Diploma in Astronomy

Department of Physics, University of Kelaniya

Course Name: Diploma in Astronomy

Objectives

All the Astronomy courses are expected to incorporate critical thinking abilities, quantitative skills, and communication skills as core objectives in their course material and coursework. These course modules are designed to provide a broad introduction to modern astronomy. Facilitate higher education in experimental and theoretical Astronomy.

Admission Requirements

Pass (3 simple passes) GCE A/L in physical science, biological science, or technology streams.

Course Duration

1 year

Minimum Credits

30 credits

Evaluation Criteria

The examination of the course will be held at the end of teaching each course

Grading System

The performance of a student shall be evaluated for each course module as described below

Range of Marks	Grade	Grade Point Values
85-100	A^+	4.0
70-84	A	4.0
65-69	A^-	3.7
60-64	B^+	3.3
55-59	B	3.0
50-54	B^-	2.7
45-49	C^+	2.3
40-44	C	2.0
35-39	C^-	1.7
30-34	D^+	1.3
25-29	D	1.0
00-24	E	0.0

Certificates Awarding Criteria

(1) For the award of the diploma, a student must

(a) Accumulate grades of C or better in course units aggregating to 30 credits
(b) Obtain a GPA of 2.00 or greater and
(c) Complete the relevant requirements within a period of three consecutive academic years.

(2) For the award of the diploma with Merit, a student must

(a) Accumulate grades of B or better in course units aggregating to 30 credits
(b) Obtain a GPA of 3.30 or greater and
(c) Complete the relevant requirements within one academic year.

(2) For the award of the diploma with Distinction, a student must

(a) Accumulate grades of A or better in course units aggregating to 30 credits
(b) Obtain a GPA of 3.70 or greater and
(c) Complete the relevant requirements within one academic year.

Structure of the Syllabus

Course Code	Course Name	Lecture hrs.	Practical hrs.	Credits
ASTR 11013	Fundamentals of Mathematics	45	-	3
ASTR 11023	Fundamentals of Physics -I	45	-	3
ASTR 11033	Fundamentals of Physics -II	45	-	3
ASTR 11043	The Sky	45	-	3
ASTR 11052	The Planets	30	-	2
ASTR 12062	Solar System Dynamics	30	-	2
ASTR 12072	Beyond the Solar System	30	-	2
ASTR 12082	Stellar Evolution	30	-	2
ASTR 12092	Galaxies	30	-	2
ASTR 12102	Space Observation and Instruments	30	-	2
ASTR 12112	Introduction to Astrobiology	30	-	2
ASTR 12122	Astronomy Laboratory	-	45	2
ASTR 13131	Astronomy Workshop	-	15	1
ASTR 13141	Astronomy Seminar	15	-	1
	Total	**390**	**60**	**30**

Course code: ASTR 11013
Course Title: Fundamentals of Mathematics
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. Classify the nature of solutions of simultaneous equations and solve a linear system for n variables.
2. Discuss the existence of limit, continuity, and differentiability on real functions.
3. Discuss the basic concepts and applications of Matrix and vectors

Course content:
Fundamentals of Mathematics: Analyses the Real Number system, Algebra, Analyses functions of a real Variable, Rational functions, Binomial Expansion, Limit of the function, derivatives of a function to solve

problems, Find indefinite and definite integers of functions, Matrix Algebra, Vectors: *i*,*j*,*k* representation, scalar and vector products, triple vector products, gradient, divergence and curl

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Stroud, K.A and Booth, D. (2007), Engineering Mathematics 6th Ed. Palgrave Publishers Ltd.
2. David Yevick, Hannah Yevick (2014), Fundamental Math and Physics for Scientists and Engineers, Wiley Online

Course code: ASTR 11023

Course Title: Fundamentals of Physics -I

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Apply the acquired knowledge of the basic principles of physics to practical situations
2. Demonstrate their analytic and problem-solving skills
3. Physics majors understand and articulate the nature of science and its development through the scientific method.
4. Demonstrate written and/or communication skills

Course content:

Units and Measurement, Motion Along a Straight Line, Motion in Two and Three Dimensions, Force and Motion, Newton's Laws, Kinetic Energy and Work, Potential Energy and Conservation of Energy, Center of Mass and Linear Momentum, Rotation, Rolling, Torque, and Angular Momentum, Equilibrium, and Elasticity, Gravitation

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Giancoli, D. C. (2004), Physics: Principles with Applications, 6th Ed. Pearson/Prentice Hall
2. Stroud, K.A and Booth, D. (2007), Physics for Scientists and Engineers, 4th Ed. Palgrave Publishers Ltd.
3. Randall Knight, (2013), Physics for Scientists and Engineers with Modern Physics, 3rd Ed. Pearson/Addison Wesley

