Curriculum

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Accreditation Criteria-NBA

Crirterion1: Vision, Mission and Programme Educational Objectives

Criterion2: *Program Curriculum*

Criterion3: *Program Outcomes*

Criterion4: Student Performance

Criterion5: Faculty Contributions

Criterion6: Facilities and Technical Support

Criterion7:Continuous Improvement

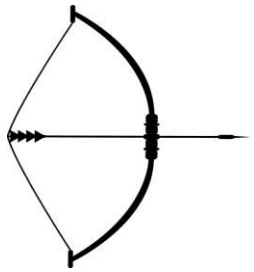
Criterion 8:First Year Academics

Criterion 9: Student Support systems

Criterion10: Governance, Institutional Support and Financial Resources

Role of the two criteria

- Program Curriculum
- Program Outcomes
- *Curriculum and the Teaching/ Learning processes are the basis on which the program is built*
- *Attainment of POs indicates that the job is well done*



PO

Program Educational Objective-PEO

Program Educational Objectives Essentially Answer the Question: Why does the Program exist in the first place?

It has to be answered by the management in Consultation with all the Stakeholders!

Program Educational Objectives

- The educational **objectives** of an engineering degree program are the statements that describe the **expected** achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during **the first few years** after graduation.

PEOs are broad statements- Describe the career and professional accomplishments that the program prepares its graduates to accomplish.

For example, PEOs of an academic program could read like this:

- Statement of areas or fields where the graduates find employment

- Preparedness of graduates to take up higher studie

- Twist*

Qu. Employment Scenario?

Shadow of the IT!

Designing the accreditation Process

Accreditation Model …

- Modern Trend: **Objectives /Outcomes (measurable)**
- Detailed Evaluation Guidelines – Allows the Institution to ***Assess itself*** (and Change)
- ***Assesses in a two tier system. One more suitable for the autonomous, other for the affiliated***
- Infrastructure part plays a much smaller role

NBA's Accreditation Process

Based on **SAR-**
Self Assessment Report

SAR Structure

- **Institutional**: Infrastructure, Finance, Admissions, Governance, Faculty, etc
- **Department/Program** Related

- ***Academics: Curriculum, Teaching & Learning, and <u>Outcomes*</u>***

Accreditation Criteria-
On Which, to make the Judgment

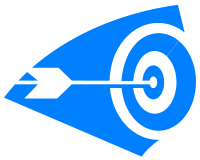
Qu. Who decides the Criteria?
Accreditation Agency?
The Stakeholders?

Ans. The Accreditation Agency with Stake holder's Interests in View.

Accreditation Process Flow

- Institution- Complete the SAR
- Institution- Evaluate yourself and Bridge Gaps that you find *(Leads to Improvements in the Institution's Functioning even without…)*
- **Evaluators**- Initial Assessment based on SAR and Observations thereon
- Visit – Judgments Based on **Evidence**

Process Structure (*Skeletal*)



Program Outcomes/

(Graduate Profile)

(To be achieved)

Assessment and Evaluation
Attainment of → Program
Outcomes

Revise?

Accredit?

Teaching/Learning: Curriculum,
Faculty, Assessment & Evaluation

(Design and implementation component)

How to make the judgment?

As dictated by the Accreditation Criteria-*Slide2*

Curriculum & Teaching Learning Processes **Tier II**

120

Curriculum

Curriculum, Assessment and Evaluation are the major tools by which Program Outcomes are attained. We should look at all of these together.

Curriculum- Tier 2 Institution

Structure of a Typical Engineering Curriculum

1 Contents of Basic Science, Humanities, and Program Specific Courses – Core, Elective

2 Content Delivery

3 Laboratory Work

4 Project Work

For Tier-2 Institutions
Curriculum & Evaluation are by the University,
So, Institution's Role here is….

Qu. How to Attain POs in View of the Given Curriculum?

Curriculum- Tier 2-Tasks

- Analyze the University Curriculum
- Determine the Gaps in Attainment of POs
- Design Extra {modules} / {Assessments} to Bridge these gaps
- Could need a few iterations
- These steps are important. They impact on what follows.

This analysis should allow us to Answer the Following Questions :

{Terms to be defined soon}

What are the COs?

Can the POs be Met?

If Not, What are the Gaps?

Participants in Curriculum Review/ Design *More True for Tier-1, But …*

- Faculty {Team}
- Industry
- Academics from Peer Institutions *{Very Desirable}*
- Students and Alumni
- Academic Bodies

Action Points in Tier-2

- Our analysis may indicate that not all POs are *Attainable with the Given Curriculum.*
- May need some **additional** modules AND
- **Design** of In-Sem evaluation and assessment to take care of the gaps.
- A record of all this work is needed.

Details of Bullets 2 and 3 are to be made available

- List of All additional modules added along with the details of contents, and where these are being offered. etc
- Evaluation *{In-Sem. Papers, Tutorials, typical answer scripts, etc}* along with COs- POs targeted therein.

Some of this detail is needed- attainment of POs

Sample sections from SAR:

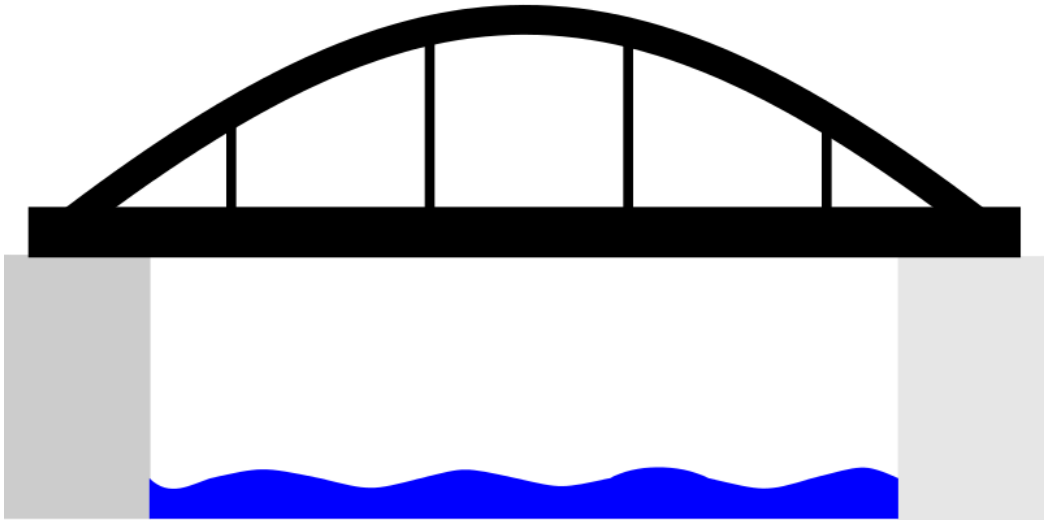
2.1.1. State the process used to identify compliance of the University curriculum for attaining the NBA defined '12' Program Outcomes as mentioned in Annexure . Also mention the identified curricular gaps.

