

SUBJECT REVIEW REPORT

DEPARTMENT OF PHYSICS



**FACULTY OF SCIENCE
UNIVERSITY OF KELANIYA**

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1. SUBJECT REVIEW PROCESS

Subject review process formulated by the University Grants Commission evaluates quality of education within a specific subject or discipline. It is basically focused on teaching, and the quality of the student learning experience and on students' achievements. It has been designed to evaluate the quality of both undergraduate and postgraduate programs offered by academic departments of the Sri Lankan Universities.

This report describes the outcome of a review carried out to evaluate the quality of the academic programs and related issues in the Department of Physics (DP) of the Faculty of Science of the University of Kelaniya. Evaluation is based on the following aspects pertaining to the present curriculum.

1. Curriculum Design, Content and Review
2. Teaching, Learning and Assessment Methods
3. Quality of Students, Student Progress and Achievements
4. The Extent and Use of Student Feedback
5. Postgraduate Studies
6. Peer Observations
7. Skills Development
8. Academic Guidance and Counselling

It is noted that the DP had been the choice for a pilot curriculum revision which was held soon after the introduction of the current scheme of the Quality Assurance by the University Grants Commission.

2. BRIEF HISTORY OF THE UNIVERSITY, FACULTY AND THE DEPARTMENT

University of Kelaniya

The University of Kelaniya has its origin in the historic Vidyalankara Pirivena, founded in 1875 as a centre of learning for Buddhist priests. It was one of the two great national centres of traditional higher learning, heralding the first phase of the national movement and national resurgence.

With the establishment of modern Universities in Sri Lanka in the 1940s and 1950s, the Vidyalankara Pirivena became the Vidyalankara University in 1959, later the Vidyalankara Campus of the University of Sri Lanka in 1972 and, ultimately, the University of Kelaniya in 1978.

Today, the University of Kelaniya is one of the leading national Universities. It is located just outside the municipal limits of Colombo, in the ancient and historic city of Kelaniya, on the north bank of the Kelani River. It has two major campuses, seven locations, six faculties and three institutes.

Vision of the University of Kelaniya: University of Kelaniya will position herself as the seat of academic excellence providing Wisdom and Human Values in the South Asian Region.

The Mission of the University is to achieve excellence in providing learners with opportunities to develop knowledge, attitudes, and skills to serve the world with respect for dignity of life.

Faculty of Science

The Faculty of Science, established under the University Act No; 45 of 1958, started functioning in October 1967. This Faculty was intended to be different in outlook and orientation from the conventional Faculties of Science then in existence. The rationale behind this intention was that Sri Lanka in its industrialization effort needed Science graduates with an expertise and training different from the traditional variety. The first batch of students numbering 57 was admitted in October 1967 and with the recruitment of members of the academic staff, the infant Faculty started its initial development program and its academic activities.

The Faculty was housed in the main building known as the “Science Block”. Due to the continued increase in the student intake from year to year, a new Lecture Theatre Complex and an Auditorium were constructed in 1992. By 2003, a new laboratory complex for the Department of Chemistry and three buildings for the Departments of Industrial Management, Microbiology and Zoology were completed. The present annual intake of students to the Faculty is 510.

The mission of the Faculty of Science of the University of Kelaniya is to produce highly motivated graduates and post-graduates capable of making a significant contribution towards national development and the well being of mankind, to conduct research and provide advice and consultancy services in various scientific disciplines to foster a better understanding of the environment for sustainable use and conservation of natural resources.

The Faculty of Science of the University of Kelaniya was the first among the Sri Lankan Universities to initiate the change over from the traditional three subject (General) degree with end of year examinations to a more flexible Course Unit System, i.e. a modularized credit based system within a two-semester academic year with the end of semester examinations

Presently, the Faculty of Science consists of eight academic departments and offers six B.Sc. degree programs viz., three General degree programs of 3 years duration and three Special degree programs of 4 year duration. The general degree programs are B.Sc. (General) degree, B. Sc. (General) degree in Environmental Conservation and Management (ENCM) and B.Sc. (General) in Management and Information Technology (MIT). Students have the option of following either three or two subjects as main disciplines and selecting elective and/or auxiliary course units in accumulating the required minimum of credits.

The special degree programs are B.SC. (Special) Degree, B.Sc.(Special) Degree in NECM and B.SC.(Special) Degree in MIT. To be eligible for a General Degree, a student must have accumulated minimum of 90 credits of which 4 credits should be from Faculty of Science Auxiliary course Units. For a special degree, the corresponding minimum number is 126 credits of which 6 credits should be from Faculty of Science Auxiliary course Units.

In addition to its undergraduate program, the Faculty of Science also conducts research programs leading to M. Phil. and Ph. D, and several M. Sc., and Postgraduate Diploma Programs.

Department of Physics

The Department of Physics (DP) which is one of the eight academic departments belonging to the Faculty of Science of the University of Kelaniya came into existence with the commencement of the Faculty of Science in October 1967.

Vision of the DP is to be a nationally and internationally recognized centre of academic excellence in Physics and related disciplines.

Mission: The DP seeks to

- *Create an environment for students to excel in Physics and related fields enabling them to face challenges in their endeavours.*
- *Strengthen the identity with highest national and international standards in teaching and research.*
- *Contribute towards enhancement of scientific awareness of the society.*

The DP had been conducting courses only for the students who were in the B.Sc. (General) degree program up to the year 1980. The first batch of students was taken for the B.Sc. (Special) degree program in Physics in 1981. Since then the DP has developed the Physics program, with the revisions of the syllabi in regular intervals, and improvements of the laboratory facilities. In parallel, the academic staff of the department has also been developed with the recruitment of qualified lecturers in various branches of Physics and Electronics.

