Department of Physics
University of Liverpool

Strategy for Teaching Learning and Assessment

The Physics Department's teaching, learning and assessment strategy is summarised in the Self Assessment Document. These notes provide supplementary information on, and evidence for the effectiveness of, that strategy.

Contents

1. Introduction ____ *3*

2. Lectures and Problems Classes or Tutorials ____ *3*

2.1 Case Study, PHYS121 ____ **3**

2.2 Additional Maths Provision ____ **5**

2.3 Other Modules ____ **5**

2.4 Summary ____ **6**

3. Computing Classes ____ *6*

3.1 Introduction ____ **6**

3.2 B.Sc. Course ____ **6**

3.3 M.Phys Course ____ **8**

3.4 Summary ____ **8**

4. Practicals ____ *8*

4.1 PHYS111 ____ **8**

4.2 PHYS378 ____ **9**

4.3 PHYS379 and PHYS489 ____ **10**

4.4 PHYS491 ____ **10**

4.5 Summary ____ **10**

5. Assessment ____ *11*

5.1 Introduction ____ **11**

5.2 Examinations ____ **11**

5.3 Class Tests ____ **12**

5.4 Homework and Tutorial Problems ____ **12**

5.5 Science Communication Projects ____ **13**

5.6 Practicals ____ **13**

5.7 Projects ____ **13**

6. Concluding Remarks ____ *13*

7. Appendix 1 ____ *14*

1. Introduction

The aims of the Physics Department are described in the Self Assessment Document. These lead to various objectives, which include the requirements that our students develop:

13) Knowledge and understanding of the syllabus material.

14) The ability to think logically and to analyse problems.

15) An appreciation of the role of mathematical modelling of physical phenomena to produce predictions which can be tested against observations.

16) An awareness of the importance of accurate experimental observation.

17) Practical and technical skills.

18) An awareness of and familiarity with computer based techniques for experimentation and analysis.

19) An ability to communicate physics concepts.

20) An ability to organise time and meet deadlines.

Our objectives for undergraduates taking 4 year courses are that, in addition to the above, they should develop:

21) Knowledge and understanding across a wider range of physics.

22) An appreciation of selected areas of current physics research.

23) Additional skills resulting from the experience of more extensive project work.

(The numbering above corresponds to that in the Self Assessment Document.) The Department realises these objectives within various three and four year Programmes of Study. These consist of numbers of modules, the majority of which rely on lectures and problems classes or tutorials as the primary means of achieving the above objectives. Here, we first examine these teaching methods and present evidence that they are appropriate and contribute effectively to achieving the above objectives. We consider in some detail a particular module and then show that this is not exceptional. Other aspects of our teaching provision are then considered, in particular the computing and practical elements of our courses. Again, evidence is presented that these contribute effectively to achieving our objectives. The methods of assessment used in the Department are also discussed.

2. Lectures and Problems Classes or Tutorials

2.1 Case Study, PHYS121

We describe here some evidence for the effectiveness of lectures and problems classes, considering as a representative example the first year Mechanics module, PHYS121. For the purposes of this section, the criterion we use to assess the success of our teaching is the performance of our students in the examinations. As described in the Student Handbook, these are designed to test, among other things:

a) Comprehension of the material covered by the module.

b) Ability to solve problems based on this material.

c) Knowledge of key definitions and laws.

d) Ability to apply fundamental knowledge to solve problems demanding reasoning ability and understanding of the material covered in the module.

The examinations are thus an appropriate means of assessing the level to which objectives 13) and 14) above are met, and have been agreed to be such by the External Examiner. (For more detailed discussion on the role of the External Examiner see TLA 3.3.4)

It is difficult to provide evidence demonstrating to what extent lectures as opposed to problems classes contribute to achieving the objectives above. The intention is that lectures address in particular objective 13) whereas the problems classes are designed to further develop students' understanding of the material covered, objective 13), but also to help them develop their ability to think logically and analyse problems, objective 14). It is, however, possible to show that both the lectures and the problems classes contribute positively to students' achievement in the examinations.

