108	Contemporary Issues	-	2 (2+0+0)
IC 109	Woman and Her Developmental Role	-	2 (2+0+0)

List of the Elective Courses

A- Elective requirement courses from *OUTSIDE* the Specialization
(The student elects 6 credit hours)

(List A):

Course Code	Course name	Credit (Lect - Exer- Pract)
102 ASTR	Introduction to Stellar and Solar System	3 (2+0+1)
100 STAT	Introduction of Statistics	3 (2+1+0)
103 CHEM	General Chemistry-1	3 (3+0+0)
140 MBIO	Microbiology	3 (2+0+1)
student chooses only two courses		

B- Elective requirement courses from the Specialization (List B)
(The student elects 7 credit hours)

(List B1):

Course Code	Course Title	Pre-req.	Credits (Lect - Exer- Pract)
435 PHYS	Laser Physics	331 PHYS	3(3+0+0)
460 PHYS	Biophysics	481 PHYS	3(3+0+0)
473 PHYS	Material Science	371 PHYS	3(2+1+0)
477 PHYS	Energy & Environment Physics	371 PHYS	3(3+0+0)
12 credit hours, *student chooses 1 course only 3 credit hours*			

(List B2):

Course Code	Course Title	Pre-req.	Co-req.	Credit (Lect - Exer- Pract)
411 PHYS	Astrophysics I	102 ASTR	-	2 (2+0+0)
412 PHYS	Astrophysics II		-	2 (2+0+0)
423 PHYS	Semiconductor Physics	371 PHYS	-	2 (2+0+0)
456 PHYS	Atomic and Molecular Spectroscopy	453 PHYS	-	2 (2+0+0)

457 PHYS	Laser laboratory	435 PHYS	435 PHYS	2 (0+0+2)
462 PHYS	Medical Physics	481 PHYS	460 PHYS	2 (2+0+0)
463 PHYS	Solid State Physics II	371 PHYS	-	2 (2+0+0)
476 PHYS	Nano Science and Technology	373 PHYS	473 PHYS	2 (2+0+0)
480 PHYS	Elementary Particles Physics	453 PHYS	-	2 (2+0+0)
483 PHYS	Nuclear Physics II	481 PHYS	-	2 (2+0+0)
485 PHYS	Accelerators Physics		-	2 (2+0+0)
486 PHYS	Radiation Physics		-	2 (2+0+0)
488 PHYS	Nuclear Reactors Physics		-	2 (2+0+0)
26 credit hours, student chooses 2 courses 4 credit hours				

List of service courses to other Departments and Colleges.

Course Code	Course Title	Credits (Lect. – Exer.- Pract.)	Department/College of
PHYS 101	General Physics (1)	4 (3+0+1)	GEO - GPH - Agriculture
PHYS 102	General Physics (2)	4 (3+0+1)	CHEM - GPH
PHYS 103	General Physics	4 (3+0+1)	Engineering
PHYS 104	General Physics	4 (3+0+1)	Engineering - Computer Sciences
PHYS 105	General Physics	2 (1+0+1)	Architecture and Planning
PHYS 145	General Physics	3 (2+0+1)	Health Scinces
PHYS 201	Mathematical Physics (1)	3 (2+1+0)	GPH
PHYS 205	Biophysics	2 (2+0+0)	ZOOL
PHYS 209	General Biophysics (1)	3 (3+0+0)	BOT MBIO
PHYS 221	Electromagnetism (1)	3 (3+0+0)	GPH
PHYS 232	Vibration and waves	3 (2+1+0)	

Short Courses Description

I- Compulsory courses *from* the Specialization

[credit hours (Lect. – Exer. – Pract).]

