APPENDIX

A. Bloom's Taxonomy Reference Guide

Bloom's Taxonomy is a hierarchical framework for classifying educational learning objectives into levels of complexity and specificity.

LEVEL	COGNITIVE LEVEL	DESCRIPTION	COMMON ACTION VERBS
1	Remember	Recall facts and basic concepts	Define, List, Name, Identify, State, Recall, Label, Match, Recognize, Record
2	Understand	Explain ideas or concepts	Explain, Summarize, Describe, Interpret, Classify, Compare, Discuss, Paraphrase, Infer
3	Apply	Use information in new situations	Apply, Execute, Implement, Solve, Use, Demonstrate, Calculate, Illustrate, Operate
4	Analyze	Draw connections among ideas	Analyze, Differentiate, Organize, Examine, Compare, Contrast, Distinguish, Categorize, Test
5	Evaluate	Justify a stand or decision	Evaluate, Judge, Critique, Assess, Defend, Justify, Recommend, Appraise, Prioritize
6	Create	Produce new or original work	Create, Design, Construct, Develop, Formulate, Compose, Plan, Devise, Synthesize

Note: Questions should progressively target higher cognitive levels as students advance through the course. A well-designed assessment typically includes a mix of levels, with emphasis on Apply, Analyze, and Evaluate for undergraduate courses.

B. Scoring Methodology

1. Question Performance (QP) Score

The QP score measures how well individual questions align with their expected cognitive levels based on Course Outcome specifications.

Q-Score System:

Q-SCORE	CONDITION	MEANING
+2	`Question Level < CO Level - 1`	Question exceeds expected complexity (higher cognitive challenge)
+1	`Question Level = CO Level` or `CO Level + 1`	Question matches expected level (appropriate alignment)
-1	`Question Level ≥ CO Level + 1`	Question below expected level (needs improvement)

QP Final Score Formula:

```
QP_Final = ((QP - QP_Min) / (QP_Max - QP_Min)) × 100 Where: QP =
Sum of all individual Q-scores QP_Min = Minimum possible score
(all questions at Level 6) QP_Max = Maximum possible score (all
questions at Level 1)
```

This normalization ensures the QP score is always between 0 and 100, regardless of the number of questions or their distribution.

2. Penalty Calculations

Penalties are applied only for **under-representation** to ensure comprehensive coverage of all learning objectives.

Module Coverage Penalty (C2):

```
C2 = (1/n) × Σ[(Expected% - Actual%) / Expected%] Where: n = Total
number of modules Sum applies only to modules where Actual% <
```

```
Expected%
```

Interpretation: If a module is allocated 20% of teaching hours but receives only 10% of assessment marks, it contributes a penalty of (20-10)/20 = 0.5 or 50%.

Course Outcome Coverage Penalty (C3):

```
C3 = (1/CO_Count) × Σ[(Expected% - Actual%) / Expected%] Where:
CO_Count = Total number of Course Outcomes Sum applies only to COs
where Actual% < Expected%
```

Interpretation: If a CO is weighted at 25% but receives only 15% of marks, it contributes a penalty of (25-15)/25 = 0.4 or 40%.

Combined Penalty:

```
P_Final = (C2 + C3) / 2 (when module data exists) P_Final = C3
(when no module data) PF_Percentage = (P_Final / 2) × 100
```

3. Final Score Calculation

```
Final Score = (QP_Final + (100 - PF_Percentage)) / 2
```

Components:
- **50%** - Question-level cognitive alignment (QP_Final)
- **50%** - Distribution compliance (100 - PF_Percentage)

Score Interpretation:

SCORE RANGE	INTERPRETATION & RECOMMENDATIONS
80-100%	**Excellent:** Strong alignment and balanced distribution. Minor refinements may enhance quality further.
60-79%	**Good:** Reasonable alignment with some areas needing attention. Review under-represented modules/COs.

SCORE RANGE	INTERPRETATION & RECOMMENDATIONS
40-59%	**Moderate:** Significant improvements needed. Revise question cognitive levels and balance distribution.
Below 40%	**Poor:** Comprehensive restructuring required. Major misalignment in cognitive levels and/or distribution.

