SUBJECT BENCHMARK STATEMENT

IN

ELECTRONICS

Quality Assurance and Accreditation Council
University Grants Commission
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CONTENT

FOREWORD

The work in connection with the development of Subject Benchmark Statements was begun in August 2003 as a part of the overall quality assurance framework that supports academic standards and the furtherance and dissemination of good practice in Universities in Sri Lanka.

Subject Benchmark Statements will support and promote quality and standards by:

- Providing universities with a common and explicit reference point for internal and external programme approval and review;

- Guiding and promoting curriculum development, especially in new departments and new universities, and in other institutions of higher education;

- Evolving over time to take account of changes and innovations that reflect subject development and new expectations;

- Providing an authoritative and widely recognized statement of expectations of what is expected of a graduate in a specific (or designated) subject area in a form readily accessible to students, employers and others with a stake in higher education;

- Providing a clear and transparent reference point for External Examiners;

- Assisting international comparison and competitiveness of higher education awards and student achievement.

SUBJECT BENCHMARK STATEMENT
ELECTRONICS

1. INTRODUCTION

1.1 Subject Benchmark Statement – Scope and Purposes

Electronics is a branch of science and technology which makes use of the controlled motion of electrons through different media and vacuum. The ability to control electron flow is usually applied to information handling or device control. Field of Electronics began around 1906 with the invention of triode which made electrical amplification possible with a non-mechanical device. Most electronic devices today use semiconductor components to perform electron control. The study of semiconductor devices and related technology is considered a branch of Physics, whereas the design and construction of electronic circuits to solve practical problems come under Electronic Engineering.

The Benchmark Statement for Electronic Engineering is formulated for the purpose of laying down the desirable features of a First Degree Program in Electronic Engineering in the Sri Lankan University System. It is noted that the current first degree engineering programs in Sri Lanka and many other countries are of four year duration on full-time basis or of equivalent duration on part-time basis. The Benchmark Statement is formulated on a generic basis for the purpose of curriculum design, review and approval, assessment of the professional quality of graduates, setting goals to be achieved by students and as reference points for professional recognition and accreditation. Since the actual content of the curriculum may be different in different universities and may change from time to time, even in a given university, the Benchmark Statement is formulated in general terms and as such there will be many common elements in Benchmark Statements across all Engineering Degree Programs.

2. THE SKILLS, ATTRIBUTES AND QUALITIES OF AN ELECTRONIC ENGINEER

Electronic Engineering is a profession directed towards design and construction of electronic circuits to solve practical problems using knowledge and understanding based on mathematics, science and technology integrated with business and management. An electronic engineer shall be able to exercise original thought, have good professional judgment and be able to take responsibility. Hence, it is necessary to foster following knowledge, abilities and qualities in electronic engineering undergraduates.

2.1 Knowledge and Understanding

All graduating electronic engineering students should demonstrate understanding of essential facts, concepts and theories relevant to

a) Electronic Devices and Components
b) Analog and Digital Circuits
c) Heat Dissipation and Thermal Management
d) Noise
e) Computer Aided Design

f) Construction Methods

They should have a sound grasp of Science, Mathematics and Technological base. Further, it is desirable that all students have basic knowledge and understanding of business management techniques. They must also have a clear understating of professional and ethical responsibilities.

2.2 Intellectual Abilities

Electronic Engineers need to be creative and innovative in solving problems, and in designing systems, circuits, components and processes. They must be able to apply appropriate tools from mathematics, science and technology, coupled with know-how drawn from professional experience. Graduating engineers should be able to:

a) solve problems, often on the basis of limited and possibly contradictory information;
b) analyze and interpret data and, when necessary, design experiments to gain new data;
c) design a system, circuit, component or process to meet a need;
d) evaluate designs, processes and products, and make improvements;
e) maintain a sound theoretical approach in enabling the introduction of new and advancing technology to enhance current practice.

In all of these cases, the graduate engineer should be able to:

a) take an holistic approach, applying professional judgments, balancing costs, benefits, safety, quality, reliability, appearance and environmental impact;
b) assess risks, and take appropriate steps to manage those risks.

