Appendix A: Data Collection Formats & Methodology

A.1 Overview

There are 34 Australian universities with a group of academics teaching physics. For convenience we refer to such a group as a ‘department’ even though several groups do not carry this title. All such groups in the 34 universities have agreed to participate in the project and each has nominated a contact person. Privacy arrangements require that institutions and individuals are not identified except when a department agrees to have a good practice example showcased.

In Stage 1 of the project, the data collection process took place in two distinct sections (in the following chronological order):

- all 34 departments were asked to complete a questionnaire
- nine chosen departments were asked to participate in an in-depth study

The questionnaire covered all areas specified in the project brief and provided an overview of the diversity of approaches and issues in the teaching and learning of physics. Based on the results of the questionnaire, nine institutions were selected, as representative of the range and geographical spread of departments, for an in-depth study to draw out how, in practice, departments decide, develop, and resource their academic programme. This in-depth study comprised an interview with the Head of Department, an interview with the chair of academic programs, and focus groups with students.

A.2 Description of Data Collection

Questionnaire

The questionnaire was distributed to each of the 34 departments, requesting responses by the HOD or a designated representative. It was stipulated that the responses should provide a representative view of the whole department and not reflect individual opinions. The questionnaire design was based on the recognition that each department has a unique teaching and learning situation, including its institutional structure, degree programs, and student cohorts, so that the local context will often affect how a question is interpreted. For this reason the questionnaire questions were almost entirely free-form. It focused on the current situation and those changes in the past 5 years which have impacted on the present, with opportunity to comment on future directions. The sections covered included:

- physics majors
- service and multidisciplinary teaching
- good practices
- employment / industry involvement
• staff development and support
• school teacher training

The data from the questionnaire was used to provide an overview of the teaching and learning across all Australian universities, and to identify trends, themes, and successful practices. Data analysis and interpretation occurred as data was gathered, at times influencing further research questions.

All 34 institutions completed the questionnaire.

*Interview with Head of Department*

The Head of Department interview was designed to gain insight into the priorities and strategies of each of the chosen nine departments. It explored issues in greater depth than the written questionnaire allowed and provided a glimpse into the department’s broad vision or “philosophy”. The majority of the questions were themed around three important areas relating to teaching and learning:

• the teaching profile
• infrastructure/resources
• the staff profile

Both the near past-to-present situation and future directions in these areas were explored. The issues involved in developing and maintaining good teaching practices were also sought.

Interviews were conducted with the Head of Department of all nine chosen institutions.

*Interview with the chair of academic programs*

The interview with the chair of academic programs was designed to complement the Head of Department interview by seeking more specific departmental information about:

• the processes involved in curriculum development
• achieving the learning outcomes
• other areas needing clarification (after the questionnaire)

Interviews were conducted with the chair of academic programs of all nine chosen institutions.

*Focus groups of students*

Focus groups of students were run in all but one of the nine chosen institutions, to gauge opinions on their physics education and thus provide the learning perspective. Students at four stages of their physics education were surveyed – first year mainstream, first year service, third year and postgraduate. They were asked:

• what has most helped them learn in physics
• what skills they have gained in physics
• physics-based employment opportunities

Focus groups of students were conducted at eight of the nine chosen institutions.

*External data sources*

Two external sources of data were acquired but do not feature in the main analysis.
The Department of Science Education and Training (DEST) in Australia maintains enrolment statistics for Australian universities, and it was hoped that these may be used to show trends in student numbers. However there are recognised difficulties in using such data, as reported by the Australian Council of Deans of Science (Dobson 2003). Difficulties in isolating physics subjects due to the coding used and the apparent omission of certain data introduced an amount of subjectivity into any synthesising of the data. This made the process irreconcilable with obtaining accurate student number trends. A number of institutions were asked to verify the DEST numbers and their inability to do so provided further confirmation of their unsuitability for use in the project.

The Course Experience Questionnaire (CEQ) is administered to university graduates within six months of their graduation, and can be used to study trends and comparisons for student satisfaction and attitudes. Concerns about CEQ’s relatively low return rate and the inclusion of astronomy and materials science with physics in the ‘Physical Sciences’ category, has also made using these data impractical.
Appendix B: Data Collection Instruments

B.1 Questionnaire

<table>
<thead>
<tr>
<th>AUTC Physics Project</th>
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<tbody>
<tr>
<td>Questionnaire on Physics Teaching and Learning</td>
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</table>

**Introduction**

The Australian Universities Teaching Commission (AUTC) has funded a study to obtain an accurate and representative picture of the teaching and learning of physics in Australian universities. As physics in Australia has experienced major changes, this study is timely and it aims to assist in revitalising tertiary physics education to the benefit of all stakeholders.

This is an extensive survey. We believe the data will be valuable for the physics community, for instance by identifying and sharing successful approaches in a variety of situations. As the main findings emerge we hope to be able to meet with you and interested members of your and other departments to examine them before finalising the report.

We appreciate your time and commitment in completing this survey.

Thank you,


**Advice on completing the questionnaire**

The questions refer to **undergraduate teaching**, i.e. year 1, year 2, year 3 and honours, and the employment possibilities of physics majors and honours students. The final questions are about the support provided for staff teaching undergraduate subjects and the training of school teachers.

You can either complete the questionnaire electronically or on hardcopy. Email completed survey as an attachment to a.mendez@physics.usyd.edu.au or post to:

AUTC Physics Project Officer
Alberto Mendez
School of Physics
University of Sydney
NSW 2006, Australia

When completing the hard copy version please feel free to use the reverse sides of the pages or add extra sheets.

In answering the questions please provide a collective/representative view of the department rather than your own personal view. Please consult colleagues.

Please feel free to include more information than the question asks for.

In some cases the sub-questions indicate the sort of data we are interested in.

An Explanatory Statement for this project, as required by the Ethics approval granted by Monash University is attached. It is the same as one previously sent to your department’s head and other participants.
Privacy of data pertaining to institutions and individuals will be respected. We will seek your department's permission for the disclosure of any information that identifies your department, for example, in highlighting the use of a successful teaching and learning approach.

**Terminology used in the questionnaire**

Different terms are in use at different institutions. To avoid ambiguity, terms used in the questionnaire have the following meanings:

**Physics department**: is a team of academics that teach physics in Australian universities. This may in fact be a small group within a department or faculty, rather than actually being called a department.

**Subject**: is a study of a particular set of topics usually over a period of about 12 or 14 weeks and being assessed as an individual element within a degree program.

**Physics service subject**: is one delivered, maintained and assessed largely by the department of physics, specifically designed for non-physics majors (including interest courses such as Physics for Life Sciences and Astronomy).

**Multidisciplinary subject**: is where the teaching of a subject is substantially shared between physics and other departments, schools or faculties.

**Mainstream subject**: is one that physics majors or potential physics majors take. A mainstream subject can also be taken by non-physics majors.

**Program**: is the complete 3 or 4 year degree study schedule.

**Physics Major**: is the 'physics degree' with which we are familiar, often comprising mostly Physics and Mathematics subjects with electives in earlier years and increasing physics content in higher years.

**Multidisciplinary Program**: one of the newer types of 3 or 4 year specialised degree programs, for example Nanotechnology, Biotechnology, Environmental Science, Medical Physics and Computational Science. Physics may make a significant contribution to such a program.

**Joint or Double or Combined Degree Program (with Physics majors)**: a degree program which fulfils the requirements for two degree programs, for example, Science/Arts, Science/Law, Physics and Computing, Engineering and Physics (often electrical or mechanical engineering).

**Section A: Local information**

In this section we seek to document statistical data from your department.

We have collected the following data regarding physics subjects taught at your institution from the web and DEST. Could you please verify the data in the tables provided? Please tick those subjects usually offered by your department [column 2] and also tick those subjects that your potential physics majors would typically study (i.e. mainstream subjects) [column 3]. Any subjects omitted can be added in the empty cells at the bottom of the table.