2.1.2. State the delivery details of the content beyond the syllabus for the attainment of POs

(Provide details of additional course/learning material/content/laboratory experiments/projects etc., arising from the gaps identified in 2.1.1 with the delivery details)

2.2.2. Initiatives to improve the quality of internal/semester tests and assignments

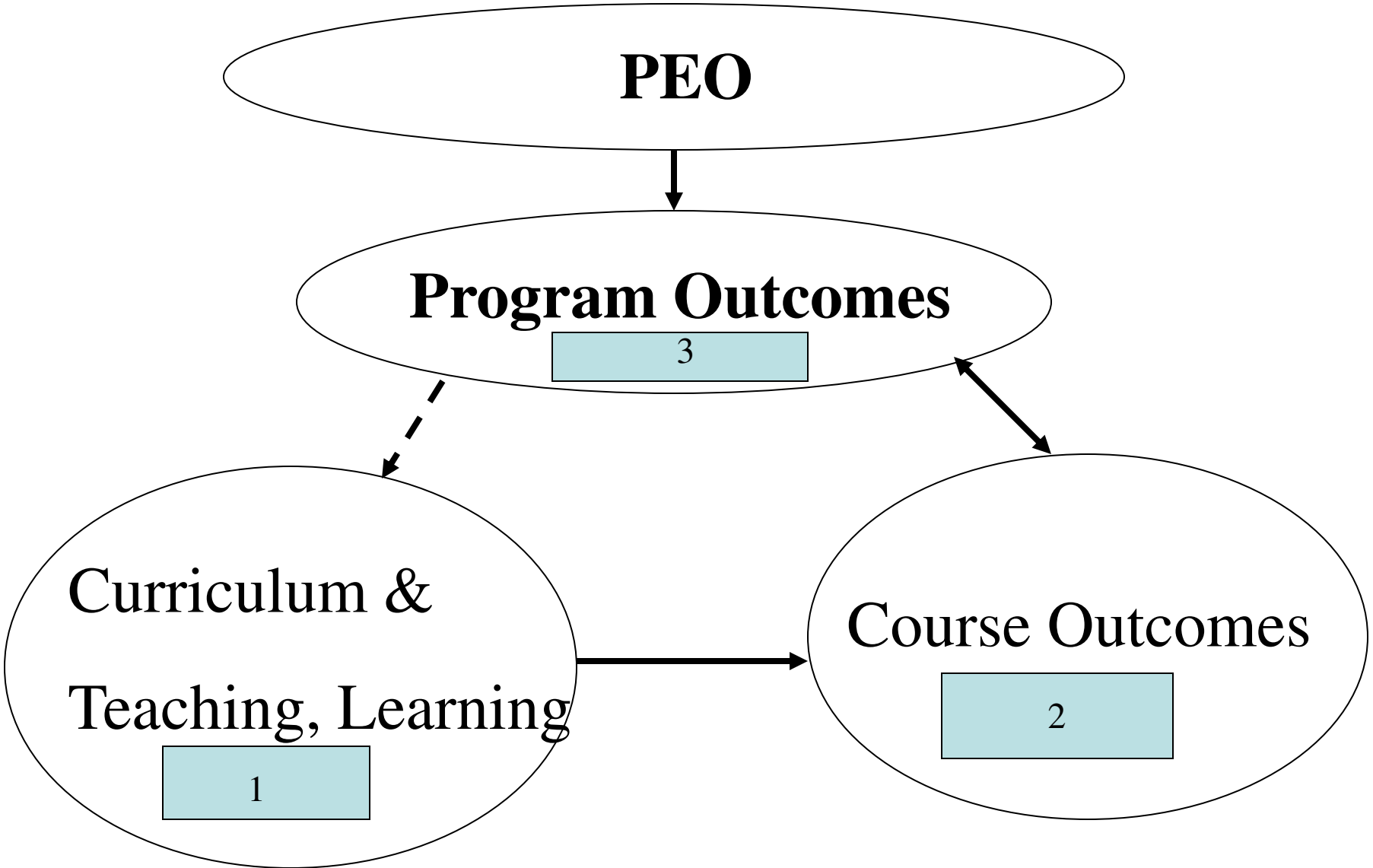
For Tier II Institutions, Curriculum Tasks are largely About Bridging the Gaps



Curriculum Tier I

Here the entire responsibility rests with the Institutions

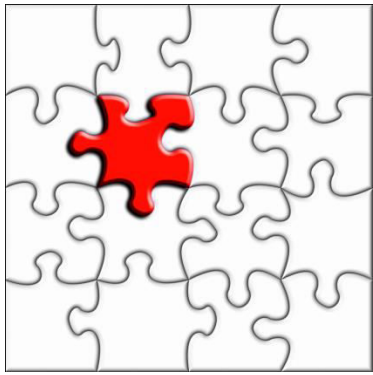
Framework


PEO
Program Outcomes
3
Curriculum &
Teaching, Learning
1
Course Outcomes
2

For Evaluators – Records?

Curriculum Design Flow

- Define PEOs
- Place Starting Design alongside NBA's Program Outcomes.
- Can you **cover All POs** within the Credit Limit Requirements?
- **If Yes, then** Sequencing Requirements? **Else,**
- In a Few iterations a Solution should emerge



Sample Syllabus

Course: Electrical Circuits and Network Theory.
Offered in either 2nd or 3rd semester to students of Electrical Sciences. Credits: (Typical) 3-1-0. Course is Compulsory.
Course Objective: To prepare a student to take courses normally offered in subsequent semesters, like: Electronic Circuits, Signals and Systems, Advanced Electronics, etc.
Syllabus: The circuit concept as an approximation to a physical system ***{modeling, Application of laws of physics (PO 1)}.***
Kirchoff's Laws, voltage and current sources, Network equations, use of source transformations, Loop and Nodal analysis, Matrix representation of circuit equations and their solutions ***{Apply knowledge of mathematics (PO1)}*** ***Continued…***

Transient response, solution of differential equations with constant coefficients, initial and final conditions, time constant, its physical significance, and use in solving engineering problems ***{PO 2 particularly, switching circuits}.*** Use of Laplace transform in circuit analysis ***{again PO 1}***

Two-port networks, two-port parameters *{necessary for all the electronics systems that would follow},* sinusoidal steady state analysis and frequency response

Use of computers for solving large problems ***{PO 5}***

Text books: 1.Van Valkenburg, Network Analysis, 3rd Edition, PHI.

