Outcome-Based Approach to Engineering Education
- Towards EAC Accreditation in 2010

B.Eng. (Hons) Electronics Majoring in Optical Engineering

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Why This Briefing?

- FOE has been practicing Outcome-Based Education (OBE) approach since 2006.
- The B.Eng. (Hons) Electronics Majoring in Optical Engineering Program will be assessed by a team from Engineering Accreditation Council (EAC) around June/July 2010.
- EAC is the custodian of OBE practices for engineering degrees and accredits engineering programmes at institutes of higher learning in Malaysia.
- Students will be randomly selected by EAC for interview, to obtain feedback about the program.

This means to perform quality control and decide whether or not to recognise the programmes.
What Is Outcome Based Engineering Education?

IT’S NOT WHAT WE TEACH, IT’S WHAT **YOU LEARN**

In a nutshell, learner-centric approach to tertiary education
Contents

• What is EAC?
• Why Need Accreditation?
• EAC Accreditation Criteria
• Deficiencies of Traditional Education
• Outcome Based Education (OBE)
• Roles of Lecturers
• Roles of Students
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What Is EAC?

- Formed in 2000, a delegated body from Board of Engineers Malaysia (BEM), the only body for accrediting engineering degree programs.
- Comprises members from BEM, IEM, PSD, MQA and Industry Representatives.

Useful links:
EAC: [www.eac.org.my](http://www.eac.org.my)
BEM: [www.bem.org.my](http://www.bem.org.my)
MQA: [www.lan.gov.my](http://www.lan.gov.my)
Roles of EAC

**Engineering Accreditation Council**

- Formulates and updates accreditation policies and criteria.
- Approves guidelines and operating procedures.
- Oversees operational arrangements and appoints evaluation panel.
- Receives evaluation reports and decides on accreditation.
- Responds to complaints, appeals or any proposals for change.
- Oversees development and operation of accreditation and mutual recognition agreement with other countries.
- Fosters the dissemination of developments and best practices in engineering education.
Why Need Accreditation?

Recognition by Malaysian Government, under REGISTRATION OF ENGINEERS ACT 1967 (Revised 2002)

- An accredited engineering degree means the degree is recognized by the Malaysian government.
- It is also a sign of the degree being of high quality and the holder of the degree has already attained a certain level of knowledge, skill and maturity of thought related to the relevant discipline.
- A person with accredited engineering degree may be able to work for the government, as well as private sector.
- He/she may subsequently become a Professional Engineer.
Why Need Accreditation?

• Legally, no person is allowed to practice unless he/she is a professional engineer.

• Professional engineer may use “Ir” before his name OR “PEng” after his name.

• Graduate engineers to register with BEM before taking up employment as an engineer.
Why Need Accreditation?

- graduate engineers to register before taking up employment as an engineer.

Those who has successfully completed an accredited (recognized) engineering programme

**Professional Engineer** - a graduate engineer who has obtained the prescribed practical experience, passed the Professional Assessment Examination, and satisfied all other requirements of the Board of Engineers (BEM)
Why Need Accreditation?

_**International Mobility (Washington Accord)**_

- **The Washington Accord (WA):** Agreement that establishes equivalence of other countries’ accredited professional engineering programs.

- Accredited Engineering Graduates are recognized by other signatory countries - Possible employment as engineers in those countries without further examinations.
International Mobility (Washington Accord)

• Established in 1989, as of 2007, the following countries are full members of WA: Australia, Canada, the Republic of Ireland, Hong Kong, Japan, New Zealand, Singapore, South Africa, South Korea, Taiwan, the UK and the USA.

• The following countries are provisional members of the WA and may become a full member in the future: Germany, India, Russia, and Sri Lanka.

• Malaysia was provisional member since 2003 and now become full member in 2009.
Why Need Accreditation?

Our last accreditation was in 2006 for 5-year programme.

Next accreditation visit will be in June/July 2010
- for intakes of 2006 & onwards

Our programme has been accredited before, so what’s the big deal?

Programmes to be accredited in 2010 will have to be based on OBE approach!

NO OBE = NO ACCREDITATION
EAC Accreditation Criteria

- Academic Curriculum
- **Students**
- **Academic and Supporting Staff**
- Facilities
- Quality Management System
EAC Accreditation Criteria

• Academic Staff
  ▪ Academic qualifications
  ▪ Professional qualification, experience & development
  ▪ Research/publication/consultancy
  ▪ Industrial involvement
  ▪ Teaching load/contact hours
  ▪ Motivation and enthusiasm
  ▪ Use of lecturers from industry/public bodies
  ▪ Aware and practice of OBE
Outcome-Based Education (OBE)

• OBE is an educational process that focuses on what students can do or the qualities they should develop after they are taught.

• OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than accumulation of course credits.

• Both structures and curricula are designed to achieve those capabilities or qualities.

• Discourages traditional education approaches based on direct instruction of facts and standard methods.

• It requires that the students demonstrate that they have learnt the required skills and content.
Why OBE - Deficiencies of Traditional Education

- Provides students with a learning environment with little attention to whether or not students ever learn the material.

- Students are given grades and rankings compared to each other – students become exam oriented or CGPA driven.

- Graduates are not completely prepared for the workforce.

- Lack of emphasis on soft skills needed in jobs e.g. communication skills, interpersonal skills, analytical skills, working attitude etc.
Why OBE - Exam Result is Not the Most Important Consideration by Employer

Employers Rating of Skills/Qualities – 2002

- Communication (verbal & written) 4.69
- Honesty/Integrity 4.59
- Teamwork skills 4.54
- Interpersonal skills 4.50
- Strong work ethics 4.46
- Motivation & initiative 4.42
- Flexibility/adaptability 4.41
- Analytical skills 4.36
- Computer skills 4.21
- Organisational skills 4.05
- Detail oriented 4.00
- Leadership skills 3.97
- Self confidence 3.95
- Friendly/outgoing personality 3.85
- Well mannered / polite 3.82
- Tactfulness 3.75
- GPA (3.0 or better) 3.68
- Creativity 3.59
- Sense of humour 3.25
- Entrepreneurial skills/risk taker 3.23
Focus and Benefits of OBE

OBE addresses the following key questions:

- **What** do we want the students to have or be able to do?
- **How** can we best help students achieve it?
- **How** will we know whether the students have achieved it?
- **How** do we close the loop for further improvement (Continuous Quality Improvement (CQI))?

Benefits of OBE

- More directed & coherent curriculum.
- Graduates will be more “relevant” to industry & other stakeholders (more well rounded graduates).
- Continuous Quality Improvement (CQI) is in place.
Expectations on Students under OBE – the Outcomes

- Students are expected to be able to do more challenging tasks other than memorize and reproduce what was taught.
- Students should be able to: write project proposals, complete projects, analyze case studies, give case presentations, show their abilities to think, question, research, and make decisions based on the findings.
- Be more creative, able to analyze and synthesize information.
- Able to plan and organize tasks, able to work in a team as a community or in entrepreneurial service teams to propose solutions to problems and market their solutions.
OBE Versus Traditional Education Process

- Traditional education process focuses on the inputs.

  - Assessment mainly via exam, test, assignments.
  - Quality control from teaching evaluation.
Outcome-Based Education Versus Traditional Education Process

- OBE shifts from measuring input and process to include measuring the output (outcome)

• Teaching Staff
• Curriculum
• Labs
• Other Resource

Teaching & Learning

Students at Graduation

Graduates to Fulfill Stakeholders’ Satisfaction

(Short-term) Program & Subject Outcomes

(Long-term) Program Education Outcomes

• Assessment by exam, test and assignments.
• Assessment of teaching staff, lecture material & flow, results and student ‘capabilities’ (Short & long-term outcomes), lab interview, exit survey etc.
• More ‘thinking’ projects, with analysis.
• Feedback from industry, alumni and other stakeholders.
• Clear continuous improvement step.

Stakeholders:
- EAC
- Employers
- Industry Advisors
- Academic Staff
- Public and Parents
- Students
- Alumni
Outcomes in OBE

A Model Hierarchy of Outcomes

- Vision and Mission of the Institution/Faculty
- Programme Educational Objectives (PEO)
- Programme Outcomes (PO)
- Learning Outcomes (CO) of Subjects

Interrelated and Complement Each Other

- Long-term Outcomes
- Short-term Outcomes
Vision and Mission of MMU

Vision of the University

To be a premier university that propagates the generation and dissemination of knowledge in cutting edge technologies

Mission of the University

1. To deliver quality academic programmes based on state-of-the-art R&D.
2. To attract and nurture quality minds who will contribute towards the global knowledge economy
3. To inculcate a strong research culture within a dynamic, efficient and effective team of academic and support staff
4. To be financially self-sustaining via education and the commercialisation of R&D products and services.
Vision and Mission of FOE

Vision of the Faculty

To be a leading engineering faculty for creation, preservation and dissemination of knowledge, training of knowledge workers for nation building, and providing continuous technical support for the ICT industry in Malaysia.

Mission of the Faculty

1. To produce multi-skilled graduates who are able to spearhead nation-building in the Information Age.
2. To provide opportunities and resources for academic and researchers to carry out the state-of-the-art research and development work.
3. To support the growth of nationwide ICT industry through provision of continuous professional development of knowledge.
Programme Educational Objectives (PEO) are long term goals (5 years or more after graduation) describing expected achievements of graduates in their career.