A1. Name of Institution:
A2. Head of physics department/group:
A3. Liaising physicist for AUTC Physics Project:
A4. Names and codes of all first year subjects that your department is involved in teaching, including mainstream, service and multidisciplinary subjects, in both semesters:

<table>
<thead>
<tr>
<th>subjects</th>
<th>offered</th>
<th>mainstream</th>
</tr>
</thead>
</table>

A5. Names and codes of all subjects taught in second year in both semesters:

<table>
<thead>
<tr>
<th>subjects</th>
<th>offered</th>
<th>mainstream</th>
</tr>
</thead>
</table>

A6. Names and codes of all subjects taught in third year in both semesters:

<table>
<thead>
<tr>
<th>subjects</th>
<th>offered</th>
<th>mainstream</th>
</tr>
</thead>
</table>

A7. Names and codes of all subjects taught in honours year in both semesters:

<table>
<thead>
<tr>
<th>subjects</th>
<th>offered</th>
<th>mainstream</th>
</tr>
</thead>
</table>

Statistics: We are in the process of tabulating data for students enrolled in physics subjects from year 1 to honours (for the years 1998 to 2003), as well as staff numbers at your institution. We have requested these data from DEST and when available they will be sent to you for verification.

Section B: Overview of teaching and learning at a departmental level

In this section we seek to:
- understand how and why the teaching and learning of physics is evolving,
- identify strengths and resources which can be shared.

B1. What challenges has your department faced in the teaching and learning of physics in the last 3 to 5 years?

B2. How has your department responded to the challenges mentioned above?

B3. What directions will the teaching and learning in your department take in the near future? Why? Please note any specific changes that are planned.
B4. What are the strengths of the teaching and learning in your department?

B5. Aside from traditional lectures, labs and tutorials, have you introduced new modes of teaching and learning (e.g. web based or e-learning, active learning labs, undergraduate research activities, field trips)? Please describe. It would help if you could explain why you have chosen to explore alternative modes of teaching.

B6. Can you identify resources that could be developed cooperatively by the physics education community that could support the teaching and learning of physics in your department? Please provide a brief description.

B7. Please make any general comments regarding student backgrounds entering physics, including effect of changes to high school physics or mathematics. How has your own department adapted to these changes?

Section C: Physics majors

In this section we seek to understand the:
• characteristics of students who major in physics,
• experiences of students who major in physics (teaching environments, school physics, etc).

C1. What is the focus of your undergraduate physics majors program? How would you describe or characterise a graduate from that program? (Please indicate if there are special skills that are particular to your graduates.)

C2. Physics departments have particular strengths within certain research areas. How is this reflected in your undergraduate curriculum? Are undergraduate students exposed to these research areas within the department?

C3. For each of the years (1 to 3), approximately what fraction of the students’ contact time in physics is spent in experimental laboratories? Please describe the strengths of the teaching in your experimental laboratories as well as any issues regarding maintaining a laboratory program.

C4. The following is a list of possible ways in which industry partners can be involved in the teaching of physics majors. Please tick those being currently used by your department.
C5. Does your physics majors program involve a component that is multidisciplinary? Please describe.

C6. Please describe the balance between applied and theoretical physics in your physics majors program.

C7. Are your physics majors informed of jobs in physics? If so, how? Does this include multidisciplinary areas?

C8. For each of the following areas, within the entire physics major degree program (excluding honours), please provide an approximate percentage denoting the student time (both contact and non-contact) spent on and the assessment weighting of each area. Any areas not included can be added in the blank cells at the bottom of the table. In this table, *generic skills* refers to a range of general skills, such as listed in table F3 below (F3 refers to a broad range of graduate outcomes).

<table>
<thead>
<tr>
<th>areas</th>
<th>student time spent</th>
<th>assessment weighting</th>
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</thead>
<tbody>
<tr>
<td>classical mechanics</td>
<td></td>
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<tr>
<td>computational physics</td>
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<tr>
<td>electromagnetism</td>
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<tr>
<td>electronics/instrumentation</td>
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<td>fluids</td>
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<tr>
<td>nuclear &amp; particle physics</td>
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</table>
Section D: Service and multidisciplinary teaching

In this section we are seek to understand:
- the role of service and multidisciplinary teaching in your department,
- how changes in service and multidisciplinary teaching are affecting your department.

D1. Traditionally physics has been involved in teaching engineering, life science and medical science students. Please describe the changes in the past 3 to 5 years in such service and multidisciplinary subjects and the impact of these changes on your department.

D2. Please name the newer multidisciplinary degree programs that your department has been involved in developing and delivering. Have such programs been successful? If so, how?

D3. More institutions are offering double/combined/joint degrees. Have these programs been successful in your department? If so, how?

D4. Approximately what fraction of your departmental income from teaching is from service and multidisciplinary teaching (not joint degrees)?

D5. How well supported is your service and multidisciplinary teaching? Please describe.
Section E: Teaching and learning practices that are effective in particular situations

In this section we seek to:

• understand how the effectiveness of teaching and learning of physics is determined,
• identify good practice in teaching and learning of physics for particular situations.

E1. Are there any special features associated with teaching, subject content or assessment of students that are particularly effective/successful in your situation/department? If so, please describe these briefly. How have you measured their effectiveness and what are the outcomes?

Section F: Employment possibilities, employer satisfaction

In this section we are seeking to understand graduate employability and employer/industry satisfaction.

F1. How has your curriculum changed in the past 5 years in response to changing perceptions of employment opportunities? Please provide brief descriptions.

F2. How does your department ascertain the suitability of your graduates for their various employment destinations? Do you obtain feedback from employers? If so, how?

F3. For each of the following areas, within the entire physics major degree program (excluding honours), please provide an approximate percentage denoting the student time (both contact and non-contact) spent on and the assessment weighting of each area. Any areas not included can be added in the blank cells at the bottom of the table.

<table>
<thead>
<tr>
<th>areas</th>
<th>student time spent</th>
<th>assessment weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>computational skills</td>
<td></td>
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<tr>
<td>ethical and social issues</td>
<td></td>
<td></td>
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<tr>
<td>information retrieval</td>
<td></td>
<td></td>
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<tr>
<td>oral communication</td>
<td></td>
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<td>problem solving</td>
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<td>project planning</td>
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<td>research methodology</td>
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<tr>
<td>teamwork</td>
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<td>written communication</td>
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<tr>
<td>knowledge and understanding of physics</td>
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<td></td>
</tr>
<tr>
<td>concepts, models and theories</td>
<td></td>
<td></td>
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<tr>
<td>total</td>
<td>100 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>
### Section G: School teacher training

In this section we seek to understand the involvement of physics departments in school teacher training.

G1. How does your department contribute to the training of school teachers? Please provide example(s) of both in-service and prospective teacher training.

G2. Is your department concerned about the shortage and training of high school physics teachers? If so, does your department plan to contribute to the training of high school physics teachers or increase its involvement with the Education faculty?

### Section H: Academic staff development and support for teaching and learning

In this section we are seeking to determine the level of support for academic staff to seek to identify, create and implement good teaching and learning practice.

H1. Are there any forums for discussion of physics education (teaching innovation) within the department? If so, please provide examples of some of the forums.

H2. How does your department (or faculty) support staff interested in curriculum enhancement and investigating issues related to teaching and learning of physics? Are staff who employ innovations in teaching and learning valued? Please provide example(s).

H3. Is there a mechanism for training new teaching staff (tutors, sessional and academic staff)? If so, please provide a brief description.

### Section I: Other comments

In this section we are seeking to find if there are factors that you would like to be noted in this project.

I1. Are there other local factors that we should note when interpreting your departments response to this survey?

I2. Are there any other comments that your department would like noted in this project?
Glossary

Physics service subject: is one delivered, maintained and assessed largely by the department of physics, specifically designed for non-physics majors (including interest courses such as Physics for Life Sciences and Astronomy).