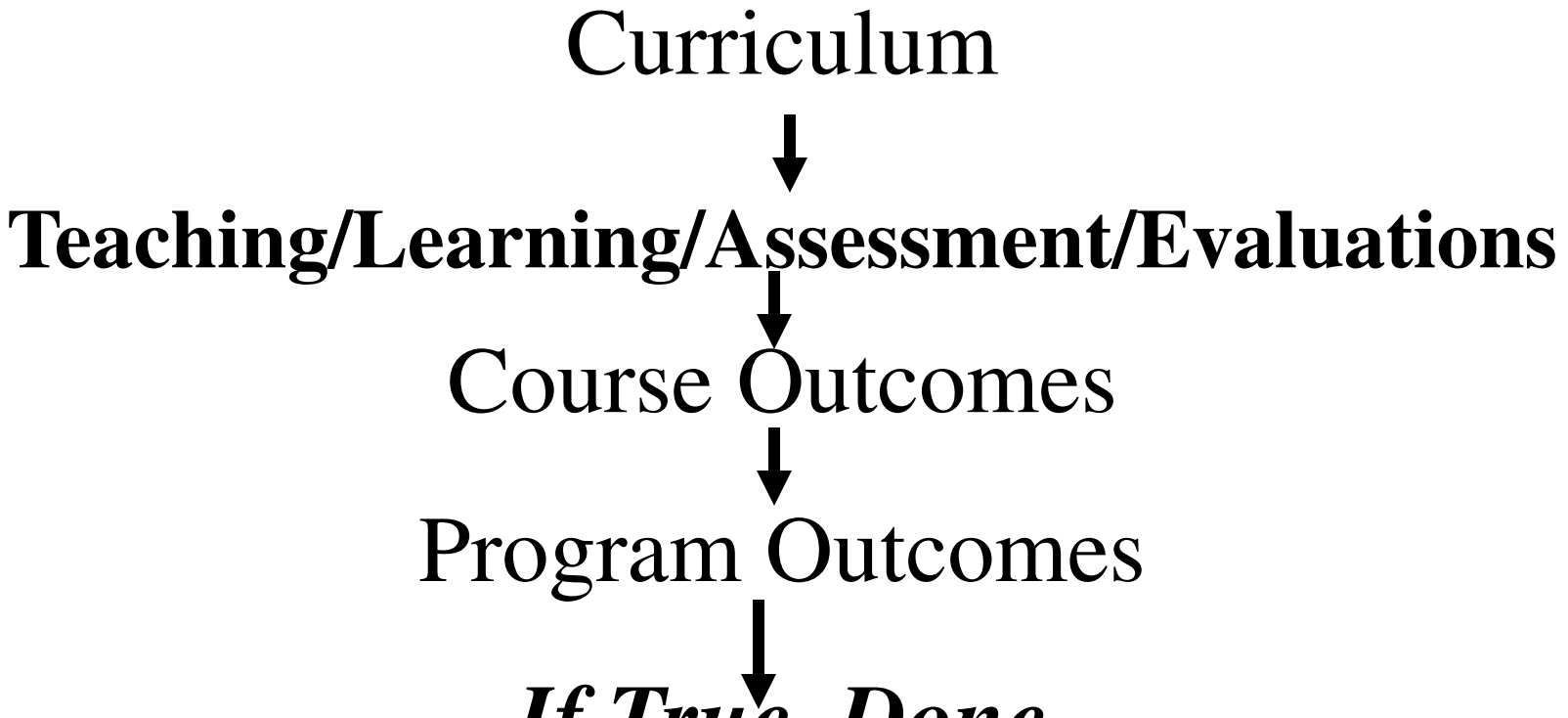
{For an 8 credit advanced course}

2. V Del Toro, Electrical Engineering Fundamentals, 2nd Edition

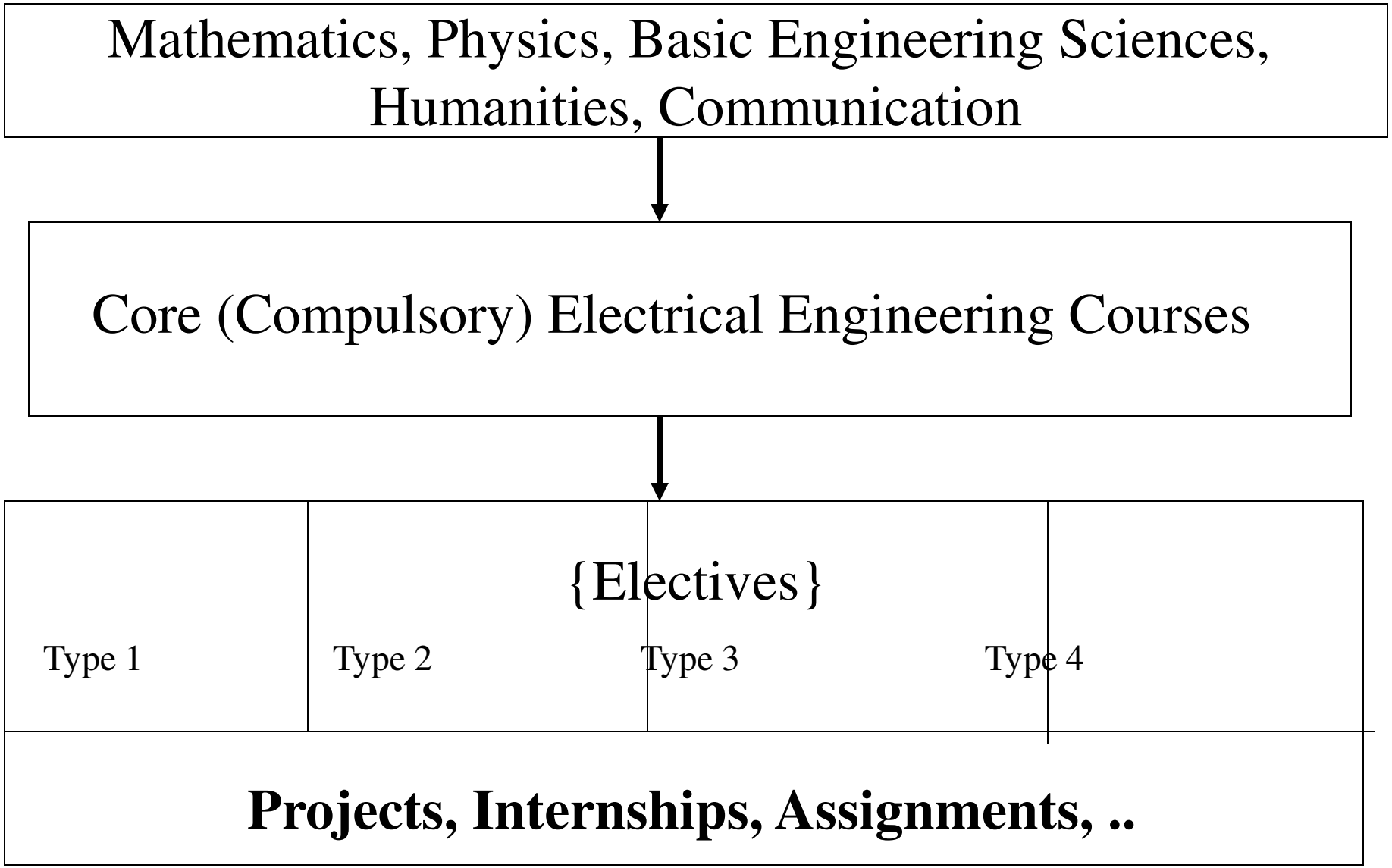
{For a 6 credit standard course}

Course Outcomes: PO 1, PO 2, PO 5

Reference: The Mathematics of Circuit Analysis, E.A. Guillemin, Oxford & IBH


Curriculum
Teaching/Learning/Assessment/Evaluations
Course Outcomes
Program Outcomes
If True, Done