- To develop highly competent engineers who are acquainted with the latest developments in the emerging photonics technology.
- To produce technical leaders who are innovative in implementing acquired knowledge in the photonics industry.
Programme Outcomes (PO) are short term outcomes (at the point of graduation) describing what students are expected to know and be able to perform.

1. Ability to acquire and apply fundamental principles of science and engineering.
2. Capability to communicate effectively.
3. Acquisition of technical competence in specialized areas of engineering discipline.
4. Ability to identify, formulate and model problems and find engineering solutions based on a systems approach.
5. Ability to conduct investigation and research on engineering problems in a chosen field of study.
6. Understanding of the importance of sustainability and cost-effectiveness in design and development of engineering solutions.

7. Understanding and commitment to professional and ethical responsibilities.

8. Ability to work effectively as an individual, and as a member/leader in a team.

9. Ability to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurial skills.

10. Awareness of the social, cultural, global and environmental responsibilities as an engineer.

# POs, PEOs and Vision and Mission of FOE

## Example of how POs are linked to PEOs and then to the Vision and Mission

<table>
<thead>
<tr>
<th>Vision of the Faculty</th>
<th>Mission of the Faculty (M1-M3)</th>
<th>Programme Educational Objectives (PEOs)</th>
<th>Description of how POs (Programme Outcomes) are linked to the PEOs</th>
</tr>
</thead>
</table>
| To be a leading engineering faculty for creation, preservation and dissemination of knowledge, training of knowledge workers for nation building, and providing continuous technical support for the ICT industry in Malaysia. | 1. To produce multi-skilled graduates who are able to spearhead nation-building in the Information Age. 2. To provide opportunities and resources for academic and researchers to carry out the state-of-the-art research and development work. 3. To support the growth of nationwide ICT industry through provision of continuous professional development of knowledge. | 1. To develop highly competent engineers who are acquainted with the latest developments in the emerging photonics technology.  
-Related to M1 & M2.  
2. To produce technical leaders who are innovative in implementing acquired knowledge in the photonics industry.  
-Related to M1 & M3. | 1. Ability to acquire and apply fundamental principles of science and engineering.  
- The graduates have firm fundamental knowledge and therefore can easily understand and adapt to any change in the technology.  
- This will ensure that the graduates will be of high calibre equipped with the fundamental technical principles of science and engineering so that they can lead, facilitate and support the development of engineering practices in the industries in Malaysia.  
-Related to PEO 1.  
2. Capability to communicate effectively.  
- Communication and networking skills are enhanced through presentations, exchanging ideas and arguing with solid rational.  
- To be a good leader, effective communication is a must.  
-Related to PEOs 1 and 2. |
### Outcome-Based Education

Example of how the course subjects contribute towards POs

<table>
<thead>
<tr>
<th>Programme Outcome</th>
<th>Descriptions</th>
</tr>
</thead>
</table>
- Basic concepts and theories and their relation to actual engineering systems are applied and extended in Final Year Projects and Industrial Training.  
- Extensive laboratory experiments to provide in-depth practical knowledge and hands-on experience to students. |
Learning Outcomes (LO) of subject are statements of a learning achievement on completion of the subject.

**LOs of EEN1036 Digital Logic Design:**

1. Describe the differences between analog and digital systems, and their respective advantages and disadvantages.
2. Apply positional notations, number systems and computer codes in digital systems.
3. Apply algebraic methods based on Boolean algebra and truth table to analyse logic circuits.
4. Apply minimisation methods such as Karnaugh maps and Quine-McCluskey tabular method to simplify switching functions.
5. Apply the concepts of sequential logic and memory devices in digital systems.
6. Design modular combinational circuits using encoders, decoders, multiplexers and demultiplexers.
# Outcome-Based Education

Course to Program Outcomes Matrix for Courses under the **Electronic Engineering Majoring in Optical Engineering**