Electronics was first introduced to the Physics curriculum in the B.Sc. (General) degree program in early 1970s as a part of the subject. Electronics was also included as a separate unit in the special degree program in Physics when it was started in 1981. In the year 2000, the DP introduced Electronics as a separate subject in the Faculty of Science for its B.Sc. degree program. As a result, the DP is currently offering two mainstream subjects, Physics and Electronics, for the science undergraduates at the University of Kelaniya. Only a limited number of students (about 30), out of those who follow the subject, Physics are selected to follow the subject Electronics as a main subject. The DP at the University of Kelaniya is the first and only Physics department in Sri Lanka to provide facilities for B.Sc. (General) Degree students to follow Electronics as a main subject in a Faculty of Science.

With the aim of providing a higher knowledge in the theoretical aspects of Physics, the DP introduced the B.Sc. (Special) Degree Program in Mathematical Physics in collaboration with the Department of Mathematics in the year 2004.

Furthermore, the DP jointly with the Department of Statistics & Computer Science is planning to offer a new B.Sc. Degree program at the University of Kelaniya in Computer Science & Electronics (B.Sc. CSE), which will provide students a thorough knowledge and exposure to modern techniques required to be able competitors in the present demand-driven employment market. The Department of Mathematics will also contribute to this proposed program.

The total student enrolment for the DP, for both Physics and Electronics courses, is about 500. Among them eleven students are following four-year special degree program in Physics and 5 students are following four-year special degree program in Mathematical Physics.

At present the DP has eleven senior academic staff members specialised in different areas of Physics and Electronics with foreign training in the relevant fields. The facilities available for both the Physics and the Electronics include separate laboratories for Elementary Physics, General Physics, Physical Optics, and Electronics. Another laboratory is allocated for students specialising Physics, which has the capacity to accommodate about twenty students.

Under the supervision of academic staff members of the Physics and Mathematics departments, final year research projects of special degree students are conducted. Also, the final year research and industrial projects for general degree students offering Electronics as a mainstream subject are conducted under the supervision of academic staff members of the DP.

A research laboratory is available for postgraduate research work. One of the research programs carried out by the academic staff members is growth and characterization of semiconductor materials, fabrication of thin film solar cells. The department has established active research links with the Kyushu University, Japan, the Sheffield Hallam University in the United Kingdom and other State Universities in Sri Lanka.

As the Faculty conducts its academic programs based on a modularised credit based system within a two-semester academic year with end of course examinations, the course units offered by the DP are also structured in compliance with the policies adopted by the faculty.

The course units offered by the DP are organized at four levels, namely the Level 1, Level 2, Level 3 and Level 4 for the B. Sc. (Special) Degree Program, and up to the Level 3 for the General degree program. A credit value has been assigned for each course unit, which is based on the number of interactive hours of the student with the lecturer. Each theory course unit at levels 1, 2 and 3 having one lecture hour per week throughout the semester carries a credit rating of one. A laboratory course unit at these levels with 3 - 4 hours of laboratory work per week throughout the semester also has a credit rating of one and those with 5 – 6 hours per week have a credit rating of two. For theory course units at Level 4 with 15 hours of lectures, seminars and tutorials at any combination carry a credit rating of one. For laboratory course units and research projects with 30 hours of laboratory or field works carry a credit rating of one.

List of the programs to be evaluated

- (i) B. Sc. (General) Degree Program
- (ii) B.Sc. (Special) Degree Program in Physics
- (iii) B.Sc. (Special) Degree Program in Mathematical Physics

B.Sc. (General) Degree students are required to follow the levels 1, 2 and 3 course units and the normal duration for completion is three years. Core course units or at least two elective course units in Pure Mathematics are mandatory for all the students offering subjects under physical science stream, and for such students, Physics or Physics & Electronics are offered by the DP as second or second & third subjects respectively. Students also have the option of following two subjects as main disciplines and selecting elective and/or auxiliary course units in accumulating the required minimum of credits.

B.Sc. (Special) Degree Program in Physics is designed for students who want to specialise Physics, and the duration for the program is four years. Students are selected to follow this program at the end of the second year of their studies, based on the performance during the first two years.

Students who have followed three subjects Applied Mathematics, Pure Mathematics, and Physics during their first two years and reached a level better than the minimum requirements as stipulated by the Faculty of Science are eligible to apply for the B.Sc. (Special) Degree program in Mathematical Physics. Students who follow this program are given the opportunity to study more theoretical courses with a relatively low exposure to the experimental aspects.

The minimum aggregation of credits required for the eligibility for B.Sc. (Special) Degree is 126.

3. AIMS AND THE LEARNING OUTCOMES

3.1. Aims

- to impart the undergraduates a thorough knowledge in fundamental concepts in Physics and their applications in real life situations (for example Electronics), through a series of theory course units based on standard university physics and electronics curricula.
- to prepare the students in confidently handling equipment they encounter in research or industrial environment, by exposing them to basic laboratory equipment and techniques.
- to encourage the students who follow the B.Sc. (Special) Degree in Physics, to pursue their future careers in academic or research institutions by offering them more advanced courses and laboratory classes. In particular, their research ability is enhanced by providing them the opportunity to carry out an independent research project under the supervision of a senior faculty member.
- to expose the students to contemporary topics in physics by offering elective/auxiliary course units.

3.2. Learning Outcomes

3.2.1. *B.Sc. (General) Degree Program with Physics as a Main Subject or Physics and Electronics as Main Subjects*

Students who follow Physics as a main subject or Physics and Electronics as main subjects and qualified for B.Sc. (General) degree are expected to have

- gained a good conceptual understanding of fundamental principles, together with the associated theories, in core areas of Physics and Electronics or Physics.
- learnt how to apply the knowledge gained, efficiently in practical situations, wherever appropriate.
- acquired the necessary skills in handling scientific and industrial equipment properly.
- learnt technical and intellectual skills necessary for acquisition and analysis of experimental data.
- developed the ability to face and solve any problem they encounter in their careers, whether it is related to physics or not, by enhancing analytical and critical thinking power which is an integral part in learning physics.

