Academic Programs Booklet

College of Science

2017

Prepared By: VP For Academic Programs and Graduate Studies Office

College of Science

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College of Science

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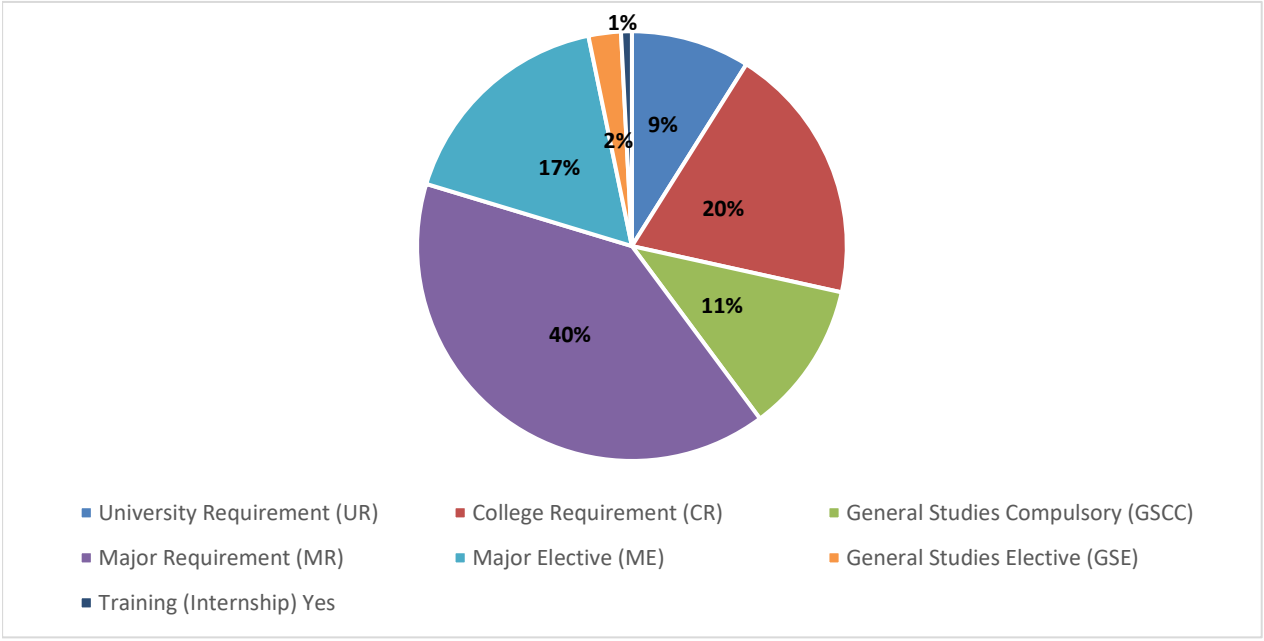
List of College Requirement Courses

Course Code	Course Title	Course Hours			Course Type	Pre requisite
		LEC	PRAC	CRD		
CHEMY 101	Geneal Chemistry I	3	3	4	CR	-----
BIOLS 102	General Biology I	3	3	4	CR	-----
PHYCS 101	General Physics I	3	3	4	CR	-----
MATHS 121	Calculus and Analytic Geometry I	3	0	3	CR	-----
TCS 113	Computer Programming I	3	2	3	CR	-----
ENGL 125	English for Science I	3	0	3	CR	-----
NGL 126	English for Science II	3	0	3	CR	-----

B.Sc. in Physics (Single Track) 2017

Program Components



University Requirement (UR)	**11**
College Requirement (CR)	**24**
General Studies Compulsory (GSCC)	**14**
Major Requirement (MR)	**49**
Major Elective (ME)[1]	**21**
General Studies Elective (GSE)[2]	**9**
Training (Internship) **Yes**	**1**
Total Credit (CRD)	**129**

[1] Student must select Seven (3XX & 4XX) courses from Major Elective (ME) List.

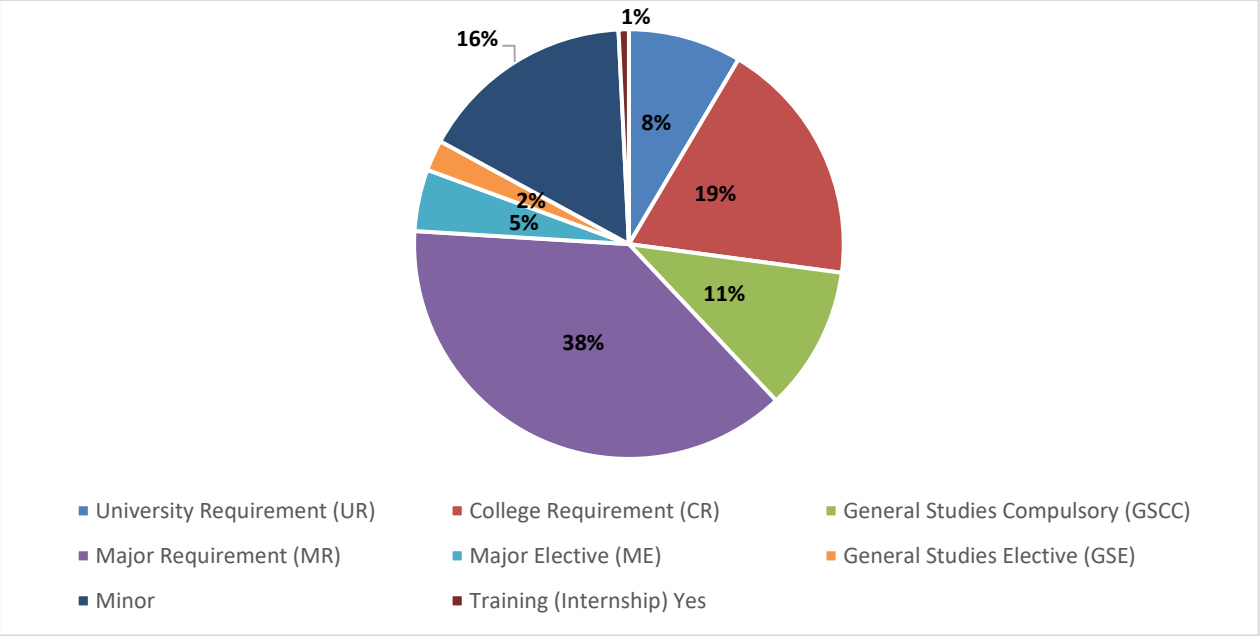
[2] Student must select three General Studies Electives, one of them must be from Humanities and Social Science.
Note:

- Free Elective Courses: any UOB course excluding: (1) courses offered for special students, (2) courses covered in the B.Sc. curriculum, (3) courses equivalent or lower than those already taken in the curriculum and should not be a science course prepared by College of Science for other colleges.

- HU/SS Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, English, (Foreign Language) French, Music, Philosophy, Theatre, Literature (Arabic), Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, Political Science.

B.Sc. in Physics (Major Physics) 2017

Program Components



University Requirement (UR)	**11**
College Requirement (CR)	**24**
General Studies Compulsory (GSCC)	**14**
Major Requirement (MR)	**49**
Major Elective (ME)[1]	**6**
General Studies Elective (GSE)[2]	**9**
Minor[3]	**21**
Training (Internship) **Yes**	**1**
Total Credit (CRD)	**129**

[1] Student should select four major elective courses from Major Elective List.