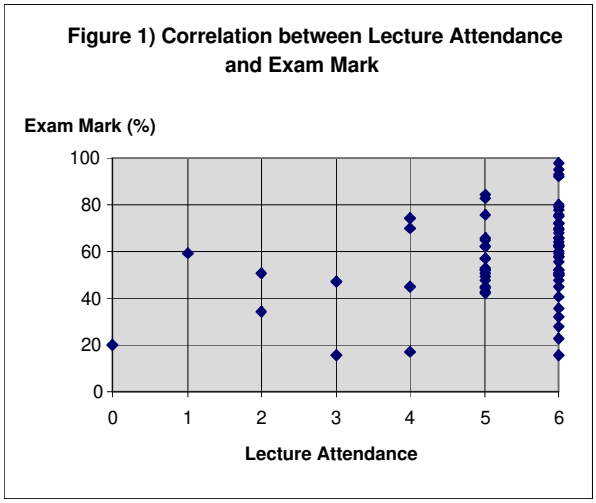


Figure 1) Correlation between Lecture Attendance and Exam Mark

The correlation between the exam marks achieved and the attendance at lectures for a period chosen at random in 1998 (14/10 to 6/11) is shown in figure 1). The correlation coefficient is 0.33.

The correlation between attendance at the problems classes and achievement in the exams for the same period in 1998 is also positive, the correlation coefficient being 0.22.

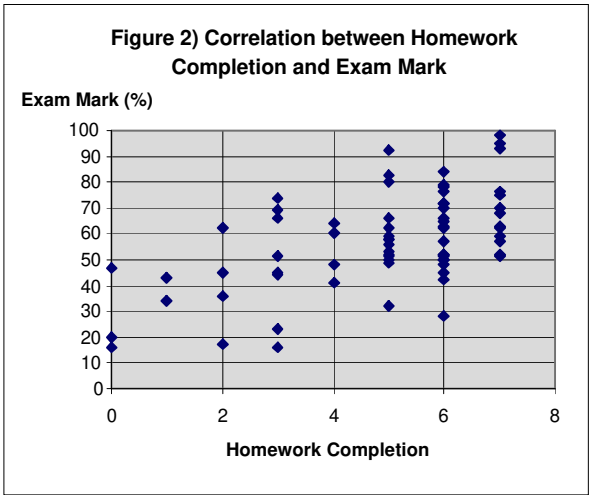


Figure 2) Correlation between Homework Completion and Exam Mark

The problems classes (PHYS121 and some other modules) and tutorials are also designed to encourage students to discuss physics problems in small groups, providing an opportunity for developing communication skills; objective 19). Observation of problems classes and tutorials shows that this approach can be successful. Part of the motivation behind the introduction of problems classes was the hope that this would encourage the students to discuss physics in a more relaxed atmosphere; there is not always a demonstrator or tutor "listening in". Objective 19) is addressed more directly in

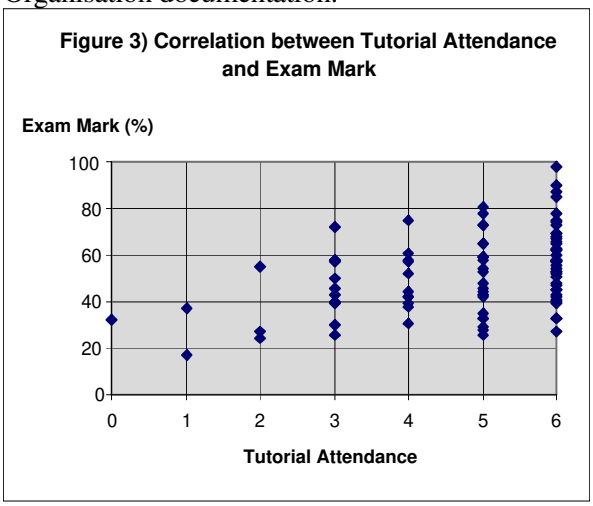
modules such as PHYS123 (first year Electricity and Magnetism) and PHYS255 (second year Quantum and Atomic Physics) in which there is a Science Communication project. These consist of essays and short oral presentations.