PHYS 110: General Physics I **4(3+0+1)**

An overview of topics in general physics - an initial platform for core courses in Units and dimensions, vectors , Motion in straight line, Newton's Laws of motion, work, energy and momentum, simple harmonic motion, elasticity, mechanics of non-viscous fluids, flow of viscous fluids, surface tension, temperature, quantity of heat, work and heat

PHYS 111: General Physics II **4(3+0+1)**

- Vectors and forces analysis, Electric forces, field and potential. motion of charged particle in electric field, Capacitance, Energy of charged capacitor, Direct current (DC), Ohm's law, Resistance and temperature, energy and power, Kirchhoff's rules, Current in charged Capacitor.
- Reflection and refraction of light: reflection and refraction laws, refraction by plane-parallel plate, Prism, total internal reflection and the critical angle.
- Introduction to quantum theory, Black Body radiation, Photoelectric effect, X-Rays, Nuclear Decay, Decay Law, Nuclear reactions, Radioactivity

PHYS 201: Mathematical Physics I	3(2+1+0)

- System of Linear Equations: Methods of solving Systems of Linear equations (Elimination methods, Gauss- Jordan …).
- Matrices: (Definitions, Operations on Matrices, Transpose Matrix, the trace…). The inverse, Elementary row operation method, the determinant, Cramer's rule.
- Vector spaces: Two and Three dimensional vector spaces, Distance in two and three dimensional spaces. Norms, Dot product, projection, cross product, N-dimensional (linear) spaces: Euclidean spaces, Inner product spaces, Linear Transformations, Eigen values and Eigenvectors problems.

PHYS 210: Classical Mechanics I	4(3+0+1)

2D and 3D motion, projectiles, Systems of Particles: Center of Mass, Motion of the center of mass, Linear Momentum of a Particle, Linear Momentum of a System of particles, Conservation of Linear Momentum, the rocket. **Collisions**: What is a Collision, Impulse and Momentum, Conservation of Momentum During Collisions, Collisions in one Dimension, Two Dimensions Collisions, Center of Mass Reference Frame. **Rotation**: Rotational Motion, The Rotational Variables, Rotation with Constant Angular Acceleration, Rotation Quantities as Vectors, Relationships between Linear and Angular Variables: Scalar Form, Relationships between Linear and Angular Variables: Vector Form, Torque, Work. **Rolling, Torque and Angular Momentum**: Rolling Motion, Kinetic Energy, Torque, Angular Momentum of Rotating rigid Bodies, Conservation of Angular Momentum, Conservation of Angular Momentum, The processing Top. **Equilibrium and Elasticity**: Equilibrium, Requirements for Equilibrium, Equilibrium and the Force of Gravity, Stacking block. **Gravity:** The Gravitational Force, The gravitational constant G, Free fall acceleration, Gravitational Potential Energy, Motion of planets, The law of Area, Orbits and Energy, **Special theory of Relativity**.

PHYS 222: Electromagnetism	4(3+0+1)

Gauss law and its applications, Electric Potential, Potential gradient and applications, Capacitors and Dielectrics, Dielectrics and Gauss theory, Electric displacement, polarization, Susceptibility, Dielectric Strength. The magnetic field of conductors, Ampere's law and its applications. Motion of charged particle in magnetic field and its applications. Electromagnetic induction, Induced electromotive force, Faraday's law& Lenz's law, Self and mutual Induction, Current in inductive circuit. Vector operations; Electric and magnetic fields in materials; magnetic potential vector, Electrostatic and magnetic energy; Maxwell's equations in differential forms; Electromagnetic waves, propagation and radiation. Ac Circuit, Series and Parallel connection, Resonance AC Circuit, Complex Numbers in AC Circuit.

PHYS 234: Vibrations and Waves	4(3+0+1)

Periodic motion. Free Vibrations, mathematical and Fourier analysis. Super position of periodic motion. Sound, plasma, molecular and electrical circuit oscillations analysis. Damped vibrations, heavy light and critical damping. Forced Vibrations. Superposition. Transients. Resonance circuits. Waves: travelling , standing, dispersive and non-dispersive. Fourier Theory**.**

PHYS 301: Mathematical Physics II	3(2+1+0)