[2] Student should select one Elective course from Humanities and Social Science.

Note:

- HU/SS Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, Foreign Language, Music, Philosophy, Theatre, Literature (Arabic), and Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, and Political Science.

[3] Student should take 7 courses as Minor track from one of the following specializations: Astronomy, Biology Chemistry, Computer Science, Mathematics, or Statistics according to the requirements of the department offering the minor.

Important Note: Overlapping Courses

If any of the listed courses in the minor requirements tables below is covered as part of the major degree requirements, then the student must replace them with an equal number of courses from the minor field, which are at the same level or higher. The total number of minor courses must be seven for all fields, with a minimum of 21 credit hours.

Detailed Study Plan (Single Track) 2017

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ARAB 110	Arabic Language Skills	3	0	3	UR	-----	No
CHEMY 101	General Chemistry I	3	3	4	CR	-----	No
ENGL 125	English for Science I	3	0	3	CR	-----	No
MATHS 121	Calculus and Analytic Geometry I	3	0	3	CR	-----	No
PHYCS 101	General Physics I	3	3	4	CR	-----	Yes

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ITCS 113	Computer Programming I	3	2	3	CR	-----	No
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	-----	No
MATHS 122	Calculus and Analytic Geometry II	4	0	4	MSR	MATHS 121	No
PHYCS 102	General Physics II	3	3	4	MR	PHYCS 101	Yes
ENGL 126	English for Science II	3	0	3	CR	ENGL 125	No

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
BIOLS 102	General Biology I	3	3	4	CR	-----	No
ISLM 101	Islamic Culture	3	0	3	UR	-----	No
MATHS 211	Linear Algebra	3	0	3	MSR	MATHS 121	No
PHYCS 209	Bulk Properties of Matter	3	2	3	MR	PHYCS 101	Yes
PHYCS 222	Modern Physics	3	2	3	MR	PHYCS 102	Yes

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 102	General Chemistry II	3	3	4	MSR	CHEMY 101	No
MATHS 205	Differential Equations	3	0	3	MSR	MATHS 122	No
PHYCS 221	Methods of Mathematical Physics I	3	0	3	MR	PHYCS 102 & MATHS 122	Yes
PHYCS 241	Introductory Electronics	3	2	3	MR	PHYCS 102	Yes
GSE XXX	Humanities / Social Science	X	X	3	GSE	-----	No

Year 3 - Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
HRLC 107	Human Rights	2	0	2	UR	-----	No
PHYCS 314	Classical Mechanics	3	2	3	MR	PHYCS 221 or MATHS 205	Yes
PHYCS 326	Quantum Mechanics I	3	2	3	MR	PHYCS 222	Yes
PHYCS 331	Physical Optics	3	2	3	MR	PHYCS 102	Yes
PHYCS 348	Electromagnetic Theory	3	2	3	MR	PHYCS 221 or MATHS 205	Yes
PHYCS 365	Thermal Physics	3	2	3	MR	PHYCS 209	Yes

Year 3 - Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 324	Atomic and Molecular Physics	3	2	3	MR	PHYCS 222	Yes
PHYCS 351	Solid State Physics I	3	2	3	MR	PHYCS 222	Yes
PHYCS 3/4XX	Major Elective 1	X	X	3	ME	As per ME list	Yes
PHYCS 3/4XX	Major Elective 2	X	X	3	ME	As per ME list	Yes
PHYCS 3/4XX	Major Elective 3	X	X	3	ME	As per ME list	Yes

Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 398	Internship	0	0	1	MR-Training	Completion of 75 credits	No

Year 4 - Semester 7

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
GSE XXX	Free Elective Course 1	X	X	3	GSE	-----	No
GSE XXX	Free Elective Course 2	X	X	3	GSE	-----	No
PHYCS 3/4XX	Major Elective 4	X	X	3	ME	As per ME list	Yes
PHYCS 3/4XX	Major Elective 5	X	X	3	ME	As per ME list	Yes
PHYCS 499	Senior Research Project	0	9	3	MR	Department Approval	Yes

Year 4 - Semester 8

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 425	Computational Physics	3	2	3	MR	PHYCS 221 or MATHS 205	Yes
PHYCS 432	Laser Physics	3	2	3	MR	PHYCS 324 & PHYCS 331	Yes
PHYCS 471	Nuclear Physics	3	2	3	MR	PHYCS 326	Yes
PHYCS 4XX	Major Elective 6	X	X	3	ME	As per ME list	Yes
PHYCS 4XX	Major Elective 7	X	X	3	ME	As per ME list	Yes

Detailed Study Plan (Major Physics) 2017

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ARAB 110	Arabic Language Skills	3	0	3	UR	-----	No
CHEMY 101	General Chemistry I	3	3	4	CR	-----	No
ENGL 125	English for Science I	3	0	3	CR	-----	No
MATHS 121	Calculus and Analytic Geometry I	3	0	3	CR	-----	No
PHYCS 101	General Physics I	3	3	4	CR	-----	Yes

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ITCS 113	Computer Programming I	3	2	3	CR	-----	No
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	-----	No
MATHS 122	Calculus and Analytic Geometry II	4	0	4	MSR	MATHS 121	No
PHYCS 102	General Physics II	3	3	4	MR	PHYCS 101	Yes
ENGL 126	English for Science II	3	0	3	CR	ENGL 125	No

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
BIOLS 102	General Biology I	3	3	4	CR	-----	No
ISLM 101	Islamic Culture	3	0	3	UR	-----	No
MATHS 211	Linear Algebra	3	0	3	MSR	MATHS 121	No
PHYCS 209	Bulk Properties of Matter	3	2	3	MR	PHYCS 101	Yes
PHYCS 222	Modern Physics	3	2	3	MR	PHYCS 102	Yes

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 102	General Chemistry II	3	3	4	MSR	CHEMY 101	No
MATHS 205	Differential Equations	3	0	3	MSR	MATHS 122	No
PHYCS 221	Methods of Mathematical Physics I	3	0	3	MR	PHYCS 102 & MATHS 122	Yes
PHYCS 241	Introductory Electronics	3	2	3	MR	PHYCS 102	Yes
Minor	Course 1	X	X	3	Minor	As per Minor	No
GSE XXX	Humanities / Social Science	X	X	3	GSE	-----	No

Year 3 - Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
HRLC 107	Human Rights	2	0	2	UR	-----	No
PHYCS 314	Classical Mechanics	3	2	3	MR	PHYCS 221 or MATHS 205	Yes
PHYCS 326	Quantum Mechanics I	3	2	3	MR	PHYCS 222	Yes
PHYCS 348	Electromagnetic Theory	3	2	3	MR	PHYCS 221 or MATHS 205	Yes
PHYCS 365	Thermal Physics	3	2	3	MR	PHYCS 209	Yes
Minor	Course 2	X	X	3	Minor	As per Minor	No

