ACADEMIC AUDIT
- OBE Perspective

Prof T Ramesh (Retd.)
CSE, NIT Warangal
rmesht@gmail.com
9490455118

OUTCOME BASED EDUCATION TERMINOLOGY

- OUTCOME: Specify what the student will be able to **learn and do at the end** of a Course / the Program
- TARGET: Identify achievable targets for each outcome / course / program
- TLP: Adopt Teaching Learning Process that makes the student to learn (preferably by him/her self) and reach the set targets.
- ATTAINMENTS: Develop suitable mechanisms to measure the achievements of the attainments.

OUTCOME BASED EDUCATION TERMINOLOGY

- AUDIT: Conduct academic audit (including student performance in examinations) and identify the gaps (including revision / additional topics), between attainments and targets.
- GAP: Analyze the reasons for the gaps between targets and attainments and identify the remedial actions including coverage of additional topics for the subsequent batches with approval from competent authority.
- Curriculum Revision: Adopt revised curriculum, Teaching Learning Process and measurement of attainment of achievements

ACADEMIC AUDIT

KEY COMPONENTS IN ACADEMIC AUDIT

- Course Plan including Course Outcomes
- Question Papers – with tagging for each question – Course Outcome, Cognizant level, marks allotted
- Mapping of questions with COs, COs with POs.
- Assessment of attainments – Identification of gaps and Plan of action to bridge gaps.
- Submit to department level committee for suggestions and improvements
- Institute level audit committee recommends for modifications in course / course delivery
- Action To be Taken Report

OBE - Documentation

Documentation of processes – All the processes used for must be presented to the competent academic body of the institute and the minutes of such meetings and approvals must be documented.

- defining Vision / Mission statements
- Defining Course Outcomes, CO-PO mapping
- for fixing of targets,
- measurement of attainments,
- identification of gaps,
- remedial actions, preparedness for revision

Teaching Learning Processes

- Teaching – Learning Processes
  - The Gurukul Age – Overall Development

    Student lives with Guru and Guru takes care of overall development of the student
  - Teacher Centric – Teaching to learn

    Student goes to an institution and guru teaches to a group of students and conducts examination at the end to test the knowledge gained by the students.
  - Student Centric – Learn through teaching

    Teacher makes the student to learn by himself to reach set goals, observes the progress and corrects wherever necessary.

Teaching Learning Process - Classifications

- The Gurukul Age

  Teacher / Guru takes care of the student very carefully like a cat taking care of its kittens while moving them from one place to other

- Teacher Centric

  Teacher delivers the contents and the student gains knowledge. Like monkey jumping from one tree top to another while the baby holds the mother.

- Student Centric

  Teacher decides what the student should learn at the end of the course and prepares learning material with specific targets, measures the attainments of students. Like lion teaching its cubs

MARJALA – MARKATA – KISORA NYAYAM

OBE – Teaching Learning Process.

MARJALA – MARKATA – KISORA NYAYAM

Which of the above is

OBE way of teaching learning process?

OBE – Teaching Learning Process.

MARJALA – MARKATA – KISORA NYAYAM

OBE – A Lion's way of teaching!

KEY COMPONENTS OF OUTCOME BASED ASSESSMENT

- Vision and Mission of the institute and department
- Program Educational Objectives
- Graduate Attributes – as defined by NBA
- Program Outcomes – as defined by NBA
- Program Specific Outcomes – as defined by institute
- Curricular Components – Core and Elective
- Course Outcomes – as defined by department
- Course Structure – Prerequisite Chart

KEY COMPONENTS OF OUTCOME BASED ASSESSMENT

- Set the targets for attainments through discussions with stake holders
- Assess the attainments through direct and indirect methods
- Identify the gaps.
- Analyse reasons through discussions
- Identify strategies to bridge gaps.
- Prepare a Report and propose schemes for improvements
- Implement the changes for subsequent batches.
- CLOSE THE LOOP

Course Outcomes

- Course Outcomes are the precise statements, which can be attained by every student at the end of the course.
- Every Statement must be measurable and attainable
- Every statement must be correlated with one or more PO / PSO.
- There should be scope for analysing the attainment and improvement.
- Institute should have documentary evidence for establishing the correlation with PO / PSOs and their modifications, if any.

