UTM
UNIVERSITI TEKNOLOGI MALAYSIA

21st CENTURY CURRICULUM

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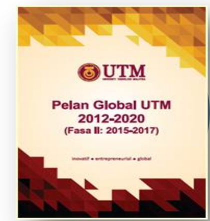
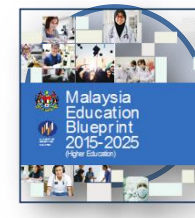
CRITICAL AGENDA 2 (TNCAA)



PGU

(KFA 1) Merekabentuk dan melaksanakan kurikulum berdasarkan inovasi dan pembelajaran baharu



PPPM (PT)

Lonjakan 1

Graduan Holistik, Keusahawanan dan Seimbang

Kurikulum Abad 21

Inisiatif 1: Membangunkan kurikulum Abad 21 yang menerajui industri

Inisiatif 2: Memperkasakan kurikulum melalui semakan semula kursus umum, kursus amali/ makmal dan kursus keusahawanan

UGS → **Fakulti**

OVERVIEW ON CURRICULUM

- Employability-based
- Holistic
- Competency-based
- Experienced-based
- Sustainability

- Building blocks design
- Branching design
- Spiral design
- Specific tasks/skills design
- Process-pattern design

OVERVIEW ON CURRICULUM

KEY SKILLS

- Numeracy skills
- CTPS
- Literacy skills
- IT
- Interpersonal skills/CELEC

OVERVIEW ON CURRICULUM

Workforce Skills

- Sense-making
- Social Intelligence
- Novel and Adaptive Thinking
- Cross-cultural Competency
- Computational Thinking
- New-media Literacy
- Transdisciplinarity
- Design mindset
- Cognitive load management
- Virtual Collaboration

ENGINEERING EDUCATION

Redefining the role of an engineer

- Developer of technology for society
- Participant in the societal process through which technology shapes society
- Integration of science and the humanities

ENGINEERING EDUCATION

The approach

Technology shapes society as much as it is shaped by it

The latest technologies (bio-, nano-, and IT) – technical intelligence

Integrated culture (embodied by set of personal, group and professional practices)

ENGINEERING EDUCATION

The approach

Engineers to integrate 2 kinds of complexity

Complexity inherent in the newest technologies

Complexity inherent in the multiplicity and diversity of societal needs and perspectives in relation to those technologies

ENGINEERING EDUCATION

Curriculum Reform

- Holistic curriculum
- Engineering ethics and societal values
- Shift of focus from problem solving to problem formulation
- Communicate about the costs (i.e. risks) of complex technology as well as its benefits
- Globalization and producing "flexible" engineers

The need to broaden and strengthen engineering curriculum

ENGINEERING EDUCATION

Historical Background

Building of infrastructure bridges, sky-scrapers, hydro-electric dams, etc.) : support of industrialization and a rapidly growing population

Science based engineering curriculum - new areas of activity (space exploration, nuclear energy, jet aircraft, modern telecommunications, computers and semi-conductor devices)

New period of scientific achievement - New frontiers for technology (biotechnology, nanotechnology, nuclear technology etc. with profound implications for the society)

ENGINEERING EDUCATION

Characteristic of newest technology

Science & Technology	
20^{th} Century Industrial Age Newtonian/Cartesian worldview **Complicated system**	21^{st} Century Post-industrial Age **Complex system**
• Understandable by studying the **behaviour** of their component parts • Exist **independent** of the observer • **Deduced** from "objective" empirical observations (aerospace vehicles, chemical and nuclear plants, and computer and robotics system)	• **Holistic/emergent**— system has properties exhibited only by the whole (cannot be described in terms of its parts) • **Chaotic**—small changes in input often lead to large changes in output and/or many possible outputs for a given input • **Subjective**—some aspects of the system may not be describable by any objective means

ENGINEERING EDUCATION

Implication of newest technology

Change in Paradigm	
Reductionist	**Holistic**
• Engineer is considered to be separate from and independent of the technical system that he or she is developing • Technology is assumed to be value neutral and engineer's personal point of view is considered irrelevant	• Engineer is understood to be part of the technical system in that his or her point of view and values are necessarily expressed in the technology • To act responsibly, the engineer must understand the implications of this recursive relationship

ENGINEERING EDUCATION

Engineer of the 21st Century needs to develop competence not only in **technical** matters, but also in **humanistic** concerns

Humanistic – understanding oneself and how one relates to nature and to the social environment

Does not mean taking a few extra courses in the humanities or take a double major