3.2.2. *B.Sc. (Special) Degree in Physics*

In addition to have a good conceptual understanding of fundamental principles and associated theories in core areas of Physics, students who follow the B.Sc. (Special) Degree in Physics are expected

- to have gained an advanced knowledge and understanding of Classical Mechanics, Advanced Electronics, Statistical Mechanics, Theory of Relativity, Nuclear and Particle Physics, Quantum Mechanics, Solid-State Physics, Electromagnetic Theory, and Cosmology and Astrophysics.

- to learn how to carry out an independent research project, how to interpret and present the data and write scientific reports based on the results.
- to acquire the skills and knowledge required in pursuing postgraduate studies in Physics and related areas.

3.2.3. B.Sc. (Special) Degree in Mathematical Physics

In addition to have a good conceptual understanding of fundamental principles and associated theories in core areas of Physics, students who follow the B.Sc. (Special) Degree in Mathematical Physics are expected

- (i) to have gained an advanced knowledge and understanding of Classical Mechanics, Statistical Mechanics, Theory of Relativity, Nuclear and Particle Physics, Quantum Mechanics, Solid-State Physics, Electromagnetic Theory, and, Cosmology and Astrophysics.
- (ii) to have achieved a proficiency in areas in mathematics such as Differential Equations and Integral Transforms, Complex Variables, Functions of Several Variables, Quantum Field Theory, General Relativity etc., which are essential ingredients in building up a proper foundation in theoretical physics.
- (iii) to learn how to carry out an independent research project, how to interpret and present the results and write scientific reports based on the results.
- (iv) to acquire the skills and knowledge required in pursuing postgraduate studies in theoretical physics.

4. FINDINGS OF THE REVIEW TEAM

4.1. Curriculum Design, Content and Review

Curriculum Design and Content

DP conducts courses for both General and Honours Degree programs. In addition to providing course units in Physics, the DP offers electronics also as a subject for the General degree.

Physics component of the General Degree Program comprises fifteen course units amounting to 32 credits that spread over three years. The list of course units is given in Annex I.

General Degree Curriculum (Physics)

Course modules of level 1 of the General Degree curriculum have been designed to provide students the basic understanding on the fundamental concepts of Physics in Mechanics, Electric Circuits and Properties of Matter. In addition, under modern Physics, students learn the fundamental concepts in Special Theory of Relativity, Atomic and Nuclear Physics, and Quantum Mechanics. During these courses students will develop skills in relevant applications with the ability of solving problems and to follow the other Physics course units offered thereafter.

Two laboratory course units offered at level 1 have been designed to develop systematic foundation of experimental work to gain necessary skills in understanding the working and the capabilities of the apparatus, the inherent limitations of measurements and the manipulation of experimental techniques.

Level 1 course unit related to Computer Application in Physics is offered for the students who follow special degree in Physics. During this course unit students are expected to develop skills with the guidance of staff. At the end of this course, student will gain basic IT working skills required in the analysis of experimental data, and preparation of technical reports.

Two theory course units at level 2, each of 4 credits, have been designed to provide an understanding of the basic concepts in Thermodynamics, Wave Optics, Vibrations and Waves, Solid State Physics including semiconductor devices. Two laboratory course units at level 2 have been designed to provide students the skills of handling scientific instruments and performing experiments in mechanics, properties of matter, optics and some computer based experiments. In this level it is necessary for students to write comprehensive lab reports for each lab-experiment, and it provides them with experience in data analysis and technical report writing.

Level 3, Semester I course units, both theory and laboratory will provide detailed understanding on fundamental concepts of Electromagnetism. Both theory and laboratory course units offered in Electronics provide opportunity for the students in understanding the basic concepts of Analogue and Digital Electronics and their applications.

In addition to traditional Physics units, Environmental Physics, and Cosmology & Astrophysics units are included in the level 3, Semester II units offered by the DP. Environmental Physics and Cosmology & Astrophysics courses are two credit units and are also open to all Physical Science and Biological Science level 3 students. These units provide important links between several fields of Physics. Environmental Physics course unit will explain the physical aspects of the environment.

Reviewers are of the opinion that the Physics course units offered by the DP for the General Degree have been designed in order to provide a good conceptual understanding of fundamental principles, together with the associated theories, in core areas of Physics. The inclusion of courses on Environmental Physics and Cosmology & Astrophysics should be appreciated. The mathematical knowledge necessary to understand the subject matter in Physics is gained from Pure Mathematics courses provided by the Department of Mathematics. According to the Aims and the Learning outcomes spelt out by the DP, which are given in chapter 3 of this report, at the end of the General degree course students should be able to handle equipment they encounter in research or industrial environment. Automation and the ICT are two key areas that a science graduate could get involved when working in modern industrial environment, and therefore reviewers believe that the students following the General degree should also be exposed at least to the basics of such technologies. One way to fulfil this task is to provide theory and practical courses of electronics at an earlier level and introduce more application oriented exercises to cover the above mentioned areas. The Review Team also recommends that the level I course on Computer Application in Physics be extended to General degree students.

General Degree Curriculum (Electronics)

In addition to Physics, the DP offers Electronics also as a separate subject to limited number (30) of undergraduate students. The entry qualification to follow Electronics as a main subject is Advanced Level Physics. Course units are organised at three levels as in physics, namely level 1, level 2 and level 3, and the total number of credits offered by the DP under Electronics is 31. Course titles are given in Annex II.

Two theory course units of credit value 4 and two laboratory course units conducted concurrently with the theory units, of credit value 1 are offered at levels 1, 2 and 3. In

addition one elective course units of credit value 4 are offered at level 3. The course unit called research project which is offered to level 3 students, carry a credit value 2.