How to write PO / PSO / CO Statements?

- Every Statement must be measurable
- Every Statement must emphasize the measurable component.
- Every Statement preferably should start with an action verb and principally measurable component of the statement must appear at the beginning of the statement.
- The institute must provide documentary evidence for adopting the statements and their measurability.

USE BLOOM'S TAXONOMY FOR DEFINING OUTCOMES

Sample COs

Course: Problem Solving and Computer Programming

CO1:Develop algorithms for mathematical and scientific problems

- **Observations on underlined terms**
  - Develop may be replaced with Design. Design means analysing the problem, developing a solution and then designing algorithm. All are measurable
  - Mathematical and Scientific Problems is too general a statement.
  - Be specific regarding the kind of problems being addressed
- CO1: Design Algorithms for solving simple mathematical problems including computing, searching and sorting

Course: Problem Solving and Computer Programming

- **CO2: Explore alternate algorithmic approaches to problem solving**

Observations:

  - Explore may not an appropriate verb. Alternately Compare or Contrast can be used
  - What is being emphasised?
  - Is it identifying alternate approaches or
  - To identify the algorithms that are suitable for the specific problems in terms of time and space complexity.
  - However, word explore may be retained in view of alternate algorithm approaches.

- **CO2: Compare and contrast algorithms in terms of space and time complexity to solve simple mathematical problems.**

Course: Problem Solving and Computer Programming

- **CO3 Understand the components of computing systems**

Observations:

- Can understand be measured?
- Even if it Yes, it can be measured through memory tests only.
- Examination based on memory test (written) does not really measure the level of understanding
- Understand is too low in terms of assessment.
- Emphasis is on exploring internals of computing systems.
- CO3: Explore the internals of computing systems to suitably develop efficient algorithms.

Course: Problem Solving and Computer Programming

- **CO4 Choose data types and structures to solve mathematical and scientific problem**

Examine the suitability of data types and data structures to solve specific problem

- **CO5 Develop modular programs using control structures**

Apply control structures to develop modular programs to solve mathematical problems

- **CO6 Write programs to solve real world problems using object oriented features**

Apply Object Oriented features to develop programs to solve real world problems

Mathematics - III

- **CO1 Solve linear differential equations using Laplace transforms**

Observations:

- What is the purpose of this CO?
- Is it to solve linear differential equation or to apply Laplace transforms
- CO must begin with action verb and the measurable component of the CO must be in the beginning of the statement

Apply Laplace transforms to solve linear differential equations

Mathematics - III

- CO2 Evaluate multiple integrals and improper integrals
- CO3 Convert line integrals to area integrals
- CO4 Convert surface integrals to volume integrals
- CO5 Determine potential functions for irrotational force fields

Observation:

The emphasis is more on the processes rather than on the applications. Accordingly they may be reworded with applications in specific areas

Statistical and Numerical Methods

- CO1 Construct a curve by least squares method
  - It is vague, may not be measurable

Apply least square methods to approximate ….

- CO2 Analyze the data based on large and small sample sizes.
  - 'Analyze' is acceptable. But what is the expected outcome, which is measurable
  - What is the relevance of large and small samples

Conduct sampling tests based on small and large sample sizes

Statistical and Numerical Methods

- **CO3 Determine service time and waiting time in a queue.**
  - Emphasis is on process.
  - Use standard formula, insert data and get the result!
  - CO is not a question that appears in an examination paper

Model a real world system as queue and measure its characteristics

- **CO4 Determine an interpolating function for data**

Apply interpolation methods to ….

- **CO5 Solve initial value problems.**
  - Outcome is missing

Discrete Mathematics

- CO1 Understand sets, relations, functions and discrete structures
- CO2 Apply Propositional logic and First order logic to solve problems
- CO3 Understand discrete mathematical structures
  - Repetition of part of CO1
  - In general a question in an examination should aim at (preferably) only one PO.