Bridge the gap inherent in the reductionist paradigm; the need for integration

CURRICULUM DESIGN

Essential Elements

New context based on shift from linear to nonlinear paradigm

New and revised content consistent with this context

New and existing pedagogical approaches for reinforcing the context and supporting the delivery of the content

CURRICULUM DESIGN

Principle of Context

World perceived as machine, engineer as mechanic - linear

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World is alive as complex adaptive system, engineer is apart – nonlinear

Analogy: magnetic field that gives shape and meaning to the content

Shaking up the curriculum (content and pedagogy) without reorienting the field (context) may produce some temporary changes

Contextual shift is from **linearity** to **nonlinearity**

CURRICULUM DESIGN

Key Competencies - **Content**

1. Maintaining a high level of technical expertise – course participation to limit linearity

2. Developing an historical perspective in order to understand the nature and role of contexts and paradigms

3. Developing an understanding of systems and networks in order to see the world holistically/ecologically

4. Developing "ethical know-how"

5. Developing leadership and entrepreneurship – capstone design experience

CURRICULUM DESIGN

2. Developing an historical perspective in order to understand the nature and role of contexts and paradigms

Role of the engineer in society through time and across cultures

Role of ethics pertaining to technology through time and across cultures

Influence of science, mathematics and technology on the thinking of the historical period

Evolving role of Engineering Standards & Practices; Professional Codes of Conduct

CURRICULUM DESIGN

3. Developing an understanding of systems and networks in order to see the world holistically/ecologically

Underlying physical and mathematical concepts of nonlinear systems and networks

Open living systems (e.g. ecological systems) and the principles of emergence & sustainability

Social systems as networks

CURRICULUM DESIGN

4. Developing "ethical know-how"

- Flexibility and a tolerance for ambiguity
- Appreciation and concern for dealing with diverse opinions in multi-stakeholder situations
- Ability to engage in dialogue
- Eco-centric and world-centric perspective
- Ability to be self reflective and transparent to oneself and others
- Mindset shift from control to participation

CURRICULUM DESIGN

Pedagogy

"Praxis"—personal, group and professional practices that internalize knowledge and lead to more effective action

Reinforcing the new context and supporting the delivery of the new content

Expand students' capacity to access knowledge beyond the traditional analytical approach

CURRICULUM DESIGN

Types of Knowledge

Explicit : analytical knowing based on conclusions derived from empirical observation

Tacit/Embodied : a knowing that is acquired through personal experience leading to more intuitive and spontaneous action

Primary : a knowing derived from an awareness of "interconnected wholes rather than isolated contingent parts" – leading to innovative thinking and creativity

CURRICULUM DESIGN

Practices that reinforce the nonlinear context

Personal Praxis (leading to personal mastery)— Based on learning by doing

Involves practices that help embody knowledge so that it becomes second nature

Increase self-awareness; foundation of ethical behaviour

Body awareness— Through martial arts, yoga etc.

Contemplative practice – meditation cultivate concentration ; “makes it possible to see connections that may not have been visible before”

Creative self-expression - music, dance, painting or sculpting – primary knowledge

Nature as Teacher - a personally experienced and alive relationship with Nature is the basis for an authentic commitment to sustainability

CURRICULUM DESIGN

Practices that reinforce the nonlinear context

Group Praxis (leading to inter-personal competence)

Dialogue - process by which assumptions and judgments are exposed, perceptual filters are revealed, real listening can occur and true communication is possible

Presencing – process that provides access, both individually and collectively, to one's deepest capacity to sense and shape the future; deeper levels of learning for discovering new possibilities

Inquiry based learning and team learning - students encouraged to work on assignments through independent research, both individually and in teams

CURRICULUM DESIGN

Practices that reinforce the nonlinear context

Professional Practice (gaining engineering experience)

In-Service or Action Learning (Design projects with engineering companies, communities or government agencies)

Mentoring and Shadowing -shadow practicing engineers during the time that they are working on their projects

THE WAY FORWARD

"Engineering faculty members cannot…simply consign young students to the other side of campus for humanities classes and consider our obligation for providing a broad and liberal education fulfilled. It is for us to complement the rigors of our technical classes with the humanistic framework within which engineering resides…as the new century unfolds, the engineering profession is uniquely poised to redefine a liberal education. Thoughtfully considered, engineering education can develop in our students a fundamental and visceral view of the unity of knowledge and the ability to use this knowledge for socially responsible and reasoned judgment. The academy must lead the way in engineering a liberal education of our students and prepare them for the leadership roles required of a technologically advanced society."

Domenico Grasso, "Engineering a Liberal Education," PRISM, November 2002, p.76.


Thank You