Year 3 - Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 324	Atomic and Molecular Physics	3	2	3	MR	PHYCS 222	Yes
PHYCS 331	Physical Optics	3	2	3	MR	PHYCS 102	Yes
PHYCS 351	Solid State Physics I	3	2	3	MR	PHYCS 222	Yes
Minor	Course 3	X	X	3	Minor	As per Minor	No
Minor	Course 4	X	X	3	Minor	As per Minor	No

Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 398	Internship	0	0	1	MR-Training	Completion of 75 credits	No

Year 4 - Semester 7

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 499	Senior Research Project	0	9	3	MR	Departmet Approval	Yes
PHYCS 3/4XX	Major Elective 1	X	X	3	ME	As per ME list	Yes
PHYCS 4XX	Major Elective 2	X	X	3	ME	As per ME list	Yes
Minor	Course 5	X	X	3	Minor	As per Minor	No
Minor	Course 6	X	X	3	Minor	As per Minor	No

Year 4 - Semester 8

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
Minor	Course 7	X	X	3	Minor	As per Minor	No
PHYCS 425	Computational Physics	3	2	3	MR	PHYCS 221 or MATHS 205	Yes
PHYCS 432	Laser Physics	3	2	3	MR	PHYCS 324 & PHYCS 331	Yes
PHYCS 471	Nuclear Physics	3	2	3	MR	PHYCS 326	Yes

Major Elective Courses

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 333	Oscillations and Waves	3	2	3	ME	PHYCS 221	Yes
PHYCS 334	Optoelectronics	3	2	3	ME	PHYCS 241	Yes
PHYCS 340	Electronics II	3	2	3	ME	PHYCS 241	Yes
PHYCS 342	Digital Electronics I	3	2	3	ME	PHYCS 241	Yes
PHYCS 344	Plasma Physics	3	0	3	ME	PHYCS 348	Yes
PHYCS 353	Physics of Materials	3	2	3	ME	PHYCS 209	Yes
PHYCS 364	Meteorology	3	2	3	ME	PHYCS 209	Yes
PHYCS 366	Environmental Physics	3	2	3	ME	PHYCS 209	Yes
PHYCS 381	Stellar Astrophysics	3	0	3	ME	PHYCS 283	Yes
PHYCS 382	Astronomy	3	0	3	ME	PHYCS 102	Yes
PHYCS 383	Space Science and Technology	3	0	3	ME	PHYCS 102	Yes
PHYCS 384	Galaxies and the Universe	3	0	3	ME	PHYCS 381	Yes
PHYCS 385	Observational Astronomy	3	2	3	ME	PHYCS 381	Yes
PHYCS 407	Geophysics	3	2	3	ME	PHYCS 333	Yes
PHYCS 408	Medical Physics	3	2	3	ME	PHYCS 209	Yes
PHYCS 421	Mathematical Physics	3	0	3	ME	PHYCS 221	Yes
PHYCS 422	Particle Physics	3	0	3	ME	PHYCS 326	Yes
PHYCS 426	Advanced Computational Physics	3	2	3	ME	PHYCS 425	Yes
PHYCS 427	Quantum Mechanics II	3	0	3	ME	PHYCS 326	Yes
PHYCS 428	Space and Time	3	0	3	ME	PHYCS 222 & PHYCS 314	Yes
PHYCS 433	Applied Optics	3	2	3	ME	PHYCS 331	Yes
PHYCS 444	Electrodynamics	3	0	3	ME	PHYCS 348	Yes
PHYCS 456	Physics of Semiconductor Devices	3	2	3	ME	PHYCS 351	Yes
PHYCS 457	Solid State Physics II	3	2	3	ME	PHYCS 351	Yes
PHYCS 462	Statistical Physics	3	0	3	ME	PHYCS 365	Yes

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 465	Solar Energy	3	2	3	ME	PHYCS 365	Yes
PHYCS 481	Solar System Dynamics	3	0	3	ME	PHYCS 283	Yes
PHYCS 482	High-Energy Astrophysics	3	0	3	ME	PHYCS 384	Yes
PHYCS 483	Extragalactic Astrophysics and Cosmology	3	0	3	ME	PHYCS 384	Yes
PHYCS 484	Astrophysics	3	0	3	ME	PHYCS 382	Yes
PHYCS 485	Astronomical Data Analysis	3	2	3	ME	PHYCS 385	Yes
PHYCS 492	Selected Topics in Modern Physics	3	0	3	ME	Department Approval	Yes

General Studies Elective Courses List

Course Code	Course Title	Course Hours			Course Type	Pre requisite
		LEC	PRAC	CRD		
ARAB 141	Modern Arabic Lit.	3	0	3	GSE	------
ARAB 242	Arabic Poetry In The Renaissance Period	3	0	3	GSE	------
ART 133	Fundamentals of Music and Its Appreciation	3	0	3	GSE	------
ART 141	Drawing and Painting	2	1	3	GSE	------
ART 221	Traditional Music of Bahrain and Its Application	3	0	3	GSE	------
CHL 101	Introduction to Chinese Language	3	0	3	GSE	------
CHL 102	Basic Chinese Language	3	0	3	GSE	CHL 101
EDAR 126	Playing on Piano and Org 1	3	0	3	GSE	------
EDPS 144	Psychology of Learning and Memory	3	0	3	GSE	------
EDTC 100	Teaching and Learning Technology	3	0	3	GSE	------
ENGL 130	Introduction to Literature	3	0	3	GSE	------
FREN 141	French I	3	0	3	GSE	------
FREN 142	French II	3	0	3	GSE	FREN 141
GERM 101	Introduction to German	3	0	3	GSE	------
HISTO 212	Contemporary History of The Arab World	3	0	3	GSE	------
HISTO 281	Landmarks of Islamic Civilisation	3	0	3	GSE	------
ISLM 114	Quranic Sciences	3	0	3	GSE	------
ISLM 136	Biography of The Prophet	3	0	3	GSE	------
ISLM 141	Introduction to Shari'A	3	0	3	GSE	------
ISLM 252	Islamic Doctrine	3	0	3	GSE	------
JAPN 101	Japanese Level I	3	0	3	GSE	------
JAPN 102	Japanese Level II	3	0	3	GSE	JAPN 101
KL 101	Korean Language I	3	0	3	GSE	------
KL 102	Korean Language II	3	0	3	GSE	KL 101
LAW 101	Introduction to Legal Studies	3	0	3	GSE	------
LAW 102	History of Law	3	0	3	GSE	------
LAW 106	Constitutional Law I	3	0	3	GSE	------
PHEDE 214	Principles of Educational Statistics	3	0	3	GSE	------
PSYC 103	Introduction to Psychology	3	0	3	GSE	------
PSYC 120	Psychology of Marriage	3	0	3	GSE	------
PSYC 211	Educational Psychology	3	0	3	GSE	------
PSYC 281	Thinking Skills	3	0	3	GSE	PSYC 103 or EDPS 241
SOCIO 161	Introduction to Sociology	3	0	3	GSE	------
SOCIO 181	Introduction to Anthropology	3	0	3	GSE	------
SOCIO 191	Citizenship, Identity and Globalization	3	0	3	GSE	------
SOCIO 224	Sociology of Health	3	0	3	GSE	------
SOCIO 226	Sociology of Arabian Gulf	3	0	3	GSE	------
TL 101	Turkish Language	3	0	3	GSE	------
GSE XXX	Other electives	X	X	3	GSE	Department Approval

Course Description

Course Code: PHYCS 102 **Course Title:** General Physics II
Electric charges and fields; Coulomb's and Gauss's laws; electric potential; capacitors and dielectrics; direct current circuits; Kirchoff's rules; magnetic field and flux; ampere's law; induced emf; Lenz's law; mutual and self inductance; AC circuits; RLC circuit.