Broad Outline



Typical **Core** Composition for EE

- Mathematics – 4/5 courses
- Physics – 3/4 Courses
- Chemistry 1/2
- Biology (?) ≥ 1
- Humanities and Social Sciences 3/4

Maths: Calculus (1/2), Linear Algebra, Discrete Maths, Complex Variables

Physics: General Physics, Electricity & Magnetism (Adv), Modern Physics,

BREAK - LUNCH

NBA's Program Outcomes

They are interesting!

NBA-Program Outcomes

1. **Engineering Knowledge,**
2. **Problem Analysis**
3. **Design/development of solutions,**
4. **Conduct investigations of complex Problems,**
5. **Modern tool usage,**
6. The engineer and society,
7. Environment and sustainability,
8. Ethics**,**
9. Individual and team work,
10. Communication,
11. Project management and finance,
12. ***Life-long learning***

PROGRAM OUTCOMES – PO

- Have to be understood
- Some Difficult to Attain
- Also, Difficult to Assess and . Evaluate
- We examine all these aspects

Why the NBA's POs are-
What they are?

WA – Graduate Attributes and NBA- Program Outcomes

Washington Accord Attributes	NBA Program Outcomes.
1.Engineering knowledge, Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1.Engineering knowledge, Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems**
2. Problem Analysis, Identify, formulate, research literature and analyze *complex* engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences	**2. Problem Analysis, Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.**

Crux of the Matter – Program Outcomes

What is True for Evaluators is True for Authors of SAR

Two Terms- Assessment & Evaluation

Assessment

It is one or more processes that ***identify, collect, and prepare data*** to **evaluate** the achievement of **Program Outcomes** and program educational objectives

Important for both, SAR and the Evaluators

Evaluation

These are processes for interpreting the data and evidence accumulated through assessment practices.

Evaluation determines the extent to which POs or PEOs are being **achieved,** and results in decisions and actions to **improve** the program as also for accreditation.

Attainment of PO1 to PO4

Evaluator's View

Presentation

Part A : Evaluation Processes

Part B: Evaluation

Part C : Examples

PART A: Evaluation Processes

Presentation Flow

Meaning and Purpose of POs {s*lides 60-65}*

Determine the set of COs related to POs using CO-PO Matrix *{slide 66}*

Analysis of COs *{slides 67 & 68}*

Attainment of COs & then POs *{slides 69-73}*

Statements of the POs- From SAR

PO 1 and PO 2

- PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engineering. specialization to the solution of ***complex engineering problems.***
- PO 2. **Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

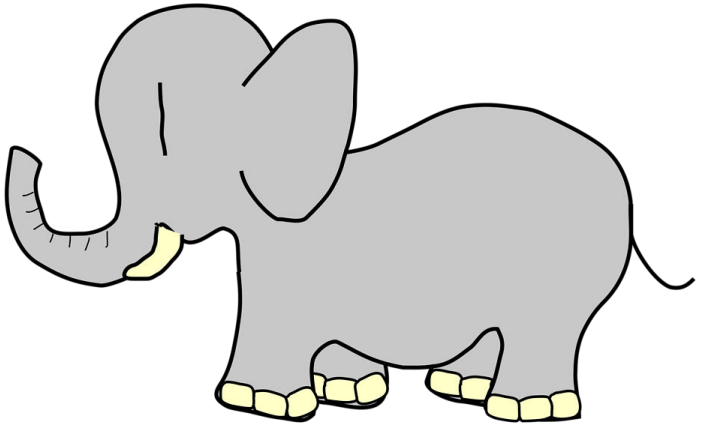
PO 3 and PO 4

- PO 3 **Design/development of solutions:** Design solutions for **complex engineering problems** and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO 4. **Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Why place these four POs in one Basket?

- The Statements show that one part *{That of (complex) Engineering Problem CEP} is* <u>*common to all.*</u>
- *Though, individually each PO deals with a different aspect of CEP. Recognizing this commonality makes the discussion easier.*

CEP- PO1 to PO4 & The Elephant



Complex Engineering Problem-CEP

1. Problems not the kind generally encountered at the ends of text book chapters. (These often test if the contents of the chapter have been understood)
2. These are problems that have not been completely framed and leave at least a few* choices for the student to make.
3.Problems may require use of laws of physics, or bring in some mathematical tools in which the problem can be framed.

The different aspects of CEP

- Application of Mathematics and sciences- PO1
- Identify and Research to Solve – PO 2
- Design and Development of Solutions – PO 3
- Conducting Investigations and Research PO 4

Factors We Examine

- Assessment: *{ Information and Evidence for Evaluation of attainment}*
- Evaluation: *{From the evidence making judgments on attainment levels}*
- We examine both the factors from procedural and evidence interpretation aspects

The First Step

- Towards Assessment: *{ We recognize that POs are attained through the COs. So we determine the corresponding set COs. These COs in turn lead us to places where we find information and evidences}*
- This step is pictured in the next slide. We will need the CO-PO matrix for this. It is in the SAR