Semester I theory course module of level 1 has been designed to provide students the basic knowledge of fundamental concepts in Analogue Electronics and relevant application. In the level 1, Semester II, course module student will gained a basic knowledge in Combinational and sequential logic circuits.

Two laboratory course units offered at level 1 have been designed to develop necessary skills in handling electronic test equipment and use them to understand basic concept on Analogue & Digital Electronics through basic experiments.

Two theory course units at level 2 have been designed to provide knowledge on more advanced Analogue Electronics, and signal processing & data acquisition techniques. Two laboratory course units at level 2 have been designed to provide hands-on experience in designing electronic circuits and systems with operational amplifiers and related devices. Furthermore students will have gained an experience in handling signal processing and data acquisition equipment and their applications. They will also gain a practise of writing technical reports based on their experimental data.

Level 3, Semester I course units, both theory and laboratory, are compulsory for students who take Electronics as a main subject. Theory course unit will provide detailed understanding of microprocessors, microcomputers, and microcontrollers, with an ability to use them in practical applications. Level 3, semester II theory course, 'Special Topics in Electronics' is an elective course unit. This course deals with industry oriented applications.

A group research project is assigned to students following electronics under the supervision of a senior staff member at the beginning of the Year 3.

The Review Team feels that the course units covered by the DP are essential when offering Electronics as a subject. They are of the opinion that it would be better if topics in power electronics and circuit analysis are also to be introduced into the curriculum. In the case of practicals reviewers observed that a substantial number of experiments are designed to test the characteristics or performance of standard electronics circuits. While acknowledging that they are essential in understanding the concepts, the Review Team recommends that more experiments dealing with real world applications be introduced to the practical course. In a discussion the Review Team had with students it was revealed that some students are keen to do a special degree in Electronics. This may be a double major degree with Physics and Electronics as subjects. The Review Team consider this as a good suggestion.

Special Degree Curriculum

Special Degree curriculum comprises of the entire General Degree course units and twelve more course units offered at level 4, amounting to 52 credits. Three of the level 4 units (11 credits) are offered at the third year while the remaining nine units are offered at the fourth year. Level 4 theory course units have been designed to provide students an advanced knowledge on the fields of study such as Quantum Mechanics, Statistical Mechanics, Solid State Physics, Nuclear Physics & Fundamental Particles, Electromagnetic Theory, Relativity, Advanced Cosmology & Astrophysics, Advanced Electronics, and Special topic in Physics. Two level 4 laboratory course units offered to the part I and part II students have been designed to provide a hands on experience in advanced experimental techniques through laboratory work on Advanced Electromagnetic Theory, Properties of Matter, Quantum Mechanics, Modern Physics and Electronics. A one year research project is assigned to each special degree student and it is carried out during the fourth year under the supervision of a

senior member of the academic staff. At the end of the year, students are expected to prepare comprehensive research reports which will be evaluated through presentations.

In general, the Review Team is of the opinion that the design and the content of the Physics curriculum offered by the DP are adequate to achieve its outcomes. However, the reviewers observed that the number of practical exercises done by the special degree students per year is low, and it may be due the time they spent in preparing a comprehensive and type written report for each experiment. The DP may consider increasing the number of experiments by imposing suitable restrictions on the style of report preparation. Concept of virtual instrumentation and data analysis with standard software programs such as *labVIEW* and *MATLAB* are also recommended. When carrying out certain research projects or laboratory experiments with modern instruments background knowledge in Electronics is always useful. As such the Review Team recommends that the Advanced Electronics course and the associated practical exercises be done preferably at the first semester of the level III. In this context it is also advantages if the course unit on Data Acquisition and Signal processing is made available to Physics special students as well. As mentioned above another important observation made by the Review Team is that the mathematical knowledge necessary to understand the subject matter in Physics is gained from Pure Mathematics courses provided by the Department of Mathematics. Although courses from Department of Mathematics are compulsory to follow both Physics and Electronics subjects, purposely built courses in Mathematics which have direct impact on Physics Curriculum are not available.

Curriculum Review

In order to keep the degree program up to date curriculum revisions in the DP are made regularly. The last revision was made in 2005 and the next revision is scheduled to be done in 2008. The feedback from graduated students and current students are considered in the revisions.

In addition to its central role in offering course units in Physics and Electronics as main subjects for the B. Sc. Degree, the DP provides course units of more applied and general nature. Two such course units of level 3 on Environmental Physics and Cosmology and Astrophysics were in the curriculum revision in 2002. These course units are open to all the science students of the Faculty.

Furthermore, in keeping with the University's aim to provide a balanced and liberal education, the DP offers from the year 2002, a Faculty of Science Auxiliary Course unit (FSAC) "Physics for Understanding Nature" for non-physics students of the Faculty of Science. This course unit has been designed to enhance the awareness of students of the scientific concepts in progress of science. By the end of course, student will be able to recognize the importance of Physics in understanding the nature.

Acquisition of new equipment and introduction of new practicals regularly have been a common practice in the DP. The DP has introduced the use of computers in laboratory experiments at all levels. Computer aided experiments provides the opportunity to investigate the behaviour of physical quantities under test in more liberal manner when compared to conventional experiments. The instantaneous analysis of the data collected using computers with interfaced equipment and the graphical display of the results are appreciated by students. In this respect Review Team feels that it is even more beneficial to students if they are exposed to situations in which they themselves have to write simple software programs to control/communicate with devices through computer ports.

The Review Team noted that the DP jointly with the DP of Statistics & Computer Science is planning to offer a new undergraduate degree program of B.Sc. in Computer Science & Electronics (B.Sc. CSE), which will provide students with the technical knowledge and exposure required to be able competitors in the present demand-driven employment market. The Department of Mathematics will also contribute to this proposed program.

As such, the Review Team judges the Curriculum Design, Content and Review aspect in the DP as GOOD.