Further opportunity for students to develop their problem solving skills is provided by the homework or tutorial problems. These help students to structure their private study. (More information on private study is contained in document TLA3.3.6.) Again, analysis of the correlation between satisfactory completion of homework and exam results for PHYS121, see figure 2, shows that this element of the module makes a positive contribution to students' achievement. The correlation coefficient in this case is 0.56.

2.2 Additional Maths Provision

The Department offers special provision for students with poor Maths qualifications. Evidence for the effectiveness of the lectures and problems classes offered in the Maths support module PHYS118 is provided in document TLA 3.3.5 and in the Curriculum Design, Content and Organisation documentation.

Figure 3) Correlation between Tutorial Attendance and Exam Mark



2.3 Other Modules

The effectiveness of the lectures and problems classes or tutorials in other modules can also be demonstrated statistically. For example, in 97/98 the correlation coefficient between tutorial attendance and examination marks for PHYS123, the first year Electricity and Magnetism course, was 0.41, the data are shown in figure 3).

As an aside, it is interesting to compare PHYS123 with PHYS492, a module entitled Topics in Advanced Physics offered to our fourth year M.Phys students. This latter includes a description of the latest ideas in Electroweak Unification, see objectives 21) and 22). Our students can thus learn about the unification of Electricity and Magnetism in their first year, one of the great achievements of 19th Century science, and progress in their fourth year to discussion of a problem that will hopefully be solved early in the 21st Century.

Considering all first year modules for the three years 96/97, 97/98 and 98/99 the numbers of students passing the year can be examined as a function of attendance. Defining attendance at 90% or more of teaching sessions to be satisfactory, the results are as follows:

	Attendance unsatisfactory	Attendance satisfactory
No. who passed year 1	33	74
No. who failed year 1	25	13

As can be seen, the lectures, problems classes and tutorials offered to first year students are successfully preparing them for their examinations. The hypothesis that performance is unrelated to attendance at the teaching sessions can be rejected at the 99% CL using the above data (χ^2 analysis of contingency table).

The evidence for the importance of attempting homework and tutorial problems justifies the Department's policy of awarding a small component of the marks for first year modules for

"satisfactory completion" of these elements of the modules. This was introduced to try and establish a culture of attending tutorials in the first year and has resulted in a significant improvement. (Average attendance at first year tutorials for PHYS123 in 96/97 was 68% rising to 81% in 97/98 after the introduction of the mark for attendance.)

2.4 Summary

Lectures, tutorials and problems classes have been shown to contribute effectively to the achievement of our students in their examinations, demonstrating the appropriateness of this choice of teaching methods.

3. Computing Classes

3.1 Introduction

Our computing provision is designed primarily to contribute to objectives 17) and 18) above.

3.2 B.Sc. Course

In their first year, all B.Sc. students take the module Computing Techniques in Physics, PHYS113. This module illustrates the Department's strategy with respect to the teaching of computing, namely to provide our students with a familiarity with typical examples of the kinds of software package that are useful for the analysis of experimental data, for solving physics problems on a computer and for the written communication of scientific results and ideas. The packages currently used are MS Excel, MathCAD from Math Soft and MS Word. About two thirds of the teaching time in PHYS113 is in the form of supervised training sessions at which the lecturer and post-graduate demonstrators are available to help students who run into difficulties; the remainder of the time consists of lectures. As witnessed by the continuous assessment marks for PHYS113 (see module file), the vast majority of our students are able to use Excel to perform simple analysis of data and can use Word to produce attractively written documents following this module.

PHYS113 also exposes our students to the idea that problems can be solved using a computer. They treat the problem of drag and terminal velocity analytically in PHYS121 (see Lecture 2 and first problem in Problems Class 2) and shortly afterwards the same problem using Euler's Method (applied within Excel) in PHYS113 (see worksheet for week 4). This also illustrates two different ways in which mathematics can be used to model the same phenomenon, objective 15). It is hoped that these two treatments will help our students to recognise that the computing techniques they learn are relevant to other modules in their courses.

