National Institute of Technology Jamshedpur
Mechanical Engineering Department

P.25: Rubrics Developed to Validate POs for B.Tech.(Hons.) Program in Mechanical Engineering

The eleven steps towards validation of POs are as follows:

Step 1: Defining the Vision and Mission of the Department.

Step 2: Defining Program Educational Objectives (PEOs) of the Department.

Step 3: Establishing relation between PEOs and POs to setup target level of PO attainment.

Step 4: Defining relation between Course Outcomes (COs) and POs for each course to obtain overall CO mapping with each POs.

Step 5: Development of overall CO-PO mapping matrix for all courses.

Step 6: Computation and construction of overall CO attainment matrix for each course using course assessment tools.

Step 7: Calculation and construction of direct PO attainment matrix using overall CO-PO mapping matrix and overall CO attainment matrix.

Step 8: Calculation of overall direct PO attainment.

Step 9: Calculation of indirect PO attainment.

Step 10: Computation of overall PO attainment.

Step 11: Comparison of target level and obtained PO attainment.

These steps are elaborated below:

Steps 1 and 2:

These are the basic steps to define vision, mission of the department and program educational objectives which are presented in SAR report. The important steps in calculation of overall PO attainment are discussed below.

Step 3: Establishing relation between PEOs and POs to setup target level of PO attainment.

In this step the PEOs are mapped with POs as

POs and PEOs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
PEO 1	Core Strength	**3**	**3**	**3**	**3**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
	Provide solutions for the benefit of society	**3**	**3**	**3**	**3**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
PEO 2	Design and Innovation	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Provide technically and commercially feasible solutions	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
PEO 3	Personal development and social responsibilities	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**3**	**2**	**2**
	Energy security awareness, communication skill, professionalism	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**3**	**2**	**2**
Target level of outcomes		**2.33**	**2.33**	**2.33**	**2.33**	**1.66**	**1.66**	**1.66**	**1.66**	**1.33**	**1.66**	**1.33**	**1.33**

3 **High** **2** **Moderate** **1** **Low** **No Relevance**

Step 4: Defining relation between Course Outcomes (COs) and POs for each course to obtain overall CO mapping with each POs.

In this step, COs of each course are mapped with POs. The CO levels corresponding to each PO are averaged to obtain overall CO level for each PO and this is repeated for all courses.

Example: Obtaining overall CO level with each PO for the course ME503.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	2	1					1
CO2	3	2	2	2	1	1	1	1	1	1		2
CO3	3	3	3	3	2	3	2		1		1	1
CO4	3	3	3	3	2	2	2	1	1	1		2
ME503	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**

The last row of above table is showing the corresponding overall CO levels with each PO for ME305.

Step 5: Development of overall CO-PO mapping matrix for all courses.

The overall CO levels obtained for all courses from step 4 can be expressed in matrix form. Each element of the matrix can be expressed as $COPO_{i,j}$ where i denotes serial number of a course and j corresponds jth PO.

Example: A part of the COPO mapping matrix is given below

Course	Sl. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ME505	37	3	3	2	3	2	2	2	1	1	1	1	1
ME506	38	1	1	2	3	2	1	1	1	1	2	1	2
ME507	39	1	2	2	3	2	2	2	1	1	2	1	2
ME508	40	1	2	2	3	2	2	2	1	1	2	1	2
ME601	41	3	2	1	3	2	1	1	1	1	1	1	2
ME602	42	3	3	1	3	2	1	1	1	1	1	1	1
ME603	43	3	3	2	3	2	1	1	1	2	1	1	2
ME604	44	3	3	2	3	2	2	2	1	1	1	1	2

From the above matrix, the bottom right element can be written as $COPO_{44,12}$.

Step 6: Computation and construction of overall CO attainment matrix for each course using course assessment tools.