Comprehensive introduction to the physics of the charged particle beams and modern particle accelerators. Basic components of accelerator. Various types of accelerators including electrostatic accelerators, induction linear accelerators, linear radio-frequency (RF) accelerators, and various circular accelerators such cyclotrons, synchrotrons, charged particle in electromagnetic fields, beam acceleration and phase stability. Applications of accelerators**.**

PHYS 312: Classical Mechanics II	3(3+0+0)
Normal coordinates, some methods in the calculus of variations, Hamilton's and Lagrangian's principles. Lagrangian's and Hamiltonian's dynamics, central force motion, dynamics of a system of particles, dynamics of rigid bodies, motion in a non-inertial reference frame, coupled oscillations, wave equation	

PHYS 325: Electronics	3(2+0+1)
Semiconductors, semiconductor doping, the p-n junction properties and applications, the diode, the bipolar transistor, signal amplification, the field effect transistor, Circuit symbols and components, Semiconductor devices, Amplifier operation, feedback. Lock-in operational amplifiers and applications, modulation and detection, integrated circuits. A brief introduction to digital electronics and analog to digital (A/D) conversion.	

PHYS 331: Optics	3(3+0+0)
Wave's theory of light: wave equation, sinusoidal waves, phase velocity, complex representation, and plane waves. Superposition of waves: superposition principle, superposition of waves of the same frequency, standing waves, phase and group velocities, energy and power, random and coherent Sources. Interference: two-beam interference, Young's double-slit experiment, double-slit interference with virtual sources, interference in dielectric films, Newton's Rings. Optical Interferometers: Michelson, and Fabry-Perot interferometer. Polarization: Linear, circular, and elliptical polarization, production of polarized light, double refraction (birefringence), optical activity, and photo elasticity. Diffraction of light: types of diffraction, Fraunhofer diffraction by single slit, by double slit, and by many slits, rectangular and circular apertures, beam spreading, and resolution. Diffraction grating, grating equation, dispersion, types of grating and grating instruments.	

PHYS 343: Thermal and Statistical Physics	4(3+1+0)
General difinitions and basic concepts of thermal Physics, Introduction in thermal units, heat capacity, enthalpy and entropy , Kinetics theory of gases , First law of thermodynamics, (isochoric and isobaric processes, internal energy function, thermal work, reversible and irreversible thermal processes in ideal and real gases, Carnot cycle and thermodynamic performance), Second law of thermodynamics (Entropy function and its various applications in thermal systems), Third law of thermodynamics (Free energy and thermodynamic equations), The thermodynamic functions U,H , F and G ; the Maxwell relations. -The thermal equilibrium distribution, the Boltzmann distribution, constructing the partition function and using it to obtain thermodynamic quantities of interest, Quantum statistics; the Fermi – Dirac, Bose –Einstein and Maxwell-Boltzmann distributions. Computing in thermal physics (Solving problems and graphics using standard programs).	

PHYS 352: Optics	4(3+0+1)
Postulates of quantum mechanics; wave particle duality, probability, and the Schrödinger equation; one-dimensional Schrödinger equation; operator methods in quantum mechanics, eigenvalues, eigenfunctions; angular momentum; the Schrödinger equation in three-dimensions and the hydrogen atom; matrix representation of operators ; spin; the addition of angular momenta; time-independent perturbation theory	

PHYS 371: Solid State Physics I	3(3+0+0)
Definition of the Solid State and Crystal Growth, Crystalline Amorphous and Nano solids, Atomic Binding, Crystal Lattices and Structures, Miller indices Elastic Constants, Crystal Defects, Fourier Analysis of Periodic Structures, Reciprocal Lattice, X-ray Diffraction, Brillouin Zones, Lattice Vibrations and Phonons, Thermal properties of Solids, Einstein and Debye Models of Heat Capacity, Phonon Density of States, Planck Distribution. Free Electron (Fermi gas) model, Electron Density of States, Electrical, thermal and optical properties of the Electron Gas.	