In order to further encourage our first year students to use their computing skills outside the boundaries of their computing module, they are required to "word process" some of their first year practical reports (one in each of the modules PHYS111 and PHYS114) and use Excel to analyse laboratory data. Second and third year practicals, in particular the third year projects, provide further opportunities for the honing of computing skills.

Our B.Sc. students are not formally taught a programming language. Evidence from the first destinations of our students who do not take up academic or industrial research positions suggests that few would benefit from such knowledge[1]. Those who intend to become

[1] Using job title as a guide leads to a figure of 5 to 10% of students (1996...1998, prior to introduction of M.Phys.) who would possibly have benefited from having programming skills in their first jobs. The uncertainty arises largely from the difficulty of assessing to what extent programming skills may be important from the available job description. It is also impossible to judge how many of these

professional researchers we would advise to take the M.Phys course, where such training is provided. Further, evidence that employers do not expect that B.Sc. physics graduates should be trained computer programmers comes from the Physics Advisory Panel on Taught Courses. This body consists of teachers and industrialists[2] and the latter have stressed, for example in their meeting on July 17th 1997 (minutes filed in report circulated for meeting on July 6th 1998), that an ability to use relevant packages is the skill they value most highly. Some points made by the panel were, and we quote:

- Industry hired professional programmers when required.

- Versatility was useful. In particular it was important to:
  - i) be able to handle and manipulate data between packages
  - ii) recognise the limitations of programming and packages
  - iii) be able to ask the right questions about a computer programme or computer system

- There was a mixed response to the value of the knowledge of the Monte Carlo technique, though it was acknowledged that awareness of the kind of problem that could be addressed with it was useful.

- There was little consensus about which language, if any, should be taught. On the whole, Quick Basic was regarded as a poor choice for professional use.

- There was general agreement that the concentration on packages was the correct bias.

End of quote. (The comment on Quick Basic arose from the use at that time of this language to teach M.Phys. students the elements of computer programming and the Monte Carlo method, see below for more recent developments.)

Recently, concern has been expressed about the amount of computing required in our second year courses (see External Examiner's Report for May 1999) and also that, despite the above efforts, the skills learnt in PHYS113 are too "compartmentalised" in the minds of our students (e.g. Notes on New Lecturers' Meeting held on 16/2/2000); they are very seldom used in the solution of problems in other modules. An example of this is provided by the answers to one of the problems presented in the 5th homework in 1999 to students taking PHYS121 (Problem 78P from Chapter 16 of Halliday, Resnick and Walker). This problem can easily be solved using MathCAD (for graphical method, see model answer to this problem), a package with which the students are familiar at this stage. Despite this, none of the students taking the module attempted to answer the problem using a computer.

Proposals are being considered to address both the above concerns. (See, for example, notes of the abovementioned New Lecturers Meeting.) These suggest firstly the introduction of problems which are required to be solved using a computer in all years of study, including the second year. Secondly, it is suggested that the possibility be considered of introducing a module in which various computational techniques are presented for solving problems drawn from across the curriculum. In line with the first proposal above, a series of three questions has been

---

students would have opted to take the M.Phys. and hence would have been trained in programming techniques.

[2] The panel referred to here consisted of: D. Barnes, ICI Research and Technology, J.A. Cain, Calderstones Community Comprehensive School; J.S. Griffith, Health & Safety Executive; M. Joyce, BNFL; H.G. Price, Rutherford Appleton Laboratory; T. Russell, Hiden Analytical; J.E. Shaw, Douglas Cyclotron Laboratory.

given to students taking PHYS258, the module on Waves and Related Phenomena, which require the use of MathCAD for their solution (see handout for 13th March 2000). The Science Communication project for PHYS256, the second year Nucleii, Molecules and Solids module, now contains Excel and MathCAD based options. A further problem is to be given to students taking PHYS254 (Electromagnetism). A proposal for a new module along the lines discussed above will be presented to a forthcoming BoSiP meeting by the New Lecturers.

