The Mechatronics Engineering

Program Benchmarks

1. Introduction

Mechatronics can be defined as the analysis, design, and integration of mechanics with electronics through intelligent computer control. Today, mechatronics system engineering has gained much recognition and importance in the industrial world and therefore many universities have established engineering degrees in mechatronics.

The plan to launch a mechatronics curriculum at PU was motivated by several factors:

Industrial needs. As regional industry developed through automated production and computerized manufacturing, requirements for multi-disciplinary engineers with in-depth knowledge of mechanics, electronics, and computers increased. The demand for such system engineers was fast developing, even though "mechatronics" as a term was still not known in the industry.

Educational motivation. As interaction among different engineering fields increased, students were encouraged to study system functionality. This developed the need for a curriculum that offers integrated system engineering.

Mechanical engineering development. As technology advanced, computers and electronics started to play bigger roles in mechanical systems and therefore more and more mechanical engineers started to take computer and electronics courses in order to strengthen their grasp on mechanical system technology.

2. Objectives

Given the cited three main motivations, PU underscored that its main objectives in launching the mechatronics curriculum was to provide the following:

a. Integrated system education to equip the graduates with the necessary knowledge and skills needed for the regional industry.
b. In-depth knowledge in the analytical, experimental, and computational areas of mechanics, electronics, control, and computer engineering.
c. Knowledge and skills to analyze, design, program, build, and maintain fully integrated engineering systems.

3. Challenges

The biggest challenges in developing a successful mechatronics curriculum in the middle east region are:

a. The size of the "production, automation, and manufacturing" industry is relatively small.

b. The technology used is imported and therefore there is a lack of design and support centers.

c. Research is subdued since most of the local universities do not offer graduate degrees in mechatronics.

4. Benchmarking

The primary purposes of the Benchmarking Statements are to assist:

- Higher education institutions in designing and validating programs of study.
- Academic reviewers and external examiners in verifying and comparing standards.
- Where appropriate, professional bodies during accreditation and review process.
- Students and employers when seeking information about higher education provision.

Table I lists the criteria content of mechatronics engineering program.

Table 1: Criteria Content of Mechatronics Engineering Program:

Engineering practice	
knowledge and understanding	▪ Manufacturing and/or operational practice ▪ Codes of practice and the regulatory framework ▪ Requirements for safe and secure operation
Intellectual abilities	▪ Ability to produce solutions to problems through the application of methodologies related to mechatronics engineering ▪ Knowledge and understanding ability to undertake technical risk evaluation
Practical skills	▪ Ability to apply mechatronics engineering techniques taking account of industrial and commercial constraints ▪ Project management and application of System and software engineering methodologies
General transferable skills	▪ The mechatronics engineering approach to the solution of problems ▪ Time and resource management ▪ Teamwork and leadership

5. Assessment

In developing an assessment strategy some key factors should be considered:

- There must be sufficient clearly identified opportunities for students to demonstrate that they have met the threshold in all components of the benchmark;
- Achievement of threshold standards may, in some cases, be implicit in the learning process (e.g. the completion of a project may demonstrate attainment of some general transferable skills);
- Achievement of threshold standards should be possible without an individual student being required to pass all units of assessment. For example, a particular unit may include the assessment of only one element of the benchmark. A student may achieve the threshold in this element but not achieve a pass mark in the unit as a whole.
- Careful selection from a wide range of assessment methods can make the process more efficient and effective;
- It is important that the strategy provides sufficient opportunity for the best students to exhibit the level of innovation and creativity associated with excellence.

6. Recommendations

The Benchmark Statements set out in Table II and based upon the rationale provided by the Criteria for Content above should be used to guide the academic review of programs in engineering.

Individual disciplines within engineering should use the generic criteria of content in Table I to provide an interpretation of content and balance of attainment for their own discipline.

Professional Engineering Institutions when setting criteria for their discipline and for the sections of the Engineering Council Register, for which they hold responsibility, should relate them to the generic criteria and the appropriate discipline-specific interpretation.

Table II: Benchmark Statements:

Engineering practice	***Threshold***	***Good***	***Excellent***
Knowledge and understanding 1. Manufacturing and/or operational practice 2. Codes of practice and the regulatory framework. 3. Requirements for safe and secure operation	1.Knowledge of current practice in the real word 2. basic knowledge of specific codes of practice in routine problems, including the role of design factors 3. Basic knowledge of codes of practice relating to hazards and operational safety understands the need for operational safety by design and good working practices	1. Wide knowledge and good understanding of current practice 2. Knowledge and some understanding of specific codes of practice, with some understanding of the limitations of the techniques and design factors involved 3. knowledge and understanding of codes of practice relating to hazards and operational safety and can apply these to familiar and some unfamiliar situations	1. A comprehensive understanding of current practice, its limitations, and likely new developments 2. Understanding of appropriate codes of practice, with wide understanding of the limits of the code and design factors involved 3. comprehensive knowledge and understanding of codes of practice relating to hazards and operational safety, and can apply these to a wide range of situations
Intellectual abilities 1. Ability to produce solutions to problems through the application of methodologies related to mechatronics engineering 2. Knowledge and understanding ability to undertake technical risk evaluation	1. Ability to integrate knowledge of mathematics, science, information technology, design, business context and mechatronics engineering practice, to solve routine problems as taught 2. Ability to evaluate typical technical risks, using the appropriate tools as taught	1. Integrate knowledge of mathematics, science, information technology, design, business context and mechatronics engineering practice to solve problems, some of which are unfamiliar and require good understanding 2. Can evaluate technical risks, even in some unfamiliar circumstances	1. Can integrate knowledge of mathematics, science, information technology, design, business context and engineering practice, to solve a wide range of mechatronics engineering problems applying profound understanding to novel and challenging situations, is aware of limitations of solution methods 2. Can make general evaluations of technical risks, through an understanding of the basis of such risks

Practical skills 1. Ability to apply mechatronics engineering techniques taking account of industrial and commercial constraints 3. project management and application of System and software engineering methodologies	1. Some experience of applying engineering techniques taking account of commercial and industrial constraints 2. Ability to develop a project plan, identifying the resource requirements, and the timescales involved	1. Experience of applying mechatronics engineering techniques taking account of a range of commercial and industrial constraints 2. Can apply standard management techniques to plan and allocate resources to projects	1. Experience of applying mechatronics engineering techniques taking account of a wide range of commercial and industrial constraints 2. Can develop, monitor and update a plan, to reflect a changing operating environment
General transferable skills 1. The mechatronics engineering approach to the solution of problems 2. time and resource managemen 3. teamwork and leadership	1. Can solve some general problems through systematic analysis and design methods 2. Can develop a personal plan of work to meet a deadline and to identify the main external constraints 3. Can work as part of a team	1. Can solve some general problems through systematic analysis and design methods and where necessary learn new theories, concepts, methods etc in an unfamiliar situation outside the discipline area 2. Can identify the critical activities within a personal plan of work 3. Can undertake many of the roles within a team	1. Can solve some general problems through systematic analysis design and planning, and where necessary, learn new theories, concepts, methods etc in an unfamiliar situation outside the discipline area 2. Can monitor and adjust a personal program of work on an on-going basis 3. Can undertake most of the roles within a team including leadership