Course code: ASTR 11033

Course Title: Fundamentals of Physics -II

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Apply the acquired knowledge of the basic principles of modern physics to practical situations
2. Demonstrate their analytic and problem-solving skills
3. Modern physics majors understand and articulate the nature of science and its development through the scientific method.
4. Demonstrate written and/or communication skills

Course content:

Oscillations, Waves, Optics, Optical Instruments, Electric Fields, Gauss' Law, Magnetic Fields, Electromagnetic Oscillations and Alternating Current, Electromagnetic Waves, Temperature, Heat, and the First Law of Thermodynamics, The Kinetic Theory of Gases, Entropy and the Second Law of Thermodynamics

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Giancoli, D. C. (2004), Physics: Principles with Applications, 6th Ed. Pearson/Prentice Hall
2. Stroud, K.A and Booth, D. (2007), Physics for Scientists and Engineers, 4th Ed. Palgrave Publishers Ltd.
3. Randall Knight, (2013), Physics for Scientists and Engineers with Modern Physics, 3rd Ed. Pearson/Addison Wesley

Course code: ASTR 11043

Course Title: The Sky

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand the language of astronomy.
2. Observe the sky and identify prominent constellations, stars, and locations of major nebulas. Identify common post-main sequence stars, explain their color, and know their evolutionary stage.
3. Discuss the history of astronomy, astronomy as a science, and the laws of the Universe.

Course content:

Introduction to Astronomy; Early concepts of our place in the Universe, Scientific leaders in history and their contributions to astronomy (including Ptolemy, Copernicus, Brache, Kepler, Newton, Galileo, etc.), Units and Measurements in Astronomy; Astronomy as an observational science, fundamental naked-eye observations, coordinates, optical telescopes.

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Freedman , R.A., Geller R & Kaufman, W. J., (2010) Universe 9th ed

2. Karttunen, H., Kroger, P., Oja, H., Poutanen, M., Donner, K.J. (Eds) (2007) Fundamental Astronomy, 5th Edition. Springer Verlag

Course code: ASTR 11052
Course Title: The Planets
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. Explain the reasons for phases of the Moon, solar and lunar eclipses, and the origin of the motion of the Sun, Moon, stars, and planets in the night sky
2. Explain the structure of Jupiter and Saturn and their rings and moons, especially the four large moons of Jupiter and the largest Moon of Saturn
3. Describe the structure of planet atmospheres and explain the greenhouse effect and its relation to global warming

Course content:
Formation of planets, the structure of planets, moons and rings, Meteorites, asteroids and comets, Planetary Interiors, Planetary Surfaces, Planetary Atmospheres, Mercury, Venus, Mars, The outer planets, Life in the Solar System, Mars Exploration. Stars; The observational Hertzsprung-Russell diagram and the basic properties of stars, the Sun as a star. Binary stars. Nuclear energy generation in stars and a descriptive overview of stellar structure.
Method of Teaching and Learning:
Lecturers and Discussions.
Assessment:
Continuous assessment and end-of-year exam.
Recommended reading:

1. Jeffrey O. B, Megan O. D, Nicholas S., Mark V., The Cosmic Perspective: The Solar System with Mastering Astronomy, 6th Edition
2. Karttunen, H., Kroger, P., Oja, H., Poutanen, M., Donner, K.J. (2007) Fundamental Astronomy, 5th Edition. Springer Verlag

Course code: ASTR 12062
Course Title: Solar System Dynamics
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. Explain the current structure and composition of the solar system, its formation, dynamics, and methods for studying it.
2. Understand and use specific theories, laws, and models that have proven useful in astronomy and physics.

Course content:
The solar system, Sun, Earth, and Moon's relationship with seasons, eclipses, planets' night and day orbital motions, minor planets and dust complexes in planetary systems, Exoplanet detection techniques, and

Properties of other planetary systems. Physics of viscous accretion disks, growth of dust to planetesimals, Formation of terrestrial and giant planets, Small bodies in the outer and inner solar system, Exo-Kuiper and Zodiacal Belts.

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Golub, L, and Pasachoff, J.M., (2002), Nearest Star: The Surprising Science of Our Sun, Harvard University Press.
2. William K. H., (2004) Moons and Planets, 5th Edition, Brooks Cole

Course code: ASTR 12072

Course Title: Beyond the Solar System

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand the relationship between light, matter, and energy in an astronomical context
2. Understand the nature and evolution of galaxies and the Universe.

