ULSTER UNIVERSITY

REPORT OF A MEETING OF THE REVALIDATION PANEL: 10A2 Engineering (PG)

28 May 2020

PANEL:
Professor B Murphy, Interim Dean of Academic Business Development, Ulster University (Chair)
Ms U Chaney, Lecturer, School of Nursing, Ulster University
Ms N Parkinson-Kelly, Vice President (Education), Ulster University Students' Union
Professor C O'Bradaigh, Head of School of Engineering, The University of Edinburgh
Professor A Taktak, Clinical Scientist, Department of Medical Physics and Clinical Engineering, Royal Liverpool University Hospital
Professor T Ward, Department of Electronic Engineering, University of York

REVALIDATION UNIT CO-ORDINATOR: Dr Alan Brown, School of Engineering, Ulster University

IN ATTENDANCE:

Mr B McArthur, Academic Policy and Standards Officer, Academic Office, Ulster University

1 INTRODUCTION

The Panel met (via Skype) to consider the following provision within Revalidation Unit 10A2 Engineering (PG).

- PgDip/MSc Advanced Composites and Polymers (with PgCert exit award) (FT/PT) (JN)
- PgDip/MSc Biomedical Engineering (with PgCert exit award) (FT) (PT)
- PgDip/MSc Manufacturing Management (with PgCert exit award) (FT/PT) (JN)
- MSc Mechanical Engineering (with PgDip exit award) (FT/PT) (JN)

Two major changes to the provision proposed at APAG on 23/1/20 and approved by ASQEC on 10/3/20 (min 20.07) were introduced to the provision:

1) The introduction of a 240-credit point 'Applied Research' pathway into the full-time MSc Advanced Composites and Polymers and MSc Biomedical Engineering. The introduction of a 120-credit point Applied Research

module was designed to provide an alternative to the traditional 60-credit point Dissertation module (min 20.23).

2) The introduction of linked programmes rather than separate PgDip and MSc programmes (which was previously the case) for the Advanced Composites and Polymers, Biomedical Engineering and Manufacturing Management programmes (min 20.22).

The three linked programmes have professional body accreditation:

- Advanced Composites and Polymers – Institute of Mechanical Engineering (IMechE) and Institution of Engineering and Technology (IET)
- Biomedical Engineering - Institution of Engineering and Technology (IET)
- Manufacturing Management - Institute of Mechanical Engineering (IMechE) and Institution of Engineering and Technology (IET)

The MSc Mechanical Engineering was approved without evaluation for introduction in September 2019 (ASQEC min 18.116).

Maximum and minimum student intake figures are detailed in the following table.

Year	2020/21		2022/22		2022/23		2023/24		2024/25	
Adv Composites & Polymers FT	5	15	10	20	10	20	10	20	10	20
Adv Composites & Polymers PT	3	5	3	5	3	5	3	5	3	5
Biomedical Engineering FT	5	10	10	20	10	20	10	20	10	20
Biomedical Engineering PT	3	5	3	5	3	5	3	5	3	5
Manufacturing Management FT	0	5	0	5	0	5	0	5	0	5
Manufacturing Management PT	3	5	3	5	3	5	3	5	3	5
Mechanical Engineering FT	2	10	5	10	10	20	10	20	10	20

Mechanical Engineering PT	3	5	3	5	3	5	3	5	3	5

Recruitment to the provision was largely drawn from three sources:

- Recent (normally Engineering) graduates from Ulster and elsewhere.
- International graduates.
- Part-time students who wish to complete a Master's programme either to apply for chartered engineer status and/or to further develop their career.

The three linked programmes meet the academic requirements for Chartered Engineer registration (CEng). It was anticipated that the 'new' Mechanical Engineering programme would also meet these requirements.

A professional engineer was required to meet the standards set out in the UK Standard for Professional Engineering Competence 2014 (UK-SPEC) which describes the competence and requirements that must be met for registration as an Engineering Technician (EngTech), Incorporated Engineer (IEng) or Chartered Engineer (CEng). Since meeting the UK-SPEC requirements involves both academic and professional achievement, graduates of the academic programmes would not have achieved the requisite competence levels which would be required to be achieved post-graduation.