PHYS 391: Thermal physics lab	2(0+0+2)
Experiments will be performed by the students: Specific Heat – longitudinal expansion – Joule's Law (The mechanical equivalent of heat) – Boyle's Law - Newton's law of cooling – Viscosity - Heat Engine - Carnot Engine - Heat Transfer- Determination of density and expansion of fluids.	

PHYS 394: Electromagnetism lab	2(0+0+2)
Experiments will be performed by the students: Milikan experiment, Resonance in RCL services circuits, Full wave rectification, Determination of magnetic field intensity using the search coil, Determination of the charge to mass ratio for the electron (e/m), Determination of dielectric constant using RCL resonance circuit. Transformers.	

PHYS 395: Waves Physics lab	2(0+0+2)
Experiments will be performed by the students: Young's double slit experiment, Diffraction grating, Newton's rings, (Abbe's) study of polarization of light, Lloyed's Mirror, Fresnel biprism experiment, Prism Spectrometer, Refractometer. Verification of the inverse square law for light radiation and determination of the absorption coefficient of light in glass using a photocell, determination of refractive index Meld's experiment. Determination of diffraction coefficient of liquids using Abbe's apparatus. Specific rotation measurements using polarometer.	

PHYS 396: Modern Physics lab	2(0+0+2)
Experiments will be performed by the students: Fabry-Perot interferometer, Laser Diffraction in Ultrasonic phase grating. Electro-optic Kerr-Effect, Magneto-optic Faraday Effect. Measurement of Line Spectra using Spectrograph. Rydberg Constant measurement. Determination of Planck's constant, Michelson interferometer. Zeeman Effect. Franck-Hertz experiment. Study X-ray spectrum. Characteristics of Microwaves. Waveform analysis and synthesis.	

PHYS 400: Computational Physics	2(1+0+1)
1. Introduction: Computation and science, The emergence of modern computers, Computer algorithms and languages, Applications: Newton and Kepler Laws. 2. Numerical Linear Algebra: Systems of linear equations, Eigenvalues and eigenvectors. 3. Interpolation, Extrapolation and Data Fitting: Polynomial Interpolation, Data fitting, least squares fit. 4. Ordinary differential equations: Initial-value problems, The Euler and Picard methods, The Runge-Kutta method , Chaotic dynamics of a driven pendulum , Boundary-value and eigenvalue problems , The one-dimensional Schroedinger equation. 5. Numerical Integration: One-dimensional integral, Multi-dimensional integral, The Runge-Kutta method, Monte Carlo Method.	

PHYS 404: Mathematical Physics (3)	3(3+0+0)

1- Complex numbers: Algebra of Complex numbers, Point representation of complex numbers, Vector and Polar Forms, The complex Exponential, Powers and Roots.
2- Analytic Functions: Function of a Complex variable, Limits and continuity, Analyticity, Cauchy-Riemann Equations.
3- Elementary Functions: Polynomials and Rational Functions, Trigonometric and Hyperbolic Functions, Logarithmic Function, Complex Powers and Inverse Trigonometric Functions.
4- Special Functions: The Gamma, Bessel Functions, Legendre Functions, Spherical Harmonics,
5- Hermite Functions, Laguerre Functions.

PHYS 453: Quantum Mechanics	4(3+1+0)

The real hydrogen atom; atomic and molecular structure; time dependent perturbation theory; the interaction of charged particles with electromagnetic field; radiative decays; radiation; scattering theory.

PHYS 481: Nuclear Physics I	3(3+0+0)

- Properties of the nucleus: Isotopes, nuclear binding energy, angular momentum, nuclear electromagnetic moments, nuclear forces.
- Radioactivity: Decay law (τ, $t_{1/2}$), natural radioactivity, successive decay, artificial radioactivity basic α – decay process, β -decays and γ -transitions.
- Nuclear reactions: Q-value, threshold energy (E_{th}), Internal Conversion, Decay Schemes.
- Interaction of radiation with matter: Interaction of heavy (α, p, d) and light (e^-, e^+), charged particles with matter, stopping power, interaction of gamma radiation with matter (Photoelectric, Compton and pair production)

-Binding energy and the liquid drop model.