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>CONTRIBUTION TO PROGRAMME OUTCOMES (POs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO 1</td>
</tr>
<tr>
<td>EEM1016</td>
<td>Engineering Mathematics I</td>
<td>80</td>
</tr>
<tr>
<td>EEM1026</td>
<td>Engineering Mathematics II</td>
<td>80</td>
</tr>
<tr>
<td>EEM2036</td>
<td>Engineering Mathematics III</td>
<td>80</td>
</tr>
<tr>
<td>EEM2046</td>
<td>Engineering Mathematics IV</td>
<td>80</td>
</tr>
<tr>
<td>ECT1016</td>
<td>Circuit Theory</td>
<td>60</td>
</tr>
<tr>
<td>ECT2036</td>
<td>Circuits and Signals</td>
<td>50</td>
</tr>
<tr>
<td>EEN1016</td>
<td>Electronics I</td>
<td>60</td>
</tr>
<tr>
<td>EEN1026</td>
<td>Electronics II</td>
<td>50</td>
</tr>
<tr>
<td>EEN1046</td>
<td>Electronics III</td>
<td>50</td>
</tr>
<tr>
<td>EEN1036</td>
<td>Digital Logic Design</td>
<td>50</td>
</tr>
<tr>
<td>EEN2056</td>
<td>Physical Electronics</td>
<td>50</td>
</tr>
<tr>
<td>ECP1016</td>
<td>Computer and Program Design</td>
<td>10</td>
</tr>
<tr>
<td>ECP1026</td>
<td>Algorithm and Data Structure</td>
<td>40</td>
</tr>
<tr>
<td>ECT1026</td>
<td>Field Theory</td>
<td>60</td>
</tr>
<tr>
<td>EMG2016</td>
<td>Electromagnetic Theory</td>
<td>60</td>
</tr>
<tr>
<td>EPM1016</td>
<td>Instrumentation and Measurement Techniques</td>
<td>60</td>
</tr>
<tr>
<td>EPM1076</td>
<td>Introduction to Machines and Power Systems</td>
<td>50</td>
</tr>
</tbody>
</table>
Example of Assessment Methods for Program Outcome 2: Capability to Communicate Effectively

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Subjects</th>
<th>Assessment Methods</th>
<th>Documents to be Kept</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Present and document ideas and experimental results properly documented in a specified format, and supported with evidence. The document must contain explanation with sufficient detail, with minimum grammatical and spelling errors.</td>
<td>• All Subjects- Lab Experiments, FYP, ITP, Mini Projects</td>
<td>• Coursework and exam • presentation of Final Year Project and Industrial Training reports • Lab Reports</td>
<td>Exam scripts and assignment Final Year Project and Industrial Training reports and mark sheets, lab reports,</td>
</tr>
<tr>
<td>• Use multimedia content in oral and visual communication</td>
<td>• EPT4046 Final Year Project, EPT4066 Industrial Training • Mini Project • Other Seminars, and • Meetings</td>
<td>• Presentation of Final Year Project, Industrial Training, Mini projects and other seminars</td>
<td>Final Year Project and Industrial Training, Mini Projects mark sheets, PowerPoint presentation slides. Attendance records in other seminars</td>
</tr>
<tr>
<td>• Respond to audience’s questions correctly and confidently</td>
<td>• EPT4046 Final Year Project, EPT4066 Industrial Training, EPT3016 Mini Project, other seminars and meetings</td>
<td>• Presentation of Final Year Project, Industrial Training, Mini projects and other seminars</td>
<td>Final Year Project and Industrial Training, Mini Projects mark sheets, PowerPoint presentation slides. Student attendance records in other seminars</td>
</tr>
</tbody>
</table>
Outcome-Based Education

Stakeholders’ Mission & Vision

Program Objectives

Program Outcomes

Learning Outcomes of Subjects

Assessment

Analysis

CQI
Continuous Quality Improvement (CQI)

Say what you want

Do what you say

Improve it

Prove it

Outcome-Based Education
Roles of Lecturers

• Review PEOs, POs, course structures and syllabi.
• Teach the relevant engineering, mathematics, and other relevant subjects.
• Conduct relevant tutorials and laboratory practical sessions.
• Give appropriate guide on assignments and projects.
• Conduct empirical measurements of POs.
• Prepare the required documentation.
• Assure EAC and public on the standard of our graduates.
• Obtain and maintain accreditation from EAC through Continuous Quality Improvement (CQI).
Roles of Students

• Know the required Programme Outcomes and Programme Objectives (available at the FOE website).

• For each course, review the Learning Outcomes (available at the FOE website/uploaded in MMLS) at the beginning of each trimester. This gives you an idea of the knowledge and skills expected from a particular course.

• Be more proactive in the learning process to acquire the Learning Outcomes of subjects.

• Demonstrate through the assessment methods that the required skills and knowledge have been acquired.

• Attain the Programme Outcomes and Programme Objectives as a whole during the entire programme.

• Give constructive feedbacks on the programme/course/academic staff to obtain accreditation through active participation in Online Teaching Evaluation, Academic Advisory System, dialog sessions with Dean, etc.
Acknowledgement

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Assoc. Prof. Dr. Mohd. Saleh Jaafar (UPM)
References


• *TOWARDS EAC ACCREDITATION IN 2009* - Direct Assessment of Program Outcomes, Fakulti Kejuruteraan Elektrik, Universiti Teknologi Malaysia (http://encon.fke.utm.my/OBE.ppt).


The End

Q & A

Thank you