3.3 M.Phys Course

Our M.Phys students take the modules outlined above and therefore acquire skills in the use of software packages. However, as they are aiming for careers in research, we feel it is important to give these students a grounding in programming. As demand for skills in "old" languages, such as Fortran and Pascal, is diminishing, whereas facility with object orientated techniques is much in demand, we have elected to teach our M.Phys students Java. The module PHYS488, Modelling Physical Phenomena, provides students with the opportunity to learn Java in the framework of producing a Monte Carlo model of a physical process, the passage of high energy particles through material and their subsequent detection. This, plus the additional project work our M.Phys students undertake, addresses objective 23). The first cohort of students is now taking this module.

3.4 Summary

Our computing classes, together with the application of computers within the practical and project elements of our courses, give B.Sc. students of a wide range of experience and expertise the opportunity to develop skills in the use of Excel, Word and MathCAD. The levels of achievement of some of our students are impressive, as witnessed by the use of computers in project work. A range of levels of achievement is visible in the reports by Dominic Banks, Christopher Egan, Stuart Lanceley and Mark Reilly (see Appendix 1). The M.Phys. students are exposed to the elements of programming in an object orientated framework and the use of the Monte Carlo method in module PHYS488. The first cohort of students has yet to complete this module, but student progress at the half-way point in this course is very pleasing, as witnessed by Daniel Nilson's Monte Carlo program (see module file for PHYS488).

4. Practicals

The practical modules offered by the Department of Physics are designed to provide students with a range of learning opportunities, from acquiring familiarity with basic laboratory equipment such as oscilloscopes and vernier callipers to performing independent investigations of physical phenomena. As such they address in particular objectives 16) and 17) above. Some experiments require the use of computers for data capture and are therefore pertinent to objective 18). Efficient time management is essential if good results are to be obtained, so objective 20) is also addressed. We illustrate the range of practical provision here by describing PHYS111, the first practical module taken by our students, and then the third year practical and project, modules PHYS378 and PHYS379, respectively. The M.Phys. project, module PHYS489, is also described. Finally, brief mention is made of PHYS491, another of the modules available to our M.Phys. students which presents some of the skills necessary for researchers.

4.1 PHYS111

This module is the first practical module taken by most of our students. They receive a Manual which describes the organisation of the practical, safety considerations, assessment methods and the writing of laboratory reports. The first exercises the students perform are described in the section "Introduction to Measuring Instruments and Data Analysis". This describes the mechanical and electrical measuring instruments they are to use (see for example page 16 on

the oscilloscope) and some exercises designed to engender familiarity with the instrument in question. These are to be completed in four periods of three hours each.

The students are divided into groups of roughly 12, each of which is assigned a demonstrator. Typically 35 students take PHYS111 and there are 3 demonstrators available. Students are expected to attempt the practical exercises independently. If they encounter problems they cannot solve, they are asked to seek help in the first instance from "their" demonstrator, but if he/she is not available, to ask any of the demonstrators in the laboratory.

The first part of PHYS111 also includes information on the importance of error estimation and on error analysis and exercises designed to give some familiarity with error analysis. A further section deals with data analysis using a spreadsheet and with the fitting of straight lines to data using the program Linefit (finds minimum of χ^2). An exercise using Excel and Linefit, including the transportation of data between the two, takes a further practical session. These latter illustrate another aspect of the "mathematical modelling" referred to in objective 15).

The students then move on to perform three "Foundation Experiments", each of which takes about three hours and for which they are allotted four laboratory sessions. These give them the chance to develop the skills they have acquired and sort out problems before they start assessed practical work. The students produce brief write-ups of these experiments which are discussed with a demonstrator and thus have the opportunity to develop report writing skills.

In the third part of PHYS111, students have to perform three "Long Experiments", each of which takes 9 hours, or 3 laboratory sessions. These are written up and the write-up is marked by one of the demonstrators. Oral feedback is often given to the students and written feedback is provided both in the student's notebook and on a separate sheet. The latter allows the student to keep a record of comments and progress made, as the notebooks are retained by the Department for possible future examination by the External Examiner.