2.3 Practical Skills

Graduating Electronics engineers need to demonstrate discipline-specific practical skills, particularly concerning laboratory work, project work and use of discipline-specific software. They should be able to:

a) use a wide range of tools, techniques and equipment, including pertinent software;
b) use laboratory and workshop equipment to generate valuable data;
c) develop, promote and apply safe systems of work.
d) communicate effectively with colleagues and others, using both written and oral methods;
e) manage resources and time;
f) work in a multi-disciplinary team;
g) undertake lifelong learning, particularly for continuing professional development.

To enable students to become effective electronic engineers, they need to develop certain qualities of mind, through the study of engineering. They need to become:

a) creative, particularly in the design process;
b) analytical, in the formulation and solution of problems;
c) innovative, in the solution of engineering problems and the transfer of technology;
d) self-disciplined and self-motivated, in the pursuit of their studies and professional practice;
e) Inquisitive and eager for new knowledge and understanding;
f) independent of mind, with intellectual integrity, particularly in respect of ethical issues;
g) enthusiastic, in the application of their knowledge and understanding and skills in the pursuit of the practice of engineering and the promotion of the engineering disciplines.

3. ELECTRONIC ENGINEERING DEGREE PROGRAMS

Electronic Engineering education through the university stream consists of the B.Sc. Engineering Degree program of four years' duration followed by a minimum of six months of practical training at a recognized work place under the supervision of a chartered engineer. On completion of the required experience after graduation, a professional review is carried out by the Institution of Engineers to determine the suitability of granting the Chartered Engineer' status.

3.1 Syllabus Content

Electronic Engineering degree programs should consist of subjects covering field cores in
1. Electromagnetic
2. Network Analysis
3. Electronic Devices
4. Analog Electronic Circuits
5. Digital Electronic Circuits
6. Signals and Systems
7. Control Systems
8. Analog Communication Systems
9. Digital Communication Systems

In order to develop the required intellectual abilities, Electronic Engineering Degree programs should contain subjects covering following areas of engineering sciences and mathematics
1. Mechanics
2. Fluid mechanics
3. Properties of Material
4. Differential equations
5. Calculus
6. Probability
7. Statistics

In order to develop the required knowledge in design, creativity and innovation, Electronic Engineering Degree programs should contain subjects covering following areas
1. Engineering Design
2. Engineering in Context

In order to develop the required knowledge in Business Context, Electronic Engineering Degree programs should contain subjects covering following areas
1. Business Economics
2. Financial Accountancy
3. Business Management
4. Entrepreneurship
5. Industrial Management
6. Marketing

In order to develop the required knowledge in Engineering Practice, Electronic Engineering Degree programs should contain

1. At least six month in-plant training
2. Mini Projects during studies
3. Laboratory Practical's
4. Major Project at the Final Year of study

3.2 Delivery Modes

The nature of the delivery of each program will depend upon its aims and the student population. Appropriate teaching and learning methods will need to be developed uninhibited by over-prescriptive guidance. However, there are some elements which should be part of the student experience. All students should be aware of the aims and objectives of the degree program, the assessment regulations and strategy, and the learning outcomes of the modules or subjects studied. There should be some formal contact with staff teaching on the program in structured settings, and this may be through a variety of different experiences, such as lectures, seminars, tutorials, practical sessions, design classes and workshop sessions. This formal contact provides a broad framework for the program, and introduces students to the underlying principles and concepts in Electronic Engineering. Such experiences should offer an interpretation and a perspective on the core material within each subject, whilst covering the application of particular theoretical and analytical tools. Lectures will be more appropriate to certain subjects than others and it is for program teams to decide on their optimum deployment.

3.3 Assessment Methods

Assessment of the student performance may be based on conventional examinations as well as on continuous assessment and assessment of performance in exercises such as seminar presentations, viva-voce examinations, and field work. The assessment process and the grading schemes must be formulated in such a way that the level of performance reached by a student reflects his true competence.

4. BENCHMARK STANDARDS

Table 1 indicates the bench mark standards in the areas of knowledge and understanding, intellectual abilities and practical skills related to electronic engineering degree programs.