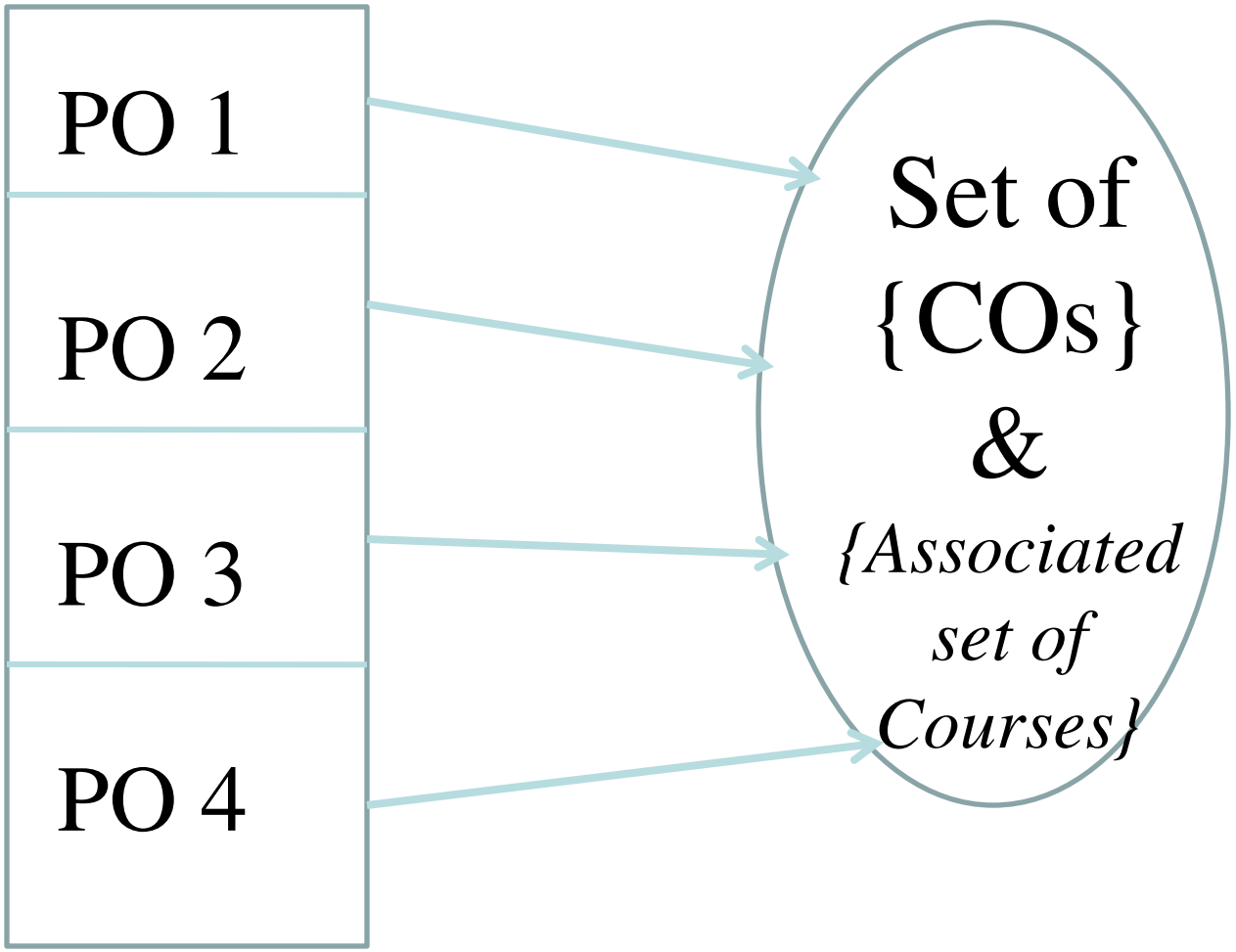
Every Course Leads to Some Outcomes. All the courses must cover the stated list of outcomes. One way of verifying this to prepare a match matrix as shown below. In the table below * could also be a number- typically in (0,1) indicating level of attainment.

Course \ PO	PO 1	PO 2		PO 9
EE 111	*		*	
EE 212		*	*	
HS 101		*		*

Every Course Leads to Some Outcomes. All the courses together must cover all the POs (and PSOs). For a course we map the COs to POs through the CO-PO matrix shown below. Assume that it is for a course EE111

CO / PO	PO 1	PO 2		PO 9
CO 1	*		*	
CO 2		*	*	
CO n		*		

Mapping from the CO-PO matrix
{from SAR}



Are the COs well defined?

- CO Analysis-
- How well do the CO statements match with the PO statements?
- Very often a part of a PO is embedded in the CO.
- Else, **we reason** on the degree of match.
- contd

Answer to this question could be in terms of degree of match such as:

(a) Excellent/ 4

(b) Good / 3

(c) Fair /2

(d) Little /1

{To be recorded for all the COs. Examples follow}

Assessment Procedure

- Step 1- Collect information from question papers, assignments, tutorials, answer scripts, etc
- Step 2- SAR might also furnish projects {mini and major} and Lab work as evidence towards attainment
- The two steps together give assessment.

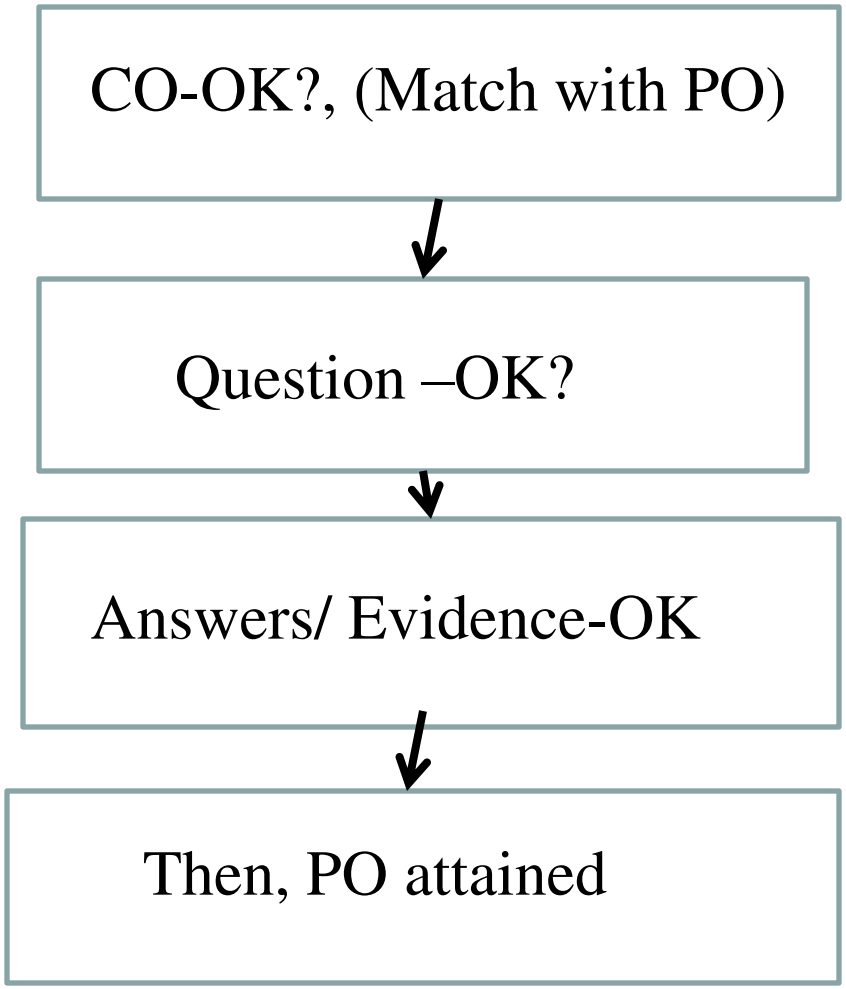
• Step 3: Analysis of questions in examinations {In-semester for Tier-2}, tutorials, assignments, etc*. will point to those questions that are devised to evaluate attainment of COs.