The assessment tools for CO attainment of the courses are minor exams, major exam and continuous assessment. The CO attainment levels for each method of assessment are defined below

Definition of CO attainment levels for each method of assessment		
Assessment method	Level	Attainment
Major	1	50% of students scoring more than 50% marks
	2	60% of students scoring more than 50% marks
	3	70% of students scoring more than 50% marks
Minor	1	50% of students scoring more than 50% marks
	2	60% of students scoring more than 50% marks
	3	70% of students scoring more than 50% marks
Continuous	1	50% of students scoring more than 60% marks
	2	60% of students scoring more than 60% marks
	3	70% of students scoring more than 60% marks

Course attainment levels through Major ($MJ_{i)}$, Minor (MN_i), and Continuous (CS_i) assessment method for ith course are obtained using the above table and method-wise marks obtained by students in acourse.

Overall course attainment level for each course is given by

$$OCO_i = 0.4 \times MJ_i + 0.4 \times MN_i + 0.2 \times CS_i$$

where MJ_i, MN_i, and CS_i represent CO attainment levels using Major, Minor and Continuous assessment methods respectively. i is the serial number of a course.

Example: Over all CO attainment level for a course

Assessment tool	Course **ME 505**
Minor	1
Major	3
Continuous	3
Overall CO	**2.6**

Overall CO attainment level of ME505

$$OCO_{37} = \mathbf{0.4 \times 3 + 0.4 \times 2 + 0.2 \times 3 = 2.6}$$

Step 7: Calculation and construction of direct PO attainment matrix using overall CO-PO mapping matrix and overall CO attainment matrix.

The direct PO attainment of a course is given by

$$DCPO_{i,k} = COPO_{i,k} \times \frac{1}{3} OCO_i \ ,$$

where i is the serial number of a course, k corresponds to kth PO. $COPO_{i,k}$ and OCO_i can be obtained from step 5 and step 6 respectively for each course.

Step 8: Calculation of overall direct PO attainment.

$$DPO_j = \frac{1}{p} \sum_{k=1}^{p} DCPO_{j,k}$$

Step 9: Calculation of indirect PO attainment.

Indirect assessment is done through program student survey, alumni survey and employer survey. Program student's survey is given a weight age of 40%, employer and alumni survey are given a weight age of 30% each. Survey forms were prepared (hard copy and Google form) and distributed among current students, graduating students, alumni and employers. Feedback forms were designed with questions corresponding to POs and PSOs relevant to the program. Sample copies of the forms are attached at the end of this document. All the feedback forms are collected and data are tabulated in an excel sheet.

Average level for each PO has been calculated using the formula

$$IPO_j = \frac{0.4}{p} \sum_{k=1}^{p} QPO_{j,k} + \frac{0.3}{q} \sum_{k=1}^{q} QPO_{j,k} + \frac{0.3}{r} \sum_{k=1}^{r} QPO_{j,k}$$

Where p is the number of current student participants, q is the number of alumni participants, r is the number of employer participants, j is the number of PO related questions and $QPO_{j,k}$ is the level given by pth participant for jth question. IPO_j is the indirect attainment of jth PO.

Step 10: Computation of overall PO attainment

The formula for calculating overall PO attainment is given by

$OPO_j = 0.8 \times DPO_j + 0.2 \times IPO_j$,

where $j = 1\ldots12$ (12 POs).

Step 11: Comparison of target level and obtained PO attainment

In this step the target levels of PO attainment which were obtained from step 3 are compared with the attainment computed in step 10.

Example:

Sl. No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
Target level	**2.33**	**2.33**	**2.33**	**2.33**	**1.66**	**1.66**	**1.66**	**1.66**	**1.33**	**1.66**	**1.33**	**1.33**
Actual Attainment OPO_j	**2.46**	**2.33**	**2.05**	**2.37**	**1.95**	**1.62**	**1.65**	**1.31**	**1.42**	**1.53**	**1.22**	**1.75**
Remarks	**Y**	**Y**	**N**	**Y**	**Y**	**N**	**N**	**N**	**Y**	**N**	**N**	**Y**
Y: Target Achieved, N: Target Not Achieved												