Course content:

Stars and Nebulae, Extreme objects in our Galaxy, white dwarf stars, neutron stars, and black holes. Properties of galaxies, galactic dynamics, and star formation in galaxies, the cosmological model that accounts for the presently observed chemical composition of galaxies and stars, and the presently observed dynamical structures of the Universe, Origin of the Universe

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Michael A. S., the Solar System, 8th Edition. Cengage Learning
2. William K. H., (2004) Moons and Planets, 5th Edition, Brooks Cole

Course code: ASTR 12082

Course Title: Stellar Evolution

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Demonstrate clear insight into the underlying physical principles associated with all the key stages of stellar evolution from initial star formation within gas clouds in the Galactic plane through the various stages of "stability" to the end products

2. Describe how astrophysics brings together all branches of physics and thus allows us to understand the 'big picture of physics

Course content:

Composition and physical properties of the interstellar medium, Characteristics of emission nebulae, Properties of dark interstellar clouds, Theory of star formation, Effect of mass on star formation, Evolutionary stages followed by a Sun-like star, Evolutionary stages of high-mass and low mass stars, Types of supernovae, Origins of heavy elements, Observations that verify theories of stellar evolution & Black holes.

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Sparke, L.S, & Gallagher, J.S., (2007), Galaxies in the Universe, 2nd edition Cambridge University Press
2. Karttunen, H., Kroger, P., Oja, H., Poutanen, M., Donner, K.J.) (2007) Fundamental Astronomy, 5th edition. Springer Verlag

Course code: ASTR 12092

Course Title: Galaxies

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand the key properties of the Universe beyond the solar system: stars and galaxies
2. Understand the scientific method, with examples in Astronomy

Course content:

Milky Way (physical structure), Variable stars, Orbital paths of stars in the Galaxy, Explanations for the existence of spiral arms, Possible nature and existence of dark matter, Phenomena observed at the center of our Galaxy, Characteristics of Normal Galaxies/Classification, Hubble's Law, Mapping the Universe beyond our Milky Way Galaxy, Active Galaxies, Seyfert and Radio Galaxies and Quasars, Theories of galactic evolution

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Continuous assessment and end-of-year exam.

Recommended reading:

1. Sparke, L.S, & Gallagher, J.S., (2007), Galaxies in the Universe, 2nd edition Cambridge University Press
2. Freedman R., Geller R.,. Kaufmann W.J., (2013) Universe: Stars & Galaxies, 5th Edition

Course code: ASTR 12102
Course Title: Space Observation and Instruments
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. To gain knowledge of the physical scales, masses, sizes, lifetimes, and other properties associated with a wide variety of astronomical objects
2. Graph, analyze, and interpret various types of astronomical data involving spectra from stars, galaxies, quasars, and planetary and stellar orbits.

Course content:
Types of Telescopes; Major types of optical telescopes, Advantages of reflecting telescopes, Effect of Earth's atmosphere on astronomical observations, Advantages and disadvantages of radio astronomy, Uses of interferometry, Infrared, ultraviolet, and high energy astronomies, Use of various parts of the electromagnetic spectrum to make observations and Hubble telescope
Method of Teaching and Learning:
Lecturers and Discussions.
Assessment:
Continuous assessment and end-of-year exam.
Recommended reading:

1. Kitchin, C.R., (2008), Astrophysical Techniques, 5th Edition, CRC Press
2. Kitchin, C.R., (2003), Telescopes and Techniques: An Introduction to Practical Astronomy, Springer-Verlag UK
3. Rieke, (2003), Detection of Light from Ultraviolet to the Submillimeter, Cambridge University Press

Course code: ASTR 12112
Course Title: Introduction to Astrobiology
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. Describe the wide variety of carbon---based life on Earth
2. Have an overview of the formation, planetary science, and biological processes that made Earth habitable.
3. Understand the search for evidence of past (or current) life elsewhere in our Solar System, particularly on Mars.
4. Understand current ideas as to whether life may be present elsewhere in the Universe.

Course content:
Life from a historical perspective, The basic requirements for life and possible alternate options Approaching life from an information theoretic point of view, The molecular basis for life, The Earth cycles, climate feedback mechanisms, The origin of life on Earth, Requirements for life, Prospects for life on Mars, Prospects for life elsewhere in the Solar System, Extraterrestrial life.

Method of Teaching and Learning:
Lecturers and Discussions.
Assessment:
Continuous assessment and end-of-year exam.
Recommended reading:

1. Rothery D. A., Gilmour I. and Sephton M. A, (2011) An Introduction to Astrobiology 2nd Edition, Cambridge University Press
2. Plaxco K. W. and Gross M., (2006) Astrobiology: A Brief Introduction, the Johns Hopkins University Press.

Course code: ASTR 12122
Course Title: Astronomy Laboratory
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. Use simple laboratory equipment in astronomical observations;
2. Write a report on the experiment, communicating the details, results, and conclusions
3. Identify environmental factors that affect an experiment's outcome or observation and apply basic error analysis techniques.
4. Demonstrate a basic understanding of the use of standard astronomical instruments.
5. Demonstrate a working knowledge of computer online and Internet astronomical programs.