Course Code: PHYCS 209 **Course Title:** Bulk Properties of Matter
Elasticity; fluid statics and dynamics; mechanical waves; vibrating bodies; acoustic phenomena; kinetic theory of gases; first and second law of thermodynamics; geometrical optics.

Course Code: PHYCS 221 **Course Title:** Methods of Mathematical Physics I
Curvilinear coordinates; vector calculus; multiple integrals; ordinary differential equations; power series; complex numbers; linear equations; matrices and determinants; Fourier series; application to physics problems**.**

Course Code: PHYCS 222 **Course Title:** Modern Physics
The special theory of relativity; relativistic dynamics; blackbody radiation; the photoelectric effect; Compton effect; pair production and annihilation; bremsstrahlung and x-ray production; wave-particle duality; de Broglie's hypothesis; the uncertainty relationships; the Schrodinger equations and applications; elementary particles.

Course Code: PHYCS 241 **Course Title:** Introductory Electronics
Properties of semiconductors; diode characterization; Zener diodes; tunnel diodes; photodiodes; construction and operation of bipolar junction and field effect transistors; dc biasing; stabilization; small signal analysis of BJT; JFET and MOSFET amplifiers; multistage systems; operational amplifiers.

Course Code: PHYCS 282 **Course Title:** The Cosmic Perspective
History of Astronomy; geocentric and heliocentric universe; celestial sphere and constellations; time and calendars; sky maps and astronomical calculations; the solar system; stars and galaxies; telescopes and tools of Astronomy.

Course Code: PHYCS 283 **Course Title:** Planets and the Solar System
Mechanics of the solar system; dynamics of the Earth and the Moon; eclipses; physical properties of the solar system; terrestrial and Jovian planets; solar wind; asteroids and comets; Kuiper belt and Oort cloud; Lagrangian points; origin of the solar system.

Course Code: PHYCS 314 **Course Title:** Classical Mechanics
Dynamics of particles; conservation theorem and symmetries; linear harmonic oscillations; Lagrangian and Hamiltonian dynamics; motion of particles and systems in a central force field; dynamics of a system of particles (collision and scattering).

Course Code: PHYCS 324 **Course Title:** Atomic and Molecular Physics
Atomic model; the Rutherford nuclear atom; the Bohr model; line spectra; the Schrodinger equation in spherical coordinates; quantum numbers and degeneracy; the hydrogen atom wave functions; intrinsic spin and spin angular momentum; the Pauli exclusion principle; addition of angular momenta; the hydrogen molecule; molecular vibrations and rotations; molecular spectra.

Course Code: PHYCS 326 **Course Title:** Quantum Mechanics I
Postulates of quantum mechanics; operators; eigenfunctions and eigenvalues; Dirac formalism in Hilbert space; timevariation of expectation values and conservation laws; Hamiltonian operator; harmonic oscillator; angular momentum algebra; eigenvalues and eigenfunctions of the Schrodinger equation for central forces with hydrogen- atom as an example; time independent perturbation theory.

Course Code: PHYCS 331 **Course Title:** Physical Optics
Periodic motion; superposition of periodic motions; free vibrations of physical systems; properties of light; interference of light; Fraunhofer diffraction; the double slit experiment; diffraction; the double slit experiment; the diffraction grating; Fresnel diffraction; absorption and scattering; dispersion; reflection and polarization of light.

Course Code: PHYCS 333 **Course Title:** Oscillations and Waves
Free and forced vibrations; resonance; coupled oscillations and normal modes; normal modes of continuous systems; Fourier analysis; progressive waves; normal modes and travelling waves; transmission and reflection of waves; impedance matching; standing waves; acoustical phenomena; non-linear oscillations.

Course Code: PHYCS 334 **Course Title:** Optoelectronics
Nature of light; electrical and optical processes in semiconductors; the p-n junction; optical effects; luminescence and display devices; solar cells; lasers and applications; photodetectors; fiber optics; waveguides; optical communication systems.

Course Code: PHYCS 340 **Course Title:** Electronics II
Multistage systems and frequency considerations; differential and operational amplifiers; feedback amplifiers and oscillator circuits; active filters; voltage regulators; pn-npn and other devices; introduction to electronic communication and modulation: AM and FM.

Course Code: PHYCS 342 **Course Title:** Digital Electronics I
Number systems and codes; logic gates and Boolean algebra; combinational logic; introduction to sequential logic; counters and shift registers; design of sequential circuits; introduction to microprocessors.

Course Code: PHYCS 344 **Course Title:** Plasma Physics
Plasma in nature; application of plasma physics; theoretical description of the plasma phenomena; plasma as fluid; plasma diffusion and resistivity; non-linear effects in plasma; plasma diagnostic techniques; application of plasma in controlled fusion.

Course Code: PHYCS 348 **Course Title:** Electromagnetic Theory
Vector calculus; electrostatic fields; electric fields in dielectric materials; solutions for the electrostatic boundary-value problems; the magnetic field; magnetic materials; electromagnetic induction and the flow of power; Maxwell's equations; plane electromagnetic waves; Poynting vector.

Course Code: PHYCS 351 **Course Title:** Solid State Physics I
Structure of crystals; diffraction of x-rays; thermal properties of solids; free electron theory of metals; the band theory of solids; Maxwell-Boltzmann and Fermi-Dirac distributions; phonons and lattice vibrations; atomic bonding; non-crystalline solids; introduction to semiconductors.

Course Code: PHYCS 353 **Course Title:** Physics of Materials
Introduction to materials; microstructure and properties; ferrous and non-ferrous alloys; ceramic materials; polymers and plastics; composite materials; magnetic materials.

Course Code: PHYCS 364 **Course Title:** Meteorology
Survey of the atmosphere; weather observations; synoptic charts and forecasts; radiation and atmospheric heat exchange; horizontal winds; clouds; precipitation and fog formation and condensation of cloud droplets; formation and growth of ice crystals; rain and snow; weather radar; atmospheric storms; hurricanes and tropical cyclones; severe thunderstorms; lighting and hail; tornadoes.

Course Code: PHYCS 365 **Course Title:** Thermal Physics
Fundamental concepts in thermodynamical systems; equations of state; the first law of thermodynamics; consequences of the first law; entropy and the second law of thermodynamics; combined first and second laws; thermodynamic potentials; the principle of equation of energy; equation of state of an ideal gas; classical theory of specific heat; statistical thermodynamics and applications.

Course Code: PHYCS 366 **Course Title:** Environmental Physics
A broad course concerning the identification and measurement of environmental problems; the prevention and alleviation of existing problems. It is a calculation-based course. Topics covered: essentials of environmental physics; environmentally friendly energies; global climate change; physics of natural disasters; nuclear energy (carbon free energy); noise and noise pollution; state of the atmosphere; electrosmog.