All the above COs are confining to about 25% of the syllabus only

Discrete Mathematics

- CO4 Formulate and solve graph problems
  - Including searching, spanning
- CO5 Count discrete event occurrences
  - Apply techniques for counting the occurrences of discrete events including permutations, combinations, with/without repetitions
- CO6 Formulate and solve recurrence relations
  - Emphasis on formulation of recurrence relations. However equally important aspect is solving recurrence relation. Probably it may be written as another outcome or CO6 may be retained as it is.

Data Structures and Algorithms

- CO1 Understand the concept of ADT
  - Avoid understand. Compare data types and Abstract Data Types
  - Explore the components of ADTs
- CO2 Identify data structures suitable to solve problems
  - More important than identification, it is to choose a data structure to represent data and to solve efficiently.
  - Emphasis is on choice and efficiency

Data Structures and Algorithms

- CO3 Develop and analyse algorithms for stacks, queues
  - Design and analyse algorithms for stack and queue operations including creation, insertion, deletion.
- CO4 Develop algorithms for binary trees and graphs
  - Design and develop algorithms for binary search tree operations, graph algorithms like searching, scanning, insertion and deletion.

Assessment of Attainments

Direct and Indirect Methods

Assessment of Attainments

- Attainments of every CO, PSO and PO need to be assessed through
  - Direct Attainment Method
  - Indirect Attainment Method
- An approved mix of direct and indirect attainments is to be taken as the attainment of the outcomes
  (usually 6:4 to 8:2)
- The assessments then are to be compared with prior approved and set targets.
- The reasons for shortcomings (if any) are to be identified
- Initiate appropriate remedial action to fill the gaps.

Direct Assessment of Attainments

- Every question in the examination paper must be aimed at assessing the attainment of a particular Course Outcome.
- Each question preferably should be mapped to ONLY one CO
- Many questions can be mapped to same CO.
- The attainment of Course Outcome can be measured through class average marks obtained by all the students in the questions mapped to the CO

Direct Assessment of Attainments

Scheme when the marks for every question in the end semester examination are known

Question Tagging

Questions are tagged to COs of Courses.
CO attainments as % measured by Faculty

Mapping Tables

Qn – CO mapping by Faculty

CO – PO/PSO mapping HOD

1-weak, 2-moderate, 3-strong

Measuring Direct Attainments

Attainment Parameters

q_k : Class Average mark(%) of Qn-k

a_i : Attainment of CO-i

p_j : Attainment of PO/PSO-j

s_{ki} : mapping of Qn-k with CO-i

c_{ij} : mapping of CO-i with PO/PSO-j

Attainment Values

$$a_i = \sum_k (q_k * s_{ki}) / \sum_k (s_{ki})$$

$$p_j = \sum_i (a_i * c_{ij}) / \sum_i (c_{ij})$$

Implementation

A web based application, with Average marks obtained by students in each subject as input and CO and PO/PSO attainments as output.

Alternately excel sheet can be used to compute COs

CO Attainment

- Teachers enter average marks for each question and finds CO attainments for their subject.

PO, PSO Attainment

- HOD enters CO-PO/PSO tables.
- Computes PO and PSO attainments for each program

Correction

- ~~The attainments of POs and PEOs computed as above are expected to be 10-15% lower than the actual grades in view of relative grading.~~

Statements to indicate any correction

An example of Mapping

- CO1 Analyze worst-case running times of algorithms using asymptotic analysis.
- CO2 Prove the correctness of algorithms using inductive proofs and invariants.
- CO3 Analyze randomized algorithms with respect to expected running time, probability of error using tail inequalities
- CO4 Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms
- CO5 Analyze approximation algorithms including algorithms that are PTAS and FPTAS.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2		1	2			
CO2	2		2		2			
CO3	1	2	3	2	2			
CO4		2			2			
CO5	1	2	2	2	1		1	1

- A proper justification for the mapping is advisable!