Multidisciplinary subject: is where the teaching of a subject is substantially shared between physics and other departments, schools or faculties.

Mainstream subject: is one that physics majors or potential physics majors take. A mainstream subject can also be taken by non-physics majors.

Overview

The project team has been asked to explore how physics teaching is responding to changes such as the increasingly multidisciplinary nature of science and broader employment possibilities, new technologies and approaches to teaching and learning, and the evolving nature of service teaching.

This interview will explore some issues in more depth than was possible in the written questionnaire. It will first cover three areas relating to teaching and learning: the teaching profile, infrastructure and the staff profile. We will then look at how your department develops and maintains good teaching practices.

Section 1 - Departmental Profile (25-30 mins)

First, the undergraduate teaching profile of your department (i.e. the directions and emphases in your teaching). What influenced the decisions for recent and planned developments in your teaching profile?

Second, in relation to the infrastructure and resources for teaching: What influenced the recent decisions and plans for infrastructure and resources for teaching?

In relation to the staff profile of your department; to what extent does teaching influence the decisions made in this area?

What future directions do you see for the staff profile at your department?

How do the research strengths of your department influence the curriculum and the quality of teaching?
Section 2 - Good Teaching Practices (20 mins)

We will now turn to good teaching practices in your department. Questions about good practices will cover up to two instances selected where possible from multidisciplinary, service and mainstream teaching.

In reply to our questionnaire you mentioned _____ and _____ (whatever they DID mention that is relevant; up to two examples, with selection across institutions to ensure coverage of multidisciplinary, service and mainstream).

(In the case of only one case mentioned in the questionnaire, invite a further example, asking particularly for teaching in one area not mentioned above)

Can you describe another development in the last few years in the provision of (one of service/multidisciplinary/mainstream not covered above) teaching which has been successful in your department?

Could you give some background to (each) good practice and explain the extent to which it has been successful in your department?

How have you been able to ensure that good practices are sustained?

What type of support and incentives do you (your department or institution) provide for staff development in teaching, and for developing good teaching practices? Are these effective?

Section 3 – Future (10 mins)

Three broad questions in conclusion:

Has your department’s teaching benefited from interaction with peers in Australia or overseas? If so, how?

Where do you see tertiary physics teaching and learning in Australia heading in the future? (How can we improve our future?)

Is there anything else that you would like to say concerning physics teaching and learning in your department?
B.3 Additional Questions

AUTC Physics Project
Interview In-depth Questions for Selected Institutions

Interviewee is a person nominated by Head of School, ideally the person responsible for physics education matters (e.g. Education chairperson).

Anticipated Length: 75 minutes

A copy of this interview will be provided in advance of the interview.

A copy of the Explanatory Statement to Head of School and their nominated representatives will be provided in advance to the interviewee.

Permission to tape this interview is requested, to ensure accuracy of the summary used for the project.

GLOSSARY

Physics service subject: is one delivered, maintained and assessed largely by the department of physics, specifically designed for non-physics majors (including interest courses such as Physics for Life Sciences and Astronomy).

Multidisciplinary subject: is where the teaching of a subject is substantially shared between physics and other departments, schools or faculties.

Mainstream subject: is one that physics majors or potential physics majors take. A mainstream subject can also be taken by non-physics majors.

Overview:

The project team has been asked to explore how physics teaching is responding to changes such as the increasingly multidisciplinary nature of science and broader employment possibilities, new technologies and approaches to teaching and learning. This interview will explore some issues in more depth than was possible in the written questionnaire.
**Curriculum development:**

We will focus on subjects primarily offered as *(to be selected by the project team for each institution, max of two)*
- [ ] service teaching for engineering or related technologies
- [ ] service teaching for biomedical
- [ ] multidisciplinary course with substantial physics component
- [ ] mainstream physics

Representative subject(s) would be _ _ _ _ _ _ _ _ _ and _ _ _ _ _ _ _ _ _

For your *selected* subjects, who decides the subject content?
- (a) one person from physics
- (b) one person from client faculty
- (c) a team (including academics from client faculty for service subjects)
- (d) other (please describe)

For your *selected* subjects, who decides the subject content?
- (a) one person from physics
- (b) one person from client faculty
- (c) a team (including academics from client faculty for service subjects)
- (d) other (please describe)

How often is subject content reviewed and revised?
- (a) four to five years
- (b) when client faculty thinks it’s necessary
- (c) depends on circumstances (explain)
- (d) other (please describe)

**Learning outcomes:**

Do published objectives/ learning outcomes exist for your *selected* and *selected* subjects?
- (a) yes
- (b) no
- (c) other (please describe)

How are students informed of these outcomes?
- (a) handouts
- (b) verbal notices
- (c) web notices
- (d) other (please describe)

Could you please provide one of your best example of learning outcome statements. This will be useful as we seek a range of good practices in various areas.
What methods are used to establish whether objectives/learning outcomes are achieved?

(a) exams  
(b) assignments, reports and essays  
(c) oral student presentations  
(d) assessment of skills eg laboratory skills  
(e) class surveys  
(f) student focus groups  
(g) outside reviewer  
(h) other (please describe)

Do you align learning outcomes with graduate attributes and competencies? For your [selected] subjects, and for your [selected] subjects? If so, how?

Are students informed and/or aware of this alignment?

How are learning outcomes and objectives balanced with content in subject reviews and curriculum planning?

Do you use any external benchmarks to evaluate teaching and learning outcomes? (e.g. standard Course Experience Questionnaire, diagnostic tests for particular content areas, comparison with other institutions)

What processes do you have for reviewing subjects/curriculum/teaching?

Do you have outside/industry involvement in your review process? If so, how has this been helpful?

If you have made major changes in your teaching methods or curriculum recently, has this come from initiatives from within the department or from outside factors? Please comment.

If you have an effective process for review, could you please provide a copy of the relevant description of the process (for the purpose of establishing a range of good practices)

Student expectations and feedback:

Do you have ways of gauging the expectations of students entering the course in which you teach these subjects? If so, please describe.

How do you sample student feedback and how do you respond to it?
Web-based (on-line) teaching and learning:

**To what extent is the Web used for teaching and learning?**

The following four categories may be useful.
1. Information about a subject is online for students to access (optional).
2. Learning strategies and resources are available online (supplementary).
3. Completion of a subject requires on-line work or access.
4. Students study and complete subject online with no face-to-face teaching.

**Why has it been introduced? How has this resulted in improved learning? Have there been disadvantages?**

**Projects:**

To what extent do projects form part of your undergraduate physics (or multidisciplinary) curriculum. If applicable, please describe the main reasons for having projects.

**Staff development and support:**

What training and support do you provide for sessional or casual teaching staff (including postgraduate students)? Please provide brief details.
(a) Tutor/demonstrator training
(b) Evaluation and feedback
(c) Mentoring by experienced tutor/demonstrator
(d) Regular meeting with subject leader/coordinator or laboratory supervisor
(e) Regular meetings with demonstrator/tutor group
(f) Other (please describe).

If applicable, what approaches are used to deal with staff shortages? Are any particularly successful? What are the advantages, disadvantages and consequences of these approaches?

**Employment, industry involvement:**

What mechanisms are used to inform students of career prospects and the usefulness of further studies in physics?

What types of information do you gather from employers about graduate attributes, skills and overall employer satisfaction? How do you use this information?