The revalidation document indicated that development of the revalidated provision had been informed by stakeholder input from employers, external examiners, alumni and students including feedback from the Ulster Society of Student Engineers. The results of IET and IMechE employer surveys had also been taken into account. Changes had been made with the overall aim of improving the student learning experience through the introduction of more authentic assessment activities, some driven by group project work, and enhancement of the hands-on nature of laboratory and engineering practice activities through allocation of additional time for these activities. Proposed changes to the provision had been presented to stakeholders including employers and alumni and had been positively received.

Programme Structures

There are 22 modules within the subject area. Apart from the 120-credit point Applied Research module, which was available as an option to the Dissertation module in the full-time Advanced Composite and Polymers and Biomedical Engineering programmes, all modules were shared across the four programmes.

Each programme has three compulsory specialism modules. In addition, one of two optional modules must be taken, MEC863 Research Project (in the FT

programme) and MEC863 WBL 2 (in the PT programme), together with the Master's Dissertation module. The latter two modules would involve research and report in the specialism subject which would result in a total of 120 credits of study in the specialism subject in each programme (or 160 credits where the Applied Research pathway is taken).

In addition, each programme has the same two compulsory non-specialism modules, EEE839 Research Methods and EEE841 Entrepreneurship and Innovation Enterprise.

Each programme was completed by the study of two additional 15-credit point optional modules.

The Panel was informed that because of the Covid-19 pandemic, the revalidated modules would not be implemented until September 2021.

Three exemplar assessment rubrics were included in the revalidation document.

2 DOCUMENTATION

The Panel received the following documentation:

- Agenda and programme of the meeting
- Guidelines for evaluation and revalidation panels
- QAA benchmark statement for Engineering (Master's) (2015)
- Information document, 'Curriculum Design at Ulster'
- External examiner reports for the last two years
- Preliminary comments from Panel members
- Revalidation documentation

3 THE MEETING

Since the meeting took place on the day following the revalidation of the undergraduate Engineering provision (Unit 10A1) and involved the same Panel members, the Chair decided that a second separate meeting with senior Faculty staff was unnecessary. Consequently, senior staff comprising, Dr M Keenan, Associate Dean (Education), Professor J McLaughlin, Head of School of Engineering and Dr Margaret Morgan, Associate Head of School of Engineering, joined in the course team meeting. The Panel also met with a small group of current students on the Advanced Composite and Polymers and Biomedical Engineering programmes.

The following report provides a summary of issues raised during the event and responses to Panel questions provided by each of the groups that met with the Panel during the meeting.

4 SENIOR MANAGEMENT/COURSE TEAM MEETING

Overview

At the outset of the meeting, Professor McLaughlin provided an overview of the provision regarding its history, content (general themes), demand and links with local industry and commented on staffing levels.

The School has delivered Master's programmes for over 30 years. There had been periods of success mainly in attracting external students, rather than progression internally. It was noted that students taking undergraduate MEng programmes generally choose not to take a Master's programme since there was an overlap in some module content. MEng graduates who wished to continue their studies generally followed the PhD route. Even those without an MEng generally did not wish to take a Master's programme. In addition, often companies were engaged in their own training through inhouse teaching. The School has built strong links with local companies and had been asked on occasion to develop bespoke programmes for individual companies, for example, Bombardier.

While generally, programme titles were not considered of absolute importance, 'Mechanical Engineering' was a more recognisable title in the international market, particularly in China and Asia. It was therefore a more marketable title. After the Mechanical Engineering programme's introduction in 2019, there had been a great deal of initial interest although this had resulted in only five students registering. Nevertheless, there were now opportunities for targeting the international market. The other Master's courses were primarily, although not exclusively, focused on the local market.

Similar themes were evident within curricula across the School in both undergraduate and postgraduate provision such as Biomedical, Electrical, Electronic and Mechanical Engineering and Manufacturing. Consequently, there was a similarity in word usage, language and so forth. Overall, there was a coherency across the Master's provision designed to address different target audiences.