C. Alignment Logic

Each question is compared against its associated Course Outcome's target Bloom's level:

DIFFERENCE (D)	STATUS	Q-SCORE	INTERPRETATION
$D = 0$ or $D = -1$	Match	+1	Question appropriately challenges students at the intended level
$D < -1$	Higher	+2	Question exceeds expected complexity, promoting deeper learning
$D \geq 1$	Lower	-1	Question below target cognitive level, may not adequately assess the CO

Where:

- **D** = Question Bloom Level - CO Target Bloom Level
- **Q** = Question's assigned Bloom's Taxonomy Level (1-6)
- **CO** = Course Outcome's target Bloom's Level (1-6)

> **Example:** If CO2 targets "Apply" (Level 3) and a question uses "Analyze" (Level 4), then D = 4 - 3 = 1, resulting in a Q-Score of -1 (Lower). The question should be revised to better match the CO's intent.

D. Normalization Process

All mark distributions are normalized to percentages to ensure fair comparison across different assessment structures:

```
Normalized Value = (Individual Value / Total Sum) × 100
```

Applied to:

- **Module Hours:** Converted to expected percentage of total assessment marks
- **Course Outcome Weights:** Standardized to sum to 100%
- **Bloom's Taxonomy Distributions:** Calculated as percentage of total marks

E. Glossary of Terms

Actual Distribution

The real distribution of marks/questions in the assessment as analyzed from the question paper

Alignment

The degree to which assessment questions match the intended learning outcomes and cognitive levels specified in the curriculum

Bloom's Taxonomy

A hierarchical framework for classifying educational learning objectives into six levels of complexity: Remember, Understand, Apply, Analyze, Evaluate, and Create

CO (Course Outcome)

Specific, measurable learning objectives that students should achieve by the end of the course, typically mapped to program outcomes

Cognitive Level

The degree of mental processing required to answer a question, ranging from basic recall (Level 1) to creative synthesis (Level 6)

Expected Distribution

The intended or planned allocation of marks/questions across COs, modules, or Bloom's levels based on curriculum design, syllabus weightage, and module hours

Module

A distinct unit or section of course content, typically covering specific topics or themes. Distribution is based on teaching hours allocated to each module

Module Hours

The number of teaching/instructional hours allocated to each module in the course syllabus, used to calculate expected mark distribution

Normalization

The process of converting raw values to percentages summing to 100% for fair comparison across different metrics

Penalty

A negative score component indicating under-representation or misalignment in the assessment. Only applied when actual coverage is less than expected

Q-Score

A numerical score (-1, +1, or +2) assigned to each question indicating how well its cognitive level matches the expected level defined by its associated Course Outcome

QP (Question Performance)

The overall measure of cognitive alignment across all questions in the assessment, normalized to a 0-100 scale

Remark

A descriptive status for each question indicating alignment quality: "Matches Expected Blooms Level", "Higher than Expected Blooms Level", or "Lower than Expected Blooms Level"

Variance

The difference between expected and actual distribution percentages (Actual% - Expected%). Positive variance indicates over-representation; negative variance indicates under-representation

Weight

The percentage of total assessment marks allocated to a specific Course Outcome or Bloom's taxonomy level

F. Data Processing Flow

1. **Input Validation:** Verify sequence data, CO configuration, module hours, and Bloom's taxonomy mapping
2. **Normalization:** Convert all distributions (modules, COs, marks) to standardized percentages
3. **Question Analysis:** Extract Bloom's verbs from questions and determine cognitive levels using verb taxonomy
4. **Alignment Check:** Compare each question's cognitive level against its associated CO's target level
5. **Distribution Calculation:** Compute actual vs expected distributions for modules, COs, and Bloom's levels
6. **Penalty Assessment:** Calculate under-representation penalties for modules and COs
7. **Score Computation:** Combine question alignment scores and distribution penalties into final score
8. **Recommendation Generation:** Produce actionable suggestions for improving assessment quality

G. Best Practices

For Question Paper Designers:

- Ensure each question clearly targets a specific Course Outcome
- Use action verbs that match the intended Bloom's level (e.g., "Analyze" for Level 4, not "List")
- Distribute marks proportionally to module teaching hours
- Balance cognitive levels - include questions from multiple Bloom's levels
- Avoid clustering all questions at lower cognitive levels (Remember/Understand)
- Review alignment before finalizing to ensure comprehensive CO coverage

Important: This appendix provides complete transparency into the evaluation methodology, enabling educators, administrators, and quality assurance teams to understand and trust the assessment analysis. All calculations are deterministic and reproducible.