**Role of Professional organisations, networks, peers:**

Has your department’s teaching benefited from interaction with peers in Australia or overseas? If so, how? (e.g. from Australian Institute of Physics events, the AIP Accreditation process, other conferences and workshops, individual contacts?)
B.4 Focus Group Questions

AUTO Physics Project
Nominal Group Technique protocol

- Welcome by facilitator.
- Facilitator hands each student the following sheets:
  - B. Consent Form – Student Focus Groups,
  - C. Student Focus Group Questions, according to which group/subject-type,
  - D. Graduate Skills,
  - A. Explanation to Student Participants in Focus Groups if not already received.
- Participants fill in sheet B. Consent Forms and return it. Consent forms should be placed in a separate envelope within the main envelope.
- Participates spend 10 minutes answering the questions individually on form C.
- After the participants have filled in form C, they are asked, one by one, for their responses to the first question. The responses are written on butcher’s paper by the facilitator and a discussion on those responses follows. Use a separate sheet of paper for each question. Please draw a column on the left hand side for students to later write their ranking of the items.
- With 4 questions × 7.5 minutes discussion per question, the total time spent to here should be ~40 minutes. All questions are important – IF there is a risk of running out of time, you may do question 4 in a shorter time (however note that Question 4 is important for service subjects).
- The facilitator provides students each with a marker pen. Participants are asked to look at the responses to each of the 4 questions, and then as individuals to rank the top 3 responses; the participants then marks 1, 2, and 3 against the chosen items on the butchers paper, for each question. (~5 minutes for ranking exercise)
- Finally the participants complete the sheet titled D. Graduate Skills, taking ~5 minutes, ticking the skills that they believe were present and/or were developed in their physics studies.
- The facilitator collects sheets C and D from every participant before leaving.
- Facilitator extends thanks to the participants.
This is a focus group of 1st year Physics mainstream students to gauge your opinions about teaching and learning in Physics.

Please fill in the following table. Do NOT write your name on this sheet.

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Did you do high school physics?</td>
<td></td>
</tr>
<tr>
<td>Why did you decide to do tertiary Physics?</td>
<td></td>
</tr>
<tr>
<td>Degree enrolled in</td>
<td></td>
</tr>
<tr>
<td>Are you intending to major in Physics?</td>
<td>Yes No Possibly (circle one)</td>
</tr>
<tr>
<td>Physics subjects/units taken this year</td>
<td></td>
</tr>
</tbody>
</table>

Please spend 8-10 minutes answering the following questions. Please write down brief answers (dot points); feel free to provide several points for the one question.

1. **What features of your physics studies has most helped your learning?**
   Focus on approaches, teaching and learning environments, assessment practices, *not* topics, individual lecturers, or how difficult physics is.

2. **What are the valuable skills and knowledge you have gained from your Physics studies?**

3. **Has your first year Physics related Physics to other areas of science and technology? If so, how?**
   Focus on applications, multidisciplinary aspects.

4. **Has your first year physics helped you find out about employment opportunities for Physics graduates? If so, how?**
AUTC Physics Project
Student Focus Group Questions – 1st Year Service Physics

This is a focus group of 1st year students taking Physics as a service subject to gauge your opinions about teaching and learning in Physics.

Please fill in the following table. Do NOT write your name on this sheet.

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<thead>
<tr>
<th>Age</th>
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</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Did you do high school physics?</td>
<td></td>
</tr>
<tr>
<td>(If applicable) Why did you decide to do high school Physics?</td>
<td></td>
</tr>
<tr>
<td>Degree enrolled in</td>
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</tr>
<tr>
<td>Physics subjects/units done this year</td>
<td></td>
</tr>
</tbody>
</table>

Please spend 8-10 minutes answering the following questions. Please write down brief answers (dot points); feel free to provide several points for the one question.

1. What features of your first-year physics studies has most helped your learning?
Focus on approaches, teaching and learning environments, assessment practices, not topics, individual lecturers, or how difficult physics is.

2. What are the valuable skills and knowledge you have gained from your first-year Physics studies?

3. Has your first year Physics related Physics to the needs and directions of your degree? If so, how?
Focus on applications and any multidisciplinary aspects.

4. What is the value or usefulness of your first-year Physics studies to your degree?
Focus on perceived relevance/importance not the credit points for the studies. Include any long-term perspective if possible.
This is a focus group of 3rd year Physics students to gauge your opinions about teaching and learning in Physics.

Please fill in the following table. Do NOT write your name on this sheet.

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Did you do high school physics?</td>
<td></td>
</tr>
<tr>
<td>Why did you decide to do tertiary Physics?</td>
<td></td>
</tr>
<tr>
<td>Degree enrolled in</td>
<td></td>
</tr>
<tr>
<td>Physics subjects/units done in 3rd year</td>
<td></td>
</tr>
</tbody>
</table>

Please spend 8-10 minutes answering the following questions. Please write down brief answers (dot points); feel free to provide several points for the one question.

1. What features of your physics studies has most helped your learning?  
   Focus on approaches, teaching and learning environments, assessment practices, not topics, individual lecturers, or how difficult physics is.

2. What do you think are the valuable skills and knowledge you have gained from your Physics studies?

3. Have your Physics studies related Physics to other areas of science and technology? If so, how?  
   Focus on applications, multidisciplinary aspects.

4. Have your physics studies helped you find out about employment opportunities for Physics graduates? If so, how?
This is a focus group of postgraduate Physics students to gauge your opinions about teaching and learning in Physics. Participants should have done their undergraduate physics at the institution where this focus group is being conducted.

Please fill in the following table. Do NOT write your name on this sheet.

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Did you do high school physics?</td>
<td></td>
</tr>
<tr>
<td>Why did you decide to do undergraduate Physics?</td>
<td></td>
</tr>
<tr>
<td>Name of undergraduate degree completed</td>
<td></td>
</tr>
<tr>
<td>How many year of postgraduate study have you done?</td>
<td></td>
</tr>
<tr>
<td>Have you done any teaching, tutoring or demonstrating to undergraduates?</td>
<td></td>
</tr>
<tr>
<td>Has your teaching affected your view of the way your undergraduate Physics studies were taught? If so, how?</td>
<td></td>
</tr>
</tbody>
</table>

Please spend 8-10 minutes answering the following questions. Please write down brief answers (dot points); feel free to provide several points for the one question.

1. What features of your undergraduate physics studies has most helped your learning?
   Focus on approaches, teaching & learning environments, assessment practices, skills not topics, content or individual lecturers, or how difficult physics or maths is.

2. What do you think are the valuable skills and knowledge you have gained from your undergraduate Physics studies?

3. Did your undergraduate Physics studies relate Physics to other areas of science and technology? If so, how?
   Focus on applications, multidisciplinary aspects.

4. Did your undergraduate physics studies help you find out about employment opportunities for Physics graduates? If so, how?
Please fill in the following table by ticking the box that represents the level to which a particular skill or attribute was made use of or developed in your Physics studies.

<table>
<thead>
<tr>
<th>Skill/Attribute</th>
<th>not at all</th>
<th>a little</th>
<th>some</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>computational skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consideration of ethical and social issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>experimental design</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>information retrieval (electronic and print)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>laboratory skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oral communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>problem solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>project planning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>research methodology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>teamwork</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>written communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please note any other significant skill which was developed:
B.5 Graduate Interview Questions

AUTC Physics Project
Interview with recent graduates currently in the workforce

This is one in a series of interviews with recent graduates who have completed a 3 or 4 year or Honours level undergraduate degree with a Physics major or a Physics-based multidisciplinary major. We’d value your opinions on your undergraduate Physics and how well it prepared you for the workforce.

Please fill in the following table of personal details:

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Did you do high school physics?</td>
<td></td>
</tr>
<tr>
<td>Why did you decide to do Physics?</td>
<td></td>
</tr>
<tr>
<td>Undergraduate degree completed</td>
<td></td>
</tr>
<tr>
<td>When and where did you graduate?</td>
<td></td>
</tr>
<tr>
<td>Have you completed any other degrees?</td>
<td></td>
</tr>
<tr>
<td>Current position</td>
<td></td>
</tr>
</tbody>
</table>

I’d now like to ask you a series of questions pertaining to your undergraduate Physics studies (Physics below may be read as ‘multidisciplinary’ if appropriate).

1. What features of your undergraduate Physics studies were of most help to your learning?
   Prompts: Focus on styles, approaches, teaching & learning environments, assessment practices, skills not topics, content or individual lecturers.