Another example of Mapping

- CO1 Design and implement Unix kernel data structures and algorithms
- CO2 Analyze synchronization problems in uniprocessor and multiprocessor systems
- CO3 Evaluate the scheduling requirements of different types of processes and find their solutions
- CO4 Implement user level thread library and mimic the behaviour of Unix kernel for scheduling, synchronization and signals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO7
CO1		3		2	3		3	
CO2	3	3		3	3			
CO3	3	3		3	3			
CO4	3	3		3	3		2	

- ANY OBSERVATIONS ON THE ABOVE MAPPING?!

A Case Study

- Sample Question – CO Mapping

Sub 1	CO1	CO2	CO3	CO4	CO5
Q1(73.5)	3		-	-	-
Q2(62)		2	-		
Q3(58)	-	-	3		
Q4(90)		-		2	
Q5(65)	2				
Q6(50)		1		-	
Q7(72)		2			
Q8(65)	3		3		
Q9(50)				2	
Q10(75)					3
Attainment	68.19	63.6	61.5	70.0	75.0

- CO1 Attainment = (73.5*3 + 65*2 + 65*3) / (3 + 2 + 3)

A Case Study

- Sample Question – CO Mapping

Sub 1	CO1	CO2	CO3	CO4	CO5
Q1(73.5)	3		-	-	-
Q2(62)		2	-		
Q3(58)	-	-	3		
Q4(90)		-		2	
Q5(65)	2				
Q6(50)					
Q7(72)					
Q8(65)	3				
Q9(50)				2	
Q10(75)					3
Attainment	68.19	63.6	61.5	70.0	75.0

In excel this can be computed as
Sumproduct(A1:A10,B1:B10)/Sum(B1:B10)

- CO1 Attainment = (73.5*3 + 65*2 + 65*3) / (3 + 2 + 3)

A Case Study – For PO assessment

- CO-PO Mapping

Sub 1	PO1	PO2	PO3	PO4	PO5	
C01(51.9)	2	2	-	-	-	
CO2(68.9)	-	1	-	1	2	
CO3(70.8)	-	-	2	2	2	
CO4(71.2)	3	2	1	2	1	
CO5(66)						
Sub 2	CO1	CO2	CO3	CO4	--	
CO1(58.7)	2	2	1	2		
CO2(64.8)	3	1	2	-		
CO3(61.8)	1	2	2	2		
CO4(57.5)	-	1	3	2		
PO Att	62.82	61.67	63.38	64.44	70.12	

PO1 Attainment = (51.9*2+71.2*3 +58.7*2+64.8*3+61.8*1)/(2+3+2+3+1)=62.82

Indirect Assessment – Some Questions

1	**Class room ambience and learning experience.**
2	Overall quality of instruction.
3	Usefulness and availability of texts and course materials.
4	Content and structure of the program
5	Overall quality of assistance provided by the department
6	Opportunities for useful non-classroom experiences
7	Quality of facilities and equipments
8	Competence in the chosen field of study
9	Application of theoretical knowledge to practical situations.
10	Written communication skills

Indirect Assessment – Some Questions

11	**Oral communication skills**
12	Critical thinking skills
13	Quantitative reasoning skills
14	Leadership qualities
15	Worked on a class assignment, project, or presentation with other students
16	Participated in class discussions
17	Discussed intellectual ideas with other students
18	Worked on a paper or project that required integrating ideas or information from various sources
19	Prepared a major technical report/research paper
20	Read scientific articles on topics outside the curriculum

Indirect Assessment – Some Questions

21	**Worked with a faculty member on a research project (credit/non-credit)**
22	Used the library as a quiet place to read or study
23	Worked with others on a group assignment/project/seminar/presentation
24	Attended a lecture, conference, symposium or any event not required by a course
25	Memorize facts, ideas or methods from your courses and readings so you can repeat them in pretty much the same form.
26	Analyze the basic elements of an idea, experience, or theory, such as examining a particular case or situation.
27	Synthesize and organize ideas, information, or experiences into new, more complex interpretations and relationships.
28	Apply theories or concepts to practical problems or in new situations.
29	Foster positive interaction with colleagues/faculty in support of student learning and well-being.
30	Create learning environment that encourage positive social interaction, and active engagement in learning.