Course Code: PHYCS 381 **Course Title:** Stellar Astrophysics
Continuous spectrum of light; interaction of light and matter, classification of stellar spectra; stellar parameters; binary stars; stellar atmospheres and interiors; the Sun; stellar formation and evolution; stellar pulsation; stellar remnants.

Course Code: PHYCS 382 **Course Title:** Astronomy

The celestial sphere and elementary celestial mechanics; coordinate systems of the celestial sphere; time keeping systems; planetary motions; planetary phenomena and the solar system; the stars stellar motions; stellar populations and evolution; stars with special properties; nebulae; celestial objects observed outside the optical spectrum.

Course Code: PHYCS 383 **Course Title:** Space Science and Technology

Two-body orbital mechanics; the trajectory equation; low and high earth orbits; in-plane and-out-of plane orbit changes; the general ballistic missile trajectories; lunar trajectories; interplanetary trajectories; satellite information systems; satellite orbits; launchers, structure and subsystems; satellite frequency bands and telecommunication; remote sensing.

Course Code: PHYCS 384 **Course Title:** Galaxies and the Universe

Preview of the Milky Way Galaxy and its evolution; normal and active galaxies. Creation and expansion of the universe; large scale structure in the universe; cosmology, the Big Bang model and the early universe.

Course Code: PHYCS 385 **Course Title:** Observational Astronomy

The sky with the unaided eye; absorption in the Earth's atmosphere; scintillation and seeing; celestial sphere; coordinate systems and time; optical telescopes; optical detectors and instruments; radio telescopes; observing at other wavelengths.

Course Code: PHYCS 398 **Course Title:** Internship

The Internship course is designed to provide an opportunity to gain work experience related to the student's specified field of science, in a supervised workplace environment for a period of 8 consecutive weeks. The student shall submit a report upon completion.

Course Code: PHYCS 407 **Course Title:** Geophysics

Mantle; the core and the crust of the earth and its elastic, electric, magnetic and thermal properties; the techniques of gravimetry; geodesy; seismology; geomagnetism and geochronology.

Course Code: PHYCS 408 **Course Title:** Medical Physics

Energy; work and power of the body; measurements of pressure in the body; the physics of the lungs and breathing; physics of the cardiovascular system; electricity within the body; application of the electricity and magnetism in medicine; sound in medicine; physics of the eyes and vision; radiation dosimetry; biological effect of radiation; radiation protection guides.

Course Code: PHYCS 421 **Course Title:** Mathematical Physics

Calculus of variation; coordinate transformation; gamma, beta and error functions; asymptotic series; Striling's formula; elliptic integrals and functions; series solution of differential equation; Legendre polynomials; Bessel functions; sets of orthogonal functions; partial differential equation; Laplace transform; functions of a complex variables; integral equations.

Course Code: PHYCS 422 **Course Title:** Particle Physics

Elementary particles and their family classifications; invariance principles and conservation laws; covariant formulation of Lorentz transformations; four-vector algebra; relativistic collisions; phenomenology of strong; weak and electromagnetic interactions; Salam-Weinberg exchange particles; parity violation; Cabbibo theory; SU(2) and SU(3) classifications and the Quark model of hadrons; Quark confinement; search for quarks; some cosmological applications.

Course Code: PHYCS 425 **Course Title:** Computational Physics

Finite difference solution of differential equations, Newton's equation of motion in one and two dimensions, two body problem, simple linear and nonlinear systems, chaotic motion of dynamical systems, random processes, dynamics of many particle systems.

Course Code: PHYCS 426 **Course Title:** Advanced Computational Physics

Fourier transformation; FFT; computer simulations in electrodynamics; Monte Carlo simulations and integration; random walks; percolation, fractals; complexity; self-organized critical phenomena; neural networks; genetic algorithms; microcanonical ensemble; Ising model.

Course Code: PHYCS 427 **Course Title:** Quantum Mechanics II

Diatomic molecules; eigenvalue equation in matrix form; angular momentum and Pauli spin matrices; combination of angular momentum and spin states; the Clebsch-Gordon couplings; time dependent perturbation theory; Born and WKB approximations; scattering theory; methods of partial waves and s-wave scattering; introduction to relativistic quantum mechanics.

Course Code: PHYCS 428 **Course Title:** Space and Time

Differential geometry; Reimannian geometry and Newtonian gravity; Einstein's field equations and variational principles in four-dimensional geometry; flat space-time; curved space-time; the very early universe; problems of singularity; horizon and flatness; the expanding and static universe hypothesis.

Course Code: PHYCS 432 **Course Title:** Laser Physics

The nature of light; polarization and coherence of light; detection of electromagnetic radiation; laser construction and operation; characteristics of laser light; laser pumping rate; oscillations; gain and threshold; optical resonators; multimode laser operation; specific lasers and pumping mechanisms; laser applications.

Course Code: PHYCS 433 **Course Title:** Applied Optics

Wave nature and properties of light; review of the electromagnetic wave theory; Fourier transformation; matrix method in paraxial optics; optical glasses; spectral filters; fiber optics; electro and magneto-optic effect; detectors of light; introduction to asymmetric and symmetric spectroscopy; spectroscopic techniques.

Course Code: PHYCS 444 **Course Title:** Electrodynamics

Propagation; reflection and refraction of electromagnetic waves in vacuum; dielectric media and conductors; radiation by point and system of charges; resonant cavities and waveguides; radiation from an oscillating dipole.

Course Code: PHYCS 456 **Course Title:** Physics of Semiconductor Devices

Properties of semiconducting materials; crystal structure and valence model of pure and doped semiconductors; mobility and electrical conductivity; excess carriers; life time, diffusion and transport phenomena; electrical parameters of a semiconductor; energy-band models; homogeneous semiconductors in thermodynamic equilibrium; non-equilibrium semiconductors; the PN junction; semiconductors in optoelectronics; microwave semiconductor devices; heterojunctions; metal-semiconductor junctions; semiconducting and superconducting devices of the future.

Course Code: PHYCS 457 **Course Title:** Solid State Physics II

Plasmons; polaritons and polarons; optical processes and excitations; superconductivity; dielectrics and ferroelectrics; diamagnetism and paramagnetism; ferromagnetism and antiferromagnetism; magnetic resonance; theory of masses.

Course Code: PHYCS 462 **Course Title:** Statistical Physics

Principal concepts in probability theory, statistical concepts and examples, kinetic theory, partition functions, ideal Bosons and Fermions, canonical distributions, systems of interacting particles, kinetic theory of transport processes.

Course Code: PHYCS 465 **Course Title:** Solar Energy

Solar radiation; available solar radiation; selected heat transfer topics; radiation characteristics of opaque materials; radiation transmission through glazing; absorbed radiation; flat plate collectors; concentrating collectors; photovoltaic systems; indirect solar energy.

Course Code: PHYCS 471 **Course Title:** Nuclear Physics

Nuclear properties; angular momentum and parity; nuclear models; nuclear decay and radioactivity; detection of nuclear radiation; nuclear reactions; nuclear fission; nuclear fusion; accelerators; introduction to nuclear structures.

