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CHANGES OF BAETE'S ACCREDITATION MANUAL FOR BACHELOR'S DEGREE PROGRAMS IN ENGINEERING IN BANGLADESH

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Abstract:
Accreditation has recognized itself worldwide as the key appliance for quality assurance in engineering education, Beginning with the pioneering efforts of Accreditation Board for Engineering and Technology ABET [14], USA, and countries are approaching under the shade of the Washington Accord [7]. Accreditation includes a two-stage process, self-assessment and peer evaluation; the essential changes are highlighted. In the last two decades, an explosive growth in the number of institutions offering engineering programs has been detected. This unprecedented growth obviously led to several problems with regard to quality of engineering education. In order to ensure the quality of engineering education, the Institution of Engineers, Bangladesh (IEB) to formulate the criteria or standards, by which individual programs in any engineering institution can be evaluated [5]. Bangladesh has engaged a big leap forward in the area of engineering education by becoming a provisional member of the Washington Accord through the Board of Accreditation for Engineering and Technical Education (BAETE) [3]. As per the requirement the Institution of Engineers, Bangladesh (IEB) has revised the procedures and criteria of accreditation to bring it to international standards. The new procedures and criteria of accreditation came to effect from 1st January 2020. This paper presents the changed part of accreditation of the BAETE.

Keywords: education, objectives of secondary education, quality assurance, school community partnership

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1. Introduction

Improving quality of education deals exceptional profits to the society. The accrued knowledge and good skills that is applicable for economic and social development over time represent a significant factor of human resources. Starting of new programs in an institution and permitting increased intakes etc., constituted Institution of Engineers, Bangladesh (IEB) for the purpose of accreditation of various diplomas to post-graduate degree programs in Engineering and Technology, Management, Pharmacy, Architecture and related disciplines in Bangladesh.

The Outcomes-based Accreditation (OBA) Manual (Version 2, 2019) of BAETE [chapter 1, section 1.2, page 1-1] states,

"*The specific objectives of accreditation are as follows:*

- *To ensure that graduates acquire the attributes required to meet national and international standards;*
- *To assist all stakeholders in identifying specific engineering education programs that meet national and international standards; and*
- *To provide a mechanism for the continual improvement of existing engineering programs through evaluation and feedback*" [3].

To align with The International Engineering Alliance IEA [12}, minor changes have been made in the Accreditation thinking and process. It can be seen BAETE [3] accreditation manual on its website now. The Outcomes-based Accreditation (OBA) Manual (Version 2, 2019) of BAETE for the undergraduate programs has been revised which will be effective from 1 January 2020 [4].

Chowdhury et al. (2013) studied Quality assurance and accreditation of engineering education in Bangladesh [8]. The purpose of this paper is to draw attention to label the changes in accreditation manual. so that management of institutions, faculty, staff and students prepare themselves for accreditation based on new guidelines. It also brings out the necessity of drawing attention of evaluators to these changes so that they are able to do accreditation in the right spirit.

1.1 Former System of Accreditation

The steps involved in the accreditation process are as follows. All communications at every step should occur through the Registrar, BAETE.

1	Submission of the application
2	Formation of the Evaluation Team
3	Communication to the institution about the formation of the Evaluation Team
4	Communication of the institution's reservations about any member of the Evaluation Team, if any.
5	Review of the SAR
6	On-site visit
7	Evaluation Team report
8	Scrutiny by the Sectoral Committee

9	Response of the institution to factual matters
10	Recommendation of the Sectoral Committee
11	Decision of the Board
12	Communication of the decision to the institution

[3]

1.2 Changed part of Accreditation System

Changes have been done in step 5. These changes are:

Change no. 1.

BAETE Manual of Accreditation [previous page of content] states: "*Year-long Final Year Design Project or Capstone Project is no longer obligatory in the curriculum. Demonstration of culminated POs in solving complex engineering problems remains required, and the year-long Final Year Design Project or Capstone Project is the preferred method*".

Which is described in chapter 4, page 4-3, section 4.6.

"*The program should demonstrate the culmination of program outcomes (POs) at the level of solving complex engineering problems, preferably through a final-year design project or capstone project extending over a period of one year*".