4.2. Teaching, Learning and Assessment Methods

Strategy

The DP has trained/recruited a highly qualified teaching staff with postgraduate qualifications to teach almost all the course units in Physics offered by the DP. However, they take the services of the Department of Mathematics to provide the students with Mathematics knowledge that is necessary to grasp the concepts and analytical skills pertaining to Physics. Lecturers adopt the conventional pen/whiteboard teaching, and the medium of instruction is English. All the lectures are followed by tutorial discussions. Subsequently the students are given opportunity to test the concepts and applications of the subjects taught in the classroom through set practical exercises, mini projects etc.. Special degree students are given an additional opportunity to practice Physics themselves through a year long research project.

Teaching and Learning Activities

Faculty of Science annually issue two Handbooks, one providing different course units and subject combinations available, and the other containing the syllabi with recommended reading. The two books are useful for students in selecting the appropriate courses and reading materials.

Having in-class lectures is the most common way of delivering subject-specific information to students where the lecturer him/herself can enhance student's enthusiasm for studies with direct interactions. In certain instances the students are encouraged for self-studies through additional reading, by providing list of references and other required information. Occasionally-planned demonstrations are also conducted to facilitate the learning process. In addition to these methods, handouts carrying subject information are also delivered if necessary in some of level-4 units. Students particularly in level-3 and level-4 units are encouraged to look for additional subject information especially on new developments through the internet.

Theoretical knowledge gained in lectures and tutorials are practically reviewed in practical classes through development of transferable skills. Practical classes have been designed with set experiments which are held concurrently with the corresponding theory unit so that students can develop their conceptual understanding of fundamentals through experimentation. Students are provided with an opportunity to improve their ability in technical writing of scientific reports through these practical exercises.

Prior to the laboratory class, students receive a handout describing the practical to facilitate advanced preparation. The laboratory classes are conducted by senior staff members with the support of temporarily assigned demonstrators for each academic year. Duration of a practical is 3 hours for general degree students, and 6 hours for special degree students. Demonstrators guide the students in the conduction of experiments as well as in technical writing. In addition the final year students are required to give a presentation on a topic

related to their practical unit during the last semester of their final year, which is evaluated as a partial requirement of the unit. Final year research project for special degree students are conducted under the supervision of senior staff members. General degree students following Electronics as a subject carryout a 6 months long group project with 5-6 students in a group, in the same manner. Students are encouraged to present their findings at meetings, seminars, technical sessions, symposiums, and publications in reputed journals.

In addition to the class room teaching and other activities conducted within the university environment, the exposure of undergraduates to the industry under guidance is becoming an essential part of the academic activities of Universities. This necessity was mentioned also by certain students in the meetings the Review Team had with them. As such the Review Team recommends that this activity be initiated initially at least with Special degree students and the students following Electronics as a subject.

As far as the development of resources is concerned the review team noticed that the DP is making efforts to equip its laboratories in effective manner by using their limited monitory allocations. It has acquired several apparatus from India which are suitable for undergraduate teaching purposes. In addition, staff members are also provided with personal computers for academic activities. The DP also has a substantial number of personal computers allocated for students, and it is more beneficial that all such computers are provided with the internet facility. During the inspection of practical classes reviewers observed that the instructions given to students by the demonstrators were in Sinhala medium. The DP may consider improving this situation by providing instructions to students only in English medium. This will facilitate the improvement of language skills in both students and the temporary staff. During the review period it was noted that the Faculty possesses a glass blowing unit which perhaps is the best among the Universities in Sri Lanka. The DP also has an electronic workshop. In the same manner the DP may think of setting up a small mechanical workshop (perhaps in a small room initially), and provide students with some experience in workshop practice. In the long run such a facility will be useful in the construction, repair and maintenance of laboratory apparatus.

The Review Team also observed that the academic staff of the DP undertakes the teaching of another subject (Electronics) within the DP without additional cadre positions. This by any means is a commendable task. The Review Team, however, strongly feels that this state of affairs should not be continued as it will put more burden on the existing staff and may affect the quality of both programs. The Review Team therefore strongly recommends recruitment of more academic staff skilled in Electronics or to train more probationary lecturers in electronics.

Assessment Methods

Student performances in all theory units are evaluated at end of semester examinations which are of three-hour duration. Students thus have to sit for two theory papers each at the end of first and second semesters in level-1 of the program for Physics. The same procedure is adopted for Electronics as well.

Marks from the examinations contribute 100% for each unit. No contribution is taken from the tutorials to the final grade at present. According to the DP this is due to the practical problem of having relatively poor student-attendance for lectures and poor submission of written answers to tutorial problems before the due date. According their arguments this situation seems to have arisen due to the fact that the student-attendance is not considered compulsory for lectures making the tutorial classes a redundant exercise. As a consequence the DP had to assess students' performance on theory units at end of semester examinations.

This assessment procedure is same for all the theory units conducted by the DP in level-2 and level-3 as well. All Physics practical units in level-1 and level-2 are assessed continuously throughout the semester followed by an end of semester practical examination.

Physics practical units in level-3 & 4 and the electronics practical units at all levels are assessed from the coursework throughout the semester, end of semester practical examination, and from a viva which is held at the end of each semester. Final year research projects are evaluated through a dissertation written on the project which is to be defended in a presentation of about 45 minutes.

Moderation and Review of Question Papers

In the case of General degree program all the question papers set by the first examiners who are usually senior members of the academic staff at the DP are moderated and reviewed by internal second examiners appointed within the DP. All the question papers have to be approved by the head of DP before the final printing. The evaluation of answer scripts is also done by the same first and second examiners. All theory papers pertaining to the Special degree programs are moderated and reviewed by second (external) Evaluation of answer scripts is also done by the same examiners.