Course Code: PHYCS 481 **Course Title:** Solar System Dynamics

Basic planetary motion; Kepler's laws and celestial mechanics; orbital elements; two body problem and restricted three body problem; Lagrangian equilibrium points; tidal forces; Roche zone and limit; spin-orbit coupling; orbital perturbations and evolution; planetary rings; artificial satellites.

Course Code: PHYCS 482 **Course Title:** High-Energy Astrophysics
Interactions of high-energy particles with matter; interactions of high-energy photons; dynamics of charged particles in magnetic fields; high-energy astrophysics in the solar system; gamma ray bursts; accretion power in astrophysics; interstellar gas and magnetic field; synchrotron radiation and radio emission of our galaxy.

Course Code: PHYCS 483 **Course Title:** Extragalactic Astrophysics and Cosmology
The nature of galaxies; galactic evolution, active galaxies; large-scale structure; general relativity and cosmology; relics of the Big Bang; the early universe; dark matter; the accelerating universe and dark energy.

Course Code: PHYCS 484 **Course Title:** Astrophysics
Properties of matter and radiation; energy sources; atomic properties of matter; stellar evolution; stellar objects; interstellar medium; star formation; the expanding universe; the galaxy; the extragalatic universe; the big bang theory and evolution of the universe.

Course Code: PHYCS 485 **Course Title:** Astronomical Data Analysis
Numerical analysis; interpolation and extrapolation; probability distribution and error analysis; minimization, curve- fitting and least-squares; image filtering, deconvolution and compression; Fourier and wavelet transforms; the iraf and eos-MiDas packages.

Course Code: PHYCS 492 **Course Title:** Selected Topics in Modern Physics
Recent trends and advances in contemporary physics. An in-depth investigation or survey of a single or several topics as approved by the departmental council.

Course Code: PHYCS 499 **Course Title:** Senior Research Project
Advanced experimental or theoretical work with an orientation toward research. A written report that includes a critical analysis of the theoretical and experimental details is to be submitted to the supervisor upon the conclusion of the project. The grade is awarded on the basis of a written report and an oral presentation.

Minor in Astronomy for Physics Major

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 282	The Cosmic Perspective	3	0	3	Minor	PHYCS 102	Yes
PHYCS 283	Planets and the Solar System	3	0	3	Minor	PHYCS 282	Yes
PHYCS 381	Stellar Astrophysics	3	0	3	Minor	PHYCS 283	Yes
PHYCS 384	Galaxies and the Universe	3	0	3	Minor	PHYCS 381	Yes
PHYCS 385	Observational Astronomy	3	2	3	Minor	PHYCS 381	Yes
PHYCS 3/4XX*	(see the list below)	3	0	3	Minor	See the list below	Yes
PHYCS 3/4XX*	(see the list below)	3	0	3	Minor	See the list below	Yes

***Students should select electives 3/4XX from the following list:**

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 383	Space Science and Technology	3	0	3	Minor	PHYCS 102	Yes
PHYCS 481	Solar System Dynamics	3	0	3	Minor	PHYCS 283	Yes
PHYCS 482	High-Energy Astrophysics	3	0	3	Minor	PHYCS 384	Yes
PHYCS 483	Extragalactic Astrophysics and Cosmology	3	0	3	Minor	PHYCS 384	Yes
PHYCS 485	Astronomical Data Analysis	3	2	3	ME	PHYCS 385	Yes

Minor in Biology for Physics Major

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Minor GPA
		LEC	PRAC	CRD			
BIOLS 103	General Biology II	3	3	4	Minor	BIOLS 102	Yes
BIOLS 250	Microbiology	2	3	3	Minor	BIOLS 103	Yes
BIOLS 222	Plant Morphology	2	3	3	Minor	BIOLS 103	Yes
BIOLS 234	Chordate Zoology	2	3	3	Minor	BIOLS 103	Yes
BIOLS 300	Cell Biology	2	3	3	Minor	BIOLS 102	Yes
BIOLS 340	General Ecology	2	3	3	Minor	BIOLS 103	Yes
BIOLS 4XX*	(see the list below)	2	3	3	Minor	See the list below	Yes

*** List of Electives for Minor Biology**

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Minor GPA
		LEC	PRAC	CRD			
BIOLS 441	Environmental Impact Assessment	2	3	3	Minor	BIOLS 340	Yes
BIOLS 442	Conservation Biology	2	3	3	Minor	BIOLS 340	Yes
BIOLS 451	Immunology	2	3	3	Minor	BIOLS 250	Yes
BIOLS 452	Biology of Prokaryotes	2	3	3	Minor	BIOLS 250	Yes
BIOLS 481	Fish and Fisheries	2	3	3	Minor	BIOLS 234	Yes

Minor in Chemistry for Physics Major

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Minor GPA
		LEC	PRAC	CRD			
CHEMY 2XX**	Minor 1 to be taken from Chemistry: Major Requirements or Major Electives List 1	X	X	3	Minor	See the list below	Yes
CHEMY 2XX**	Minor 2 to be taken from Chemistry: Major Requirements or Major Electives List 1	X	X	3	Minor	See the list below	Yes
CHEMY XXX	Minor 3 to be taken from Chemistry: Major Requirements or Major Electives	X	X	3	Minor	See the list below	Yes
CHEMY 3/4XX	Minor 4 to be taken from Chemistry: Major Requirements or Major Electives List 1	X	X	3	Minor	See the list below	Yes
CHEMY 3/4XX	Minor 5 to be taken from Chemistry: Major Requirements or Major Electives List 1	X	X	3	Minor	See the list below	Yes
CHEMY 3/4XX	Minor 6 to be taken from Chemistry: Major Requirements or Major Electives List 1	X	X	3	Minor	See the list below	Yes
CHEMY 3/4XX	Minor 7 to be taken from Chemistry: Major Requirements or Major Electives List 1	X	X	3	Minor	See the list below	Yes

List of Electives for Minor Chemistry

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 211	Analytical Chemistry I	3	2	3	Minor	CHEMY 102	Yes
CHEMY 221	Organic Chemistry I	3	2	3	Minor	CHEMY 102	Yes
CHEMY 231	Physical Chemistry I	3	2	3	Minor	CHEMY 102	Yes
CHEMY 241	Inorganic Chemistry I	3	2	3	Minor	CHEMY 102	Yes
CHEMY 300	Professional and Transferable Skills for Chemists	3	0	3	Minor	CHEMY 102	Yes
CHEMY 311	Analytical Chemistry II	3	0	3	Minor	CHEMY 211	Yes
CHEMY 321	Organic Chemistry II	3	0	3	Minor	CHEMY 221	Yes
CHEMY 331	Physical Chemistry II	3	0	3	Minor	CHEMY 231	Yes
CHEMY 332	Practical Physical Chemistry	0	6	3	Minor	CHEMY 331	Yes
CHEMY 333	Quantum Chemistry	3	0	3	Minor	CHEMY 201 or MATHS 122	Yes
CHEMY 341	Inorganic Chemistry II	3	0	3	Minor	CHEMY 241	Yes
CHEMY 348	Industrial Inorganic Chemistry	3	0	3	Minor	CHEMY 241	Yes
CHEMY 351	Principles and applications of Green Chemistry	3	0	3	Minor	CHEMY 211 & CHEMY 221	Yes
CHEMY 422	Physical Organic Chemistry	3	0	3	Minor	CHEMY 321	Yes