2. How were you made aware of employment opportunities for Physics graduates in your undergraduate Physics studies?
   Prompts: Focus on applications, multidisciplinary aspects.

3. What aspects of your Physics education have helped you most in your career?

4. Is it an advantage having done Physics? Do you think you have an advantage over graduates from other disciplines? How? Are there special knowledge and skills that Physics provides?
   Prompts: You may choose to comment on your initial years of employment and later years of employment separately.
Graduate attributes table

Please fill in the following table by ticking the box that represents the level to which a particular attribute was used or developed in your undergraduate Physics subjects.

<table>
<thead>
<tr>
<th>attribute</th>
<th>not at all</th>
<th>a little</th>
<th>some</th>
<th>a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>computational skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consideration of ethical and social issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>experimental design</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>information retrieval</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>laboratory skills</td>
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<tr>
<td>oral communication</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>problem solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>project planning</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>research methodology</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>teamwork</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>written communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please say if there was another valuable attribute:
B.6 Employer Interview Questions

AUTC Physics Project
Interview with the employers of recent graduates

This is one in a series of interviews with employers that have recently (in the last 5 years) hired staff who have completed a 3 or 4 year or Honours level undergraduate degree with a Physics major or a Physics-based multidisciplinary major. We’d like to gauge your opinions on the value of an undergraduate Physics major as demonstrated by your employee(s).

Could you please provide the following information?

<table>
<thead>
<tr>
<th>Type of firm</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobs done by physics graduates</td>
<td></td>
</tr>
<tr>
<td>Level of education of physics graduates</td>
<td></td>
</tr>
</tbody>
</table>

We would like you to think about physics graduates who have worked for you in the last few years. Please try to separate physics graduates early in their employment from those who have worked with you for some time. We would also like to concentrate on graduates with a basic (not postgraduate) degree with a Physics major.

Are there special knowledge, skills and approaches that these Physics graduates have?

Please comment on their ability to learn and adapt.

How could Physics graduates be better? Do fresh graduates from other disciplines meet these expectations? Is it reasonable to expect university graduates to come with these attributes or are they better learnt/developed at work?

After a couple of years of employment, are Physics graduates different from those from other disciplines? If yes, in what way?

Would you employ a Physics graduate in preference to those from other disciplines? If so why?
## Graduate attributes table

Please fill in the first four columns of the following table by ticking the box that represents the level to which your employee(s) with a Physics education demonstrated a particular attribute, as gauged at the start of their employment with you, *i.e. the attributes they have*.

<table>
<thead>
<tr>
<th>Have attribute</th>
<th>Required (greater, less or OK)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>not at all</td>
</tr>
<tr>
<td><strong>computational skills</strong></td>
<td></td>
</tr>
<tr>
<td><strong>consideration of ethical and social issues</strong></td>
<td></td>
</tr>
<tr>
<td><strong>experimental design</strong></td>
<td></td>
</tr>
<tr>
<td><strong>information retrieval</strong></td>
<td></td>
</tr>
<tr>
<td><strong>laboratory skills</strong></td>
<td></td>
</tr>
<tr>
<td><strong>oral communication</strong></td>
<td></td>
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<tr>
<td><strong>problem solving</strong></td>
<td></td>
</tr>
<tr>
<td><strong>project planning</strong></td>
<td></td>
</tr>
<tr>
<td><strong>research methodology</strong></td>
<td></td>
</tr>
<tr>
<td><strong>teamwork</strong></td>
<td></td>
</tr>
<tr>
<td><strong>written communication</strong></td>
<td></td>
</tr>
</tbody>
</table>

Please say if there was another valuable attribute:

Could you now please fill in the last column, this time indicating whether a particular attribute should be present to a greater or lesser extent at the start of their employment, or whether it is about what you require (OK)?
Appendix C: Data Analysis & Results

C.1 Questionnaire

The dominant response categories are presented below with the number of institutions citing that response given in brackets.

B1. What challenges has your department faced in physics teaching and learning in the last 3-5 years?

- declining staff numbers and the general downsizing of departments (21)
- the inability to upgrade/upkeep laboratory/IT facilities and laboratory staff (14)
- counteracting the decline in student numbers (13)
- the loss of traditional service teaching and the need to find new ones (13)
- the amount of degree and subject restructuring that has been required (11)
- the poor mathematical (and physics) background of incoming students (11)
- the increased teaching loads on staff (10)

B2. How has your department responded to the challenges mentioned above?

- restructuring laboratories and curricula (14)
- introducing new majors, degrees, double degrees (e.g. Nanotechnology) (11)
- introducing new computer technology to teaching (e.g. WebCT) (10)
- reducing subject choices (8)
- sharing service teaching with other departments (7)
- use of part-time teaching staff (5)
- ↑ staff training, monitoring (5)
B3. What directions will the teaching and learning in your department take in the near future? Why?
Please note any specific changes that are planned.

- will provide more new subjects, majors, degrees (17)
- will provide more on-line delivery of subjects (15)
- will provide more service and multidisciplinary teaching (8)

B4. What are the strengths of the teaching and learning in your department?

- experienced an dedicated staff (15)
- the nexus with the research areas of specialisation (14)
- the interactions between students and staff (11)
- the quality of the laboratory program and the equipment (9)
- the development of new teaching ideas (8)
- the small class sizes due to small student numbers (8)

B5. Aside from traditional lectures, laboratories and tutorials, have you introduced new modes of teaching and learning?

- e-learning (e.g. WebCT) (19)
- undergraduate research projects (16)
- field trips (11)
- online testing and assessment (11)
- online tutorials (7)
- online/computer labs (7)
B6. Can you identify resources that could be developed cooperatively by the physics education community that could support the teaching and learning of physics in your department?

- other shared teaching resources (on-line and others, e.g. demonstrations, including database) (13)
- lab experiments, equipment (6)
- on-line subjects or modules - package (6)

B7 (part 1). Please make any general comments regarding student backgrounds entering physics, including effect of changes to high school physics or mathematics.

- most incoming students are currently weaker in maths (20)
- most incoming students are currently weaker in physics (12)
- there is a lack of uniformity in students’ preparation for first year physics (10)

B7 (part 2). How has your own department adapted to these changes?

- allowing extra time in first year to bring students up to speed (11)
- bridging courses (4)
- ↓ maths content (4)

C1 (part 1). What is the focus of your undergraduate physics majors program?

- focus on experimental, applied areas (14)
- focus on traditional, mainstream physics areas
- focus on specialist research areas (10)
- focus on a broad range of topics (6)
- focus on theoretical areas (6)
C1 (part 2). How would you describe or characterise a graduate from that program? (Please indicate if there are special skills that are particular to your graduates.)

- possessing generic scientific skills and graduate attributes (15)
- possessing specialised field/research skills (12)
- possessing IT skills (4)

C2. Physics departments have particular strengths within certain research areas. How is this reflected in your undergraduate curriculum? Are undergraduate students exposed to these research areas within the department?

- providing subjects within those areas (18)
- having students undertake projects within the research groups (11)
- examples of current dept research in lectures (7)

C3. For each of the years (1 to 3), approximately what fraction of the students’ contact time in physics is spent in experimental laboratories?

<table>
<thead>
<tr>
<th></th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 - 60%</td>
<td>1</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>41 - 50%</td>
<td>7</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>31 - 40%</td>
<td>11</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>21 - 30%</td>
<td>8</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>11 - 20%</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
C4. The following is a list of possible ways in which industry partners can be involved in the teaching of physics majors. Please tick those being currently used by your department.

- guest lecturers (16)
- advisory committees (12)
- field trips and site visits (11)
- optional industry projects (10)
- career advice (9)
- required industry experience (9)

C5. Does your physics majors program involve a component that is multidisciplinary?

- some multidisciplinary component (14)
- big multidisciplinary component (6)
- NO multidisciplinary component (6)

C6. Please describe the balance between applied and theoretical physics in your physics majors program.

- towards applied, experimental physics (12)
- towards theoretical physics (8)
- 50:50 (7)
### C7. Are your physics majors informed of jobs in physics? If so, how?

- via noticeboards (12)
- via the lecturers (7)
- via website information (6)
- NOT explicitly informed (6)
- via email newsletters (5)

### D1. Traditionally physics has been involved in teaching engineering, life science and medical science students. Please describe the changes in the past 3 to 5 years in such service and multidisciplinary subjects and the impact of these changes on your department.

- a general reduction in service teaching (mainly in Engineering) (19)
- move towards new areas of service teaching (10)
- reduction/elimination of physics content by other disciplines (9)
- ↑ input into curriculum by other disciplines (7)
- service teaching loss = ↓ funding (6)

### D2 (part 1). Please name the newer multidisciplinary degree programs that your department has been involved in developing and delivering.

- Nanotechnology (12)
- Photonics (6)
- double degrees (6)
D2 (part 2). Have such multidisciplinary programs been successful?

- quite successful (10)
- only attracted small numbers of students (7)
- only moderately successful (6)

D3. More institutions are offering double/combined/joint degrees. Have these programs been successful in your department? If so, how?

- popular and (largely) successful (16)
- not yet widely popular (12)
- mainly attract high achievers (11)
  - large % of their physics majors (5)
  - good employment opportunities (5)

D4. Approximately what fraction of your departmental income from teaching is from service and multidisciplinary teaching (not joint degrees)?

- 81 - 90 % (1)
- 71 - 80 % (3)
- 61 - 70 % (6)
- 51 - 60 % (4)
- 41 - 50 % (3)
- 31 - 40 % (1)
- 21 - 30 % (4)
- 11 - 20 % (3)
- 1 - 10 % (2)
- 0 % (1)
D5. How well supported is your service and multidisciplinary teaching?

- very well (11)
- the same as all other teaching (10)
- badly (4)

E1 (part 1). Are there any special features associated with teaching, subject content or assessment of students that are particularly effective/successful in your situation/department?

- undergraduate project work (7)
- weekly tutorials (7)
- online supplementary material (6)
- assessment regularly (4)

E1 (part 2). How have you measured their effectiveness and what are the outcomes?

- student evaluation surveys (11)
- student/staff liaison (4)

F1. How has your curriculum changed in the past 5 years in response to changing perceptions of employment opportunities?

- by introducing named/new degrees (12)
- put greater emphasis on generic skills (7)
- introducing topical subjects (5)
- It hasn’t (5)
F2. How does your department ascertain the suitability of your graduates for their various employment destinations? Do you obtain feedback from employers? If so, how?

- no direct feedback (11)
- informal feedback only (10)
- formal feedback, built-in (5)

G1. How does your department contribute to the training of school teachers? Please provide example(s) of both in-service and prospective teacher training.

- generally teaching to prospective physics teachers (21)
- providing in-service training through courses, development days, workshops (15)
- teaching into a double degree with Education (14)
- direct contact with school teachers through AIP, school visits (10)
- running courses training physics teachers (7)

G2. Is your department concerned about the shortage and training of high school physics teachers? If so, does your department plan to contribute to the training of high school physics teachers or increase its involvement with the Education faculty?

- all institutions stated that they were concerned
- just over half of them have some type of program in place to offset this trend
H1. Are there any forums for discussion of physics education (teaching innovation) within the department? If so, please provide examples of some of the forums.

- departmental committees, staff meetings (7)
- Faculty T&L forums (7)
- informally over tea/coffee (7)
- departmental T&L forums (5)

H2. How does your department (or faculty) support staff interested in curriculum enhancement and investigating issues related to teaching and learning of physics? Are staff who employ innovations in teaching and learning valued?

- resources, financially, and with sharing of teaching loads (18)
- encouraging staff to further their T&L qualifications (15)
- rewarding teaching in promotions (6)
- T&L innovation awards (5)
- dependent on available time (5)
- NO special support (5)

H3. Is there a mechanism for training new teaching staff (tutors, sessional and academic staff)?

- encouraging/requiring new staff to complete university run generic T&L courses (22)
- mentoring under senior staff (7)
- by providing dept run training courses (6)
- teaching cert. required (4)

C.2 Student Focus Groups
The student focus groups were run according to the protocol reproduced in Appendix B4. The top three responses to each question are set out below, for each of the six institutions where focus groups were conducted.

1. What features of your physics studies has most helped your learning?

<table>
<thead>
<tr>
<th>1st year mainstream</th>
<th>1st year service</th>
<th>3rd year</th>
<th>postgraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. regular assessment</td>
<td>1. worked examples</td>
<td>1. good study guides</td>
<td>1. lively lectures</td>
</tr>
<tr>
<td>2. examples in class</td>
<td>2. inspirational lecturers</td>
<td>2. experience as a student</td>
<td>1. challenging content</td>
</tr>
<tr>
<td>3. lab and group work</td>
<td>3. study guides</td>
<td>3. working at own pace</td>
<td>2. enthusiastic lecturers</td>
</tr>
<tr>
<td>1. student/staff communication</td>
<td>1. interesting lecturers</td>
<td>1. lecturers ability to teach</td>
<td>3. low student / teacher ratio</td>
</tr>
<tr>
<td>2. worked examples in lectures</td>
<td>2. practical components</td>
<td>2. web based resources</td>
<td></td>
</tr>
<tr>
<td>3. notes on the web</td>
<td>3. regular quizzes</td>
<td>3. good course structure</td>
<td></td>
</tr>
<tr>
<td>1. assignments</td>
<td>1. handouts in lectures</td>
<td>1. regular small assessment</td>
<td>1. Honours year thesis, research</td>
</tr>
<tr>
<td>2. worked examples in lecture notes</td>
<td>2. worked examples in class</td>
<td>2. problem solving assessment</td>
<td>2. interested lecturer</td>
</tr>
<tr>
<td>3. practicals</td>
<td>3. mid semester exam</td>
<td>3. notes on the web</td>
<td>3. labs</td>
</tr>
<tr>
<td>1. problem solving</td>
<td>1. examples in tutorials</td>
<td>1. regular assignments</td>
<td></td>
</tr>
<tr>
<td>2. tutorials</td>
<td>2. notes on the web</td>
<td>2. problem solving assessment</td>
<td></td>
</tr>
<tr>
<td>3. helpful lectures</td>
<td>3. demonstrations</td>
<td>3. notes on the web</td>
<td></td>
</tr>
<tr>
<td>1. smaller classes</td>
<td>1. examples in tutorials</td>
<td>1. regular small assessment</td>
<td>1. Honours year thesis, research</td>
</tr>
<tr>
<td>2. tutorials</td>
<td>2. notes on the web</td>
<td>2. problem solving assessment</td>
<td>2. interested lecturer</td>
</tr>
<tr>
<td>3. helpful lectures</td>
<td>3. mid semester exam</td>
<td>3. notes on the web</td>
<td>3. labs</td>
</tr>
<tr>
<td>1. problem solving</td>
<td>1. examples in tutorials</td>
<td>1. regular assignments</td>
<td></td>
</tr>
<tr>
<td>2. tutorials</td>
<td>2. notes on the web</td>
<td>2. problem solving assessment</td>
<td></td>
</tr>
<tr>
<td>3. helpful lectures</td>
<td>3. mid semester exam</td>
<td>3. notes on the web</td>
<td></td>
</tr>
<tr>
<td>1. regular assessment</td>
<td>1. practice (perplexing) questions</td>
<td>1. continuous assessment</td>
<td>1. peer support</td>
</tr>
<tr>
<td>2. physics studio workshops</td>
<td>2. lecture notes</td>
<td>2. studio learning environment</td>
<td>2. taught how to learn, problem solving</td>
</tr>
<tr>
<td>3. theory/practical balance</td>
<td>3. weekly assignments</td>
<td>3. problem solving in tutorials</td>
<td>3. practical, labs</td>
</tr>
<tr>
<td>1. access to knowledgeable teachers</td>
<td>1. overview of each section &amp; references to textbook</td>
<td>1. working through problems in tutorials &amp; assignments</td>
<td>1. continual assessment - assignments</td>
</tr>
<tr>
<td>2. tutorials - tutors &amp; other students</td>
<td>2. relevance of tutorials to lectures</td>
<td>2. applying &quot;maths tricks&quot; to physics problems</td>
<td>2. labs - hands on, physics in action</td>
</tr>
<tr>
<td>3. immersion in physics &quot;world&quot;</td>
<td>3. group work in practicals</td>
<td>3. starting with the &quot;story&quot; - maths</td>
<td>3. collaborating with other students</td>
</tr>
</tbody>
</table>
2. What do you think are the valuable skills and knowledge you have gained from your physics studies?

<table>
<thead>
<tr>
<th>1st year mainstream</th>
<th>1st year service</th>
<th>3rd year</th>
<th>postgraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. experimental, lab skills</td>
<td>1. logical thinking skills</td>
<td>1. ability to optimise problems</td>
<td>1. maths and computer modelling</td>
</tr>
<tr>
<td>2. organisation, co-operation</td>
<td>2. problem solving strategies</td>
<td>2. problem solving skills</td>
<td>2. problem solving, logic</td>
</tr>
<tr>
<td>3. time management</td>
<td>3. understanding of basic principles</td>
<td>3. systematic approach to problems</td>
<td>3. research methods</td>
</tr>
<tr>
<td>1. problem solving skills</td>
<td>1. background knowledge</td>
<td>1. problem solving skills</td>
<td>1. learning how to learn</td>
</tr>
<tr>
<td>2. better approach to problems</td>
<td>2. experimental method</td>
<td>2. understanding of how technology works</td>
<td>2. independence with support</td>
</tr>
<tr>
<td>3. how things work, laws</td>
<td>3. everyday physics applications</td>
<td>3. thinking in terms of models</td>
<td>3. problem solving</td>
</tr>
<tr>
<td>1. physics description of everyday</td>
<td>1. description of everyday things</td>
<td>1. analytic, problem solving skills</td>
<td>1. problem solving</td>
</tr>
<tr>
<td>2. logical thinking</td>
<td>2. good general knowledge</td>
<td>2. can see how things work in everyday</td>
<td>2. logical thinking</td>
</tr>
<tr>
<td>3. calculation skills</td>
<td>3. teamwork</td>
<td>3. logical thinking</td>
<td></td>
</tr>
<tr>
<td>1. analytical skills</td>
<td>1. understanding of fundamentals</td>
<td>1. ability to apply</td>
<td></td>
</tr>
<tr>
<td>2. understanding of fundamentals</td>
<td>2. logical thinking</td>
<td>2. power to understand</td>
<td></td>
</tr>
<tr>
<td>3. skills in synthesising</td>
<td>3. problem analysis</td>
<td>3. analytical skills</td>
<td></td>
</tr>
<tr>
<td>1. ability to apply</td>
<td>1. application of basic physics concepts</td>
<td>1. operating equipment</td>
<td></td>
</tr>
<tr>
<td>2. power to understand</td>
<td>2. basic physics concepts</td>
<td>2. understanding physical processes</td>
<td></td>
</tr>
<tr>
<td>3. analytical skills</td>
<td>3. how to approach problems</td>
<td>3. application to other disciplines</td>
<td></td>
</tr>
<tr>
<td>1. data processing using computer software</td>
<td>1. application of physics to other disciplines</td>
<td>1. problem solving, logical / critical thinking</td>
<td>1. scientific way of thinking</td>
</tr>
<tr>
<td>2. problem solving</td>
<td>2. everyday applications</td>
<td>2. research skills</td>
<td>2. analytical skills</td>
</tr>
<tr>
<td>3. lab report writing</td>
<td>3. report writing</td>
<td>3. communication, report writing</td>
<td>3. report writing</td>
</tr>
<tr>
<td>1. learning &amp; experimentation using scientific method</td>
<td>1. error analysis</td>
<td>1. computational skills</td>
<td>1. analytical approach to thinking</td>
</tr>
<tr>
<td>2. application of physics to mathematics</td>
<td>2. problem solving skills</td>
<td>2. identifying what is essential, negligible</td>
<td>2. problem solving skills</td>
</tr>
<tr>
<td>3. application to the real world</td>
<td>3. scientific instrumentation</td>
<td>3. using maths in science</td>
<td>3. mathematics</td>
</tr>
</tbody>
</table>
3. Have your physics studies related physics to other areas of science and technology? If so, how?

[first year service] Has your first year physics related physics to the needs and directions of your degree? If so, how?

<table>
<thead>
<tr>
<th>1st year mainstream</th>
<th>1st year service</th>
<th>3rd year</th>
<th>postgraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. connections with maths</td>
<td>1. direct relation with real life problems in engineering</td>
<td>1. overlap with chemistry at the atomic level</td>
<td>1. physics makes you aware of all its applications</td>
</tr>
<tr>
<td>2. connections with computing, eng.</td>
<td>2. areas liked in physics, liked in engineering</td>
<td>2. everything related to physics</td>
<td>2. all bits come together at the end</td>
</tr>
<tr>
<td>3. connection with IT (and skills in)</td>
<td>3. not specifically, only broadly</td>
<td>3. astronomy and elec. eng.</td>
<td>3. don’t remember</td>
</tr>
<tr>
<td>1. basis for much of engineering</td>
<td>1. foundation – crosses over to all courses</td>
<td>1. physics is core which relates to other sciences</td>
<td>1. case studies helped relate physics to other areas</td>
</tr>
<tr>
<td>2. basis for lots of maths</td>
<td>2. provided the experimental skills</td>
<td>2. makes understanding other subjects easier</td>
<td>2. scope for branching out in degree</td>
</tr>
<tr>
<td>3. nanotechnology</td>
<td>3. refreshing of skills helpful</td>
<td>3. relates to almost all other subjects</td>
<td>3. no</td>
</tr>
<tr>
<td>1. algebra a huge part of physics</td>
<td>1. general overview of physics</td>
<td>1. helps with maths</td>
<td>1. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>2. chemistry: energy &amp; atomic structure</td>
<td>2. good explanations but sceptical as to use</td>
<td>2. helps to understand popular science articles</td>
<td>2. conceptual underpinnings merge</td>
</tr>
<tr>
<td>3. problem solving in maths &amp; chem</td>
<td>3. back’d platform for other sciences</td>
<td>3. understand eng. subjects better</td>
<td>3. methodologies similar for x &amp; t</td>
</tr>
<tr>
<td>1. physics is integrating by its nature</td>
<td>1. helps with skills in chemistry and maths</td>
<td>1. helps with maths</td>
<td>1. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>2. gives a reason for learning maths</td>
<td>2. not sure of direction of degree</td>
<td>2. helps to understand popular science articles</td>
<td>2. scope for branching out in degree</td>
</tr>
<tr>
<td>3. chem. overlap: thermodynamics</td>
<td>3. helps with chem. &amp; mech. eng.</td>
<td>3. understand eng. subjects better</td>
<td>3. no</td>
</tr>
<tr>
<td>1. application of engineering principles</td>
<td>1. understanding of concepts, can be applied other areas</td>
<td>1. ???</td>
<td>1. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>2. maths</td>
<td>2. maths: e.g. vector analysis</td>
<td>2. communications</td>
<td>2. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>3. use of graphs</td>
<td>3. relate to solving life problems</td>
<td>3. engineering</td>
<td>2. scope for branching out in degree</td>
</tr>
<tr>
<td>1. better understand theories in chem: thermodynamics</td>
<td>1. knowledge about equipment used in other areas</td>
<td>1. applications covered briefly at end of unit</td>
<td>1. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>2. in other lab disciplines: use physics application</td>
<td>2. physics concepts relate specifically to other areas</td>
<td>2. glazed over, only covered in passing</td>
<td>2. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>3. in a very general way</td>
<td>3. focus: technical aspect of degree</td>
<td>3. not applied much</td>
<td>3. industry applications</td>
</tr>
<tr>
<td>4. biology (molecular), chem. (atomic), geology (fragg’s)</td>
<td>4. some parts reinforce concepts in degree, others not relevant</td>
<td>4. computational applications to technology</td>
<td>4. not generally to other areas</td>
</tr>
<tr>
<td>1. chemistry derives from physics</td>
<td>1. general information relevant to degree</td>
<td>1. computational applications to technology</td>
<td>1. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>2. applications to space eng.</td>
<td>2. general information relevant to degree</td>
<td>2. computational applications to technology</td>
<td>2. by nature physics covers other areas: maths, chem</td>
</tr>
<tr>
<td>3. molecular biology and maths</td>
<td>3. computational applications to technology</td>
<td>3. computational applications to technology</td>
<td>3. by nature physics covers other areas: maths, chem</td>
</tr>
</tbody>
</table>
4. Have your physics studies helped you find out about employment opportunities for physics graduates? If so, how?

[first year service] What is the value or usefulness of your first year physics studies to your degree?

<table>
<thead>
<tr>
<th>1st year mainstream</th>
<th>1st service</th>
<th>3rd year</th>
<th>postgraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. lecturer shows career path as postgraduate/researcher</td>
<td>1. introduction to which field you will choose in eng.</td>
<td>1. NO!</td>
<td>1. government institutions</td>
</tr>
<tr>
<td>2. a sense of a range of options - no specifics</td>
<td>2. establishes knowledge base across all areas</td>
<td>2. no access for externals</td>
<td>2. limited opportunities exist</td>
</tr>
<tr>
<td>3. no specific info</td>
<td>3. physics provides tech. knowledge</td>
<td>3. perception: not many options</td>
<td>3. not much, bits only, v. general</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. nanoscience talks about careers</td>
<td>1. foundations with following subjects</td>
<td>1. not a lot of info is passed on - no common approach</td>
<td>1. lecturers tell you about experience of other graduates</td>
</tr>
<tr>
<td>3. no - internship may help</td>
<td>2. opens eyes to applicability in the real world</td>
<td>2. internships are good but mostly with govt dept</td>
<td>2. info on noticeboards, types of job available</td>
</tr>
<tr>
<td>3. ???</td>
<td>3. no ideal situation exist in life</td>
<td>3. science industry part/ship needed</td>
<td>3. summer sch'ship provide exposure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. small class told about main paths for physics majors</td>
<td>1. little relevance - see no relationship with solar energy</td>
<td>1. need more suggestions about portability - outside physics</td>
<td>1. no</td>
</tr>
<tr>
<td>2. opportunity to go to workshop on jobs</td>
<td>2. not yet useful - expect it will in later years</td>
<td>2. aware of options due to physics careers seminar</td>
<td>2. no - need to find out for yourself</td>
</tr>
<tr>
<td>3. advisory day talks - science careers</td>
<td>3. helps with other subjects</td>
<td>3. need for H.S. physics teachers</td>
<td></td>
</tr>
<tr>
<td>4. advisory day talks - science careers</td>
<td>4. little relevance - see no relationship with solar energy</td>
<td>4. little relevance - see no relationship with solar energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. 1. not yet</td>
<td>1. provide a broad view of physics</td>
<td>1. talks by special guests</td>
<td></td>
</tr>
<tr>
<td>2. ideas of various possible employment paths</td>
<td>2. big impact on other parts of studies</td>
<td>2. informed by the lecturer on work in research</td>
<td></td>
</tr>
<tr>
<td>3. lead to studying of other subjects</td>
<td>3. IBL - help to look at jobs available</td>
<td>3. IBL - help to look at jobs available</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. 1. only about dept research groups</td>
<td>1. provides fund. understanding &amp; practical implementation</td>
<td>1. told little about opportunities past graduates info needed</td>
<td>1. can use physics knowledge, skills in many areas</td>
</tr>
<tr>
<td>2. eg of different areas used in lectures</td>
<td>2. provides useful foundation to degree</td>
<td>2. &quot;work experience&quot; type unit would be helpful</td>
<td>2. if specialising in physics need further study</td>
</tr>
<tr>
<td>3. lecturers talk of physics teaching</td>
<td>3. not highly useful to degree</td>
<td>3. only PhDs - need to see industry</td>
<td>3. dept newsletter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. 1. talking to physicists inside and outside uni</td>
<td>1. apply understanding gained in physics to other subjects</td>
<td>1. work exp. would be useful - what does a physicist do?</td>
<td>1. NO!</td>
</tr>
<tr>
<td>2. exposure to PG students</td>
<td>2. useful, future research career in science</td>
<td>2. no! ( despite having thought this advice)</td>
<td></td>
</tr>
<tr>
<td>3. no</td>
<td>3. feel for which subjects to do</td>
<td>3. general answers - optics, photonics</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: AIP Accreditation

D.1 Information for Universities seeking to have a qualification accredited by the Australian Institute of Physics

(1) Issues considered in the accreditation process.

In examining an individual course for accreditation purposes, the accreditation panel will consider the following factors:

- the general academic practices and standards of the education institution;
- the objectives of the course and the methods adopted to achieve these objectives;
- the standards of admission to the course;
- the duration of the course;
- the breadth, depth and balance in the subjects involved and the intellectual effort and demands of the course;
- the methods of assessment of student progress;
- the arrangements for practical training and experience as part of the course;
- the teaching staff conducting the course, their numbers, professional qualifications and experience and their educational expertise;
- the accommodation and facilities available including equipment, libraries, laboratories, workshops etc.

Each University requesting accreditation of a course or courses will be required initially to provide the information listed below in a clear and concise form and subsequently to host a visit of up to one day's duration by an accreditation panel. This panel will normally comprise 3 members of the full Accreditation Committee of the AIP.

(2) Documentation required:

(It is anticipated that most of the documentation required could be extracted by Universities from existing Handbooks and similar publications.)

- a statement of the objectives of the course;
- a statement of the requirements for completion of the degree (or the degree sequence for which accreditation is sought);
- a calculation of the amount of physics and mathematics in the course which shows how it is believed to satisfy the AIP requirements;
- detailed syllabi of all units, classifiable as physics or mathematics, which could be included in a properly constituted course including details of texts, and the relevant pre- and co- requisites;
- a description of a typical program of study leading to the award of the degree;
- a statement of the method of assessment used and their relative weightings;
- brief resumes of the physics staff involved in teaching the course and a summary list of all physics staff which includes their highest qualification and professional memberships. If this qualification is not in physics then the highest physics qualification should also be given;
- any other material considered relevant by the University.
D.2 IEAust Policy on accreditation of professional Engineering programs

This section reproduces the Policy as issued by the Council of IEAust in November 1997. Minor amendments have been made, such as substitution of the word program for course. Clauses of the Policy are numbered as in the original issue.

(1) Preamble.

University education provides the learning base upon which competence for a professional engineering career is built. It is important that the education provides the graduate with the generic attributes listed in Section 2 below. It is equally important that the education process be accredited by the Institution of Engineers, Australia (IEAust) to give confidence to the students, the universities and the profession that the education will indeed provide a graduate with the required attributes. Through the process of accreditation of university education, as the representative of the profession, IEAust will:

- ensure that graduates from an accredited program are adequately prepared to enter and to continue the practice of engineering;
- promote best practice;
- promote the standing of accredited programs to members and potential members of the engineering profession in Australia.

(2) The Generic Attributes of a Graduate.

Graduates from an accredited program should have the following attributes:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of professional and ethical responsibilities and commitment to them;
- expectation of the need to undertake lifelong learning, and capacity to do so.