•Step 4: An examination of the relevant answer scripts along with the extent of relevance of the questions with the COs will reveal the actual level of attainment. **{*Steps 3 and 4 are judged by you as the domain expert.* The CO *Attainment levels need to be determined and recorded in your notes. Some illustrative examples will follow }***

PO Attainment

- Establish Attainment levels for all the COs applicable for that course by Inspection of the evidence available for the purpose.
- Then, as per the CO – PO matrix, created for the purpose, map these results into PO attainment levels. ***{∑Cumulate}***
- Continue this with selected set of courses so that attainment levels are established for all POs- PO1-PO4.

Important Sequence of Steps



PART – B: Evaluation

Let us look at PO 1

Why is PO 1 needed?

- Modern Engineering Practice requires a very good Understanding of Mathematics, Physics, and Basic Engineering Sciences.

- Such an understanding helps in tackling problems encountered in professional practice as well as development tasks that have to be carried out.

- PO 1 essentially proves these abilities.

Our Job as Evaluators is to ascertain whether
PO 1 has been attained
in the Program

Illustrative Example

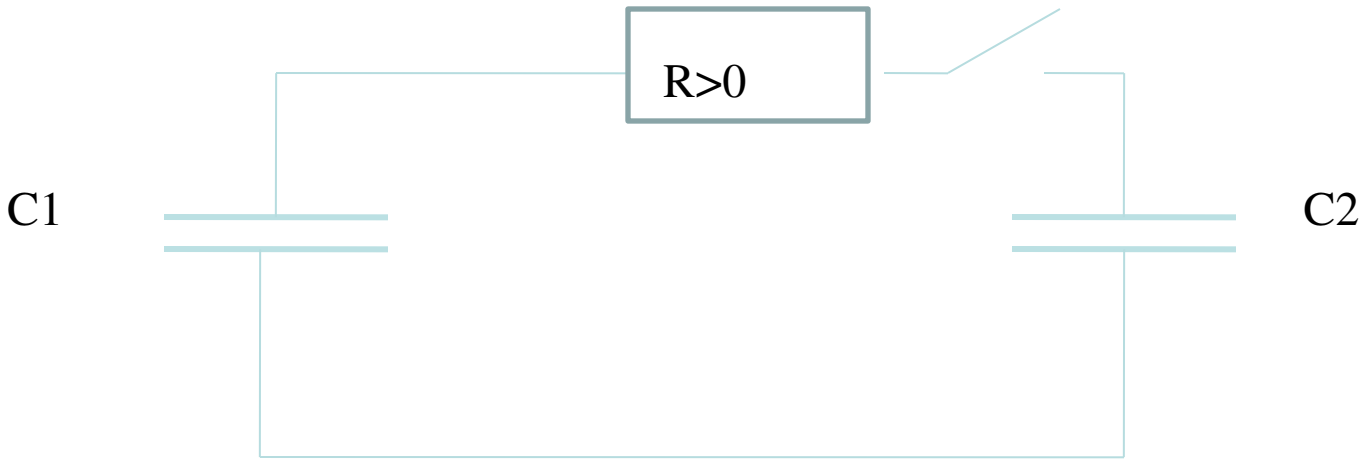
•A Course on Basic Electric Circuits has this as :
CO1 *{as per SAR}:* Ability to apply laws of Physics through Modeling of Electro magnetic fields phenomenon as lumped parameter circuit elements. {**Leads to PO 1**}

• In this case the CO-PO matching is very high.

• Search for questions related to this CO *{SAR is also expected to point out such questions.}*

• An example of such a question follows

A Question



Capacitors are of the same value, 1F; Initially, C1 is charged to V volts, and C2 is in a fully discharged state. The switch s closed at t = 0. Determine the energy dissipated in R at t = infinity

Let us analyze this question

- Does the question require just memory recall? NO!
- Can it be solved by direct application of text book material? NO!
- Does it require you to frame the problem in appropriate context? YES!
- Apply knowledge (maths, science) to arrive at a solution. YES! Laws of conservation of energy and of electrical charges

Implication

- The question is: Is the question appropriate for the CO 1?
- CO1: *{as per SAR}:* Ability to apply laws of Physics through Modeling of Electro magnetic fields phenomenon as lumped parameter circuit elements.
- Yes, it is indeed.
- Next, we look for attainment.

Assume that a question is Good, then

- We ask the question: Was the CO attained?
- For that, we look into answer scripts.
- We ask: How many of the students:
- (a) attempted?,
- (b) understood the question?
- (c) solved it correctly?
- (a), (b), and (c) together allow us to answer: How well the CO was attained. *{Please record your observations and judgment}*

Another Example

Course is Electronic Circuits, CO: Apply Knowledge engineering specialization to the solution of complex engineering problems

- ***Judgment needed***:

- (a) Is it a complex problem?{defined in slides63-64}
- (b) Does the solution require knowledge of engineering specialization?

Complex Engineering Problem-CEP

1. Problems not the kind generally encountered at the ends of text book chapters. (These often test if the contents of the chapter have been understood)
2. These are problems that have not been completely framed and leave at least a few* choices for the student to make.
3.Problems may require use of laws of physics, or bring in some mathematical tools in which the problem can be framed.

Tier -1 and Tier-2

For tier 1 , (2) could read as- only skeletal details provided in the problem, and student is required make out the rest. Such a problem could require amongst others defining constraints in terms of power, cost, weight, life span, different engineering choices, etc. For such problems, there are, in all probability multiple valid solutions.

Difference between Tier-2 and Tier 1, in this respect, is in the degree of complexity and numbers

A question on Complex Engineering Problem

•Design an amplifier using BJT(s). Given: Signal source: 500mV (peak to peak), impedance 100KΩ; Load:1KΩ, Output required 1V (peak to peak)

• Problem does not state:

• (a) What amplifier configuration?

• (b) Reasoning behind the choice

• (c) What would be the typical device characteristics you visualize, etc

• For Tier -2 such a question could appear in a home assignment. For Tier-1,it could be design & build

Analysis of the question

The question does not state many aspects like:

(i) What amplifier configuration would be good for the given situation?

(ii) Whether feedback should be applied?

(iii) Answers to these questions require, **"knowledge of engineering specialization (Electronics)"** *{PO 1}*

(iv) Attainment to be determined as given earlier

Projects and Assignments

- Projects and Assignments can often lead to attainment of PO 1 and PO 2
- Assessment: In Project Reports, Project Labs., and in the associated Marking Schemes.
- Evaluation will look for the following:

Evaluation of Projects

- Evaluation of Project Topics
- Method of Allotment (if any)
- Progress Seminars (during project execution)- Records of these.
- Evaluation of the state of the project in the final submission *{This includes marking scheme used, level of completion, level of understanding in a study project, etc}*

Some Points for the Institutions

TYPICAL ASSESSMENT TOOL TYPES:

Direct, Indirect

Assessment and Evaluation

Qu. What is it that we are trying to assess?

Ans. Have the Graduates qualified for the Profession.

But, we assess the students **continually** as they progress through the program!

