Complex Engineering Problems and Activities in CE Programs

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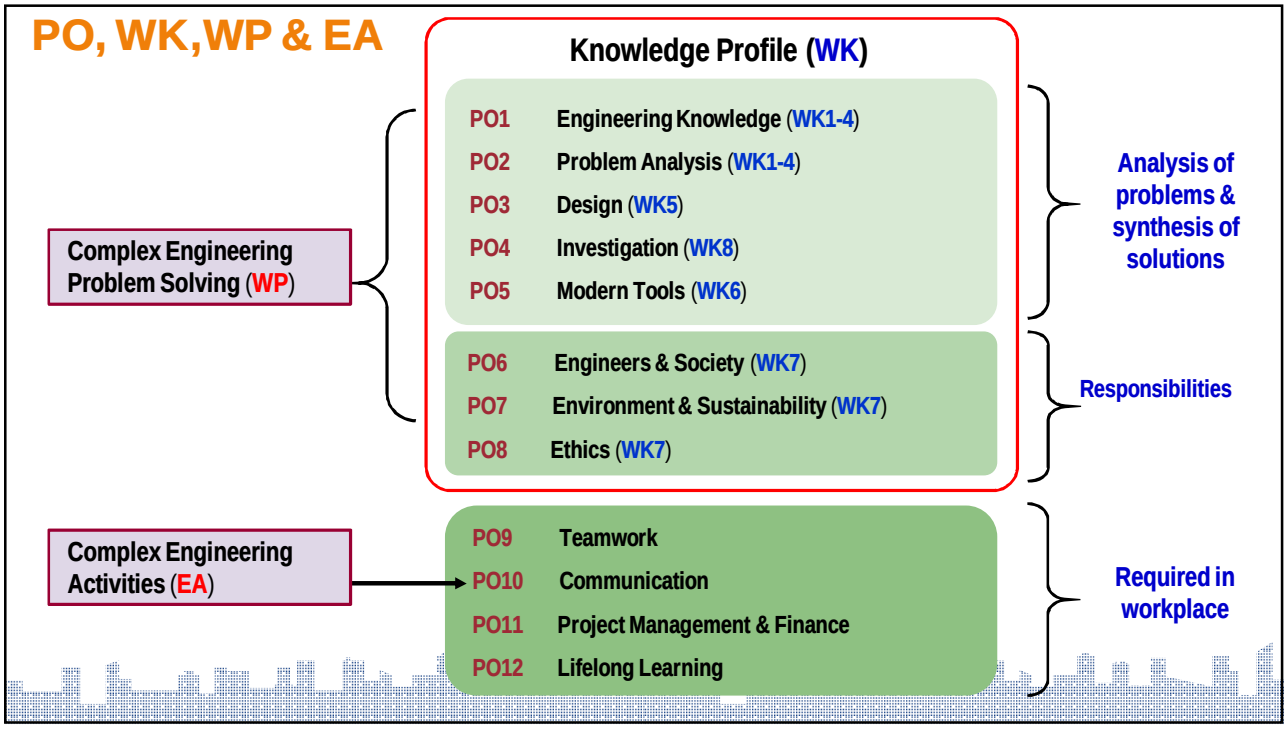
Workshop on Complex Engineering Problems and Activities
International Symposium on Quality Assurance in engineering Education Through Accreditation-II
26-27 August, Dhaka, Bangladesh

OUTLINE

- Complex Engineering Problems (WPs) & Activities (EAs) and Knowledge Profile (WKs)
- Complexity Relation with Courses
- Example: Design Course Addressing WPs and EAs
- Example: Mapping of POs and COs & Mapping of POs with WPs and WKs
- Example: Design of Assessment Tool



How does complexity relate?

- Industrial Training- ***Complex Activities***
- Core and Specialist (Engineering) Courses- ***Complex Problem Solving***
- Core Open-ended/ Design Sessional Courses - ***Complex Problem Solving***
- Elective Courses- ***Complex Problem Solving***
- Final Year Design Project/ Capstone Project- ***Complex Problem Solving and Activities***

POs addressed by Courses (Example)

No.	Title of Course	Programs Outcomes(PO)												
		WP								EA			Complex Engineering Problem Solving	Complex Engineering Activities
		Engineering Knowledge	Problem Analysis	Design	Investigation	Modern Tools	Engineer and Society	Environment and Sustainability	Ethics	Teamwork	Communication	Project Management and Finance	Life-long Learning	
1.	Design of Concrete Structures (theory)	X	X										X	
2.	**Design of Concrete Structures (Sessional)**		X	X		X					X		X	X	X

Design of Concrete Structures
(Sessional Course-Example): PO to CO Mapping

Course Outcomes	Program Outcomes (PO) and Knowledge Profile (K)
CO-1: Explain the design principles and guidelines of RC structures as per the National/ International Codes	**PO(b) Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. **(K3 , K4 and K8)**
CO-2: Analyze the building structure and **Compute** the design forces of members of RC building	
CO-3: Design different components of the building, such as slab, beams, columns and foundation, etc.	**PO(c) Design/Development of solutions:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. **(K5)**
CO-4: Apply the modern tool in analysis and design of building components	**PO(e) Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. **(K6)**
CO-5: Prepare the structural drawing of the building with Auto CAD and present it by oral presentation and written report	**PO(j) Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Design of Concrete Structures (Sessional):

Design Example (Group Assignment)

Conduct a structural design of a 10-story reinforced concrete residential building, located in a densely populated area in Chattogram town. The structural cost of the building must be low and it must ensure the public health and safety issues.