Based on the above observations the Review Team concludes that Teaching, Learning and Assessment Methods in the DP are GOOD.

4.3. Quality of Students, Student Progress and Achievements

Quality of Students

Students are selected to the Faculty of Science of the University of Kelaniya on the basis of their achievements at the G.C.E. Advanced Level Examination. Science Faculties of the Sri Lankan Universities find it difficult to attract best students who secure high Z-scores at the G.C.E. A/L Examination due to the attractive and professionally oriented degrees courses such as Medicine and Engineering. Review Team had several meetings with the students offering Physics as a subject and in these meetings students have indicated their satisfaction with the academic programs conducted by the DP, and the cordial relationship they enjoy with the staff of the DP. Majority of students seemed to have good communication skills, and well defined future goals.

Student Progress

Progress of the students depends very much on extent of their participation in the academic program. This is demonstrated in the performance of students in practical classes attendance to which are compulsory and being assessed continuously. The DP should exploit this situation and come up with a similar mechanism to be applied for lectures in an effort to improve the lecture attendance. However according to the statistics provided by the DP, over the past several years, there has been a continuous progress in the students' performance at examinations. There is a good distribution of various achievement levels (classes) at final examinations testifying the validity of the evaluation. The pass rate is reasonably high in the case of electronics and Special degree. The staff of the DP believes that there is correlation between the students' performance and their attendance for lecture and tutorial classes. However, there is no data to support this belief.

Student Achievements

The DP has not carried out any formal surveys to ascertain the job-profile of the past students. However, most of the Honours Degree graduates prefer to pursue further studies abroad especially in UK and USA. Usually they end up as researchers or university teachers

once completed the postgraduate studies. No detailed statistics regarding their performance and progress are available.

The Review Team is of the opinion that the Quality of Students, Student Progress and Achievements are GOOD.

4.4. The Extent and Use of Student Feedback

The DP has recognized the importance of students' feedback in the improvement of the quality of its academic programs and introduced several mechanisms to receive students' views on its activities. The students' feedback is obtained either through the use of questionnaires or through discussion and interview with students. Of these methods, feedback from the questionnaires is found to be the most successful method because of the participation of a large number of students. Other advantage was that the genuine views of the students are obtainable in this method.

Qualitative Student Feedback

Through Student Representatives in the Faculty Board

Two student representatives are invited to the faculty board meetings in order to express their views on academic problems and other academic matters

Staff-Student Committee Meetings

Two student representatives from each undergraduate level and all the members of the staff are participated at regular staff-student committee meetings with the Head of the DP in the chair. These meetings provide a forum for dialog between staff and student representatives. At these meetings students present their academic problems related to teaching of Physics and Electronics, practical and tutorials and other related matters.

Questionnaires

Faculty Questionnaire

A common questionnaire prepared for all course modules by the faculty is distributed among the students at the end of the course unit. This feedback tends to focus on the evaluation of the subject content, suitability etc of the course unit, and quality of teaching.

Departmental Questionnaire

For the first time an overall evaluation of Physics teaching and other related academic matters were performed by the DP in 2002. The questionnaire was prepared to get the students independent views on the lectures, practical and tutorial classes conducted by the DP. The questionnaire was distributed among the students during a normal teaching period. This evaluation was performed again after five years in 2007 to evaluate both Physics and Electronics course modules and teaching. The outcome of the feedback revealed that the DP has achieved a significant progress in some aspects.

Quantitative Student Feedback

The DP has performed a quantitative analysis of the student feedback from the questionnaire distributed in 2007 (Annex III) and able to make several important observations on the analysis pertaining to the views of students with regard to the academic program.

The evidence given above amply demonstrates that the DP has recognize the importance of the student feedback when evaluating its academic programs.

The DP, therefore, deserves a GOOD grade for the Student Feedback aspect.

4.5. Postgraduate Studies

The DP has essential facilities for research in semiconductor material growth, characterizations and development of some semiconductor devices. Particular interests have been on the development of low cost thin film PV solar cells and photocatalytic hydrogen production. This research program is progressing satisfactorily. The project is headed by Prof W. P. Siripala, Professor of Physics. At present one student is engaged in research for an M.Phil degree. The Experimental Semiconductor Materials and Solar Energy Research group continues its research collaborations with Institute of Fundamental Studies, University of Colombo, Sheffield Hallam University, United Kingdom, and Kyushu University, Japan. One other senior member is collaborating in a research program in a near by University on Mass Spectrometry. However it is important to establish a few more research groups and encourage collaborative research not only to improve the progress of the staff but also to provide a quality learning atmosphere. Reviewers believe that DP definitely has the resources and the capability to do more than the present.

Considering the above, the Review Team is of the opinion that this aspect is SATISFACTORY.

4.6. Peer Observation

There is no regular effective peer observation process for teaching. However, a certain amount of peer observation is taking place in practical classes and also in the moderation process of question papers.

Considering the above, the Review Team has graded this aspect as SATISFACTORY.

4.7. Skills Development

Physics curriculum has been designed in such a way that it provides opportunities for students to improve their practical as well as transferable skills. Students are imparted with the required computing skills for data acquisition and data analysis, by exposing them to computer assisted interactive physics experiments during the laboratory classes. Presentation skills of undergraduate students are also developed by providing opportunities for them to make small presentations on suitable topics. It is an integral part in the Level 3 physics and all electronics laboratory course units. Furthermore, the students who follow the special degree programs also have to make presentations on their research projects at the end of the academic year.

In addition, through the theoretical course units such as Quantum Mechanics logical and analytical thinking of the students are improved considerably. The Electronics taught under both Physics and Electronics subject streams enable them to acquire necessary skills and confidence in operating and handling modern equipment. Further they get an opportunity to develop their skills related to computers and application packages.

In view of the above, skills development aspect has been graded as GOOD.