PHYS 490: Research skills	2(0+0+2)

Using scientific resources, e.g., databases and scientific journals - citation methods - training on some scientific programs and equipments which are available in the College of Science- methods of writing scientific reports - training on presentation skills.

PHYS 491: Solid State lab	2(0+0+2)

X-Ray diffraction, Dielectric constant, Hall effect, Magnetic Succipility, Magnetic Resonance, Solar Cells, Energy gap for semiconductors, Noble metal resistance, Electron diffraction, Photoelectric effect. Optical absorption of solids and solids with defects and nano inclusions.

PHYS 492: Nuclear Physics lab	2(0+0+2)

Experiments will be performed by the students:

Geiger Counter, Absorption of nuclear radiation, Counting statistics, Gamma ray Spectroscopy using NaI (Tl) and SCA, Gamma ray Spectroscopy using NaI (Tl) and MCA, β-Ray Spectrum using Magnetic Spectrometer, β-Ray Spectrum using MCA, Neutron Diffusion, Study of alpha particle Spectra, Compton Scattering.

PHYS 499: Graduation project	3(0+0+3)

This course aim is to guide the student to perform scientific project in selected areas of theoretical or experimental Physics and to train him/her to write a scientific report using the necessary references.

II- Compulsory courses *from OUTSIDE* the Specialization [credit hours (Lect. – Exer. – Pract.)]

MATH 111: Integral Calculus	**4(3+1+0)**
Definition of Definite Integral and its Properties, The Anti-derivative, Indefinite Integral and the Fundamental Theorem of Calculus. Change of Variables. Integrals of natural and general exponential functions. Integrals of natural and general Logarithmic functions. Derivatives and Integrals of Hyperbolic and Inverse-Hyperbolic functions. Techniques of Integration: by parts, Trigonometric substitutions, Completing the square, Integrals of rational functions, Miscellaneous Substitutions. Indeterminate forms, Improper Integrals. Applications of Integration: Area, Solids of Revolutions, Arc length and Surface of Revolution, Linear Motion, Work, Momentum and Center of Mass. Numerical Integration. Polar coordinates, relation between polar and Cartesian coordinates, Graphs of polar curves, Area in polar coordinates. Parametric Equations.	

MATH 209: Differential Equations	**4(3+1+0)**
- Sequences limit, infinite series, geometric series, tests for convergence (integral, comparison and ratio tests…etc) alternating series, absolute convergence. -Series of functions: Pointwise convergence, Taylor and Maclaurin Series. Fourier series, Fourier integral. -Differential Equations: First Order Differential equations, definitions. Separable Equations. Linear Equations, Method of integrating Factor. Homogenous First Order Equations. Bernoulli Equations, Modeling Physical Problems with differential equations.	

III- Elective courses *from* the Specialization [credit hours (Lect. – Exer. – Pract.)]

PHYS 411: Astrophysics I	**2(2+0+0)**
Stars: magnitude – Luminosity – introduction to spectra – stellar spectra – stellar parallax, stellar velocities- H-R diagram – binary stars and stellar masses – star formation – series of stellar nuclear reactions and stellar ages- stellar evolution and structure	

PHYS 411: Astrophysics II	**2(2+0+0)**
Interstellar matter(ISM): distribution – structures- Physics of ISM – HI and HII regions – Inter stellar clouds – star formation – astrochemistry – Physics and chemistry of planetary nebulae – Interstellar matter in galaxies.	

PHYS 423: Semiconductors Physics	**2(2+0+0)**
Electronics and materials, Semiconductors brief, Diode & applications, Bipolar junction transistors, BJT amplifiers, Principles of integrated circuits, Field effect transistors and applications, Frequency response in electronic devices, Operational amplifier theory & applications, Power amplifiers, Power supply, voltage regulators, Digital-to analogue and analogue-to-digital converters.	