Indirect Assessment – Some Questions

31	**Understand the central concepts of the subject matter**
32	Provide learning opportunities that support students' intellectual, social and physical development.
33	Develop critical thinking, problem solving, and soft skills.
34	Understand the process of continuous and life-long learning
35	Actively seek opportunities for continuous professional growth
36	Write effectively
37	Communicate well orally
38	Acquire new skills and knowledge on my own
39	Think analytically and logically
40	Formulate/create original ideas and solutions

Indirect Assessment – Some Questions

41	**Evaluate and choose between alternative courses of action**
42	Lead and supervise tasks and groups of people
43	Function effectively as a member of a team
44	Moral and ethical values
45	Function independently
46	Gain in-depth knowledge of a field
47	Plan and execute complex projects
48	Develop an awareness for social problems
49	Synthesize and integrate ideas and information
50	Prepare for a career

Indirect Assessment – Some Questions

Choose some of the above questions

Add few more question (preferably on COs)

Indirect Assessment - Evaluation

- Average response, for each of these questions given by students of concerned programs, can be computed on a scale of 5.
- Faculty prepares a mapping table (on a scale of 1, 2, 3) of the course end feedback and Course Outcomes
- Department Academic Committee prepares a mapping table (on a scale of 0,1,2,3) of exit feedback questions Vs POs of the program.
- The preparation of the tables has to be done carefully and if possible develop a set of guidelines for the mapping of the question and CO, PO/PSO on a scale of 1 or 2 or 3.

Indirect Assessment

- The average response for each question and the mapping weights are used to compute the indirect attainment of each PO / PSO.
- Student Surveys:
  - Course End Feedback
  - Exit Feedback

q_k : Average response of Qn-k on Course End Feedback
s_{km} : Mapping of Qn-k with CO-m
a_m : Attainment of CO-m

$$a_m = \sum_k(q_k * s_{km}) * 20 / \sum_k(s_{km})$$

r_i : Average response of Qn-i on Exit Feedback
p_j : Attainment of PO-j
c_{ij} : mapping of Qn-i with PO-j

$$p_j = \sum_i(r_i * c_{ij}) * 20 / \sum_i(c_{ij})$$

Overall Attainment

Overall attainment of POs and PEOs of each program are computed by giving 60% weightage to Direct attainment and 40% weightage to Indirect attainment