Change no. 2.

a. **"***The descriptions of POs have been updated following IEA [9] Version 3.21, June 2013 [10]. Requirements of the Knowledge Profiles (K1 - K8) have been explicitly mentioned in the description of each PO*".

Updated POs are page 4-4, chapter 4, and section 4.8.

"(a) *Engineering knowledge: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.*
(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. (K1 to K4)
(c) Design/development of solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs Chapter 4 Criteria 4-5 with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
(d) Investigation: Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
(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)

(f) The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
(g) Environment and sustainability: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)
(h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)".

b. *"The tables describing the Range of Complex Engineering Problem-Solving and Range of Complex Engineering Activities have been updated following IEA Version 3.21, June 2013."*

Table 4.2: Range of Complex Problem Solving

Attribute Complex	*Complex Engineering Problems have characteristic P1 and some or all of P2 to P7:*
Depth of knowledge required	*P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach*
Range of conflicting requirements	*P2: Involve wide-ranging or conflicting technical, engineering and other issues*
Depth of analysis required	*P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models*
Familiarity of issues	*P4: Involve infrequently encountered issues*
Extent of applicable codes	*P5: Are outside problems encompassed by standards and codes of practice for professional engineering*
Extent of stakeholder involvement and conflicting requirements	*P6: Involve diverse groups of stakeholders with widely varying needs*
Interdependence	*P7: Are high level problems including many component parts or sub-problems"*

Table 1: Range of Complex Problem Solving

Table 4.3: Range of Complex Engineering Activities

Attribute	Complex activities means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches".

Table 2: Range of Complex Engineering Activities

No.	Course code	Course name		COMPLEX PROBLEM SOLVING (WP)							COMPLEX ACTIVITIES									KNOWLEDGE PROFILE											
				WP1												PO1				PO2				PO3	PO4	PO5	PO6	PO7	PO8	
				DEPTH OF KNOWLEDGE	WP2	WP3	WP4	WP5	WP6	WP7	EA1	EA2	EA3	EA4	EA5	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK5	WK8	WK6	WK7	WK7	WK7	

				WK3	WK4	WK5	WK6	WK7	RANGE OF CONFLICTING REQUIREMENT	DEPTH OF ANALYSIS REQUIRED	FAMILIARITY OF ISSUES	EXTENSIVE APPLICABLE CODES	EXTEND OF STAKEHOLDERS INVOLVEMENT & CONFLICTING REQUIREMENT	INTERDEPENDENCE	RANGE OF RESOURCES	LEVEL OF INTERACTIONS	INNOVATION	CONSEQUENCES TO SOCIETY & ENVIRONMENT	FAMILIARITY OF ISSUES	NATURAL SCIENCES	MATHEMATIC	ENGINEERING FUNDAMENTAL	SPEACIALIST KNOWLEDGE	NATURAL SCIENCES	MATHEMATIC	ENGINEERING FUNDAMENTAL	SPEACIALIST KNOWLEDGE	ENGINEERING DESIGN	RESEARCH LITERATURE	ENGINEERING PRACTICE	COMPREHENSION	COMPREHENSION	COMPREHENSION
1.		FINAL YEAR PROJECT I	PO2, PO4, PO5, PO8, PO9, PO10, PO12																													
2.		INTEGRATED DESIGN PROJECT (IDP)	PO2, PO4, PO5, PO8, PO9,PO10, PO12																													

Table 3: Sample CO PO WK WP EA matrix [11]

c. "*The program should map out how each attribute of the Knowledge Profile (K1 – K8) is addressed in the curriculum. The program should also demonstrate how each attribute of the Range of Complex Engineering Problems (P1 – P7) and Complex Engineering Activities (A1 – A5) is incorporated in teaching, learning and assessment*."

d. "*Results of evaluation of PO attainment should be reported*" , described in chapter 4, page 4.4, section 4.5 .

Sample format is given below:

Change no. 3.
It is in "*Chapter 7:*
a. *Format of the SAR has been updated.*
b. *Sections 7.2, 7.3: New sections added on guidelines for preparing the SAR*".