So, most of the tools used here can be the ones that we use regularly, like: In-Semester exam, End-Semester exam, Tutorials, Quizzes, Assignments, and (may be) some more.

Qu. **Then, what has changed?**

Ans. What has changed is: Now, we have to make assessments against the POs that we have declared as creating the required profile of the Graduate. Thus Assessment and Evaluation have to address this new requirement (and that is the **Catch).**

These new needs influence the constructs of assessment and evaluation tools so that claims of COs and POs can be substantiated. {Critical for Tier-1}

Typical Assessment Tools

- Mid-Semester and End Semester Examinations**
- Tutorials*
- Home Assignments*
- Project work- Viva-Voce, Seminars etc.
- Employer/Alumni Feedback
- More

Attainment of Programme Outcomes

1. **Illustrate** how course outcomes contribute to the POs
2. Explain how modes of delivery of courses help in attainment
3. How **assessment tools,** used to assess the impact of delivery of course/course content contribute towards the attainment of course outcomes/program outcomes
4. Extent to which the **laboratory and project** course work are contributing towards attainment of the POs

{ This is for the SAR. All the Evidence- that you put on the Table }

Evaluation of the attainment of the Program Outcomes

While writing the SAR

1. Results of evaluation of each PO. (to be recorded)

What are the levels of attainment?

1. How the results of evaluation were used for curricular improvements?

(Continuous Improvement -- Criterion-7)

To Summarize

Course Outcomes

- What are these?
- Program Outcome is generally a broad statement. *For example:* . ***Problem analysis:*** *Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.*
- Not all of these may be reachable in a single course module. A Course Outcome would state the part that is addressed there. Thus,…

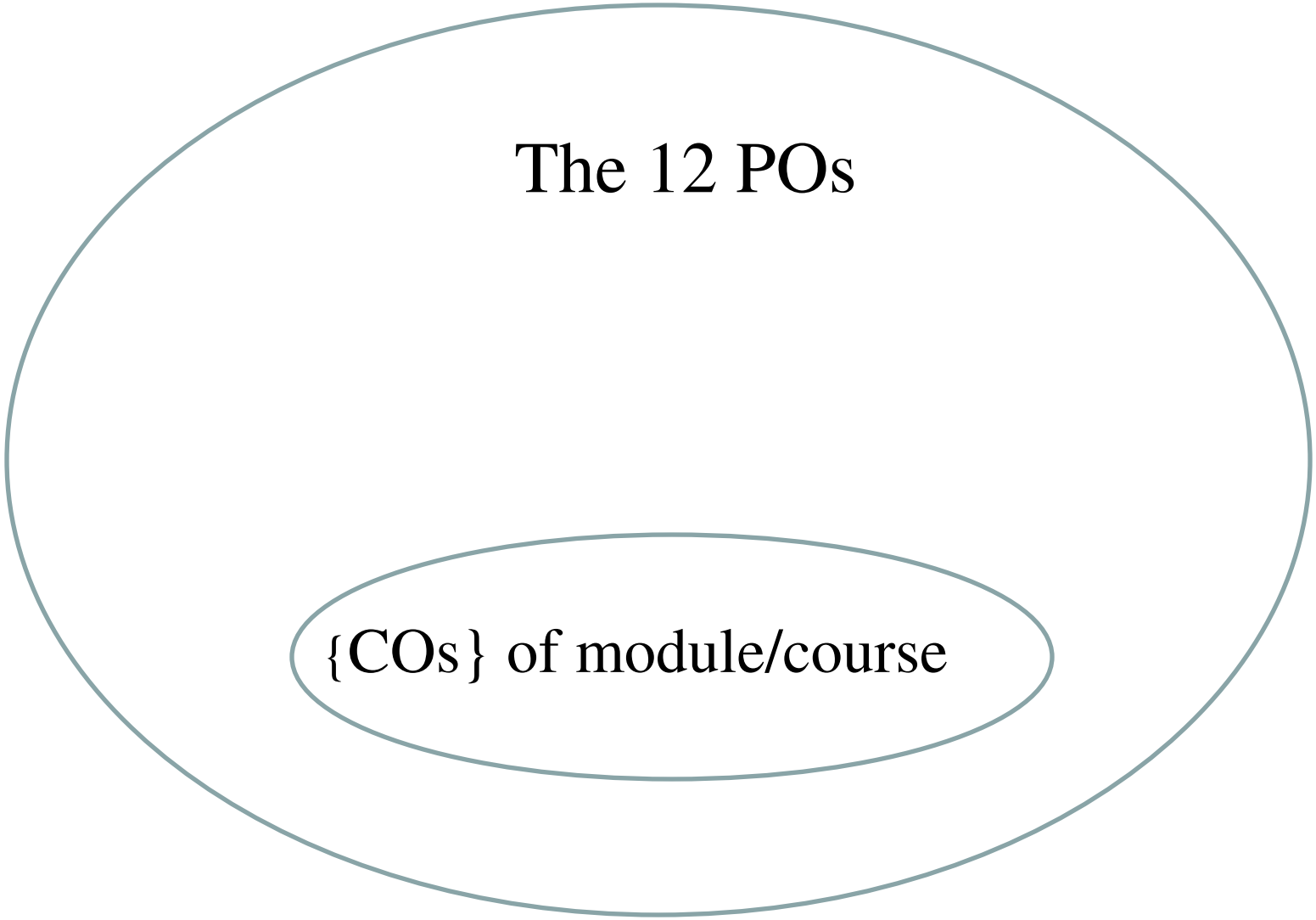
Relationship:COs and POs

A CO could be embedded in a PO

Thus,

{Course Outcomes} ⟶ {Program Outcomes}

COs AND POs



POs- Working Details

1. Definition and Validation of Course Outcomes and their mapping to Program Outcomes
2. **List all** the Course Outcomes (COs), Program Outcomes (POs), and Program Specific Outcomes (PSOs)
3. List Assessment tools employed for evaluation of level of attainment for COs (and evidence for this)
4. Establish Attainment Levels for the POs and PSOs
5. **Indicate processes employed.**
6. *{This and the next slide}*

BREAK

An Example of a Project

A Group Project Assignment:- Design a SMPS for 12V, 500 mA

Claimed COs *{as per SAR}*: Team Work, Advanced Electronic System Design, Environment, Ethics.

Assessment: Detailed Project Report, Discussion with the Instructor.

Evaluation of Attainment: (scale of 1, 5)

1. Design basically sound and in working condition, *attainment 3*
2. Report shows EMI/EMC issues taken into account- Environment *attainment 4*
3. Report mentions EMI/EMC standards – *attainment 5*

Evaluation of PO 2

. PO 2. **Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

- Key words: Identify, Formulate, Research Literature, and Analyze Problems to Reach:
- Substantiated Conclusions

Key Words

- A Task is assigned
- Identify: Locate where does the problem lie.
- Formulate: Convert the task into an "Engineering Problem" *{with specifications}*
- Research Literature: Study material relevant to the problem.
- Analyze: Draw meaningful conclusions from the above three.