Table1: Criteria for Benchmarking Electronic Engineering Degree Programs

Knowledge and Understanding	***Threshold***	***Excellent***
Mathematics	has knowledge of routine mathematical methods	has comprehensive knowledge and understanding of a wide range of mathematical methods and their limitations
Science	has basic knowledge of the essential scientific principles	has comprehensive understanding of the scientific principles
General principles of design Design techniques specific to particular products and processes Characteristics of engineering materials and components	has knowledge of the essential elements of the design process has knowledge of the essential design methodologies related to the discipline has basic knowledge of the characteristics of commonly occurring engineering materials and components	has a wide knowledge and comprehensive understanding of the design process and can apply the techniques in unfamiliar situations has comprehensive understanding of design methodologies related to discipline and can apply them in unfamiliar situations has extensive knowledge and understanding of a wide range of engineering materials and components
Management and Business practices (including finance, law, marketing, personnel and quality)	has a basic knowledge of management and business practices	has an extensive knowledge and understanding of management and business practices, and their limitations
Manufacturing and/or operational Practice	has a basic knowledge of current practice	has a comprehensive understanding of current practice, its limitations, and likely new developments

Table1: Criteria for Benchmarking Electronic Engineering Degree Programs (Cont.)

Intellectual abilities	***Threshold***	***Excellent***
Ability to select and apply appropriate mathematical methods for modeling and analyzing	is aware of the functionality of standard methods in a particular discipline	can identify appropriate methods and apply them in a practical situation
Use of scientific principles in the development of engineering solutions to practical problems Use of scientific principles in the modeling and analysis of engineering systems, processes and products	can use scientific principles to produce routine solutions to familiar engineering problems can model and analyze routine engineering systems, processes and products using scientific principles	can be innovative in the use of scientific principles in solving engineering problems can model and analyze complex engineering systems, processes and products using scientific principles and recognize the limitations of such analysis
Analysis of systems, processes and components requiring engineering solutions Creation of new processes or products through synthesis of ideas from a wide range of sources	is aware of the relation between analysis and design and can undertake analysis for particular routine design processes can design a system, component or process using routine design techniques	has a comprehensive understanding of the need for analysis in the design process and justifies fully decisions throughout a particular design can demonstrate innovation in the design and creation of new systems, components or processes
Commercial risk evaluation	can evaluate typical commercial risks, using the appropriate tools, and has some grasp of commercial risk	can make general evaluations of commercial risks through an understanding of the basis of such risks
Ability to produce solutions to problems through the application of engineering knowledge and understanding	can integrate knowledge of mathematics, science, information technology, design, business context and engineering practice, to solve routine problems	can integrate knowledge of mathematics, science, information technology, design, business context and engineering practice, to solve a wide range of engineering problems applying profound understanding to novel and challenging situations and is aware of limitations of solutions

Table1: Criteria for Benchmarking Electronic Engineering Degree Programs (Cont.)

Practical skills	***Threshold***	***Excellent***
Effective communication	can make acceptable presentations of technical and business information in a variety of ways	can integrate presentational techniques and the information to be presented for maximum impact
Lifelong learning	can learn under guidance	can learn independently and understand concepts from many areas in engineering/non-engineering

Table1: Criteria for Benchmarking Electronic Engineering Degree Programs (Cont.)

Practical skills	***Threshold***	***Excellent***
Skills in the use of appropriate mathematical methods for modeling and analyzing discipline-specific engineering problems	can apply routine mathematical methods as taught and essential to the discipline	can carry out research and use new methods required for novel situations
Use of relevant test and measurement equipment for laboratory work	can use test and measurement instrumentation appropriate to discipline can conduct prescribed laboratory experiments and draw limited conclusions can collect data and relate it to a limited range of scientific principles relevant to the particular discipline	can adapt test and measurement techniques for novel/unfamiliar situations can adapt experimental procedures to novel/unfamiliar situations can analyze data in detail, drawing on a range of scientific principles and draw comprehensive conclusions

Table1: Criteria for Benchmarking Electronic Engineering Degree Programs (Cont.)

Practical skills	***Threshold***	***Excellent***
Design of a system, component or process	can produce a design modification for an existing system, component or process to meet a specified requirement	can generate an innovative design for systems, components or processes to fulfill new needs
Practical testing of design ideas in laboratory or through simulation, with technical analysis and critical evaluation of results	can undertake routine practical or simulation tests of a design solution, report and comment on the results	can plan and execute practical or simulation tests of design solutions and present a report containing critical analysis of the results and recommendations of actions for redesign and development
Research for information to develop ideas further	can search for information related to a design solution and present it for discussion	can initiate and undertake searches for information and generate new information related to a design solution, evaluate it and recommend actions

5. ANNEX1. MEMBERS OF THE BENCHMARK GROUP

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Prof. (Ms.) S. A. S. Dias	University of Moratuwa
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