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 423	Selected Topics in Heterocyclic Chemistry	3	0	3	Minor	CHEMY 321	Yes
CHEMY 424	Natural Products	2	3	3	Minor	CHEMY 321	Yes
CHEMY 425	Mechanism in organic Chemistry	3	0	3	Minor	CHEMY 321	Yes
CHEMY 426	Food Chemistry	2	3	3	Minor	CHEMY 321	Yes
CHEMY 428	Industrial Organic Chemistry	3	0	3	Minor	CHEMY 321	Yes
CHEMY 431	Chemical Dynamics: Catalyst and Surface Chemistry	3	0	3	Minor	CHEMY 331	Yes
CHEMY 434	Polymer Chemistry	2	3	3	Minor	CHEMY 321	Yes
CHEMY 435	Advance Thermodynamics	3	0	3	Minor	CHEMY 331	Yes
CHEMY 438	Electrochemistry	3	0	3	Minor	CHEMY 331	Yes
CHEMY 442	Bio-inorganic Chemistry	2	3	3	Minor	CHEMY 341	Yes
CHEMY 443	Inorganic Reaction Mechanisms	3	0	3	Minor	CHEMY 341	Yes
CHEMY 452	Environmental Chemistry	2	3	3	Minor	CHEMY 312	Yes
CHEMY 453	Organic Environmental Chemistry	2	3	3	Minor	CHEMY 322	Yes
CHEMY 441	Application of Group Theory of Inorganic Chemistry	3	0	3	ME	CHEMY 341	Yes
CHEMY 411	Analytical Chemistry III	3	0	3	ME	CHEMY 311	Yes
CHEMY 432	Physical Chemistry III	3	0	3	ME	CHEMY 331	Yes
CHEMY 421	Organic Chemistry III	3	0	3	ME	CHEMY 321	Yes

Minor in Computer Science for Physics Major

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ITCS 114	Computer Programming II	3	2	3	Minor	ITCS 113	Yes
ITCS 214	Data Structures	3	2	3	Minor	ITCS 114	Yes
ITCS 285	Database Management Systems	3	2	3	Minor	ITCS 214	Yes
ITCS 316	Human-Computer Interaction	3	2	3	Minor	ITCS 214	Yes
ITCS 389	Software Engineering I	3	2	3	Minor	ITCS 285	Yes
ITCS* 3/4XX	(see the list below)	3	2	3	Minor	See the list below	Yes
ITCS* 3/4XX	(see the list below)	3	2	3	Minor	See the list below	Yes

List of Electives for Minor Computer Science

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ITCS 333	Internet Software Development	3	2	3	Minor	ITCS 285	Yes
ITCS 444	Mobile Application Development	3	2	3	Minor	ITCS 333	Yes
ITCS 453	Multimedia and Hypermedia Systems	3	2	3	Minor	ITCS 214	Yes
ITCS 489	Software Engineering II	3	2	3	Minor	ITCS 389	Yes
ITCS 494	Selected Topics in Computer Science	3	2	3	Minor	Department Approval	Yes
ITCS 496	Physical Implementation of DBMS	3	2	3	Minor	ITCS 285	Yes

Minor in Mathematics for Physics Major

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 204	Calculus and Analytic Geometry III	3	0	3	Minor	MATHS 122	Yes
MATHS 205	Calculus and Analytic Geometry III OR Differential Equations	3	0	3	Minor	MATHS 122	Yes
MATHS 211	Linear Algebra	3	0	3	Minor	MATHS 121	Yes
MATHS 3/4XX	Minor 4 to be taken from Mathematics: Major Requirements or Major Electives	3	0	3	Minor	See the list below	Yes
MATHS 3/4XX	Minor 5 to be taken from Mathematics: Major Requirements or Major Electives	3	0	3	Minor	See the list below	Yes
MATHS 3/4XX	Minor 6 to be taken from Mathematics: Major Requirements or Major Electives	3	0	3	Minor	See the list below	Yes
MATHS 3/4XX	Minor 7 to be taken from Mathematics: Major Requirements or Major Electives	3	0	3	Minor	See the list below	Yes

List of Electives for Minor Mathematics

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 303	Analysis I	3	0	3	Minor	MATHS 204	Yes
MATHS 304	Analysis II	3	0	3	Minor	MATHS 303	Yes
MATHS 305	History of Mathematics	3	0	3	Minor	-----	Yes
MATHS 307	Introduction to Lie Group for Differential Equations	3	0	3	Minor	MATHS 204 & MATHS 205	Yes
MATHS 311	Abstract Algebra I	3	0	3	Minor	MATHS 211	Yes
MATHS 312	Abstract Algebra II	3	0	3	Minor	MATHS 311	Yes
MATHS 331	Numerical Analysis I	3	0	3	Minor	MATHS 122 & (ITCS 114 or ITCS 102)	Yes
MATHS 332	Numerical Analysis II	3	0	3	Minor	MATHS 331	Yes
MATHS 341	Complex Analysis I	3	0	3	Minor	MATHS 204	Yes
MATHS 352	Number Theory	3	0	3	Minor	MATHS 121	Yes
MATHS 381	Methods of Applied Mathematics	3	0	3	Minor	MATHS 204 & MATHS 205	Yes
MATHS 385	Analytical Mechanics	3	0	3	Minor	MATHS 204 & MATHS 205	Yes

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 387	Fluid Mechanics	3	0	3	Minor	MATHS 385	Yes
MATHS 388	Vector Analysis and Tensor Analysis	3	0	3	Minor	MATHS 204	Yes
MATHS 395	Problem Solving in Mathematics	3	0	3	Minor	MATHS 381	Yes
MATHS 401	Applied Mathematics I	3	0	3	Minor	MATHS 381	Yes
MATHS 402	Applied Mathematics II	3	0	3	Minor	MATHS 401	Yes
MATHS 405	Theory of Differential Equations	3	0	3	Minor	MATHS 205	Yes
MATHS 411	Commutative Algebra	3	0	3	Minor	MATHS 312	Yes
MATHS 415	Topology I	3	0	3	Minor	MATHS 253 & MATHS 303	Yes
MATHS 416	Topology II	3	0	3	Minor	MATHS 415	Yes
MATHS 417	Functional Analysis	3	0	3	Minor	MATHS 211 & MATHS 303	Yes
MATHS 441	Complex Analysis II	3	0	3	Minor	MATHS 341	Yes
MATHS 451	Topics in Geometry	3	0	3	Minor	MATHS 253	Yes
MATHS 452	Differential Geometry	3	0	3	Minor	MATHS 204	Yes
MATHS 461	Elementary Partial Differential Equation	3	0	3	Minor	MATHS 204 & MATHS 205	Yes