All the experiments performed in PHYS111 are described in detail in the Manual. The descriptions include comments on the measurements to be made. They are in this sense "recipes"; the emphasis is on learning to use the instruments in the laboratory, acquiring familiarity with data and error analysis and learning the skills of report writing.

An indication of the contribution this section of our laboratory provision makes to our objectives is given by the performance of the students in the Class Test held as part of PHYS111. The test examines the students understanding of the use of the oscilloscope and their ability to perform error analysis. The average mark for Semester I 1999/2000 was 60%. The average mark for the module, which is compiled from the marks for the Class Test, a small element for satisfactory completion of the Foundation Experiments and the marks for the Long Experiments, was 66% during the same period.

4.2 PHYS378

This third year module represents the opposite end of the spectrum of our practical provision for B.Sc. students. The emphasis is now much more on giving our students the chance to perform independent investigations. To quote from the advice given to students in the introductory lecture for this module:

- You have to do background reading.
- The "script" only guides you and suggests a procedure.
- The experiments are not "turn-key"; you have to understand and set-up the equipment.

- It is a simplified simulation of doing "real" experiments where the problem is not clearly defined and has new, unknown features.

- You are required to make use of computers, spreadsheets etc. to increase your productivity.

- You must learn to organise your work to meet deadlines.

The students spend nine hours a week on these experiments and complete a maximum of six in a semester. Note the increased time management skills required and the ability to work independently within the guiding framework provided by the script.

4.3 PHYS379 and PHYS489

Within the B.Sc. course, a further step on the road to independent working is provided by PHYS379, the year 3 project module. Students are advised to spend a total of 108 hours on their project, typical examples of which are the study of the moderation of neutrons in water, of gamma-ray emissions from foodstuffs and of thermal runaway in silicon microstrip detectors. (For a complete list of the projects available in 1998/99 see Learning Resources documentation.) In this case the students are asked to plan the project themselves and set their own objectives, though these must be discussed with and agreed by the project supervisor. Communication skills, objective 19) above, are also developed within the project framework in particular in the writing of the project report and in the oral presentation of results to a group of staff and students. The module PHYS489, taken by our M.Phys. students, is similar to PHYS379, but the 216 hours available for the project allow more extensive research into the chosen topics, see objective 23). Some recent examples of M.Phys. projects include a study of the surface of graphite using X-ray photoelectron spectroscopy and atomic force microscopy and an accurate measurement of the drift velocity of electrons in gases. These projects are often carried out within one of the Department's research groups; one area in which our research and teaching activities are interlinked, and thus are part of our provision designed to address objective 22).

Further information on projects may be found in the document "Project Work, Allocation, Performance and Assessment", TLA 3.3.9.

4.4 PHYS491

Students who hope to undertake a career in research, either in the academic or industrial spheres, will need skills such as the ability to perform literature searches, to extract information from the world wide web, design experiments, write research proposals and work successfully as part of a research group, c.f. objective 23). We offer our M.Phys students module PHYS491 to give them an opportunity to develop these skills. The module consists of lectures in statistics, providing the necessary background in hypothesis testing etc. lectures on health and safety issues and a group project in which students write a research proposal. This may be based around a scenario such as the following: A museum requires that an artefact be dated. The group is one of several teams competing to obtain the contract to perform this task. They must find out which methods are appropriate for the task, for example carbon dating, the amount of material needed for each of these methods, the achievable accuracy, the equipment necessary etc. then write and present a proposal to the museum which describes the method chosen and why this is the best for the task in hand.

4.5 Summary

The degree to which the practical and project elements of the B.Sc. and M.Phys courses help the Department meet its objectives is perhaps best judged by comparing the laboratory notebooks of first year students taking PHYS111 with the project reports of students

completing their courses[3]. The reports by Dominic , Christopher Egan, Stuart Lanceley and Mark Reilly are representative of the performance of our students. The majority can be seen to have acquired a range of skills such as the use of computers to analyse data, the ability to perform error analysis, the ability to produce written reports of a reasonable standard and an understanding of the use of many basic pieces of laboratory equipment. Comparing these reports with those produced by the same students in their first year at Liverpool gives an indication of the progress they have made in their time here (see Appendix 1).