In the areas of manufacturing and medical devices, the School was considering the introduction of short summer courses using individual modules with the aim of capturing those currently on furlough because of the Coronavirus pandemic.

The School had increased staff numbers from 28 to 40 with an emphasis on recruiting those with a strong research profile. There was therefore the skills and expertise available to cover a wide range of disciplines within the School and across the provision.

Differentiation

In response to a Panel suggestion that there was little differentiation between the programmes, the Team responded that each of the three linked courses had three core modules plus a research project and dissertation which together amounted to 50% of the credit value of each programme. Students would then be counselled as to the best choice of optional modules which better suited their career aspirations. It was pointed out that feedback from the Industrial Advisory Board had been a major influence on course content.

The Team challenged a Panel suggestion that given the apparent limited difference between Manufacturing Management and Mechanical Engineering, the courses might be amalgamated and titled, 'Mechanical and Manufacturing Engineering', stating that the programme would not be as attractive to international students with 'Manufacturing' in the title. Agents in Asia had made it very clear that a title of 'Mechanical Engineering' was regarded as more attractive. For this reason, the programme would be more attractive to Chinese students, which is a key target market.

The linked programmes were professionally accredited and were 'tried and tested'. They were targeted at holders of 'good' HNDs seeking chartered status. However, generally demand dipped when the economic outlook appeared bleaker. Regarding the (relatively) new MSc Mechanical Engineering, the Team acknowledged there was a wide range of subjects that could have been included but given the finite resources available, the areas included had to be limited accordingly. If it became apparent that the demand lay in the part-time arena, then that was where the focus would be.

A discussion followed on the perceived omission of certain subject areas from the programmes and the merits of their inclusion to enhance subject specific content and thus greater differentiation.

The Team accepted much of the Panel's view and agreed to give this further consideration. Immediately following the meeting, the external Panel members provided the following comments regarding areas for consideration of inclusion (which encompassed much of the discussion during the meeting).

Professor Ward

On the Biomedical Engineering MSc there was scope for at least three significantly different programmes, one area that perhaps fitted closer to the mechanical and materials programmes was in Biomedical Engineering applied to Rehabilitation and Human Electronics Interaction – Augmented Living. I can see the relevance to content on "Biomaterials and Tissue

Engineering" and "Advanced Biomaterials for Biomedical Applications" in the application (both currently Semester 1 modules).

I can, in addition, see a place for modules on Statics (levers, pin and ball joints, etc. from a design, strength, material characteristics, resilience, etc. perspective), Mechatronics, Control principles, Data capture, monitoring and management; Clinical practice in rehabilitation and Legislative requirements.

In addition, it would be very easy to add in one or more Business Management modules exploring financial, legislative, compliance, quality assurance, even production techniques to such a programme.

On the Manufacturing Management programme, I would expect to see a module on production scheduling (push versus pull techniques); Inventory control; Quality Assurance and Control (in addition to Quality improvement); probably also basic accounting and finance and Environmental awareness as it impacts production processes is a current and important topic.

<u>Professor O'Bradaigh</u>

On the topics below, I would say that for the Mechanical Engineering MSc, there was a need for a minimum of three core modules, two of which not taken from the courses currently offered by the four MScs together:

1. *MEC 705 Advanced Thermal Fluid Sciences and CFD (existing)*
2. *A second course*
3. *A third course*

I would not be prescriptive about the extra two modules to be offered, except to say that they should be in core Mechanical Engineering areas, which could be taught to Master's standard by existing staff in the School. Possible areas (not exhaustive) might be:

1. *Solid Mechanics / Advanced Design*
2. *Fracture Mechanics and Failure*
3. *Finite Element Analysis*
4. *Powertrain*
5. *Dynamics & Vibrations*
6. *Advanced Heat Transfer*

Professor Taktak

From the Biomedical Engineering side, I would like to see explicit inclusion with enough coverage and evidence of assessment in the following topics:

1- Anatomy and Physiology
2- ICT
3- Health and Safety
4- Regulatory issues

It would also be good to have some element of image processing there although perhaps as an option.

Students would also appreciate more theory and teaching on statistics and study design.