- CO Attainment =

$$0.6 * a_i \text{ (Direct)} + 0.4 * a_i \text{ (Indirect)}$$

- PO/PSO-j attainment =

$$0.6 * p_j \text{ (Direct)} + 0.4 * p_j \text{ (Indirect)}$$

ACADEMIC AUDIT

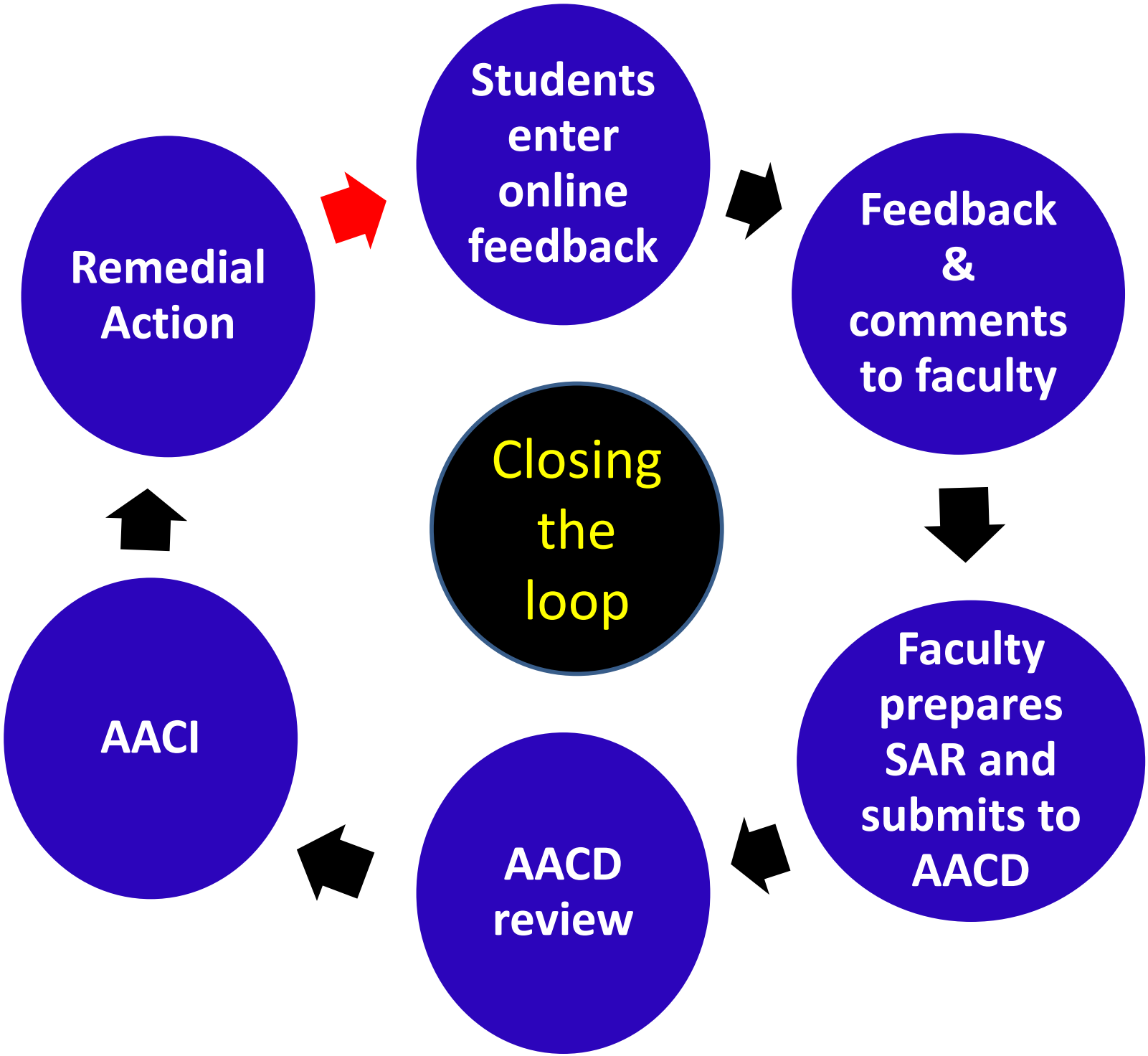
PEER REVIEW – Program Wise

- Academic activities in the department must be reviewed by a committee consisting of external members (academic as well as Industry) along with senior faculty of the department at least once every semester
- Course Files prepared by the staff members along with Self Assessment Report prepared by them are to be reviewed.
- Identified gaps and Plan of action for improvement needs to be certified by the committee.
- Based on the SARs of the faculty members, the committee prepares a consolidated report consisting of Actions to be taken to bridge the identified gaps in the content, course delivery and the rubrics to measure the attainments of the outcomes for each program.

ACADEMIC AUDIT

PEER REVIEW – Institute Wise

- Academic activities of the institute must be reviewed by a committee consisting of an external committee to consider and recommend institute level remedial actions to be taken by the management of the institute.
- Departmental peer review committee reports are to be reviewed.
- Identified gaps and Plan of action for improvements at the institute level are to be recommended
- Governing Council of the institute should consider these reports and initiate actions to implement the approved modifications


Students enter online feedback
Feedback & comments to faculty
Faculty prepares SAR and submits to AACD
AACD review
AACI
Remedial Action
Closing the loop

Concluding Remarks

- For each program, it is advisable to write the outcomes independently.
- In case of improper statements, there is scope for improvement.
- Avoid using the outcomes written by some one else
- CLOSING THE LOOP
  - Document what you plan,
  - implement what you document,
  - Analyse what you implement,
  - Identify gaps as a result of analysis.
  - Document the action taken to fill the gaps.
- CLOSING THE LOOP is very important aspect of OBE

Any Questions?…