5. Assessment

5.1 Introduction

Various forms of assessment are used within the Department. For each module the methods used and how they contribute to the final mark are described in the Student Handbook. The availability or otherwise of re-sit examinations is also pointed out.

5.2 Examinations

The primary means of summative assessment used by the Department in the majority of modules is the written examinations which take place at the end of each semester. The Student Handbook contains a brief description of the examination for each of the relevant modules as well as information on the syllabus to be examined. Examination papers are produced by the Module Organisers and are subjected to various checks, both within the Department and externally, as are the detailed mark schemes for each of the questions on the paper. These procedures are described in more detail in document TLA 3.3.2.

The Module Organiser is responsible for the marking of the Exam papers. The marking is anonymous and is subjected to internal and external checks as described again in document TLA 3.3.2 and in section 5 of the Staff Handbook.

Students are informed of their marks after they have been ratified by the relevant Year and Faculty Examination Committees. The Student Counselling and Registration Team (see Student Support and Guidance, Appendix 2) offer guidance to continuing students on the options open to them given their results. The Student Support and Guidance document also provides information on the careers support available within the University. Students who have failed a Year of Study are encouraged to consult with the members of staff responsible for the modules in which they have had difficulty for help in preparation for re-sits.

The Department seeks to set examinations such that the mean mark lies in the range 50 to 65%. If the actual mean deviates from this range, or peculiar distributions of marks are observed, this is discussed at the relevant Year Examination Committee meeting and may result in a rescaling of marks. This only takes place if:

- A significant number of students are observed to have performed noticeably less well in the examination under question than in their other examinations.

- Studying the examination paper produces evidence that there are reasons the paper has been found to be more difficult by the students than anticipated by the Module Organiser and External Examiners.

[3] Correlating attendance with the marks achieved as done for lectures etc. does not give an unbiased result here. As the assessment is continuous there is an enforced positive correlation between attendance and achievement.

Such rescalings are infrequent; in Summer 1998, the marks of 1 second year examination were rescaled and in Summer 1999 of 1 first year module. The examinations in question were those for PHYS254 (Electromagnetism) and PHYS126 (Waves and Optics). The Module Organisers for both of these modules have since changed.

5.3 Class Tests

A further method of assessment used in particular in the first and second years is the Class Test, see for example the Student Handbook entries for PHYS121 and PHYS254. This is worth typically 15% of the total marks for a module. The Class Test is held about half way through the module. Again, the Module Organiser is responsible for the marking of the Class Test. In many modules, for example those mentioned here, the Class Test questions are deliberately of a similar style and difficulty to those used in the examinations and the students are made aware of this. Students are thus able to assess their performance with respect to the standard expected of them in the main examinations and have sufficient time to take corrective action if that should prove necessary. As an example, we return to our case study, the first year Mechanics module PHYS121. Figure 4) shows the correlation between the PHYS121 Class Test marks and the results obtained in the end of semester examinations. The correlation coefficient is 0.74, indicating that the Class Test mark is a reliable indicator to the students of their progress.