Minor in Statistics for Physics Major

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 211	Linear Algebra	3	0	3	Minor	MATHS 121	Yes
STAT 271	Introduction to Probability	3	0	3	Minor	MATHS 121	Yes
STAT 371	Probability and Statistics I	3	0	3	Minor	MATHS 122 & STAT 271	Yes
STAT 372	Probability and Statistics II	3	0	3	Minor	STAT 371	Yes
STAT 373	Statistical Packages and Simulation	3	0	3	Minor	STAT 271	Yes
STAT 3/4XX	Minor 6 to be taken from Statistics: Major Requirements or Major Electives courses List	3	0	3	Minor	See the list below	Yes
STAT 3/4XX	Minor 7 to be taken from Statistics: Major Requirements or Major Electives courses List	3	0	3	Minor	See the list below	Yes

List of Electives for Minor Statistics

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
STAT 374	Regression Analysis	3	0	3	Minor	MATHS 211 & STAT 372	Yes
STAT 378	Surveys and Sampling	3	0	3	Minor	STAT 371	Yes
STAT 381	Time Series Analysis	3	0	3	Minor	STAT 372	Yes
STAT 382	Biostatistics and Epidemiology	3	0	3	Minor	MATHS 121	Yes
STAT 383	Demography and Population Studies	3	0	3	Minor	MATHS 121	Yes
STAT 384	Bayesian Inference	3	0	3	Minor	STAT 371	Yes
STAT 385	Econometrics	3	0	3	Minor	ECON140 & STAT 271	Yes
STAT 391	Non Parametric Statistics	3	0	3	Minor	STAT 271	Yes
STAT 392	Operational Research I	3	0	3	Minor	MATHS 211	Yes
STAT 393	Operational Research II	3	0	3	Minor	STAT 392	Yes
STAT 394	Linear programming	3	0	3	Minor	MATHS 122 & STAT 271	Yes
STAT 471	Decision Theory	3	0	3	Minor	STAT 372	Yes
STAT 472	Analysis and Design of Experiments	3	0	3	Minor	STAT 372	Yes
STAT 473	Introduction to Multivariate Analysis	3	0	3	Minor	MATHS 211 & STAT 372	Yes
STAT 474	Statistical Modelling	3	0	3	Minor	STAT 372	Yes
STAT 476	Queuing systems	3	0	3	Minor	STAT 372	Yes
STAT 478	Introduction to Stochastic Processes	3	0	3	Minor	STAT 372	Yes
STAT 479	Reliability	3	0	3	Minor	STAT 372	Yes

Major Support Requirements Courses Descriptions

Course Code: MATHS 122 **Course Title:** Calculus and Analytic Geometry II
Methods of integration. Applications to areas; arc length; volumes; etc. Parametric equations. Polar coordinates. Infinite series. Taylors' theorem and power series.

Course Code: MATHS 205 **Course Title:** Differential Equations
Differential equations of first order and their solution. Separable and exact equations. Equations convertible to separable type. Higher order linear equations with constant coefficients (homogeneous and non-homogeneous). Power series method for second order linear equations. Variation of parameters. Laplace transform technique. Applications of differential equations.

Course Code: MATHS 211 **Course Title:** Linear Algebra
Fields. Vector spaces. Linear dependence and independence. Bases. Dimensions. Subspaces. Quotient spaces. Linear transformations. Connection with matrices. Change of bases (PAQ and PAP). Eigen-values. Characteristic polynomial. Minimal polynomial. Canonical forms in simple cases. Real and complex inner-product spaces. Orthonormal bases. Orthogonal and complex unitary matrices and their eigen-values. Orthogonal and unitary reduction of real symmetric and complex Hermitian matrices.

Course Code: CHEMY 102 **Course Title:** General Chemistry II
Gaseous equilibrium (equilibrium constant, Kc and Kp); acids and bases (water dissociation, pH, weak acids and bases, salts); acid-base and precipitation equilibria (buffers, indicators, titrations, pH curves);thermochemistry (calorimetry, enthalpy, thermochemical equations, heats of formation, first law of thermodynamics); rate of reaction, rate and concentration, concentration and time, activation energy, rate and temperature, catalysis, mechanisms; electrochemistry; voltaic cells; cell voltages. Organic Chemistry (alkanes, alkenes, alkynes, isomerism, nomenclature, arenes, functional groups, reaction). Related practical work.

University Requirements Courses Descriptions

Course Code: ARAB 110 **Course Title:** Arabic Language Skills
This course focuses on basic Arabic skills including form, function, and meaning. It also helps the student to appreciate and understand structures and approach them from a critical point of view, through various genres in literature.

Course Code: HIST 122 **Course Title:** Modern History of Bahrain and Citizenship
Spatial identity of Bahrain: Brief history of Bahrain until the 18th century; the historical roots of the formation of the national identity of Bahrain since the 18th century; the modern state and evolution of constitutional life in Bahrain; the Arabic and Islamic dimensions of the identity of Bahrain; the core values of Bahrain's society and citizenship rights (legal, political, civil and economic); duties; responsibilities and community participation; economic change and development in Bahrain; Bahrain's Gulf, Arab and international relations.

Course Code: HRLC 107 **Course Title:** Human Rights Principles
This course deals with the principles of human rights in terms of the definition of human rights, scope, sources with a focus on the International Bill of Human Rights; The Charter of the United Nations; Universal Declaration of Human Rights; The International Covenant on Economics, Social and Culture rights; Convention against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; Mechanics and the Constitutional Protection of Rights and Public Freedoms in Kingdom of Bahrain.

Course Code: ISLM 101 **Course Title:** Islamic Culture
An introduction to the general outline and principles of Islamic culture, its general characteristics, its relationships with other cultures, general principles of Islam in beliefs, worship, legislation and ethics.

College Requirement Courses Descriptions

Course Code: CHEMY 101 **Course Title:** General Chemistry I
Significant figures, chemical formulas and equations; mass relations, limiting reactants and theoretical yield; Physical behaviour of gases; electronic structure, periodic table, covalent bonding; Lewis structures, Molecular structures, hybridization; molecular orbitals, solutions; colligative properties. Related practical work.

Course Code: BIOLS 102 **Course Title:** General Biology I
Properties of life; atoms, molecules and chemical bonds; biomolecules; cell structure and function; bioenergetics (intermediary metabolism); cell reproduction; Mendelian genetics; structure of DNA; RNA and protein synthesis; molecular genetics.

Course Code: PHYCS 101 **Course Title:** General Physics I
Units and measurements; brief review of vectors; Newton's laws of motion; projectile motion; work and energy; impulse and momentum; rotational dynamics; equilibrium of a rigid body; periodic motion.

Course Code: MATHS 121 **Course Title:** Calculus and Analytic Geometry I
Limits and continuity. Derivatives and integrals. Applications of derivatives which include mean value theorem, extrema of functions and optimization. Definite integrals and the Fundamental Theorem of Calculus. Derivatives and integrals of exponential, logarithmic and inverse Trigonometric functions.

Course Code: ITCS 113 **Course Title:** Computer Programming I
This course introduces problem solving and fundamental programming concepts and techniques implemented by a high-level programming language. Topics include primitive and compound data types, syntax, semantics, expressions, assignment, input, output, conditional and iterative control structures, functions.

Course Code: ENGL 125 **Course Title:** English for Science I
This is the first of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing. The course includes an extensive reading programme via a self-access lab.

Course Code: ENGL 126 **Course Title:** English for Science II
English for Science is the second of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing.