SUBJECT REVIEW REPORT

DEPARTMENT OF MATHEMATICS

FACULTY OF SCIENCE
UNIVERSITY OF RUHUNA

13th to 15th June 2007

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1. SUBJECT REVIEW PROCESS

Subject review process of the University Grants Commission (UGC) involves evaluating the quality of education within a specific subject or discipline, focusing on the student learning experience and on student achievement. This subject review process evaluates the quality of both undergraduate and taught postgraduate programs. It is understood that the final responsibility for quality and standards remains within the institution itself, since it alone has the powers to control and to change existing practices.

Subject review process at the Department of Mathematics (DM) of the University of Ruhuna was conducted following the guidelines provided in the Quality Assurance Handbook for Sri Lankan Universities, published by the Committee of Vice Chancellors and Directors (CVCD) and UGC in July 2002. The quality of education was reviewed according to the aims and learning outcomes given in the Self-Evaluation Report (SER) of the DM, which was made available to review team prior to the review.

The following eight aspects of education were reviewed at the Departmental level:

- Curriculum design, content and review;
- Teaching, learning and assessment methods;
- Quality of students including student progress and achievements;
- Extent and use of student feedback (both qualitative and quantitative);
- Postgraduate studies;
- Peer observations;
- Skills development;
- Academic guidance and counselling.

The review team visited the department for three days, namely 13th, 14th and 15th of June 2007. The agenda of the three-day visit is given in Annex 1. The information related to the above eight aspects were collected by:

- SER and the power point presentation given by the head of DM in the presence of other academics of the DM.
- Having discussions with the Acting Vice Chancellor, Dean of the Faculty of Science, Head of the Department, members of the academic and non-academic staff (see Annex 2 for persons attending), ~~a~~ group of about 50 General degree students and the final year Mathematics Special degree candidates.
- Observation of the teaching process (Annex 3)
- Observing the facilities at the Department (see Annex 4) and
- Examining the documents provided by the Department (see Annex 5).

At the end of the 3rd day of the review team's visit, an opportunity was given to the Department to respond to various clarifications sought by the review team.

Each of the eight aspects was judged as good/satisfactory/unsatisfactory/NA, noting the strengths, good practices, weaknesses or showing that giving a judgement is not possible under prevailing circumstances.

The review report is organized as follows. After presenting a brief history of the University of Ruhuna, the Faculty of Science and the Department of Mathematics in section 2, the section 3

presents the aims and the expected learning outcomes of Department of Mathematics as given in the SER. The findings of the Review team on each aspect are presented in section 4. The judgments on each of the eight aspects are presented in section 5. The report finally provides some recommendations to improve the quality of the program in section 6.

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

The department was founded in 1978 with two academic staff members under the Ruhuna University college, affiliated to the University of Kelaniya, at the Technical College, Matara. In the beginning the department offered 2 subjects in the B.Sc. general degree programme, namely Mathematics and Further Mathematics.

Following are the contents of the above two subjects:

First Year

Mathematics	**Further Mathematics**
Algebra	Dynamics
Geometry	Fluid Dynamics
Differential Equations	Statics
Analysis	Elementary Topology, Metric Spaces
Vector Algebra	Logic
Vector Analysis	

Second Year

Mathematics	**Further Mathematics**
Algebra	Dynamics
Geometry	Quantum Mechanics
Probability Theory	Probability Theory
Differential Equations	Number Theory
Mathematical Method	Differential Geometry and
Analysis	Elementary Tensor Analysis

Third Year

Mathematics	**Further Mathematics**
Algebra	Fluid Dynamics
Statistics	Modern Analysis
Analysis	Statistics
Differential Equations	Numerical Analysis
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The department was re-located at the present location in the main university complex at Wellamadama in 1985 together with the whole of Faculty of Science. At present, the department constitutes of 12 permanent (although there should be 19 according to the normal norm) and 18 temporary members of staff. Since 1978 the department has been dedicating

to promote higher education in Mathematics in Sri Lanka as a department of one of the major national universities. Every student who registered in the Physical Science degree stream was required to follow Mathematics as one of the subjects as it provides required skills in Mathematics that help learn other subjects such as Physics, Computer Science and Chemistry.

Under the Physical Science Degree stream the University of Ruhuna presently offers the following subject combinations.

-Mathematics, Applied Mathematics, Computer Science
-Mathematics, Applied Mathematics, Physics
-Mathematics, Applied Mathematics, Chemistry
-Mathematics, Industrial Mathematics, Chemistry
-Mathematics, Industrial Mathematics, Physics
-Mathematics, Physics, Chemistry
-Mathematics, Physics, Computer Science
-Mathematics, Chemistry, Computer Science

According to the present regulations students who do not follow Computer Science have to complete the Computer Literacy Course conducted by the Department of Computer Science.

3. AIMS AND LEARNING OUTCOMES

According to the SER, the aims of the Department of Mathematics and the expected learning outcomes of its study programs as given in the SER of the Department of Mathematics are presented in this section. These are very important to the review process as the objective of this exercise is to judge whether the Department conducts an effective program to achieve these outcomes set by the Department it self. Although there are three general degree programs and one special degree program offered by the department, the committee noted that the expected learning outcomes are presented in the SER more in a general manner. It is more appropriate if the learning outcomes are specified for each study program conducted by the Department, separately.

3.1 Aims

Main aims of the department, given in the SER are;

i. to produce graduates with a vigorous and applicable knowledge in Pure and Applied Mathematics and Statistics who are competent in international level,
ii. to guide the undergraduates to seek the possibilities in applying the Mathematical and Statistical techniques in Pure or Applicable contexts
iii. to convince the industries the importance of using mathematical and computational methods in problem solving,

3.2 Learning Outcomes

On successful completion of our study programme students are expected to

i. gain fundamental and detailed knowledge and understanding of theory and techniques in areas of Mathematics and Statistics.
ii. understand how to use and apply abstract concepts.
iii. learn, improve and practice problem solving skills.
iv. gain experience in independent learning and self studying.

v. develop computer programming skills.
vi. use mathematical methods in other areas of Sciences.
vii. gain experience in using computer software packages.
viii. develop communication skills.
ix. gain the foundation knowledge required in Mathematics and continue towards postgraduate studies.
x develop research potential in areas in Mathematics relevant to the national development.

4. FINDINGS OF THE REVIEW TEAM

4.1 Curriculum Design, Content and Review

Aims and the expected learning outcomes of the DM are to produce graduates with sufficient knowledge in the fundamental mathematical concepts who are capable of applying those skills successfully for the national development. This is in agreement with the Ruhuna university's mission: the Ruhuna University is committed to quality education, research excellence, and strategic partnership with industry and community.

Founded in 1978, the DM has enjoyed almost 3 decades of generous financial support both from local and foreign sources. There are excellent lecture theatres and a moderate size computer laboratory for students and another computer laboratory for the academic staff.

DM has initially introduced the two subjects Mathematics and Further Mathematics to the Physical Science curriculum. Starting with two academics in 1978 it has come a long way by now to have 12 permanent academics and 18 temporary members in the staff. DM presently teaches 3 subjects: Mathematics, Applied Mathematics and Industrial Mathematics (IM) for the general degree. It chooses students to follow the Special degree program in Mathematics at the end of the second year in the undergraduate program. At the moment all 210 students admitted to the Physical Science stream are following Mathematics as one of the three subjects while 40 of them follow IM as another subject. Out of the remaining 170, 120 are following the Computer Science and there are 50 students who do not follow either IM or Comp. Sc.

Positive aspects:

- DM has accepted the social responsibility and has tried to adjust the curriculum according to the societal needs. From the beginning it has diverted from the conventional universities and had introduced Further Mathematics and later had changed it to Applied Math via Applicable Mathematics. Introduction of IM as one out of the 3 undergraduate level subjects seems very promising. Perhaps DM is the first National University to do so.
- As expected, projects are compulsory for IM students in all three levels. Academics seem to take the burden of supervising, guiding and assessing 120 undergraduate projects for the benefit of the students. These students have supervised practical sessions to carry out their project work and these IM students get the opportunity to do independent studies under the supervision of an academic. Panel had the opportunity to observe presentations of such independent studies group of first year students and we felt that it is a very positive approach to encourage students'

curiosity. Committee felt that the IM students have been taken care of pretty well through their independent studies program during the first year and through the supervised project work during the subsequent years. As such they get enough opportunity to interact with the faculty members.

- After the inception in 1978, the DM has had periodic reviews and revised the curriculum in a very progressive direction. After two decades they have been able to establish their own Special degree program and thereby giving the good and promising students the opportunity of continuing their education at the DM itself without having to move to the University of Kelaniya. After the establishment of the special degree program in 1978, they have had another major review of the curriculum in the year 2000. All these are welcome moves towards progress. .

Negative aspects:

- Absence of an industrial internship program (IIP) is a major drawback for the IM students. Panel recognizes the challenges faced by the DM to find appropriate IIP for 120 students in all 3 years of the program. However, it is imperative that they at least had one such IIP be it as a group or individual.
- The difference between the subjects IM and AM is solely due to project component in IM. They seem to do common theoretical courses.
- Although the Department already possesses ample human resources, it has not introduced more appropriate industrial mathematics courses such as Optimization, Operations research and Control Theory.

Out of the 210 students following the subject mathematics, apart from the 40 IM students and 120 Comp. Sc. students the balance 50 students do not seem to get enough exposure to computing. Though the DM claims that they have the opportunity to follow the Computer Literacy course, the panel felt that such a course followed by even biological science students is hardly adequate to sharpen the computational skills of these Physical Science students. Mathematics curriculum should contain at least on Computational Mathematics course for those students. **For those who follow** either **IM or Comp Sc. could be given another option to follow.**

- Though the department possesses enough expertise, it was surprising to see that none of the Numerical Analysis courses is supported by computer practical classes. It is essential to conduct computer practical classes along with Numerical Analysis theory classes to provide proper understanding of the material.
- Introducing Topology as a compulsory subject at the general degree level is questionable.

4.2 Teaching Learning and Assessment Methods

Apart from the project work done by 4/21 (<20%) of the student intake DM follows the conventional teaching and learning strategies based on presentation of material by the lecturer followed by tutorial classes.

We observed five teaching sessions by a wide spectrum of academics (Annex 3) from grade I senior lecturer level to temporary lecturer and 2 tutorial sessions. One lecturer supported his teaching with power point presentations and another used the computer to demonstrate conceptual behaviour. Medium of instructions was mostly Sinhala. Except or two classes, expected learning outcomes were explained well in other classes. Lectures were conducted in a professional manner. Visibility of what was written on the board and the

audibility of the lecture was satisfactory. Lecturers were well prepared and the presentation of material was done in a proper manner. Presented subject matter was at an appropriate level.

However, student participation was poor and hence the success of the lecture as a two-way communication was not there. At least one lecturer encouraged student participation by asking questions and running the lecture comparatively slower.

The few tutorial classes we observed were conducted in a satisfactory manner. While one instructor was asking questions, assigning small problems to be solved and explaining from the stage, 2-3 of other instructors went around the class helping the students. This seems to be an excellent way of getting the maximum benefit of the tutorial staff without letting only a few students to get the benefit of the talented staff.

Assessment of almost all courses seems to be by the end of semester written examinations. This is no longer acceptable and very old fashioned in a Department of Mathematics. No matter how well the material was taught, the majority of the students does not grasp the important concepts without periodic testing and thereby encouraging the proper understanding. Hence it is imperative that the DM makes it compulsory for every lecturer to conduct mid-semester examinations and/or pop up quizzes or some other means to assess students understanding level of the material so that both the lecturer and the student can adjust themselves.

When asked about the procedure adopted in choosing the external examiners for moderating, the DM said that it usually goes to the web pages of the other Universities and finds out the experts in the relevant fields and discusses in a department meeting. Then the Head contacts them over the telephones or e-mails and, the relevant subject contents are informed. If they agree to serve, their names are sent to the Faculty and Senate for approval. Then official letters are issued to each external examiner by the Faculty office. However, while conversing the panel found out that some papers that needed expertise have been moderated by academics that do not possess the expertise in the specific subject areas. The committee felt that a subject expert, especially when an external examiner does it, should do the moderation.

4.3 Quality of Students, including Student Progress and Achievements

The students entering the BSc general degree programme in Faculty of Science have Z scores varying from 0.0115 to 1.5444 for batch 2006/2007. Thus the faculty has the challenge of providing education for a wide spectrum of students.

The DM did not have information on the Z scores of Physical Science students and the performance in AL for mathematics of the students following Applied Mathematics and Industrial Mathematics courses and Mathematics Special program. It could have been valuable information to evaluate the progress of the students.

For the Industrial Mathematics course the 40 students are selected by an aptitude test in general mathematics, which is held in the first week of the academic year. This guarantees the quality of students entering the IM program. However, the department did not have ready information to say how the students who are following the three courses in mathematics progress over the three years.

The special degree students are selected at the end of second semester of level II based on the performance of the examination marks of course units of level I and level II of BSc general degree program. They should have done either IM or AM in addition to Mathematics to be considered for the program. Only a very few students (maximum of 4 so far) get selected to do the Mathematics special degree. According to the data provided in the SER, in 2005 two out of four students did not complete the degree.

The DM does not have employment records of the General degree students. However, the Mathematics Special degree graduates seem to be performing well mostly as academics.

The committee felt that the Department should have kept much closer track of its graduates' employment records and specially the progress of its undergraduates.

The committee also noticed that the students in the Faculty of Science are exclusively Sinhalese, as the degree programs of this Faculty are supposed to be conducted in Sinhala medium.

4.4 The Extent and Use of Student Feedback

Positive Aspects

1. The Department has commenced using a questionnaire to obtain a feedback from the students in the last semester.
2. The comments and inputs from the Junior staff who assist the tutorial classes also provide a feedback on the teaching learning process
3. At certain lectures the students are randomly advised to keep carbon copies and at the end of the lecture these are collected and reviewed by the lecturers.
4. The curriculum reforms in 2000 has been based on the requests from the students

Negative Aspects

1. Although a questionnaire has been developed and used since the last semester by some members of the staff, the Department has still not made it compulsory for all staff members.
2. There is also no formal mechanism to assess the feedback obtained from the students and to assure that their comments are reasonably accommodated.

4.5 Postgraduate Studies

At present the Department of Mathematics does not offer any taught- postgraduate programs. However the Department staff members have taken a keen interest in conducting research based postgraduate degree programs. A number of MPhil degrees have already been completed by the Department. In addition some the Department staff members are actively involved in research activities and have secured National research grants and have published the work.

Some members of the staff are also involved in conducting courses for PG programs offered by other Departments, Faculties and other universities. They have demonstrated their commitment to research activities by registering and carrying out research leading to M. Phil degrees and also supervising some M. Phil and M. Sc. Students.

On the other hand the Department do not have an environment conducive to start a taught-PG program. It may not be possible to attract enough candidates for such a program, due to its

location and hence it would not be financially viable. Due to the same geographical factors, the Department might have to depend totally on its internal staff, which would adversely affect the on-going undergraduate programs.

4.6 Peer Observation

The Department provided evidence to show that they have initiated the process towards peer evaluation, and at least one member has implemented it in the last semester. However the department has not made it compulsory for all academics and a procedure to implement it has not been decided, and the students were not aware of that such process is taking place.

The SER provides other activities that could give an input to the lecturer on his/her teaching activity by another staff member. Following are some of them that the panel found convincing.

- Moderation of the examination papers by senior staff members of the department and discussing with the lecturer whenever necessary.
- Temporary staff who conduct lectures are supervised by a senior staff member.
- When the tutorials are prepared, tutorial staff members are advised to discuss the tutorials and answers with the senior members
- The staff members guide instructors and tutorial staff who work as demonstrators at the computer lab before the practical classes are conducted.

Although these aspects can be considered as good practices for the quality education, it does not cover the major aspect of the peer observation of teaching.

4.7 Skills Development

Computer skills

Of all the different eight subject combinations under the physical science degree stream where mathematics subject is common, all the students who do not follow Computer Science have to complete a Computer Literacy course. Basic computer awareness is guaranteed to all students, in this manner. However, not all the students who are following a mathematics subject get an opportunity to gain computer programming skills as mentioned in the learning outcomes.

The committee observed that the students following the Industrial Mathematics subject get very good opportunities to develop their programming skills and the application of computer software packages. Similar opportunities are not provided to students who are following Applied Mathematics and mathematics. Committee also observed that the computer programming component has not been introduced in courses such as Numerical Methods for the students to gain skills in this aspect.

Overall the committee feels that except for the Industrial Mathematics Subject, the opportunities are inadequate in the subject mathematics to provide computer skills to the students.

Communication skills

Although the development of communication skills has been identified as a learning outcome, it was not clear how the program is steered to achieve this, except for the case of Industrial mathematics, and mathematics special students. The project/research component in

the Industrial mathematics and the special degree help the students to develop their communication skills through report writing and presentation. Project component under the Industrial mathematics even in the first year help the students to develop such skills.

Skills for self-learning

Self-learning is usually in-built in the education process. However, a program could be designed to enhance the self-learning process that would lead to self-study of content that has not been taught in the regular classrooms. The Department has introduced this aspect very strongly in the industrial mathematics program and in the special degree program. There was no special attempt taken by the department introduce this in the mathematics and applied mathematics programs.

4.8 Academic Guidance and Counseling

The department has appointed a senior academic staff member as the academic advisor to discuss the problems related to course units. However the department lack a formal set up and mechanism to discuss and assist the students on the academic issues.

There was evidence to say that the Department staff is sensitive to the problems the students face in the academic and personal matters, and has provided assistance to resolve these problems.

There was evidence to say that, the students are assigned as a group of three or four to each academic staff member for guidance in problem solving and report writing, only for Industrial mathematics students.

However there is no formal mechanism in the department level or faculty level to guide the students in selecting their course combinations and also in selecting the maths special program.

The university has a career guidance unit and each faculty has a career guidance advisor, and this unit seems to offer programs for career planning, career development and skill development. However, the Department in general do not have career guidance program to guide the students on the job opportunities, industrial exposure and multi disciplinary role of mathematics, which would motivate the students to perform better.

5. CONCLUSIONS

Based on the observations made during the review team visit, email correspondence and the information given in the SER our judgements are given as follows:

Aspects Reviewed	Judgment
1. Curriculum Design, Content and Review	Good
2. Teaching, Learning and Assessment Methods	Satisfactory
3. Quality of Students, including Student Progress and Achievements	Satisfactory
4. Extent of student feedback, Qualitative and Quantitative	Satisfactory
5. Postgraduate Studies	N/A*
6. Peer Observation	Unsatisfactory
7. Skills Development	Satisfactory
8. Academic Guidance and Counseling	Good

Overall Judgment - Suspended

6. RECOMMENDATIONS

- DM should make it compulsory for all academics to distribute a course outline to the students on the first day of classes of every course unit with the following information.
  a) Credit value of the course
  b) Aims & objectives
  c) Expected topics to be covered with tentative dates.
  d) Assessment criterion
  e) Expected learning outcomes.
  f) Recommended reading

- Assessment criterion should compulsorily consist of at least one of the following in addition to the final examination held during the examination period.
  a_1) continuous assessments
  a_2) computer practical examinations
  a_3) popup quizzes
  a_4) homework with assigned marks
  a_5) mid semester examination

  It should be emphasised here that once a course is in progress, there should be at least one of the above mentioned evaluation procedures before it is too late. Outcome of such an evaluation would necessarily transpire the level of understanding of the student and also the student will get an opportunity to revise the material and to know what is expected.

- Encouraging students' participation during the lecture. Since there is a tendency among students not to speak up during the lecture, lecturers should try to get them participated by encouraging them to write their problems in a piece of paper and pass the chit to the front row, so that the lecturer could get to know their difficulties without any identification.

- DM should collectively agree upon a questionnaire for students to evaluate the lecturer and the course content, to be given at the end of the semester for each and every course. There should be a mechanism to analyse such student evaluations.

- Peer observation of teaching should be implemented after the DM agrees upon a code of conduct.

- DM should appoint a committee of 2-3 academics to develop an Industrial Internship Program (IIP) for IM students. This committee should try to
  a) find industrial organizations that could be sufficient to provide IIP opportunities to the aforesaid students.
  b) Develop a criterion to evaluate students' performance in IIP.
  c) Guide the students before the IIP, while the IIP is in progress and while they are preparing the report and getting ready for the presentation after the IIP.

- DM should make arrangements to provide the 50 students, following Mathematics without doing the subjects Computer Science or IM, at least 2-3 hours per week of computer access. DM could use the computers from the pool of the Faculty of Science in addition to the Department's computer laboratory for this purpose. It is worth even buying 30-40 computers to smoothen this procedure.

- There should be a compulsory computer practical component for every Numerical Analysis course and the weekly practical classes should be assigned after grouping the students. At least 10% of the final grade of the Numerical Analysis course should be for the performance for computer practical component or for continuous assessments requiring computer practical.

- DM should introduce a technical writing course unit preferably to all Mathematics students or at least for the Mathematics Special curriculum. The lecturer in charge of this course unit or any other competent academic should help improve students' communication skills, guide the students when they write project reports so that they could submit an error free (or at least with minimal language errors) project report.

- Even though the special degree curriculum does not interfere with other subjects when preparing the timetable, DM should make every effort to conduct Special Degree lectures within the normal semester without extending their semester beyond the 15-weeks. If some Special degree courses are extensions of the General Degree courses, DM should assign a separate slot for Special Degree students with more time.

- Staff members should hold regular meetings with a group of students from each program at each level to get a feedback from the students to know how the courses in particular and the program as a whole are progressing.

- DM with such a competent academic staff should consider offering at least another mathematics course for Biological Science students. This could take care of some of the problems the Bio Science students would encounter later in their academic life.

- DM should try to go for a new scientific code system for courses. It would be better if all courses conducted by the DM start with the same letters such as MAT or MATH. (If there are no degree subjects such as Mathematics, Applied Mathematics or Industrial Mathematics, letters of the code of the course unit would only indicate that from which department the course is offered.

- DM (together with the Faculty of Science) should try to introduce
  i) non-subject based degree awarding procedure going away from the 3- subject degree so that students have more flexibility to choose the courses that they want to follow.
  ii) A GPA system.

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