Entry Requirements

The Panel suggested that although the entry requirements required applicants to have a background in a relevant engineering, technology or science discipline, but not necessarily in the specific subject area of the degree, it was probable there would be a low conversion rate. In order to accommodate students without the relevant background, it was further suggested that teaching would have to start at a relatively low level resulting in the dilution of Master's level content and learning. The Team acknowledged that the entry requirements for one of the programmes was not aimed at those with primary degrees in that programme's subject area; that an applicant with *any* science degree would be able to cope with any of the programmes' core modules. Regarding optional modules, each student would be counselled as to the most appropriate given their individual background. The core modules together with the research project and dissertation modules would provide each programme with its own distinctive theme leading to a qualification in that area.

In response to the Panel, the Team stated that there had never been a case of an MEng graduate applying to do a Master's programme in the same area. If such a situation arose, the applicant would be advised against and further study in a Master's in a different subject area or a PhD recommended.

It was suggested that a narrowing of the entry requirements to reflect the Master's disciplines would be beneficial in attracting more applicants with interests in those specific areas. The Team responded that the range of degrees held by applicants was 'phenomenal' and again emphasised that a degree in a relevant Master's subject area would not be required to cope with any of the modules. For example, in the past, students with a biology degree had not been specifically targeted for the Biomedical Engineering. It was acknowledged

however that perhaps in the future those graduates with a relevant degree could be specifically targeted through a fresh marketing campaign. Mechanical Engineering students would be a suitable target audience for the Advanced Composites and Polymers programme and similarly those with a background in metallurgy and material science would be suitable for Mechanical Engineering. China was in the top five in the world for materials and metallurgy. Students would see a value in this as it would provide a natural pathway for their career aspirations.

Support for Students

Because of the small class sizes, there would be no student representatives, rather, there would be formal, minuted class meetings. In addition, there would be student representation on the Staff/Student Consultative Committee which would meet each semester.

Employability

Employability would be assured in several ways. Part-time students would already be working in industry. In addition, industry needs had been built into the programmes through feedback from the Industrial Advisory Board which had been consulted in the development of the programmes. (The Industrial Advisory Board meets twice annually.) This would be supplemented by speakers from industry and industry visits during the programme. The practice element of each programme would provide the requisite practice skills for immediate employment upon graduation.

Leadership and Management Skills

In addition to the 'hard' science/engineering-based skills, 'soft' skills such as leadership and management were woven through the curricula. These soft skills were important to employers and one of the primary reasons for their facilitating (and often funding) their employees attendance. Business, teamwork, partnership and entrepreneurship skills were other examples of the broader skills that students would be exposed to during each of the programmes.

Student Experience

The panel queried whether relatively small cohorts would have a detrimental impact on the student experience. The Team stated that in the optional modules students would be taught in larger groups with students from other disciplines. This would ensure a more rounded student experience. While the core modules in each programme would be delivered to smaller class sizes, this had a distinct advantage in bringing students from different backgrounds to the same level.

Learning Outcomes – WBL and Research Project

The Work-based Learning module would be taken by part-time students while full-time students would take the Research Project module. The Panel queried, since each module had different learning outcomes, how the overall programme level learning outcomes would be achieved by the respective cohorts. The Team acknowledged the differences and briefly outlined the operation of each module. Each student cohort would undertake a project, the part-time students within a work environment. While the skills employed in each, and the learning outcomes would slightly differ, the Team assured the Panel that the overall programme learning outcomes would be met through each module.

Prerequisite Modules

No prerequisite modules were included in the programmes. The Panel referred to examples where module descriptions referred to a module "building on" another module or previous learning. For example, 'Advanced Thermal Fluid Sciences and CFD' "builds on students' knowledge of fluid mechanics and heat transfer and introduces computational modelling for fluid mechanics, using commercial Computational Fluid Dynamics (CFD) software". Also, Advanced Automation and Control builds on "two undergraduate modules in this field". The Team responded that while there were no 'formal' prerequisite modules, during initial induction, students would be taken through the programme's core modules and, regarding choice of optional modules, informed that they should confer with staff to ensure the suitability of their choice given their background and existing knowledge. The Panel suggested that it was unfair that since the entry requirements accepted a wide range of first degrees, students may not be able to take all the modules on offer in their programme. The Panel stated that this should be made clear to applicants *in advance* in the marketing material and the prospectus.