Assessment Tools

- As the tasks involved are: Identify, Research Literature, and Formulate; such problems would typically be found in: home assignments, mini or major projects, or tutorials. *{A problem may have one or more of the above possibilities}*
- This PO is about making *Informed Choices using engineering knowledge.*

Evaluator- PO 2

- As the PO is about application of engineering knowledge,
- Analysis of questions depends very largely on the domain expertise of the Evaluator. Both, tasks as well as problem analysis have to be evaluated for application of engineering knowledge.

An Example for PO 2

- Given for a “Home Assignment”
- Task: Determine Specifications for an Audio amplifier for a dynamic microphone and output for ‘aux” input of a power amplifier.
- One needs to study material (often an appropriate handbook) to figure out meaningful specifications.
- Such an activity would cover most aspects of PO 2

PO-3

PO 3 **Design/development of solutions:** Design solutions for **complex engineering problems** ***{societal impact}***

- PO-3 examines, if during any design / development tasks issues of its impact on society are addressed?
- Issues could be any of: public health and safety, and the cultural, societal, and environmental considerations.
- Evidence of one or more of these is to be evaluated

Accumulation $\sum$

- A PO can have contributions from many COs
- Assuming these are in the range of either (0,1) or (0,4); how to calculate the resultant attainment level?
- One good possibility appears to be $\max\{l_i\}$
- No averaging process will work well here.

For Evaluators

The Visit is about collecting Evidence, Examining it, making Observations on it, and **Finally** Drawing conclusions from it!

Break

THANKS
HAVE A GREAT DAY

Extra Slides

Program Outcomes- Details

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of ***complex engineering problems***.
2. **Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, *safety, legal*, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Some Sample Program Outcomes

- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of ***complex engineering problems?***

Examples

Problems that can not be solved by just direct application of techniques and theorems taught in the course. (*Different from most problems at the end of chapters in a typical text book that allow more or less simple and direct approach*).

Problems that may or may not have a unique solution. For example, a design problem can be solved in many ways and leads to different solutions.

Could require the students to define appropriate constraints/ requirements not explicitly mentioned in the problem statement (like: cost, power requirement, life span etc).

There would be a need for the problem to be defined in an appropriate mathematical framework (taking into account any physics required).
In a design problem there would be a need for use of a modern computational tool. For example, in the design of an antenna or a DSP filter.

PO 2: Problem analysis: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

- In engineering practice one would be given only a statement on – “What is the Problem” or “How it manifests itself”
- Like- “The engine vibrations are very high” and no other clue.
- You have to figure out- How vibrations are examined, measured, sources detected and so on.
- Text book problems lay out the whole framework for you.

An Example

A Group Project Assignment:- Design a SMPS for 12V, 500 mA

Claimed Course Outcomes: Team Work, Advanced Electronic System Design, Environment, Ethics.

Assessment: Detailed Project Report, Discussion with the Instructor.

Evaluation of Attainment: (scale of 1, 5)

1. Design basically sound and in working condition, *attainment 3*
2. Report shows EMI/EMC issues taken into account- Environment *attainment 4*
3. Report mentions EMI/EMC standards – *attainment 5*

Illustrative Example- PO1

- Assessment- Direct
- Evidence through analysis of: Exam questions, Tutorials, Assignments,…
- List all the COs for the course
- Look* for questions that allow assessment of any of COs. *{examine extent of relevance}*
- % of students who answered correctly.- This establishes *level of attainment of those COs.*
- *Continued…*

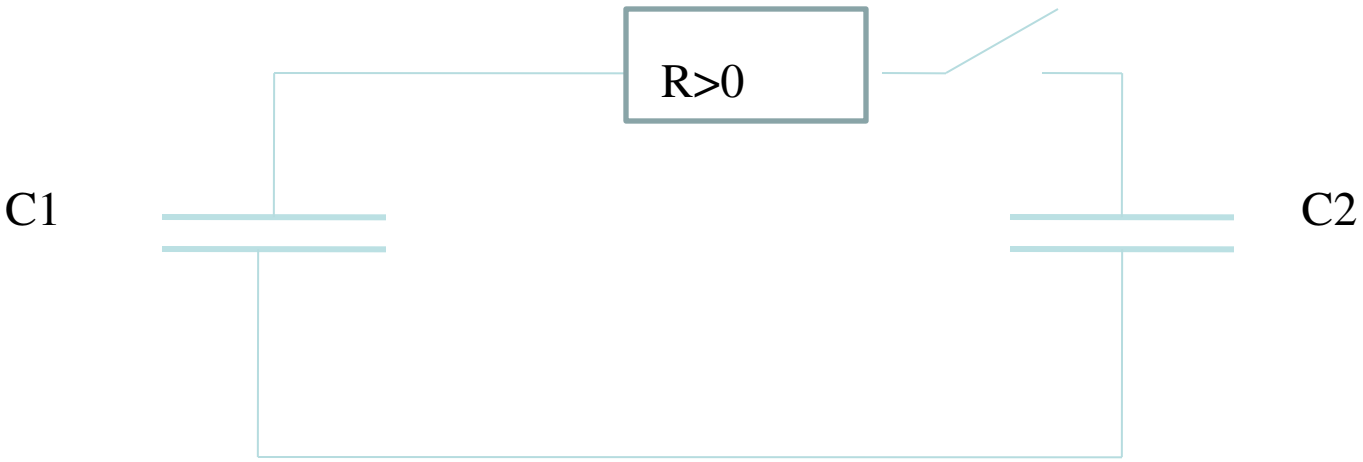
How to analyze questions?

- Does the question require just memory recall?
- Can be solved by direct application of text book material?
- It requires you to frame the problem in appropriate context?
- Apply knowledge (engineering, maths, science) to arrive at a solution.

Capability to apply Mathematics, Physics to Engineering Problems

- Do the questions require students to apply mathematical methods to answer the question?
- Or, is he required to show an understanding of laws of physics- conservation of energy, electric charges, balance of forces, magnetic induction, etc; to solve the problem
- Such a CO would *(If it's attainment is established}* lead to attainment of PO 1.

One More



Capacitors are of the same value, 1F; and is charged to V volts.
C2 is fully discharged state. The switch s closed at t = 0.
Determine the energy dissipated in R at t = infinity

Next Step

- Establish Attainment levels for all the COs applicable for that course. Inspect the evidence available for the purpose.
- Then, as per the CO – PO matrix, created for the purpose, map these results into PO attainment levels.
- Continue this with selected set of courses so that all the POs (and PSOs) are attained

For Evaluators

1. It may **not be** possible to do such an exercise for **every** course.
2. A subset of courses that would cover **ALL** the Program Outcome could be selected.
3. As can be seen from the examples, there is **evidence on record** for all the outcomes claimed.
4. **Evaluators Report** will typically **record** these findings

If attainment Levels for ALL POs are fine You are ***Through!***

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