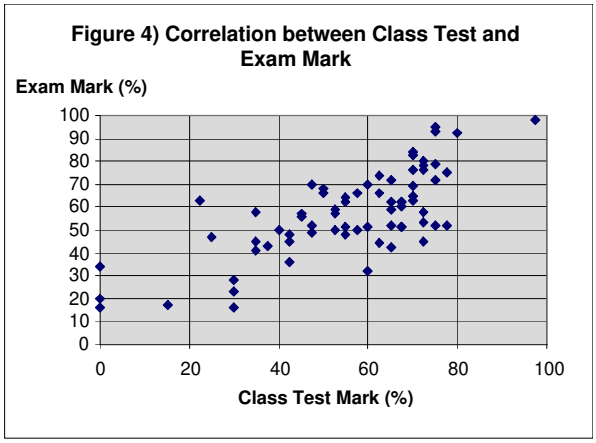


Figure 4) Correlation between Class Test and Exam Mark

5.4 Homework and Tutorial Problems

The setting and marking of Homework and Tutorial Problems form part of the Department's formative assessment strategy. It has been demonstrated above that satisfactory completion of these is important for students wishing to achieve the best possible results in their examinations. Homework and Tutorial Problems are marked and returned to the students, in the case of the former with a model answer, the answers to the latter are discussed in Tutorials. These procedures give valuable feedback to the students, allowing them to identify areas in which their understanding is incomplete and take appropriate action. Students are encouraged to discuss Problems with the relevant lecturer if they find they "get stuck", e.g. see the web pages for PHYS121, http://hep.ph.liv.ac.uk/~green/mechanics. The marks awarded are again a reliable measure of the likely performance in the Exams, allowing students to assess their progress. Data for the 1998/99 cohort of PHYS121 students confirm this, as is shown in figure 5). The correlation coefficient in this case is 0.67. Note, these data are not completely independent of those shown in figure 2)

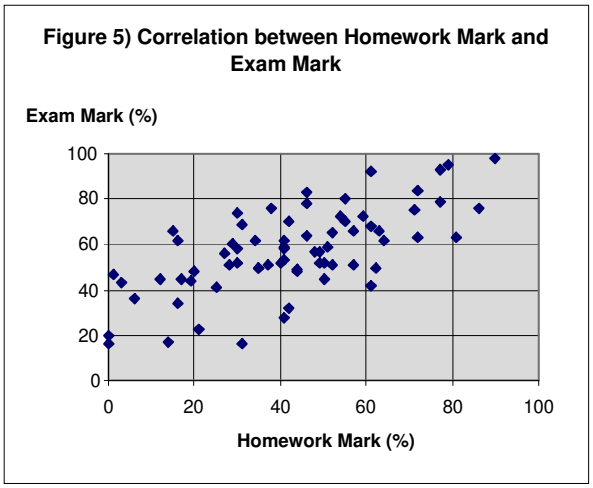


Figure 5) Correlation between Homework Mark and Exam Mark

5.5 Science Communication Projects

The Science Communication projects consist of essays on various topics, plus a brief oral presentation. The essays are marked by the student's academic tutor and then passed on to the Module Organiser who is responsible for checking the marks and ensuring consistency between tutors. In year 1, the tutor is also responsible for assessing the oral presentation. In year 2, where the mark counts to the degree, the oral presentation is assessed by two members of staff and the average of their marks used. Written and oral feedback is given to the students. More information on Science Communication projects is provided in the Curriculum Design, Content and Organisation documentation.

5.6 Practicals

Practicals are marked by one of the Laboratory demonstrators. In the first year Labs a sample of the marked reports is checked by the relevant Module Organiser to ensure consistency of marking. In subsequent years, in which the practical marks count toward the degree, all marking is checked by a member of staff.

Feedback is provided to students both orally if desired and in writing. The latter is provided on a form designed for this purpose, allowing the students to have a record of progress made as Lab notebooks must be retained by the Department for inspection by the External Examiner. Laboratory assessment is thus both summative and formative in nature.

5.7 Projects

Project reports are marked by the supervisor and a second marker. The oral presentations are marked independently by a group of staff. The final mark is a combination of the marks of the supervisor, the second marker and the average of the marks for the oral presentation with weights 50%, 30% and 20%. Students are given feedback both on the project report and on their presentation.

6. Concluding Remarks

It is hoped that this document has been able to give some insight into the teaching methods and learning objectives of the Physics Department. It is important to point out that our teaching and learning strategies are not written on tablets of stone, we are continually engaged in a range of activities to attempt to improve our teaching and the learning opportunities presented to students. Some evidence for this ongoing process has been mentioned in the above. Further examples of recent improvements to lecture modules are presented in the document Innovations in Teaching (TLA 3.3.3). Our assessment procedures are designed both to measure student achievement as fairly as possible and to aid students in their development.

7. Appendix 1

The practical and project reports referred to in this document are available on request from the Teaching, Learning and Assessment Team Leader, Dr. Mike Thomas.