Module Learning Outcomes

A discussion of the mapping of some module learning outcomes against the programme level learning outcomes took place. The Panel suggested that it was difficult to see how the mapping of some modules to the programme level outcomes could be justified. For example, in the MSC Advanced Composites and Polymers, it was difficult to see how optional module, 'Advance Automation and Control', could be mapped to certain 'Knowledge' outcomes which specifically addressed knowledge and understanding of 'Polymers and Advanced Composites'. The Panel stated that a more focused mapping of modules to each programme's programme level learning outcomes should be carried out.

5 MEETING WITH STUDENTS

The Panel met with a group of three students from the existing Advanced Composites and Polymers (PT) and Biomedical Engineering (FT) programmes. The following is a summary of their responses to issues raised by the Panel.

Feedback – via email, Blackboard Learn, during class, module feedback survey and through direct approach to staff. Staff response was normally prompt.

Access to equipment and facilities – "a little bit more" laboratory practice would be welcomed (Biomedical Engineering).

Adequacy of specialised subject content – a second 'Tissue Engineering' module in semester 2 would be welcome (Biomedical Engineering). A positive feature was the inclusion of optional modules where students had no previous knowledge – one example cited where an optional module not particularly relevant to the degree subject but was to the student's workplace. Incorporation of more design in the Research Methods module would be welcomed.

Practice Learning (Advanced Composites and Polymers) – while modules, Polymer Technology and Composite Engineering, each had only 6 hours laboratory practice, this was considered adequate since all students had prior learning in this area. Acknowledged that a student without prior learning could do with more. One student thought more "hands on" and industrial visits would be an improvement.

Balance between engineering and biology in core modules, Tissue Engineering and Advanced Biomaterials for Biomedical Applications (Biomedical Engineering) – all modules in semester 2 were engineering modules, another biology module in semester 2 was needed.

Assessment – all module learning outcomes assessed? Consensus was that each module's assessment strategy addressed all the module's learning outcomes. Master's level learning outcomes were a "step up" from undergraduate level requiring more focus and depth (although one student opined that final year undergraduate learning outcomes were at a similar level).

Assessment bunching – while there was some bunching of assessments, forward planning alleviated this.

6 CONCLUSIONS

The Panel commended the Revalidation Team on the following:

- Attainment of the Athena SWAN silver award in 2019 in recognition of significant progress in the advancement of gender equality and the opportunities for representation, progression and success for all.
- Strong links with local industry.
- Positive and extremely supportive student feedback for the provision.
- Rise in staff numbers from 28 to 40.

The Panel agreed to recommend to the Academic Standards and Quality Enhancement Committee that provision within Revalidation Unit 10A2 Engineering (PG) be approved for a period of five years (intakes 2020/21 to 2024/25 inclusive) for the minimum and maximum student intake figures detailed in Section 1 above, subject to the conditions of the Panel being met, and a satisfactory response and a revised submission being submitted to the Academic Office by 30 June 2020 for approval by the Chair of the Panel.

Conditions

1) All issues identified in the appendix to the Panel report to be addressed.

2) To create greater distinction between the programmes, review provision content to ensure the explicit inclusion of all discipline areas closely associated with each programme's subject area - see below comments from external Panel members containing suggested areas for inclusion.

3) Ensure that further opportunities are provided for the development and enhancement of practice skills through greater access to equipment both within and without the University e.g. through industry visits.

4) To ensure Competition and Markets Authority compliance, ensure that marketing material is explicit regarding the required backgrounds of applicants which would ensure access to *all* modules within the programme.

5) A minimum of two external examiners be employed to ensure all discipline areas across the provision are covered.

6) More focused mapping of the modules to the programme level learning outcomes be carried out in line with discussions with the Panel.

6 APPRECIATION

The Chair thanked the Panel members and, in particular, the external subject experts, for their valuable contribution to the revalidation process.

(BMcA/report/1.6.20)