BAETE Manual of Accreditation [2nd edition, page 7-1, chapter 7, section 7.2] states,

"*7.2 Guidelines for preparing the SAR*
The completed SAR should describe how the institution and the program comply with the regulations and requirements as stipulated in the relevant act/statute and with the benchmark of the BAETE in each of the criteria. The following points should be noted while preparing the SAR. 1. The data and the information provided in the SAR should be adequate and should be supplemented by comments and discussions that will allow the evaluation team to perform a preliminary evaluation of the program based on the SAR. 2. For any criteria and sub-criteria, the SAR should generally address the following three questions. Data, examples of cases and other supporting information should be included in the SAR to justify the assertions. The challenges faced and the way in which these were overcome during enactment, implementation and improvement of each policy and process should also be described. a. Is there a policy/process in place? b. If 'yes', is the policy/process in practice? c. Does any improvement mechanism exist for the policy/process? 3. The SAR should proactively and unambiguously identify the deviation from the act/statute where and when one exists.

7.3 Supplemental Documents
The following documents must be provided in the Annexure.
1. Latest copy of the prospectus and a copy of the institution's latest academic calendar.
2. Copy of the letter of approval to establish the institution from the appropriate authority.
3. Copy of the letter of approval to establish the program from the appropriate authority.
4. Copy of statutes/academic ordinances. All other documents requested in the SAR template shall have to be provided as Annexure(s). The SAR and the Annexure should be printed on both sides of A4 size paper arranged in two volumes. The SAR should not exceed 200 pages. A soft copy should be given with each volume contained in one file.

c. *Template of the SAR has been revised putting more emphasis on narration of the policies and*

processes and justifications".

BAETE Manual of Accreditation [2nd edition, page 7-2, chapter 7, section 7.4] states,

"*7.4 Template*
The template for the Self-Assessment Report (SAR) begins on the next page. This section provides a generic form for the SAR that an institution must submit to begin the accreditation process. All supporting documents shall have to be appended at the end of the SAR as Annexes. All the pages of the submitted SAR including the annexes shall have to be consecutively numbered.

d. *Template for Criterion 8 has been updated in line with the revisions made in Section 4.8 of the manual*".

BAETE Manual of Accreditation [2nd edition, page 7-20, chapter 7 section 8.1] states,

"*8.1 Program outcome (PO) statements and their mapping with the PEOs*
State the program outcomes (POs) and show their alignment with PEOs as per the following table.

PO No.	***PO statement***	***PEO 1***	***PEO 2***	***…***	***…***	***…***
a						
b						
c						
d						

Table 4: *PO PEO mapping*

Indicate the correlation using either binary levels (yes/no) or ternary levels (high/low/none). Leave the cell blank if there is no correlation (no/none).

8.2 Course outcomes (COs)

8.2.1 Statements of COs
State the COs for each core course offered by the program, which are used to demonstrate attainment of POs, as per the following table.

CO No.	***. CO statement***	***Corresponding PO No.***	***Domain/level of learning taxonomy***	***Delivery methods and activities***	***Assessment tools***

Table 5: *CO PO mapping with level of learning taxonomy*

The COs of all other courses offered by the program, listed by department, along with the corresponding domain/level of learning taxonomy, delivery methods and activities and assessment tools, should be provided in the Annexure.

8.2.2 Relationship between COs and POs for each course included in the table of Section 8.2.1 present a map of COs and POs, as per the following table. Alternatively, the following information may be presented graphically.

Course No. and title	***CO No.***	***PO-a***	***PO-b***	**…**	**…**	**…**	**…**

Table 6: *CO PO mapping*

Indicate the correlation using either binary levels (yes/no) or ternary levels (high/low/none). Leave the cell blank if there is no correlation (no/none).

8.3 Knowledge Profile, Complex Engineering Problems and Complex Engineering Activities
Demonstrate, through mapping, how each attribute of the Knowledge Profile (K1 – K8) is addressed in the curriculum. Additionally, demonstrate how each attribute of the Range of Complex Engineering Problems (P1 – P7) and Complex Engineering Activities (A1 – A5) is incorporated in the teaching, learning and assessment.