PHYS 435: Laser Physics	**2(2+0+0)**
Waves in dielectric media, Gaussian beams, waveguides, geometrical optics, fibre optics, Fourier optics. Photons and Atoms. Optical materials. Non-linear optical properties. Optical amplifiers. Laser development, semiconductors and nano structures (materials technology), ultra-fast phenomena, modern optics, and instrumentation (opto-electronic components).	

PHYS 456: Atomic and Molecular Spectroscopy	2(2+0+0)
Spin –Orbit Interaction in H-atom , Pauli Exclusion Principle. Electron configuration in many electron atoms, Atoms with a valance electron , Atoms with two valance electrons (ℓℓ coupling, ss coupling , LS coupling and jj coupling), Hund's Rule . The interaction of many-electron atoms with magnetic fields, Zeeman Effect, Pachen-Bach Effect, Stark Effect. Molecular Structure, Electronic, vibrational and rotational energy levels of a diatomic molecule. Spectroscopic techniques: Optical spectroscopy, IR spectroscopy, Raman spectroscopy, Magnetic Resonance , Excitation Sources, and data acquisition systems.	

PHYS 457: Laser laboratory	2(0+0+2)
Experiments will be performed by the students: Laser Safety, Coherence Length, Analysis of Gaussian Beam, Laser Cavity Design, Laser Modes Structure, Dye absorption and emission Spectra, Fourier Optics, Fiber Optics, Second Harmonic Generation, Fresnel Equations.	

PHYS 460: Biophysics	3(3+0+0)
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. Properties of fluids. Viscosity and surface tension. Bernoulli's equation and its applications. Effect of gravity and acceleration on the blood pressure. Nature of sound and sound intensity level. Ultrasound, 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; ECG, EEG and ERG. Non-ionizing Radiation. Physical and biological effects.	

PHYS 462: Medical Physics	2(0+0+2)
- 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 463: Solid State Physics II	2(2+0+0)
Fermi surfaces, Energy levels in one dimension, Energy bands, Energy gap calculations, Electrical transport theory, Hall effect. Theory and applications of bands and carriers in semiconductors and devices. Magnetism in solids and superconductivity. Interaction of solids with radiations.	

PHYS 473: Materials Science	3(2+0+1)
States of matter (liquid, crystalline & 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 & TTT curves.	

PHYS 476: Introduction to Nanoscience and Nanotechnology	2(2+0+0)

Part A: Introduction to nanophysics and nanotechnology – scaling laws and limits to smallness; quantum nature of nanoworld; nano fabrication (top-down and bottom-up process); nanoscopy (electron microscopy, atomic force microscopy, scanning tunneling microscopy).

Part B: Properties and application of dielectric and metal nanostructures - individual nanoparticles and nanoclusters; nanostructured materials; carbon nanostructures; nano spin and nanomagnets.

Part C: Properties and application of semiconductor nanostructures - fabrication of semiconductor nanowires and quantum dots; electronic and optical properties (2D and 3D quantum confinement); optical spectroscopy of semiconductor nanostructures (local probe techniques); quantum dots nanowire- and quantum-dot-based electronic and photonic devices.

PHYS 477: Energy & Environment Physics	3(3+0+0)

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

PHYS 480: Elementary Particle Physics	2(2+0+0)

- 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 483: Nuclear Physics II	2(2+0+0)

The deuteron properties.
-Nuclear models: nuclear shell model, Collective model, nuclear decay schemes.
-Nuclear reactions and decay modes: nuclear scattering, compound nucleus.
-Introductory to elementary particle Physics.

PHYS 485: Accelerator Physics	2(2+0+0)

Comprehensive introduction to the Physics of the charged particle beams and modern particle accelerators. Basic components of accelerator. Various types of accelerators including electrostatic accelerators, induction linear accelerators, linear radio-frequency (RF) accelerators, and various circular accelerators such cyclotrons, synchrotrons, charged particle in electromagnetic fields, beam acceleration and phase stability. Applications of accelerators.

PHYS 486: Radiation Physics	2(2+0+0)

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 radiation sources, decontamination, radioactive waste management.

PHYS 488: Nuclear Reactor Physics	2(2+0+0)
- 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.	