- **Given information:**

1. Soil exploration data
2. Approved architectural layout of the building
3. Structural framing of the building
4. Material Properties

Design of Concrete Structures (Example):

Mapping of Tasks with POs, WPs, WKs and EAs

Possible tasks	Course Outcomes (CO)	Program Outcomes (PO)	Knowledge Profile (WK)	Complex Engineering Problem (WP)	Complex Engineering Activities (EA)
T-1:Identify the problem, specific requirements and constraints involved	CO-1	PO(b): Problem Analysis	WK3	W P1: Depth of Knowledge	
T-2: Develop multiple potential solutions to meet functional requirements	CO-2		WK4	WP2: Range of Conflicting requirements	
T-3: Design different components of the building, such as slab, beams, columns and foundation, etc. and find the optimum solution	CO-3	PO(c): Design/ Development Solutions	WK5	WP3: Depth of Analysis Required	
T-4: Use of modern tool in analysis and design of structural components	CO-4	PO(e): Use of Modern Tools:	WK6	WP5:Extensive Applicable Codes	
T-5: Prepare a structural drawing of the building using AutoCAD and **present** the results by oral presentation and written report	CO-5	PO(j) :Communication			EA1:Range of resources EA3: Innovation

Design of Concrete Structures (Sessional Course):
Assessment Rubric for Design Solutions

No.	Criteria	Exceptional	Acceptable	Marginal	Unacceptable
1	**Design Problem and Boundaries**	Clear and complete understanding of design goal and constraints.	Overall sound understanding of the problem and constraints. Does not significantly impair solution	Some understanding of problem. Major deficiencies that will impact the quality of solution.	Little or no grasp of problem. Incapable of producing a successful solution
2	**Application of Engineering Principles**	Critical selection and application of engineering principles ensuring reasonable results.	Effective application of engineering principles resulting in reasonable solution.	Serious deficiencies in proper selection and use of engineering principle	No or erroneous application of engineering principles yielding unreasonable solution
3	**Alternative Designs**	Final design achieved after review of reasonable alternatives.	Alternative approaches identified to some degree.	Serious deficiencies in exploring and identifying alternative design	Only one design presented or clearly infeasible alternative given.
4	**Final Design**	Design meets or exceeds desired objectives.	Design meets desired objectives.	Barely capable of achieving desired objectives.	Not capable of achieving desired objectives.
5	**Cost estimation**	Effective use of profitability analysis leading to improvement recommendations.	Reasonable profitability analysis presented, but no interpretation of the results	Reasonable cost estimates presented, but no profitability analysis included	No or totally erroneous cost estimates presented.
6	**Applicable of design codes**	complete understanding and consideration of design Code	Good understanding of the design Code but limited consideration	Limited knowledge and consideration of design Code	Little or no knowledge and consideration of design Code
7	**Use of Computer–Aided Tools**	Computer–aided tools are used effectively to develop and analyze designs.	Computer–aided tools used with moderate effectiveness to develop designs	Minimal application and use of appropriate tools.	Serious deficiencies in understanding the correct selection and/or use of tools.

Design of Concrete Structures (Sessional Course):
Assessment Rubric for Engineering Communication

No.	Criteria	Exceptional	Acceptable	Marginal	Unacceptable
1	**Written Mechanics**	Production quality enhances communication.	Acceptable production quality: accurate spelling and grammar; appropriate choice of fonts and colours; appropriate use of language	Marginal production quality: minor errors of spelling an grammar; irregular fonts and layouts.	Unreadable: illegible, unprofessional.
2	**Oral Performance**	Voice, body posture, and handling of questions convey confidence and full knowledge of work being presented	Professional tone and body language: loud and clear; oral performance compliments visual ma terial; competent han dling of questions.	Acceptable tone and body language; some nervousness may be notable; relies heavily on slides to communicate rather than using slides as supporting aids	Unprepared; inaudible; nervous habits may be distracting; unable to answer reasonable questions.
3	**Graphical Representations**	Graphics enhance communication; clearly present message and meaning	Professional use of figures, tables and images that compliment the written/oral components: properly labeled, plotted, sized	Acceptable use of figures and images: some minor problems with layout, sizing, legibility, colour	Distracting, confusing, or inappropriate graphics that detract from the written or oral content

Design of Concrete Structures (Sessional Course):

PO Assessment Sheet (Example)

CE-412: Design of Concrete Structures (Sessional)
Level 4, Term-I
Course Teacher(s): 1. ..... and 2. .....

		PO Mapping:	PO(b)		% Attainment	PO(c)				% Attainment	PO(e)	% Attainment	PO(j)			% Attainment
		CO Mapping:	CO-1	CO-2		CO-3					CO-4		CO-5			
		Assessment Tools:								Rubric						
		Rubric Question No	1	2		3	4	5	6	Total	7		1	2	3	
		Weight:	50%	50%	100%	25%	25%	25%	25%	100%	100%	100%	33.33%	33.33%	33.33%	100%
NO.	Student No.	Name of Student														
1	1401001															
2	1401002															
3	1401003															
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Thank You