4.8. Academic Guidance and Counseling

Generally students are guided with regard to academic matters by the academic staff of the DP. Students are provided with the faculty handbook on the first day of their entry to the Faculty of Science. It contains information about the path-ways of various degree programs and their requirements to be fulfilled including syllabi of the courses. In addition to the faculty handbook, the new students are also provided with the university handbook which

consists of all the details of each and every working department related to the academic activities of the University of Kelaniya.

The Faculty of Science launches a special orientation program to the new students in order to guide them to be familiar with the activities of the faculty on their arrival.

The Faculty has two senior academic advisors, specially-appointed academic advisors for each and every subject, and personal tutors to guide students in academic and other matters.

The University of Kelaniya has a unique student counselling service called “Kalana Mituru Service” consisting of a male senior lecturer and a female senior lecturer from each faculty to provide guidance and counselling. The career Guidance Unit of the University also provides a valuable service to students through their programs. The Alumni Association of the Faculty of Science too provide guidance, counselling, and support to science undergraduates to develop their skills for a successful future career.

The Review Team is of the opinion that Academic Guidance and Counseling aspect of the DP is GOOD.

5. CONCLUSIONS AND RECOMMENDATIONS

1. Curriculum Design, Content and Review

Strengths/Good Practices

1. Curriculum revisions are carried out in regular four-yearly basis. Last revision was done in 2004 and the next one is due in 2008.
2. Complete coverage of Physics topics at the undergraduate level, comparable to that in any other university.
3. Electronics as a subject has motivated students in application oriented study programs. This subject is unique to the DP, University of Kelaniya.

Weaknesses

1. Although courses from Department of Mathematics are compulsory to follow both Physics and Electronics subjects, purposely built courses in mathematics which have direct impact on Physics Curriculum are not available.
2. Absence of Industrial Training program for undergraduate students

Recommendations

The DP may consider

- introducing Electronics unit at early levels (levels II & III) so that students can practice Electronics in latter practical courses and use the knowledge in student research projects
- extending Computer Applications course for General degree students following Physics
- introducing courses such as Power Electronics, Circuit Analysis for the Electronics curriculum
- introducing more application oriented practical exercises for practical units in the Electronics curriculum

- increasing the number of practicals in the level 3 and level 4 of the special degree practical course.
- making Data Acquisition and Signal Processing course unit available for Physics Special degree students
- extending of the duration of the B.Sc. General Degree Program for Physics and Electronics by an additional year giving students opportunities to specialize both subjects (Double major).
- introducing industrial training for undergraduate students following Special degrees and the degree with Electronics as a subject.

2. Teaching, Learning and Assessment Methods

Strengths/Good Practices

1. Student Representation in Teaching, Learning and Curriculum Development Committee.
2. Feedback obtainable through student representations in the Faculty Board, Staff-Student-Consultative Committee, Faculty Questionnaires, Departmental Level Questionnaires, Maintaining Box for Suggestions and Comments etc.
3. Acquisition of less expensive laboratory equipment from India
4. Providing access to Post-graduate Library for Special Degree Undergraduates.
5. Providing each staff member with a computer and laser printer.
6. Cordial relationship between Academic Staff and Students, Academic Staff and Academic Support Staff and Academic Support Staff and Students.
7. Proper maintenance of student achievement data.
8. Availability of already established research links with both local and foreign universities.
9. The availability of the best glass-blowing workshop in the Sri Lankan University system, and an electronic workshop.

Weaknesses

1. Absence of quizzes and mid-semester examinations in academic programs.
2. Abstract and theoretical nature of some Electronics experiments and mini-projects.
3. Tedious procedures adapted in recording experiments carried out in practical classes.
4. Restriction of opening hours of the library and computer centres only to office hours during academic sessions.
5. Very poor infrastructure facilities such as non-availability of departmental lecture theatres, space restrictions in laboratories, need for refurbishment of buildings which are hindering the expansion of academic programs and regular assessment procedures.
6. Non availability of a mechanical workshop at the DP

Recommendations

The DP may consider

- allowing students to record at least certain number of experiments during the practical classes.
- introducing more application-oriented experiments (specially in Electronics) into the laboratory classes.
- taking steps to extend the opening hours of library and computer centres beyond the office hours.
- increasing the computer and IT facilities and updating them.
- recruiting more academic staff skilled in Electronics or to train more probationary lecturers in Electronics.
- giving instructions only in English Medium and to facilitate the improvement of language skills perhaps by introducing English as a compulsory subject in the first or second year.

3. Quality of Students

Strengths/Good Practices

1. acceptable passing rate of Physics course units.

Weaknesses

1. Low attendance in lectures.

Recommendations

- The DP may consider introducing in-class assessments as apart of examination.

4. The Extent and Use of Student Feedback

Strengths/Good Practices

1. Regular staff-student committee meetings to discuss academic matters.
2. Faculty questionnaires and departmental questionnaires for student feedback.

Weaknesses

None observed

5. Postgraduate Studies

Strengths/Good Practices

1. Strong research activity in electrodeposition of semiconductors and fabrication of solar cells.
2. Collaboration with other universities both local and foreign.
3. Availability of a separate library and reading room for postgraduate students.

Weaknesses

1. Number of postgraduate research programs is very low.
2. No M.Sc. or postgraduate programs initiated.

Recommendations

The DP may consider

- increasing the number of postgraduate research programs.
- reactivating the solar pond research that had to be abandoned due the unfortunate tsunami disaster.
- introducing collaborative research programs in disciplines other than solar cells
- introducing applied research in electronics such as fabrication of electronic devices for consumer market.
- introducing M.Sc. programs

6. Peer Observation

Strengths/Good Practices

1. Providing assistance and training to junior staff members and temporary staff members by the senior academics.

Weaknesses

1. Unavailability of a proper mechanism to follow peer evaluation.
2. No peer evaluation for senior academics.

Recommendations

- The DP may consider designing and implementing a proper mechanism for peer evaluation.