IV- Elective courses from outside the Specialization [credit hours (Lect. – Exer. – Pract.)]

ASTR 102: Introduction to Astronomy	3(2+0+1)
Modern concept of astronomy – The Solar System -Units of astronomical distances - Astronomy in Islamic culture-Telescopes- Kepler's laws - Earth and Moon-The Terrestrial planets - The Jovian Planets –Asteroids and Comets. Origin of the solar system - The Sun – stars: apparent and absolute magnitude, color index, distances and velocities of stars.	

STAT 100: Introduction to Statistics	3(2+1+0)
Descriptive statistics - Measures of central tendency - Measures of dispersion - Basic probability concepts - Conditional probability, Expectation - Variance - Bayes law - Random variables - Probability distribution - Binomial distribution - Poisson distribution - Hyper geometric distribution - Normal distribution – Applications by Excel	

CHEM 103: General chemistry (1)	3(3+0+0)
Stoichiometry: SI units, chemical formulas, the mole, methods of expressing concentration, calculations based on chemical equations. **Gases**: Laws, kinetic theory, deviation and van der Waals equation. **Thermo chemistry**: Types of enthalpy changes, Hess Law and its applications,, first law of thermodynamics. **Solutions**: Type of solutions and laws related, colligative properties. **Chemical Kinetics**: Law of reaction rate, reaction order, factors affecting the reaction. *Chemical* **Equilibrium**: Reaction between K_c & K_p, Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions	

MBIO140. General Microbiology	3(2+0+1)
Introduction – Principals of Microbiology – Historical Review of the pioneer Microbiologist – Development of Microbiology – Methods of Studying Microorganisms – Classification of Microorganisms – Chemistry of Microbial Cell - Structure of Microbial Cell – Microbial Genetic – Nutrition and Microbial Metabolism –Survey Of microorganisms and their habitats – Growth and Reproduction – Relationships with other Organisms – Antimicrobial Agents-Immunity – Biotechnology - Microorganisms in medicine – Microorganisms in Industries- Microorganisms and Pollution	

IV- Service Courses to Another Departments and Colleges [credit hours (Lect. – Exer. – Pract).]

PHYS 101: General Physics (1)	4(3+0+1)
Reflection and refraction of light, lenses, optical instruments, wave theory of light. interference, and diffraction of light. Electrostatics, electric current, DC circuits, electrical instruments, electromagnetism and AC circuits. Introduction to quantum theory, atomic spectra, X-rays. Properties of nuclei, radioactivity, decay of alpha, beta and gamma, nuclear fission and nuclear power.	

PHYS 102: General Physics (2)	4(3+0+1)
Vectors, Motion in straight line, Newton's Laws of motion, work, energy and momentum, simple harmonic motion, elasticity, mechanics of non-viscous fluids, flow of viscous fluids, surface tension, temperature, quantity of heat, work and heat.	

PHYS 103: General Physics	4(3+0+1)
Introduction (Vectors),Motion in one dimension with constant acceleration, Motion in two dimension with application to projectile motion and circular motion, Newton's Laws of Motion, Work and Energy, Potential Energy and conservation of Energy, Linear Momentum and Collisions, Rotation of rigid object about a fix axis.	

PHYS 104: General Physics	4(3+0+1)
Electricity and Magnetism: Coulomb's law, electric fields, Gauss' Law, electric potential, potential energy, capacitance and dielectric, currents and resistance, Ohm's law, electrical energy and power, direct current circuits, Kirchhoff's rules, magnetic fields, motion of charged particle in a magnetic field, sources of the magnetic field, Ampere's law, Faraday's law of induction, self inductance, energy in a magnetic field, mutual inductance, alternating current circuits, the RLC series circuit, power in an A.C. circuit, resonance in RLC series circuit.	