Course content:
Laboratories are a combination of indoor activities and outdoor observing. The exact mix will depend on the observing seasons, Use of telescopes; coordinate systems and time; Observing the moons of Jupiter and using them to deduce the mass of Jupiter; astronomical imaging; imaging and analysis of the Moon's surface structure; Schmidt Plate Investigation; Computer Assisted Learning Packages; stellar classification; Plotting a Hertzsprung-Russell diagram for stars
Method of Teaching and Learning:
Laboratory demonstrations and Project work.
Assessment:
Continuous assessment and Lab reports.
Recommended reading:

4. Kitchin, C.R., (2008), Astrophysical Techniques, 5th Edition, CRC Press
1. Kitchin, C.R., (2003), Telescopes and Techniques: An Introduction to Practical Astronomy, Springer-Verlag UK
2. Rieke, (2003), Detection of Light from Ultraviolet to the Submillimeter, Cambridge University Press

Course code: ASTR 13131
Course Title: Astronomy Workshop
Type/ Status of the course: Compulsory
Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. understand the use of telescopes and star charts
2. relate terrestrial processes with the processes on other planets in our solar system

Course content:

ACTIVITIES: Hands-on learning in the field

View the night sky through telescopes and use star charts to help navigate through the Constellations. Learn the constellations: their significance today and their mythology from the past. Investigate physical examples of astronomical distances. Participate in role-playing games that build teamwork and facilitate decision-making. Identify characteristics of stars, planets, meteorites and other bodies in our Universe

Method of Teaching and Learning:

Night observations/ Night camps.

Assessment:

Attendance and reports.

Recommended reading:

1. Kitchin, C.R., (2008), Astrophysical Techniques, 5th Edition, CRC Press
2. Kitchin, C.R., (2003), Telescopes and Techniques: An Introduction to Practical Astronomy, Springer-Verlag U.K.

Course code: ASTR 13141

Course Title: Astronomy Seminar

Type/ Status of the course: Compulsory

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Gain familiarity with research being conducted in Physics and Astronomy.
2. Gain exposure to current research topics.

Course content:

Seminars related to astronomy are an excellent resource for students to learn about current activities in astronomy and to expose them to the breadth of research being conducted worldwide. Therefore, several talks will be organized by the department.

Method of Teaching and Learning:

Lecturers and Discussions.

Assessment:

Attendance and reflection reports.

Recommended reading:

1. General astronomy reading materials
2. Handouts

The panel of lecturers:

Senior Professor Sudath R D Kalingamudali

BSc (Kelaniya), PhD (Sheffield), CSci, CEng, CPhys, FIET, FInstP, FIP (SL), MIEEE

Senior Professor P A A Perera

BSc (Colombo), MA, PhD (Rochester), CPhys, FIP (SL)

Senior Professor L B D R P Wijesundera

BSc, MPhil (Kelaniya), DSc (Kyushu), CPhys, FIP (SL)

Senior Professor H H Sumathipala

BSc (Kelaniya), PhD (Peradeniya), CPhys, FIP (SL)

Senior Professor Prabath Hewageegana

BSc (Kelaniya), MSc (GSU, Atlanta), PhD (GSU, Atlanta), CPhys, FIP (SL)

Professor (Mrs) W J M Samaranayaka

BSc (Peradeniya), DEng (Kumamoto), CPhys, FIP (SL), MIEE (Japan)

Professor K M D C Jayathilaka

BSc (Kelaniya), MPhil (Kelaniya), PhD (Colombo), CPhys, MIEEE, MIP (SL)

Professor A L A K Ranaweera

BSc (Kelaniya), PhD (Kyung Hee), MIEEE

Professor W T M A P K Wanninayake

BSc (Kelaniya), MSc (Peradeniya), MS (Creighton), MS (UWM), PhD (UWM), CPhys, MIP (SL)

Professor M A Punyasena

BSc (Kelaniya), MSc, PhD (Alberta), CPhys, FIP (SL)

Dr. (Mrs) U K Abeywarna

BSc, MSc (Peradeniya), PhD (Colombo), CPhys, FIP (SL)

Dr. J A Seneviratne

BSc (Kelaniya), MSc (Mississippi State), PhD (Mississippi State)

Dr. F S B Kafi

BSc (Kelaniya), PhD (Kelaniya)

Dr. P L A K Piyumal

BSc (Kelaniya), PhD (Kelaniya), MIEEE

Dr. K D B H Gunawardana

BSc (Kelaniya), MS (Georgia State), PhD(Georgia State)

Dr. M Shammer Abdeen

BSc (Kelaniya), PhD(University of Akansas)

Mr. Y L Ramawickrama

BSc (Kelaniya), MSc (Colombo)

Mr. B G E T Jayashantha

BSc Honors(Kelaniya), MSc (Colombo)

Mr. R M G Wanigasekara

BSc (Kelaniya), M Phil (Kelaniya)