8.4 Assessment of COs
Describe how the attainment of COs is assessed in each course, including the rubrics, where applicable. The assessment processes, attainment criteria and scale, and expected level of attainment should be clearly stated. Present a summarized assessment of the COs of the courses listed in the table of Section 8.2.2. Evidence of CO assessments for the other courses offered by the department for the program in each semester of the last calendar year should be included in the Annexure.

8.5 Attainment of POs required by the BAETE

8.5.1 Attainment of PO(a):
Engineering Knowledge Describe how the attainment of PO(a) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attributes (K1 – K4) are incorporated in PO(a). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(a) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(a) is being attained.

8.5.2 Attainment of PO(b):

Problem Analysis Describe how the attainment of PO(b) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attributes (K1 – K4) are incorporated in PO(b). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(b) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(b) is being attained.

8.5.3 Attainment of PO(c):

Design/Development of Solutions Describe how the attainment of PO(c) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attribute K5 is incorporated in PO(c). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(c) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(c) is being attained.

8.5.4 Attainment of PO(d):

Investigation Describe how the attainment of PO(d) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attribute K8 is incorporated in PO(d). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(d) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(d) is being attained.

8.5.5 Attainment of PO(e):

Modern Tool Usage Describe how the attainment of PO(e) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attribute K6 is incorporated in PO(e). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(e) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(e) is being attained.

8.5.6 Attainment of PO(f):

The Engineer and Society Describe how the attainment of PO(f) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attribute K7 is incorporated in PO(f). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(f) and provide evidence to support the assertion. Present a summary

of the results obtained after the assessment and analysis to demonstrate the extent to which PO(f) is being attained.

8.5.7 Attainment of PO(g):
Environment and Sustainability Describe how the attainment of PO(g) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attribute K7 is incorporated in PO(g). Identify which of the attributes of the Range of Complex Engineering Problems (P1 – P7) are addressed through the attainment of PO(g) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(g) is being attained.

8.5.8 Attainment of PO(h):
Ethics Describe how the attainment of PO(h) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. State how Knowledge Profile attribute K7 is incorporated in PO(h.) Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(h) is being attained.

8.5.9 Attainment of PO(i):
Individual and Teamwork Describe how the attainment of PO(i) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. Identify the expected level of attainment. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(i) is being attained.

8.5.10 Attainment of PO(j):
Communication Describe how the attainment of PO(j) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. Identify which of the attributes of the Range of Complex Engineering Activities (A1 – A5) are addressed through the attainment of PO(j) and provide evidence to support the assertion. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(j) is being attained.

8.5.11 Attainment of PO(k):
Project Management and Finance Describe how the attainment of PO(k) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(k) is being attained. 8.5.12 Attainment of PO(l): Lifelong Learning Describe how the attainment of PO(l) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which PO(l) is being attained.

8.6 Achievement of additional POs

Describe how the attainment of each additional PO (if any) is assessed and evaluated. State and justify the methods, tools, criteria and scale used in the assessment process. State the expected level of attainment for each of the additional POs. Present a summary of the results obtained after the assessment and analysis to demonstrate the extent to which each additional PO is being attained".

2. Recommendation

BAETE Manual of Accreditation [2nd edition] states: "*An Overview of Changes [previous page of content] Change number 2(a) has been written*

a. *The descriptions of POs have been updated following IEA Version 3.21, June 2013. Requirements of the Knowledge Profiles (K1 - K8) have been explicitly mentioned in the description of each PO."*

IEA Version 3.21, June 2013', this part should be 'IEA Version 3: 21 June 2013' [12],[13].

3. Concluding Observations

IEB is delegated with the mission of developing a procedure for quality assessment in the engineering education and to support the stakeholders in engineering education to identify those institutes and their programs which meet the quality benchmarks setup by international agencies. Accreditation process is being reviewed periodically to reach the new global standards, so that many of the institutions will be accredited and Bangladesh can become a full-fledged member of the significant Washington Accord. The system of accreditation should be continuously reviewed to enhance its rationality, consistency and bring it on parity with international standards.

Changes for Accreditation of Engineering programs in Bangladesh containing tools developed in various sections of BAETE Manual of Accreditation [2nd edition] have been discussed in this paper, in the context of old Accreditation Manual. The process to display CO-PO-PEO-mission and vision of an engineering institution developed which will make the process of accreditation more objective and transparent.

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