PHYS 105: General Physics	3(2+0+1)
Mechanics: Scalars and vectors, speed, velocity and acceleration, free fall, motion in a vertical plane, Newton's laws of motion. **Properties of matter**: Density, elasticity, Young's modulus, shear and bulk module, Fluid pressure, fluid flow. Wave motion and sound: Waves, resonance, sound, interference of waves, sound intensity. **Light**: Reflection, refraction, illumination, image formation, the lens equation, magnification, the telescope, spherical mirrors. **Heat:** Temperature, Thermal Expansion, Boyles and Charles Laws, Ideal gas law, Internal energy and heat, Specific heat capacity, Heat Conduction, Convection and radiation. **Electricity:** Coulombs' Law, electric field, potential difference, electric current, Ohm's law, determining wire size, electric power, resistors in series and parallel, ammeters, voltmeters and ohmmeters.	

PHYS 145: General Physics	3(3+0+0)
Mechanics Basic Principles of Mechanics: Units & dimensions, vector analysis, velocity & acceleration, forces, Newton's law of motion, gravity, work, energy, power. **Properties of Fluids (liquids)**: Continuity equation, pressure, flow of ideal liquid, Bernoulli's equation, Blood pressure measurements. Simple medical applications. **Basic Electricity and Magnetism**: Coulomb's law, electric field, electric potential, capacitance, steady electric currents, Ohm's law, Kirchhoff's rules.	

Optics: Nature of light, reflection and refraction of light, mirrors and lenses, human eye, simple optical instruments, simple medical applications.

Modern Physics (Atomic & Nuclear Physics): Electromagnetic spectrum, photon, wave properties of matter, atomic structure, Bohr atom and atomic spectra, X-rays, Nuclear radiation, interaction of radiation with matter, radiation units, nuclear hazards, medical applications.

PHYS 201: Mathematical Physics (1)	**3(2+1+0)**

- **System of Linear Equations**: Methods of solving Systems of Linear equations (Elimination methods, Gauss- Jordan …).
- **Matrices**: (Definitions, Operations on Matrices, Transpose Matrix, the trace…). The inverse, Elementary row operation method, the determinant, Cramer's rule.
- **Vector spaces**: Two and Three dimensional vector spaces, Distance in two and three dimensional spaces. Norms, Dot product, projection, cross product, N-dimensional (linear) spaces: Euclidean spaces, Inner product spaces, Linear Transformations, Eigen values and Eigenvectors problems

PHYS 205: Biophysics	**2(2+0+0)**

- Fluid flow and its relationship to biological systems, blood pressure concept, units and measurement methods, pressure, surface tension and viscosity, thermodynamics for biological systems and its applications.
- Ultrasonic waves, production, their interaction with the material, applications.
- Electrical properties of cells, Cells and tissues static potential (resting potential), the action potential and biological applications, methods of measured.
- Non-ionizing radiation, radio waves, and microwaves, infrared, visible light, ultraviolet, laser.
- Ionizing radiation, methods of detection. Radiation dose, biological effect of radiation, genetic effects of radiation, nuclear medicine, radiation therapy system.

PHYS 209: General Biophysics (1)	**3(3+0+0)**

Animal mechanics, properties of fluids, heat and heat flow in biological systems, nature of sound and sound intensity, applications on sound hearing, echolocation, use of ultrasound in medicine, nature of light, applications on image formation, resolution of eye, mechanism of vision, color vision, biological effects of UV and visible radiation, radiation biophysics, radiation dose and its measurement, RBE multi target theory, laser in medicine.

PHYS 221: Electromagnetism (1)	**3(3+0+0)**

Electrostatics, Gauss Law and its application, Capacitors, the magnetic field of conductors with different shapes, Ampere's law and its applications. Induced electromotive force, Faraday's law. Lenz's law, magnetic properties of matter, analysis of AC circuits, resonance in series and parallel circuits.

PHYS 232: Vibration and waves	**3(2+1+0)**

Periodic motions, the super position of periodic motion, free vibrations, Damped Vibrations, Forced Vibrations, Forced vibrations in strings, longitudinal motion in bars, Fourier analysis.

Important Note: The student must review the department concerned for decisions that taught outside the college (Compulsory and Elective).