7. Skills Development

Strengths/Good Practices

1. Use of computers for report writing.
2. Organizing Career Guidance Programs in collaboration with industries.
3. Availability of Computer Centres with about hundred computers for the departments.
4. Mandatory presentations of research projects.
5. Ready access for students to the Electronics and Glass Blowing Facility rooms.

Weaknesses

1. Absence of Faculty English Language Training Unit (ELTU)
2. Giving instructions in mother tongue in lab classes.

Recommendations

- Faculty may consider forming an ELTU Unit for the faculty and recruit science graduates competent in teaching English.

The DP may consider

- giving instructions only in English and encourage students to learn English.
- using the glass blowing facilities available in the DP for student training.
- establishing well equipped mechanical workshop and use it for skill development of Physics and Electronics Undergraduate students.

8. Academic Guidance and Counselling

Strengths/Good Practices

1. University level CULTEC Committee.
2. Academic Advisors from each department.
3. Providing Faculty Handbook and University Handbook to students at the beginning of their first year.
4. Conducting orientation programs by the senior staff members with the assistance of other staff members.
5. Proper mechanism to assign Personal Tutor for each student.
6. “KALANA MITHURU” Service.

Weaknesses

1. Non-availability of an office for Academic counsellors and properly designed counselling hours.

Recommendations

The DP may consider

- designing and implementing a counselling office.
- training the academic counsellors by experts in counselling.

Based on the observations made during the visit by the Review Team and discussed above, the eight aspects were judged as follows:

Aspect Reviewed	Judgment
Curriculum design, content and review	Good
Teaching, learning and assessment	Good
Quality of students, including student progress and achievement	Good
Extent and use of student feedback	Good
Postgraduate studies	Satisfactory
Peer observation	Satisfactory
Skills development	Good
Academic guidance and counselling	Good

The overall judgment is suspended

6. ANNEXES

Annex I

Level	Course Code	Course Title
Level 1	FSAC 14032	Physics for Understanding Nature
	PHYS 11014	Mechanics, Properties of Matter and Electric Circuit Fundamentals
	PHYS 11021	Elementary Physics Laboratory-I
	PHYS 12034	Modern Physics
	PHYS 12041	Elementary Physics Laboratory-II
	PHYS 13052	Computer Applications in Physics
Level 2	PHYS 21064	Physics of Waves and Optics
	PHYS 21071	General Physics Laboratory-I
	PHYS 22084	Solid State Physics and Thermodynamics
	PHYS 22091	General Physics Laboratory-II
Level 3	PHYS 31102	Electromagnetism
	PHYS 31112	Electronics
	PHYS 31121	Electricity and Magnetism Laboratory
	PHYS 32132	Environmental Physics
	PHYS 32142	Introduction to Cosmology and Astrophysics
	PHYS 32151	Electronics Laboratory
Level 4	PHYS 44014	Quantum Mechanics
	PHYS 44024	Statistical Physics
	PHYS 44034	Advanced Electronics
	PHYS 44044	Theory of Relativity
	PHYS 43053	Advanced Physics Laboratory-I
	PHYS 44064	Solid State Physics
	PHYS 44074	Electromagnetic Theory
	PHYS 44084	Nuclear Physics and Fundamental Particles
	PHYS 44094	Cosmology and Astrophysics
	PHYS 43104	Special Topics in Physics
	PHYS 43115	Advanced Physics Laboratory-II
	PHYS 43128	Research Project

Annex II

Level	Course Code	Course Title
Level 1	ELEC 11014	Analogue Electronics-I
	ELEC 11021	Analogue Electronics-I Laboratory
	ELEC 12034	Digital Electronics
	ELEC 12041	Digital Electronics Laboratory
Level 2	ELEC 21054	Analogue Electronics-II
	ELEC 21061	Analogue Electronics-II Laboratory
	ELEC 22074	Signal Processing and Data Acquisition
	ELEC 22081	Signal Processing and Data Acquisition Laboratory
Level 3	ELEC 31094	Computer Architecture
	ELEC 31101	Computer Architecture Laboratory
	ELEC 32114	Special Topics in Electronics
	ELEC 33122	Research Project

Annex III

- (i) Most of the students selected Physics as a subject because it is closely related to the day-to-day life. Some of them believe that they can improve their thinking ability by following Physics. The interest of selecting Physics as a subject has been increased by more than 15% during the last 5 years.
- (ii) The most favourite Physics course unit varies among the students. In general, various reasons such as content, practical-orientation, job orientation, and easy understanding were given.
- (iii) The response on the method conducting lectures, practical and tutorials was satisfactory. Most of them felt that the staff was well prepared for lectures and they could gain good practical training. The satisfaction of students on the staff in the department has also increased by 20% during the last 5 years.
- (iv) Most of the students wanted the printed lecture notes. The DP does not agree to this request and encourage the students to write down the notes.
- (v) Most of them suggested increasing the number of the reference books in the library. The DP found that a fair amount of books are available in the library, but there is a problem with regard to the distribution of books among the students.
- (vi) Most of them wanted to discuss and solve the subject related problems during the lecture hours. The DP finds that a tutorial is the best solution.
- (vii) Most of them suggested conducting the practical simultaneously with the lectures. The DP is already practicing this concept for few units.
- (viii) Students have more interest in practical units than theoretical units. Their satisfaction on demonstrator assistance for the practical classes has increased considerably. More than 60% of current students feel that Physics/Electronics is easy to learn compared to other subjects.

Table 6.1 The day attendance in which the departmental questionnaire distributed in June 2007

	Physics			Electronics		
	Total No of students	Student attendance	%	Total No of students	Student attendance	%
First year	157	139	89	22	20	91
Second year	92	48	52	26	13	50
Third year	122	79	65	25	13	52